RADIO NEWS

OCTOBER
1945
35c
In Canada 40c

ONLY MECK HAS THE COURAGE TO KEEP TELLING
THIS STORY TO YOUR CUSTOMERS

"Buy Your New Radio from Your Radio Dealer"

EVERY MECK NATIONAL ADVERTISING DOLLAR
SELLS THE PUBLIC
ON THE INDEPENDENT RADIO DEALER

Every month every John Meck Industries advertisement in national magazines tells one important story—"Buy your New Radio from your Radio Dealer."

Meck puts all its efforts behind the Dealer—to help the Dealer fight postwar competition. Tie in with the Meck Preferential Dealer plan. See your Meck distributor for full details on this worthwhile franchise.

John Meck

MECK RADIOS

JOHN MECK INDUSTRIES, Inc., PLYMOUTH, IND., U. S. A.

AM • FM • TELEVISION • CONSOLE COMBINATIONS • PHONOGRAPHS

I WI RAIN YOU O START

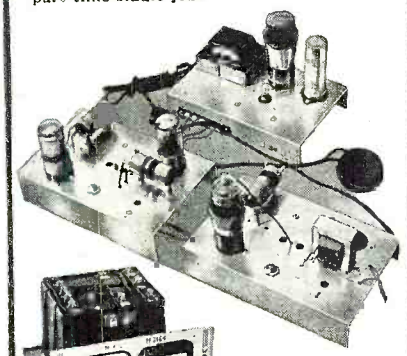
A SPARE TIME OR FULL TIME

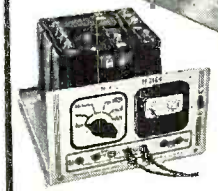
RADIO SERVICE BUSINESS WITHOUT CAPITAL

J. E. SMITH
PRESIDENT
National Radio Institute
31st Year of Training Men for Success in Radio

You Build These and Many Other Radio Circuits with 6 Kits of Parts I Supply

By the time you've conducted 60 sets of Experiments with Radio Parts I supply, made hundreds of measurements and adjustments, you'll have valuable PRACTICAL Radio experience for a good full or part-time Radio job!





You build MEASURING INSTRUMENT above early in Course, useful for Radio work to pick up EXTRA spare time money. It is a vacuum tube multimeter, measures A.C., D.C., R.F. volts, D.C. currents, resistance, receiver output.

You build the SUPERHETERODYNE CIRCUIT above containing a preselector oscillator-mixer-first detector, i.f. stage, diode-detector-a.v.c. stage and audio stage. It will bring in local and distant stations. Get the thrill of learning at home evenings in spare time while you put the set through fascinating tests!

Building the A. M. SIGNAL GENERATOR at right will give you valuable experience. Provides amplitude-modulated signals for test and experimental purposes.

The men at the right are just a few of many I have trained, at home in their spare time, to be Radio Technicians. They are now operating their own successful spare time or full time Radio businesses. Hundreds of other men I trained are holding good jobs in practically every branch of Radio, as Radio Technicians or Operators. Doesn't this PROVE that my "50-50 Method" of training can give you, in your spare time at home, BOTH a thorough knowledge of Radio principles **and** the PRACTICAL experience you need to help you make more money in the fast-growing Radio industry?

Let me send you facts about rich opportunities in the busy Radio field. See how knowing Radio can give you security, a prosperous future . . . lead to jobs coming in Television and Electronics. Send the coupon NOW for FREE 64-page illustrated book, "Win Rich Rewards in Radio." Read how N.R.I. trains you at home in spare time. Read how you practice building, testing, repairing Radios with SIX BIG KITS of Radio parts I send as part of your Course.

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

The Radio Repair business is booming NOW. There is good money fixing Radios in your spare time or own full time business. And trained Radio Technicians also find wide-open opportunities in Police, Aviation and Marine Radio, in Broadcasting, Radio Manufacturing, Public Address work, etc. Send for free book which pictures your present and future opportunities.

Think of the boom coming now that new Radios can be made! Think of the backlog of business built up in all branches of Radio! And think of even **greater** opportunities when Television and Electronics are available to the public! Use only a few hours of your spare time each week to get into Radio NOW. You may never again see the time when it will be so easy and profitable to get started. Mail coupon for complete information.

Many Beginners Soon Make $5, $10 a Week EXTRA in Spare Time

The day you enroll I start sending EXTRA MONEY JOB SHEETS to help you make EXTRA money fixing Radios in spare time while learning. You LEARN Radio principles from my easy-to-grasp Lessons — PRACTICE what you learn by building real Radio Circuits with the six kits of Radio parts I send—USE your knowledge to make EXTRA money while getting ready for a good full time Radio job.

Find Out What N.R.I. Can Do for YOU

MAIL THE COUPON for your FREE copy of my 64-page book. It's packed with facts about opportunities for you. Read the details about my Course. See the fascinating jobs Radio offers. See how you can train at home. Read letters from men I trained, telling what they are doing, earning. No obligation. Just MAIL COUPON in an envelope or paste it on a penny postal. **J. E. Smith, President, Dept. 5KR, National Radio Institute, *Pioneer Home Study Radio School*, Washington 9, D. C.**

I Trained These Men — SPARE TIME RADIO BUSINESS

"I have a spare time Radio and Electrical business of my own which has been very profitable, due to the efficient training I received from your Course. Last year I averaged over $50 a month." —FRED H. GRIFFIE, Route 3, Newville, Pa.

"I am doing radio work in my spare time, and find it a profitable hobby. My extra earnings run about $10 a week. I certainly am glad I took your N.R.I. Course." — FERDINAND ZIRBEL, Chaseley, North Dakota.

"About six months after I enrolled I started making extra money in radio. I am a farmer and just work on radios evenings and stormy days. That brought me a profit of $600 in the last year."—BENNIE L. ARENDS, RFD 2, Alexander, Iowa.

I Trained These Men — FULL TIME RADIO BUSINESS

"Not long ago I was working 16 hours a day in a filling station at $10 a week. Now I have my own radio business and average over $60 a week. The N.R.I. course is fine."—ALBERT C. CHRISTENSEN, 1116—10th Avenue, Sidney, Neb.

"I am now operating a radio shop for myself and own all my equipment. Right now I only repair radios, because there are none to sell, but I average $250 a month."—J. M. SCRIVENER, JR., Aberdeen, Miss.

"Am making over $50 a week profit from my own shop. Have another N.R.I. graduate working for me. I like to hire N.R.I. men because they know radio."—NORMAN MILLER, Hebron, Neb.

SAMPLE LESSON FREE

I will send you a FREE Lesson, "Getting Acquainted with Receiver Servicing," to show you how practical it is to train for Radio at home in spare time. It's a valuable lesson. Study it—keep it—use it—without obligation! Tells how Superheterodyne Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuning, Condenser, etc. 31 illustrations.

My Radio Course Includes
TELEVISION • ELECTRONICS
FREQUENCY MODULATION

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

J. E. SMITH, President, Dept. 5KR
National Radio Institute, Washington 9, D. C.

Without obligating me, mail your Sample Lesson and 64-page book FREE. I am particularly interested in the branch of Radio checked below. (No salesman will call. Please write plainly.)

- ☐ Radio Service Business of My Own
- ☐ Service Technicians for Radio Stores and Factories
- ☐ Spare Time Radio Servicing
- ☐ Government Civilian Radio
- ☐ Aviation Radio
- ☐ Operating Broadcasting Stations
- ☐ Army, Navy Radio Jobs
- ☐ Operating Police Radio Stations
- ☐ Operating Ship and Harbor Radio

(If you have not decided which branch you prefer—mail coupon for facts to help you decide.)

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

Address .....

City ..... Zone ..... State 4FR

OCTOBER, 1945

RADIO NEWS

REG. U.S. PAT. OFF.

VOLUME 34, NUMBER 4

BRANCH OFFICES: NEW YORK. WASHINGTON, LOS ANGELES. TORONTO

WILLIAM B. ZIFF
Publisher

B. G. DAVIS
General Manager

C. R. TIGHE
Ass't to the Publisher

GEORGE BERNER
Advertising Director

HERMAN R. BOLLIN
Art Director

H. G. STRONG
Circulation Director

H. J. MORGANROTH
Production Director

EDITORIAL

OLIVER READ, W9ETI
Editor

WM. A. STOCKLIN
Ass't to the Editor

JOE MARTY, JR.
Associate Editor

HAROLD S. RENNE
Technical Editor

RAY FRANK, W9JU
Amateur Radio

HAROLD BECKER
Eastern Rep.

FRED HAMLIN
Washington Editor

E. H. SEHNERT
Chief Draftsman

ADVERTISING

S. L. CAHN
Advertising Mgr.

L. L. OSTEN
Midwest Adv. Mgr.

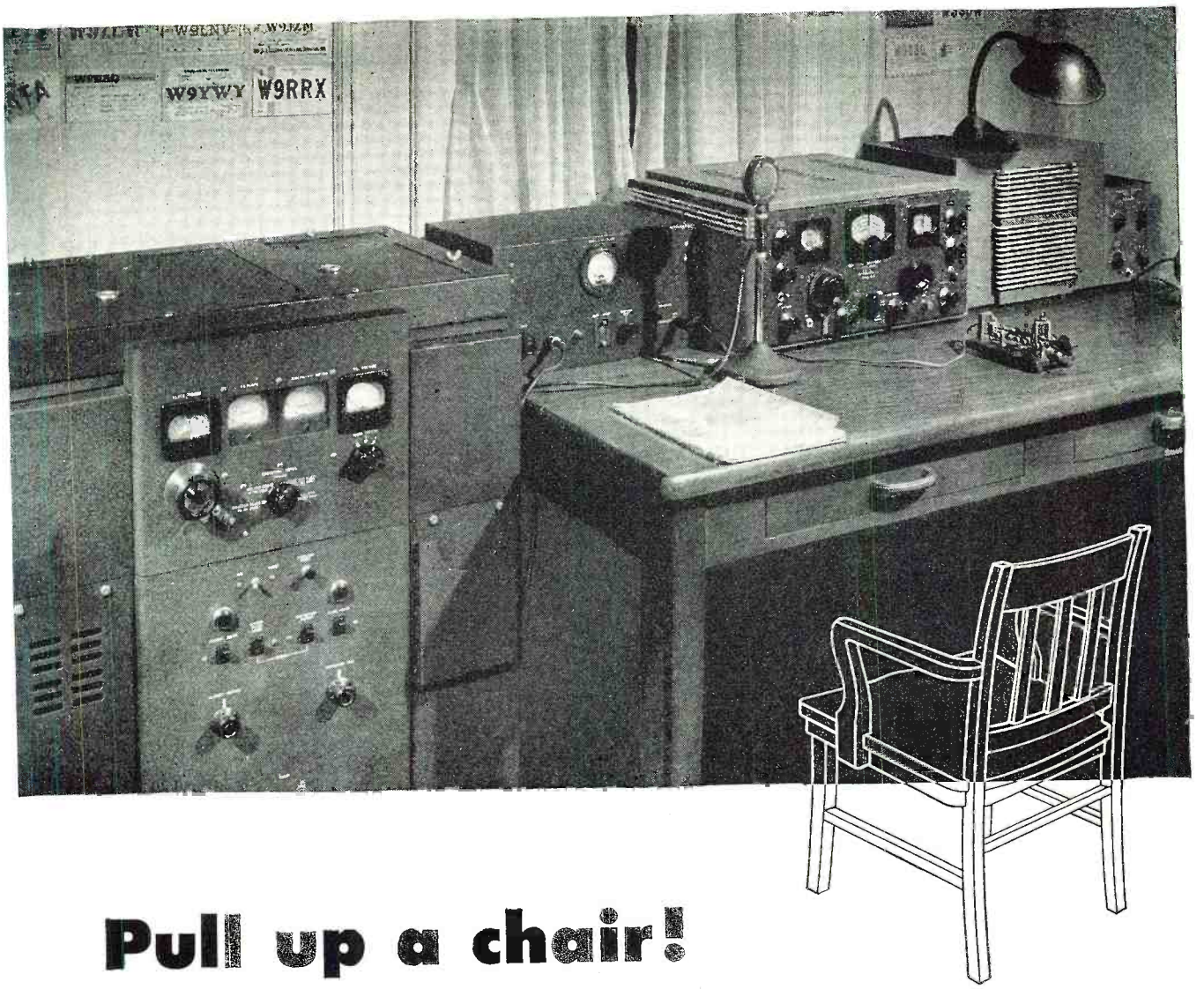
WM. L. PINNEY
Western Adv. Mgr.

Cover Photo
By Frank Ross

Engineers of Hytron devised this master tube tester to make a complete analysis of tube performance instantaneously. For complete details see October, 1944, issue of Radio News.

RADIO NEWS is published monthly by the Ziff-Davis Publishing Company, 185 N. Wabash Ave. Chicago 1, Ill. Subscription Rates: in U. S. $3.00 (12 issues), single copie 35 cents; in Mexico, South and Central America, and U. S. Possessions, $3.00 (12 issues); in Canada $3.50 (12 issues), single copies 40 cents; in British Empire, $4.00 (12 issues); all other foreign countries $6.00 (12 issues). Subscribers should allow at least 2 weeks for change of address. All communications about subscriptions should be addressed to: Director of Circulation, 185 N. Wabash Ave., Chicago 1, Ill. Entered as second class matter March 9, 1938, at the Post Office, Chicago, Illinois, under the Act of March 3, 1879. Entered as second class matter at the Post Office Dept., Ottawa, Canada. Contributors should retain a copy of contributions and include return postage. Contributions will be handled with reasonable care but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever revisions and by-line changes that are necessary. Payment, made at our current rates, covers all authors' contributors', or contestants' rights, title, and interest in and to accepted material, including photos and drawings.

Other Ziff-Davis Publications: Radio & Appliances, Radio-Electronic Engineering, Plastics Flying, Industrial Aviation, Popular Photography



Pull up a chair!

Get a ringside seat at the ideal ham shack of tomorrow. The above picture was made at Hallicrafters Ham Shack on the Boulevard, in Chicago. But no picture can represent, no artist can paint what Hallicrafters has in store for the amateurs when the demands of war production are relaxed. Rugged, dependable, sensitive high frequency transmitters and receivers — like the HT-4 which went to war as the famous mobile radio station SCR-299 and the SX-28A, the great communications receiver — belong in the postwar picture of your ideal ham shack. Hallicrafters equipment has been constantly refined and developed under the fire of war. In peace it will come closer than ever to meeting the exacting requirements of the radio amateur who has played such a prominent part in the progress of all radio and who assumed such a valuable role in war communications.

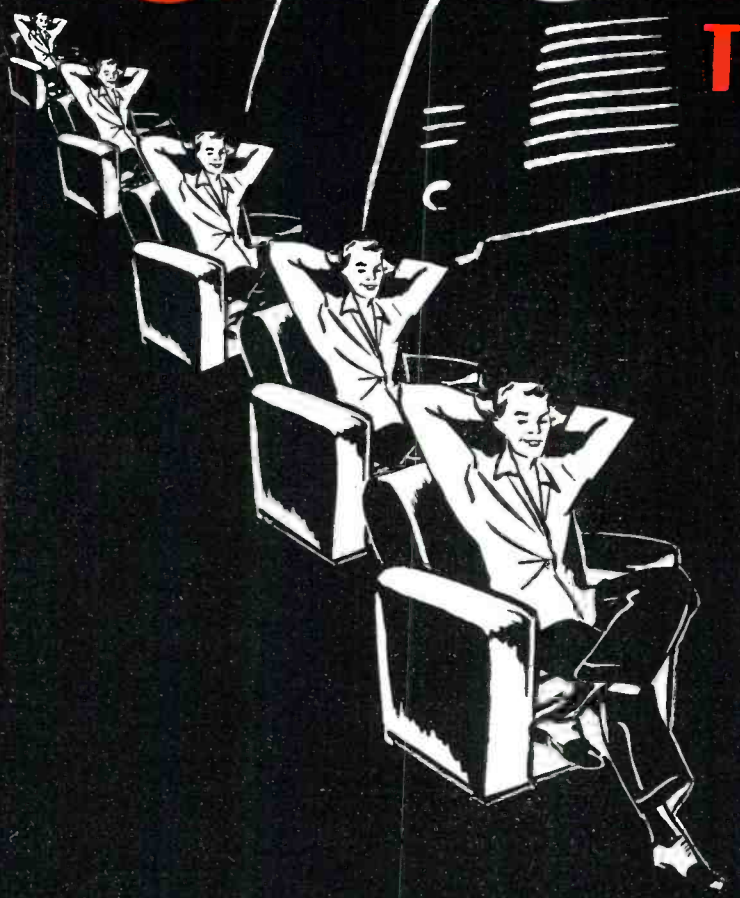
Even now you can "pull up a chair" in your ideal ham shack by sending for Hallicrafters 1945 Catalog . . . a fascinating piece of ham literature . . . detailed specifications on more than 20 models that are helping to win the radio war. Specify Catalog S-36A.

BUY A WAR BOND TODAY!

hallicrafters RADIO

THE HALLICRAFTERS CO., WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT, CHICAGO 16, U. S. A.

Symbol OF A HAPPIER TOMORROW...



Radio has deepened our appreciation of the American way of life. Out of the crucible of war, it has forged a new and better understanding of the vital forces that shape our future. It brings promise of a happier tomorrow.

For many years, FADA has symbolized the best in radio engineering and development. And — as quickly as Government restrictions are modified, Fada's great manufacturing capacity will be concentrated on producing the finest radios for the civilian market.

There are some Fada dealer franchises still available. If you are not familiar with Fada's far-sighted profit-building merchandising plans, we suggest that you communicate with your jobber — or write to us directly.

PLACE YOUR FAITH IN THE

FADA Radio

OF THE FUTURE

Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.

For the RECORD

BY THE EDITOR

THE Federal Communications Commission announced, on August 21st, that, effective at once, amateur radio operators in good standing who have been off the air since Pearl Harbor may operate until November 15, 1945, in the 112 to 115.5 megacycle band.

They will share this band with the War Emergency Radio Service, which was established as a temporary radio service for emergency communication in connection with national defense and conditions jeopardizing public safety. Many of the operators in this service were amateur volunteers. This WERS service will be terminated on November 15, 1945.

About 60,000 amateur operators were licensed at the time the Commission ordered them off the air after the outbreak of war. All of these, except those whose operator licenses were suspended or whose station licenses were revoked, will be eligible to operate in the 112 to 115.5 megacycle band thrown open by the Commission today.

Before the end of the provisional period announced today, the Commission will announce a further policy on future amateur operation. It is anticipated that other bands allocated to amateurs in the recent FCC frequency allocations will be made available to them as soon as they are vacated by present users. We predict more frequencies will be returned very soon.

AMERICAN radar, second only in effectiveness to the atomic bomb, now comes under the spotlight to reveal some of its technical magic. No one can deny the importance of radar as a contributing factor in winning both the European and Japanese war. The development of radar to its present high level of effectiveness has been the result of outstanding contributions made by American and English scientists.

We predicted many months ago that this would be, and it certainly has been, a radar war. Ever since Pearl Harbor the development of radar systems has progressed at a rapid rate. Many designs and changes have followed one another in rapid succession. Radar was not an old weapon. It was a new one especially adapted to global warfare on and over the earth and at sea.

Much has happened since RADIO NEWS presented the first story on the British radio locator. Many of you remember it. What has been accomplished is now history and the saving of thousands of lives can be attributed to the intelligent use of radar in the hands of Allied personnel thoroughly schooled to master the new technique employed.

Types of radar may be broadly classified in two categories. First comes the "search" type that sweeps distant and wide areas to detect the approximate position of a target. The second type is the "fire control" which employs a narrow beam to determine precisely the position of the target in order that shells can be aimed properly or that bombs can be released at the exact proper moment.

The search operation may be compared to the scanning of an entire scene with a naked eye. On the other hand, the fire control type of radar is comparable to focusing a telescope to "draw a bead" on the target.

Radar has not been developed by any one man or by any one manufacturer. Many firms pitched in with their full facilities in order to produce many types of radar in the quickest possible time. In fact, one large laboratory developed and produced designs for nearly 100 radars.

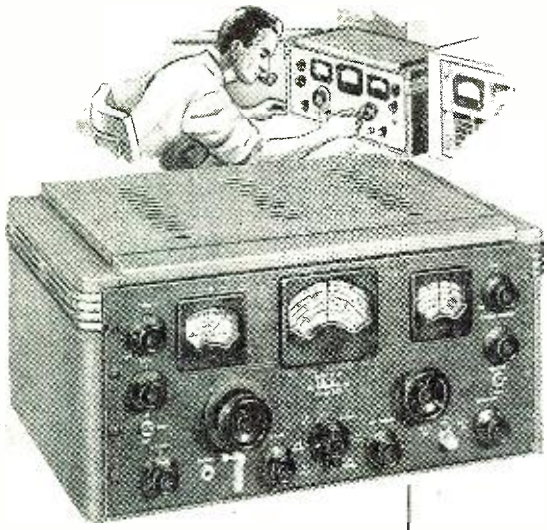
To illustrate the effective use of radar let us review quickly some typical "case histories." American troops on the Anzio beachhead in Italy were taking a terrific pounding from Army night bombers. A new fire control radar was brought in and the following morning after its first night of action, the ground was strewn with Nazi planes. The night attacks stopped. The Nazis found out that they were losing too many aircraft. The same type of radar saw plenty of action in the Pacific by furnishing anti-aircraft protection on Saipan, Leyte, Okinawa, and on other Islands, especially during the early days of each invasion.

At sea in the battle of Santa Cruz Islands, the South Dakota was credited with shooting down thirty-two enemy planes during one engagement through the use of fire control radar. In the battle of Savo Islands, the same ship teamed up with the USS Washington to sink three Japanese cruisers plus one or two battleships with the aid of another fire control radar which supplied firing information to their main batteries. This engagement began at midnight and Japanese reaction to the amazing accuracy of U.S. Navy guns in pitch darkness at a great range is shown by the following authenticated story: It was a night battle near Guadalcanal; our warships had sunk a number of enemy ships before they could open fire. A Japanese officer, fished out of the water, asked immediately to see what he called "your six inch machine gun with the electric eye pointer." This Jap was referring, of course, to our cruiser's guns which had fired so fast and with such accuracy

(*Continued on page* 122)

ORDER YOUR NEW hallicrafters Communications Receiver NOW

Available on Time Payments
Trade-ins Accepted



BE ONE OF THE FIRST to own and enjoy one of these celebrated receivers. Allied Radio is a leader in the distribution of communications receivers. WE ARE NOW MAKING SHIPMENTS. Orders are filled in turn. *Place your order now!*

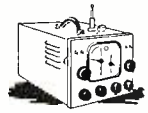
Your new receiver will have vital war-proved features . . . *plus* latest engineering developments . . . to make it one of the finest values of the day. Choice of models cover world-wide short-wave, amateur and broadcast bands. All prices are net, F. O. B. Chicago.

MODEL SX-28A—This is the latest model of Hallicrafters famous *Super Sky-Rider* . . . the finest communications receiver built today! Has a frequency range of 550 kc. to 42 Mc. continuous in 6 bands. With crystal, less speaker, net.....$223.00

MODEL SX-25—The *Super-Defiant* . . . long-time favorite of amateurs who want fine performance at a moderate price. Has a frequency range of 545 kc. to 42 Mc. continuous in 4 bands. With crystal, less speaker, net.....$94.50

MODEL S-20R—Popular *Sky-Champion* offers top performance in low cost field. Has a frequency range of 550 kc. to 43 Mc. continuous in 4 bands. With built-in speaker, net.....$60.00

MODEL S-39—*Sky Ranger* portable . . . operates from its own self-contained batteries or 115 volts a.c. or d.c. Has frequency range of 540 kc. to 30.5 Mc. continuous in 4 bands. Net.....$110.00



MODEL S-36—Covers both old and new FM bands. Operates on FM, AM, or CW. Outstanding for sensitivity, stability, high fidelity and versatility in the *very high frequencies*. Range from 27.8 Mc. to 143 Mc. continuous in 3 bands. Less speaker, net.....$307.50

PM23 SPEAKER—For SX-28A, SX-25 and S-36 above, net.....$15.00

HALLICRAFTERS

Honored for its Role in War Communications

On all fronts . . . on land, sea, in the air . . . in jungle, desert and arctics . . . Hallicrafters sets have performed gallantly for the Armed Forces of the United Nations. The fifth Army and Navy "E" award flies from Hallicrafters roof tops! Hallicrafters, you know, are *builders of the famous SCR-299.*

ALLIED RADIO

833 W. Jackson Blvd. Chicago 7, U. S. A.

Over 20 Years of Service to the Nation

NEW ECHOPHONE EC-1A

Communications-Type Receiver

This short-wave and broadcast receiver *with its many new features* will be more popular than ever! You'll get performance you didn't think possible at such low cost. Covers entire tuning range from 550 Kc. to 30 Mc. (550 to 9.85 meters) in 3 bands. For 115-125 volts AC-DC. Automatic noise limiter. Built-in PM speaker. Compact and reliable. Complete with tubes. Net.....$29.50

Subject to OPA approval

★

ALLIED RADIO

"Arsenal of Supply"

for Everything in Radio and Electronics

Allied's complete service speeds vital needs to the Armed Forces and Industry. Concentrated here are the world's largest and most complete stocks of parts and equipment under one roof. And Allied has always been one of the leaders in the sale of communications receivers.

With one of these receivers, all the world's your neighbor. You'll feel proud to be among the first to have one . . . and glad you ordered yours now.

If you prefer, convenient time payments can be arranged—or any communications receiver in good condition accepted for a liberal trade-in allowance.

SEND YOUR ORDER TODAY FOR EARLIEST DELIVERY

ALLIED RADIO CORP.
833 W. Jackson Blvd., Dept. 1-KK-5 Date.....
Chicago 7, Illinois

☐ Please ship earliest moment

.....Model.....

☐ Enclosed $.....☐ Full Payment
☐ Part Payment (Balance C.O.D.)

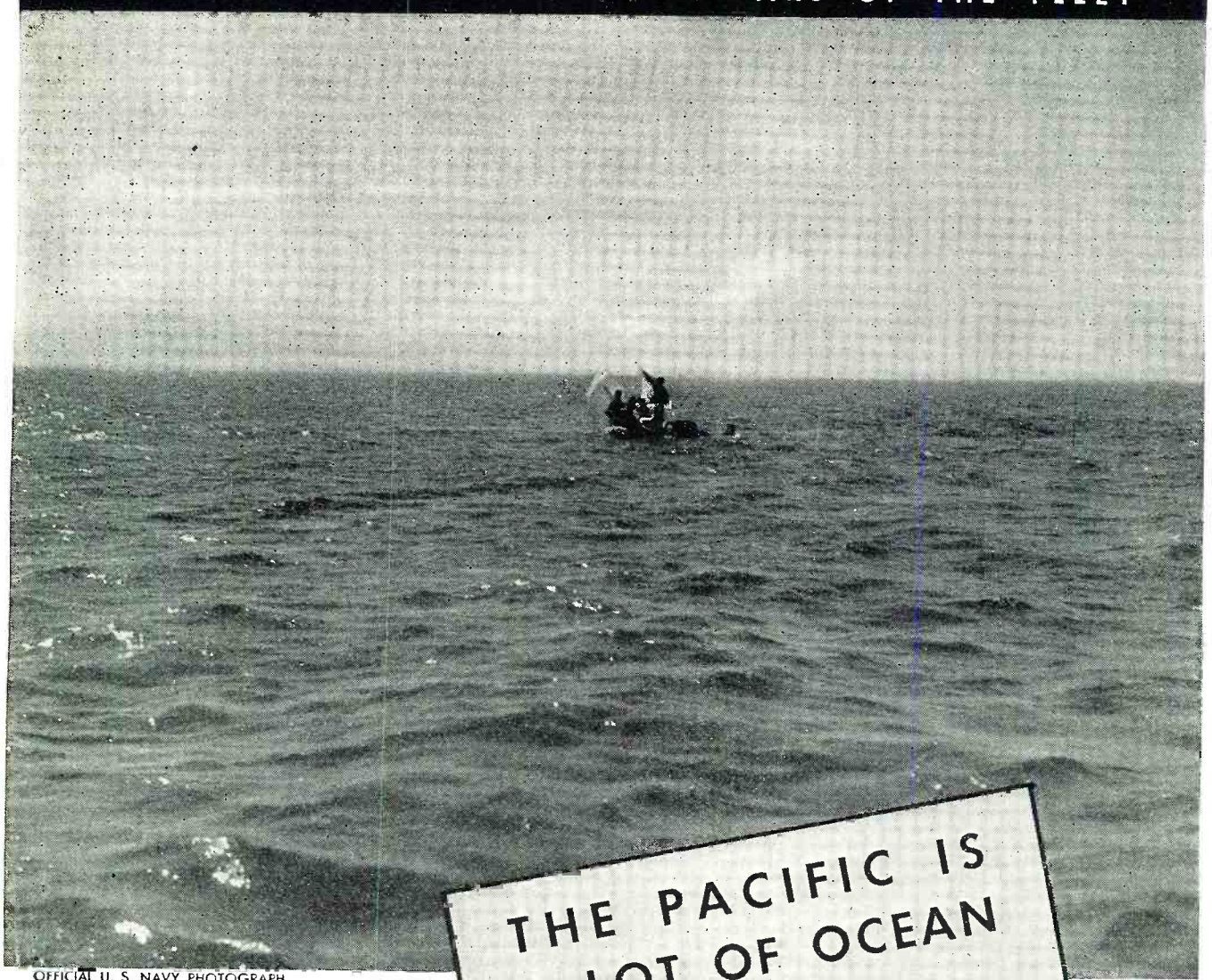
☐ Please send full information on Communications Receivers and Time Payment Plan, without obligation.

NAME.....

ADDRESS.....

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

NATIONAL RECEIVERS ARE THE EARS OF THE FLEET



OFFICIAL U. S. NAVY PHOTOGRAPH

THE PACIFIC IS A LOT OF OCEAN

It is a big place to get lost in. The ceaseless search by Navy PBM "Mariners" has saved the lives of many downed fliers. Sometimes the plane can make the rescue; often radio sends help on its way.

The Navy knows how important radio equipment is. 3 out of 4 of the Navy's ships — landing craft and larger — use receivers designed by National.

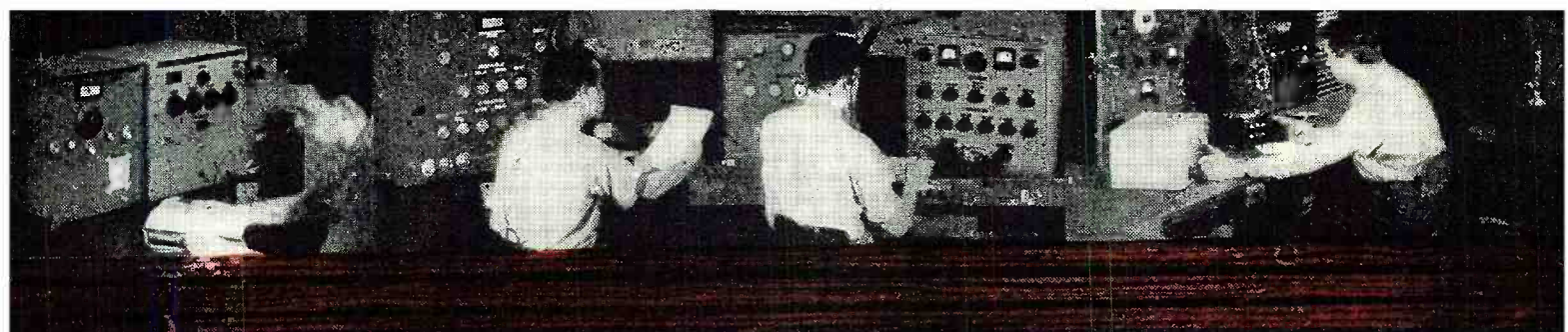
HRO

NC-200

NATIONAL COMPANY

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD



WHY CHOOSE UTC?

FOR WAR AND POSTWAR COMPONENTS

1. UTC IS THE LARGEST TRANSFORMER SUPPLIER TO THE COMMUNICATIONS INDUSTRY.

2. THE SCOPE OF UTC PRODUCTS IS THE WIDEST IN THE INDUSTRY.

3. UTC ENGINEERING LEADERSHIP IN THE INDUSTRY IS ACCEPTED . . WE DESIGN TO YOUR NEEDS.

4. THE QUALITY OF UTC PRODUCTS IS HIGHER THAN EVER.

5. THE DEPENDABILITY OF UTC PRODUCTS IS BACKED BY MANY YEARS OF EXPERIENCE. UTC IS NOT A WAR BABY.

6. UNEXCELLED PRODUCTION FACILITIES MAKE UTC'S PRICES RIGHT AND DELIVERIES ON TIME.

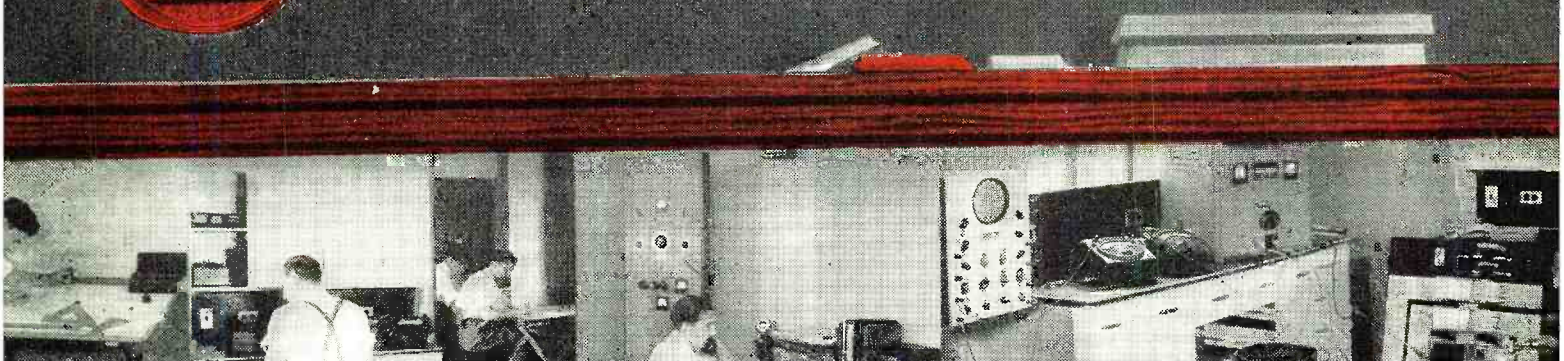
United Transformer Corp.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

ARMY NAVY

ALL PLANTS



Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By F. D. WALKER

Washington Reporter, RADIO NEWS

HEARINGS BY THE FCC on the engineering aspects of the new frequency allocations for FM continue to hold the spotlight in Washington. In line with the interest being shown by engineers throughout the country comes a communication from John Barron, Consulting Engineer of Washington, D. C., who comments as follows:

"The recently announced plan of allocation for FM stations by the FCC appears to be based upon what is termed "single market coverage", that is, any station (except 'rural') would be permitted to serve only a single market area and would not be permitted to serve two or more markets. This might be satisfactory in some cases, but it will not take care of all cases.

"For example, there are numerous AM stations now operating on low frequencies with medium power which permits them to render primary service to several metropolitan districts adjoining their trade area. If such a station obtained a 'rural' type FM assignment, it would be prohibited from placing a good city signal in these metropolitan districts. If it obtained a 'metropolitan' type assignment, it would presumably serve only the immediate trade area which accrued to the small city where its main studio is now located. If it obtained a 'community' type assignment, it would have a comparatively worthless coverage of a few miles, as such stations are proposed to be limited to 50 watts and generally low antenna heights and to be spaced so close together that their coverage will eventually be curtailed to approximately a six-mile radius. This coverage is based upon the assumption of the probable use of many receivers in such areas designed to sell at low prices and requiring a twenty-to-one ratio between desired and undesired signals.

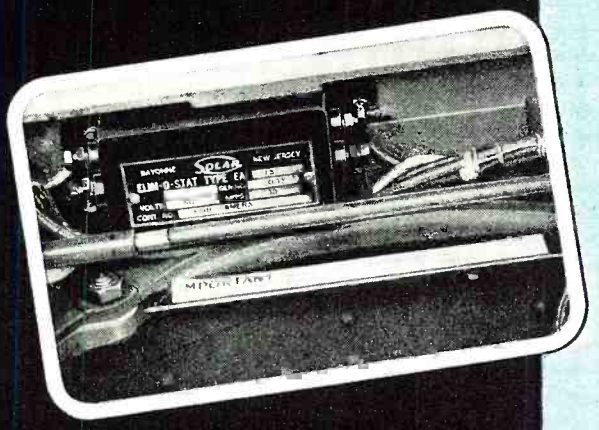
"On the other hand, it should be kept in mind that, if something like a 'single market plan' is not adopted, some stations may be faced with the loss of national advertising and network affiliation as 50 kw. FM operation would permit some stations to serve cities and areas now covered by two or more AM stations which now carry the same network program. There is one school of thought which adheres to the idea of 'survival of the fittest' and which believes that there should be no limit to the number of high-powered stations serving a given area, that the station serving the best program will get the listeners, and that the other stations can die off. It may be that more than four national networks could successfully program FM stations. The number of national networks is undoubtedly restricted at present by the limited number of AM stations having good coverage.

"It is pointed out that the proposed FM plan does not make provision for maintaining coverage of areas now served by AM stations so that some AM stations may find themselves having a greatly curtailed coverage area when they change to FM operation.

"The tentative plan of FM assignments provides for ten channels to be assigned to 'rural' type stations, fifty for 'metropolitan' type, and ten for 'community' type. It is difficult to estimate the exact total number of assignments this will provide, but obviously a great number will be permissible. Allowing for 'rural' stations to be spaced 300 miles apart, this would permit the assignment of about 24 for each frequency or a total of 240 stations. Allowing for 'metropolitan' stations to be spaced 200 miles apart, this would allow 60 of these for each frequency or a total of 3000 stations. Placing 'community' stations only 50 miles apart would permit the assignment of about 1000 on each frequency or a total of 10,000 of this class. This makes a grand total of 13,240 FM stations. Of course this does not take into account that it is not possible to use adjacent channels in the same area. (Every other channel can be used.) I would estimate that adjacent channel interference problems would reduce the number of potential assignments by 25% so that the estimate of the total number of stations is 9930. These figures are based upon the use of receivers which will operate well with a twenty-to-one ratio between desired and undesired signals on the same channel for 'community' stations and ten-to-one ratio for the other two classes of station.

"It seems doubtful to me whether the country can support or wants this many stations. The population of the continental United States in 1940 was 131,669,275. This would mean that there would be one FM station for every 13,250 persons.

"The number of cities in the U. S.



Quick as a wink the Fairchild Night Owl Camera records enemy movements intended to be hidden by darkness. Quick as a flash the radio of the photo-reconnaissance plane keeps touch with its base — and clearly — for Solar Elim-O-Stats are part of the electronic equipment of these highly perfected cameras. This is but one of many instances where Solar Elim-O-Stats are being used to absorb local interference and keep speech channels free. Let Solar advise you on radio-noise suppression.

SOLAR

WEST N. Y. PLANT BAYONNE PLANT

A TOTAL OF NINE ARMY-NAVY EXCELLENCE AWARDS

SOLAR MANUFACTURING CORP.

285 Madison Avenue • New York 17, N. Y.

does not appear to justify a necessity for this number of stations. There were only 140 'metropolitan districts' classified in the 1940 census. These districts are those including and surrounding a central city of 50,000 population or more, generally extending out to an area where the population density falls below 150 persons per square mile.

"As to the actual cities, the 1940 census shows there were 3205 cities of 1000 to 2500; 1422 of 2500 to 5000; and 2042 above 5000. These total 6669. Incorporated places under 1000 were 10,083 which, added to the above, gives a grand total of 16,752. It would, therefore, appear that the FM plan anticipates establishment of many FM stations in towns of less than 1000 population. It is hard to believe that towns of less than 5000 can support a creditable FM station. Accordingly, I see no necessity for providing for so many small 'community' stations.

"The FM engineering standards provide that interference-free reception is to be provided out to the limit of anticipated usable signal (20 microvolts per meter) for 'rural' and 'metropolitan' stations but set up a greatly depreciated limit (approximately 1000 microvolts per meter) for 'community' stations. This means that the portion of the receiver dial used by 'community' stations will carry cross-talk interference in most areas. To me, it seems poor practice to require interference-free reception in two bands and then to permit high interference in the other band. The 'community' class of station will be similar to or worse than the present 'local' class of AM station, which stations interfere with each other severely at night. It seems as though greater power with lower interference would be desirable for many 'community' stations in view of the great number of possible assignments, even if these must be placed in communities of 5000 population or more. Under the FCC proposed plan, these 'community' stations could be placed in any community, such as a small city or suburb of a large city, or could even serve a part of a large city or metropolitan district. As there could be as many as five of these in each community, it is obvious that any 'metropolitan' station would be faced with competition from numerous 'community' stations spotted in and around its service area. It appears to be unnecessary regulation to limit arbitrarily 'community' stations to 50 watts, low antennas, and 50 miles separation.

"It is felt that the gap between the 'community' station classification and the 'metropolitan' classification is too large and that the proposed FCC plans will not accommodate the need in certain areas. I would suggest the addition of a fourth classification, to be known as a 'county' station. A county is a closely-knit entity and most small stations will need to serve their county as well as the community which may be the population center of the county. It appears that any populous community would be capable of supporting one or more stations of three to ten kilowatts maximum power which should be sufficient to provide adequate rural coverage of approximately 50 to 60 miles. There were 3057 counties classified in the 1940 census (not including 26 independent cities not in counties). It is obvious, therefore, that there are sufficient frequencies to provide for an adequate number of 'county' stations, if this class is included.

"It is also believed that the 'rural' classification station should not be so severely restricted by regulation as to prohibit such stations from serving adjacent metropolitan districts. A more flexible arrangement, based upon the need in particular areas, appears preferable."

THE OPINIONS OF OTHERS who testified at the hearings vary widely, representing all degrees of acceptance or non-acceptance of the FCC proposals. Some few individuals, namely, John Morgan Davis, general counsel for the *NAB* and John W. Steen, attorney for *Westinghouse Radio Stations, Inc.*, stood pat on the brief as presented. Others rejected all of the proposals or recommended modifications of certain sections of the brief. Some of the Eastern networks asked that special consideration be given to the heavily populated New England area where AM has long been overcrowded and the FM band is filling in rapidly.

THREE ELECTRONIC COMPANIES have voted favorably on a proposed merger according to a recent announcement made public by the three companies. The *Utah Radio Products Company* of Chicago, *Universal Cooler Corporation* of Marion, Ohio, and *International Detrola Corporation* of Detroit, Michigan, have signified their intention to merge and throw their united resources into the postwar market, both domestic and foreign. *International Detrola* recently acquired controlling interest in *Rohr Aircraft Corporation* of California. Rohr has been granted permission to manufacture a limited number of domestic refrigerators and is seeking permission to build domestic washing machines. Thus, the combine will produce appliances as well as radio receivers and automatic record changers. The corporate setup has not been announced as yet.

IN A RECENT ANNOUNCEMENT the *Radio Manufacturers Association* has indicated that there might be some delay in the reconversion to civilian radio manufacture due to two major obstacles. The first of these is the shortage of critical components and the second is an uncertainty as to

Prepare Now for a Good-Pay Job in . .

RADIO ELECTRONICS

Learn at Home with . . DEFOREST'S A-B-C *Syncro-Graphic TRAINING!

ONLY DEFOREST'S OFFERS YOU THE ADVANTAGE OF MOVIES TO HELP YOU LEARN RADIO - ELECTRONICS FASTER - EASIER . . . AT HOME

Train *now* for the postwar Radio-Electronic job opportunities which wartime needs and experiences are developing! Use your *free time today* to store-up practical knowledge and experience for *good-pay* tomorrow! *Trained* men will be needed for the huge postwar requirements of Radio and Electronics, Broadcast Radio, Aviation Radio, Sound Picture Equipment, etc.—in manufacturing, merchandising, installing and servicing.

EARN EXTRA MONEY—*While You Learn*

When you learn Radio as DeFOREST'S teaches it, you can start a Business of Your Own—be your own boss, if you prefer! Even while learning, you may earn extra money doing Radio Servicing with your home as your "office." Get the facts about this fascinating home training in Radio-Electronics.

SEND FOR FREE INFORMATION!

Get "Victory for You!" book and Equipment folder. See how DeFOREST'S Training can help *you* towards good pay and a better job in a permanent industry. Also ask about *DeFOREST'S Residential Training* in the modern Chicago Laboratories shown at left. Mail coupon *today*.

DeFOREST'S TRAINING, INC.
CHICAGO 14, ILLINOIS

DR. LEE DeFOREST supervised the preparation of DeFOREST'S Training

***"SYNCRO-GRAPHIC" TRAINING**

Makes learning easier because all lesson diagrams and charts are printed on sheets that **fold out**—keeping illustrations constantly synchronized to text. Eliminates confusion from frequent flipping of pages to refer back or ahead to illustrations mentioned in text. An **exclusive** DeFOREST'S feature.

HERE'S WHAT DEFOREST'S A-B-C "SYNCRO-GRAPHIC" TRAINING INCLUDES . . .

A "LEARN-BY-SEEING" MOVIES

To help you master important Radio Fundamentals, you use the more interesting, easier-to-understand, VISUAL method of Movie Instruction . . . with a genuine De-Vry Movie Projector and Training Films!

B "LEARN-BY-DOING" EXPERIMENTS

You make 133 Fascinating Experiments with 8 Big Kits of Radio Parts and Assemblies. You build modern Radio Receiving Circuits, Electric Eye Devices, an Aviation Band Circuit, Public Address System, Wireless Microphone, etc. . . . all in your *spare time*, in your own "*Home Laboratory.*"

C 90 "SYNCRO-GRAPHIC" LESSON TEXTS

Prepared under the supervision of Dr. Lee DeForest, the "*Father of Radio,*" inventor of the Audion Tube, and holder of over 300 Radio-Electronic patents.

EMPLOYMENT SERVICE

DeFOREST'S also provides an *Effective Employment Service* which helps you get started in this *opportunity field of the future!*

DEFOREST'S TRAINING INCLUDES INSTRUCTION IN MOTION PICTURE SOUND EQUIPMENT, FM RADIO AND TELEVISION . . .

E. B. DeVry, President
DeFOREST'S TRAINING, INC.
2535-41 North Ashland Avenue, Dept. RN-B10
Chicago 14, Illinois, U.S.A.

Please send me your "VICTORY FOR YOU!" BOOK and EQUIPMENT FOLDER

*Name*_____ *Age*_____

*Address*_____

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

☐ If under 16, check here for special information.

☐ If a veteran of World War II, check here.

what prices will be allowed by the OPA. Although many manufacturers have applied for "spot" authorizations to produce a limited quantity of radio receivers, WPB officials state that these authorizations will be limited to the component producing capacity of the industry, in excess of what is needed for war purposes.

The delay in announcing an industry-wide reconversion pricing formula is claimed by the RMA to be a deterrent to speedy reconversion. More than two months after Price Administrator Chester Bowles announced his reconversion pricing formula on May 11, only radio cabinets, out of all items going into a radio, have been given a price increase. Cabinet manufacturers were given an 18 per-cent rise of 1941 prices. Many parts manufacturers are unable to quote prices on deliveries set for 2 to 3 months hence.

Under the regulations announced in the middle of July by the OPA, radio set manufacturers have their choice of selling at their 1942 prices or applying for individual adjustments pending a determination of the industry-wide "increase factor." For this purpose a "profit factor" of 3 per-cent has been given radio and phonograph manufacturers to use, with allowable increases in basic wage rates and material costs in applying for higher prices.

RADIO REPAIR SHOPS should have an adequate supply of radio tubes for repair and maintenance shortly, according to WPB officials, as tube production has been stepped up to provide almost 4,000,000 tubes a month for this purpose. This is an increase of approximately a million tubes over previous months' output.

THE NEW YORK CITY BOARD OF EDUCATION in cooperation with the Television Department of the *National Broadcasting Company* is launching an interesting educational experiment this fall. A comprehensive study is to be made into the field of the adaptation of television to classroom education. During the experiment, school officials and television experts will broadcast a weekly program over WNBT with a view to determining the type of television program most suitable for educational purposes. Pupils and teachers will evaluate these programs at the NBC studios. The first programs will be in the field of science and the initial broadcast will deal with the science of television itself. Experimentation in classroom use of these programs will begin at the junior high school level with pupils ranging from 13 to 15 years of age.

THE OWI HAS ANNOUNCED that more than 200 American technical experts drawn from various firms, universities, and government agencies have been sent to Europe to investigate Germany's technical industrial war secrets. Among the developments which have already been discovered are new applications of radiation devices not explored so far in the United States, a new and improved x-ray tube for cancer therapy and industrial purposes, new flexible high tension cables that withstand double the voltage of American-made cables of the same size, and power circuit breakers with construction details unfamiliar to the U. S. American communications interests are represented by *A. T. & T., Bell Labs., Federal Telephone and Radio Laboratories, RCA,* and *Western Electric.*

RESTRICTIONS ON THE PRODUCTION and sale of parts required for the manufacture and repair of electronic equipment, including radio sets, were removed by the WPB recently to aid reconversion in the radio industry. In addition, restrictions were removed from the sales of electronic equipment when produced under WPB authorization, according to the agency. The amendment to Limitation Order L-265 is responsible for the lifting of the controls.

AN INCREASE IN THE AMOUNT of copper wire that a repairman may buy in a calendar quarter without WPB authorization has been increased from $75 worth, or one-tenth of what was used in making repairs in 1941 (whichever is greater), to $150 worth, or one-eighth of the 1941 repair usage. This new ruling affects refrigeration repairmen, domestic appliance repairmen, electricians, electrical contractors, and radio repairmen. The amended regulation also removes the probihition against the use of new cord and other materials obtained under the regulation for certain types of maintenance and repair work.

THE ESTABLISHMENT OF A National Research Foundation by Congress for the purpose of promoting a national policy for scientific research and education has been proposed by Dr. Vannevar Bush, director of the Office of Scientific Research and Development. In his proposal, forwarded to the White House, Dr. Bush recommended that the foundation be formed to develop scientific research, financially support basic research in nonprofit organizations, encourage scientific talent in American youth by offering scholarships and fellowships, and promote long-range research on military matters. He further recommended that the foundation consist of nine members to be selected by the President and be responsible to him, these members to serve four years without compensation, and that the foundation have the following five divisions: Medical Research, Natural Science, National Defense, Scientific Personnel and Education, and Publications and Scientific Collaboration.

(*Continued on page* 148)

NO BUBBLE.

NO TROUBLE!

Production vacuum checking of Marion Glass-to-Metal Hermetically Sealed Electrical Indicating Instruments is no haphazard operation . . . After sealing in our dehydrating rooms, the instruments are submerged in glass jars which are partially filled with alcohol. A vacuum of 25 inches is drawn in accordance with newest JAN-1-6 specifications. During the test we watch for air bubbles — no bubble means no trouble. Spot checks for a period of four hours are made in a 29 inch vacuum.

The testing apparatus, illustrated above, is a Marion development, and demonstrates our sincerity of purpose in producing hermetically sealed instruments. We take nothing for granted — we neither suppose nor assume. Because imperfectly sealed instruments entrap condensation, we make certain that every hermetic instrument bearing our name is — perfectly sealed.

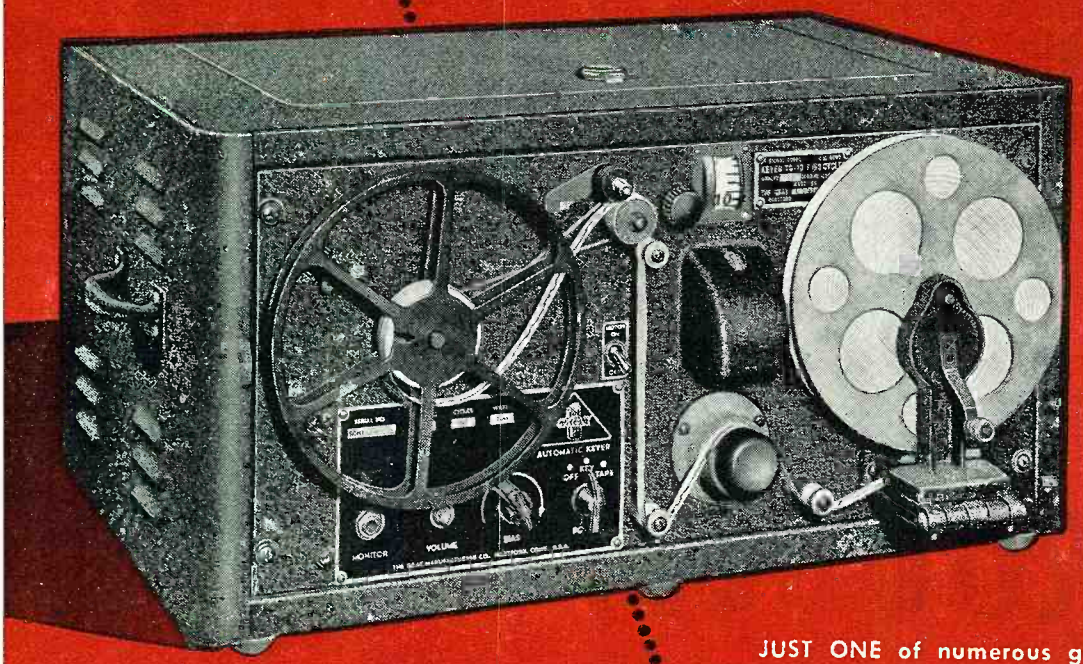
Marion Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

Write for our new, 12-page brochure. Manufacturers and users of radio and electronic equipment are invited to inquire into the advantages of Marion Glass-to-Metal Hermetically Sealed Instruments for postwar use.

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE
Jobber Sales Division: Electrical Instrument Distributing Co.
458 BROADWAY NEW YORK, N. Y.

IF YOU WEIGH OVER 110 POUNDS, THE RED CROSS CAN USE A PINT OF YOUR BLOOD

JUST ONE



JUST ONE of numerous government radio and electronic items now available through the Hallicrafters Co., Chicago, agent for Reconstruction Finance Corporation.

This is a Keyer TG-10-F, an automatic unit for providing code practice signals from inked tape recordings. Excellent for group instruction, sufficient power to operate up to 300 pairs of head phones. Can be adapted as amplifier of 10 to 15 watts output for use with crystal mike or phono pick up. Completely checked and reconditioned by Hallicrafters engineers. Send coupon for further details and lists of other available items.

THESE VALUABLE ITEMS *Available Now*
or very soon. Write, wire or phone for further information

• head phones • test equipment • component parts • marine transmitters and receivers • code practice equipment • sound detecting equipment • vehicular operation police and command sets • radio beacons and airborne landing equipment

CLIP THIS COUPON NOW

RFC DEPARTMENT 112, HALLICRAFTERS
5025 West 65th Street • Chicago 38, Illinois

☐ Send further details and price on Keyer TG-10-F
☐ Send listings of other available items

Especially interested in_____

NAME_____

ADDRESS_____

CITY_____ZONE____

STATE_____

hallicrafters RADIO

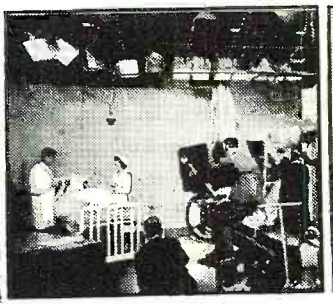
HALLICRAFTERS CO., AGENT OF RFC UNDER CONTRACT SIA-3-24

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

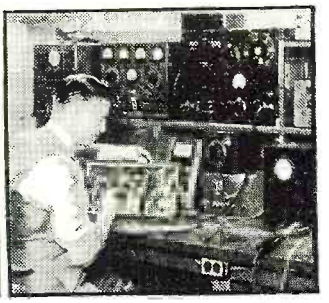
I'LL SHOW YOU HOW TO SUCCEED IN RADIO

Here's the right training for Big Post-War Pay!

A RADIO SERVICE BUSINESS OF YOUR OWN



A GOOD JOB IN RADIO & TELEVISION BROADCASTING



RADIO-ELECTRONIC SERVICE ENGINEER

F. L. Sprayberry, one of the country's foremost Radio Teachers.

BE A RADIO ELECTRONICIAN

NOW YOU CAN PREPARE AT HOME IN SPARE TIME FOR AMAZING OPPORTUNITIES AHEAD IN RADIO—ELECTRONICS—TELEVISION

The offer I make you here is the opportunity of a lifetime. It's your big chance to get ready for a wonderful future in the swiftly expanding field of Radio-Electronics INCLUDING Radio, Television, Frequency Modulation and Industrial Electronics. Be wise! NOW'S the time to start. Opportunities ahead are tremendous! No previous experience is necessary. The Sprayberry Course starts right at the beginning of Radio. You can't get lost. It gets the various subjects across in such a clear, simple way that you understand and remember. And, you can master my entire course in your spare time. It will not interfere in any way with your present duties. Along with your Training, you will receive my famous **BUSINESS BUILDERS** which will show you how to make some nice profits while learning.

Prepares You for a Business of Your Own or Good Radio Job

My training will give you the broad, fundamental principles so necessary as a background, no matter which branch of Radio you wish to specialize in. I make it easy for you to learn Radio Set Repair and Installation Work. I teach you how to install and repair Electronic Equipment. In fact, you'll be a fully qualified RADIO-ELECTRONICIAN, equipped with the skill and knowledge to perform efficiently and to make a wonderful success of yourself.

SPRAYBERRY TRAINING GIVES YOU BOTH TECHNICAL KNOWLEDGE—SKILLED HANDS

There's only one right way to learn Radio Electronics. You must get it through simplified lesson study combined with actual "shop" practice under the personal guidance of a qualified Radio Teacher. It's exactly this way that Sprayberry trains you . . . supplying real Radio parts for learn-by-doing experience right at home. Thus, you learn faster, your understanding is clear-cut, you acquire the practical "know how" essential to a good-paying Radio job or a Radio business of your own.

I'll Show You a New, Fast Way to Test Radio Sets Without Mfg. Equipment

The very same Radio Parts I supply with your Course for gaining pre-experience in Radio Repair work may be adapted through an exclusive Sprayberry wiring procedure to serve for complete, fast, accurate Radio Receiver trouble-shooting. Thus, under Sprayberry methods, you do not have one cent of outlay for manufactured Test Equipment which is not only expensive but scarce.

Read What Graduate Says "One Job Nets About $26.00"

"Since last week I fixed 7 radios, all good-paying jobs and right now I am working on an amplifier system. This job alone will net me about $26.00. As long as my work keeps coming in this way, I have only one word to say and that is, 'Thanks to my Sprayberry training' and I am not afraid to boast about it."—ADRIEN BENJAMIN, North Grosvenordale, Conn.

DON'T PUT IT OFF!

Get the facts about my training—now! Take the first important step toward the money-making future of your dreams. All features are fully explained in my big, illustrated FREE Catalog which comes to you along with another valuable FREE book you'll be glad to own. Mail Coupon AT ONCE!

JUST OUT! FREE!

"How to Read Radio Diagrams and Symbols"

. . . a valuable new book which explains in simple English how to read and understand any Radio Set Diagram. Provides the quick key to analyzing any Radio circuit. Includes translations of all Radio symbols. Send for this FREE book now, and along with it I will send you another big FREE book describing my Radio-Electronic training.

GET FREE BOOKS

SPRAYBERRY ACADEMY OF RADIO
F. L. Sprayberry, Pres.
Room 25105
Pueblo, Colorado

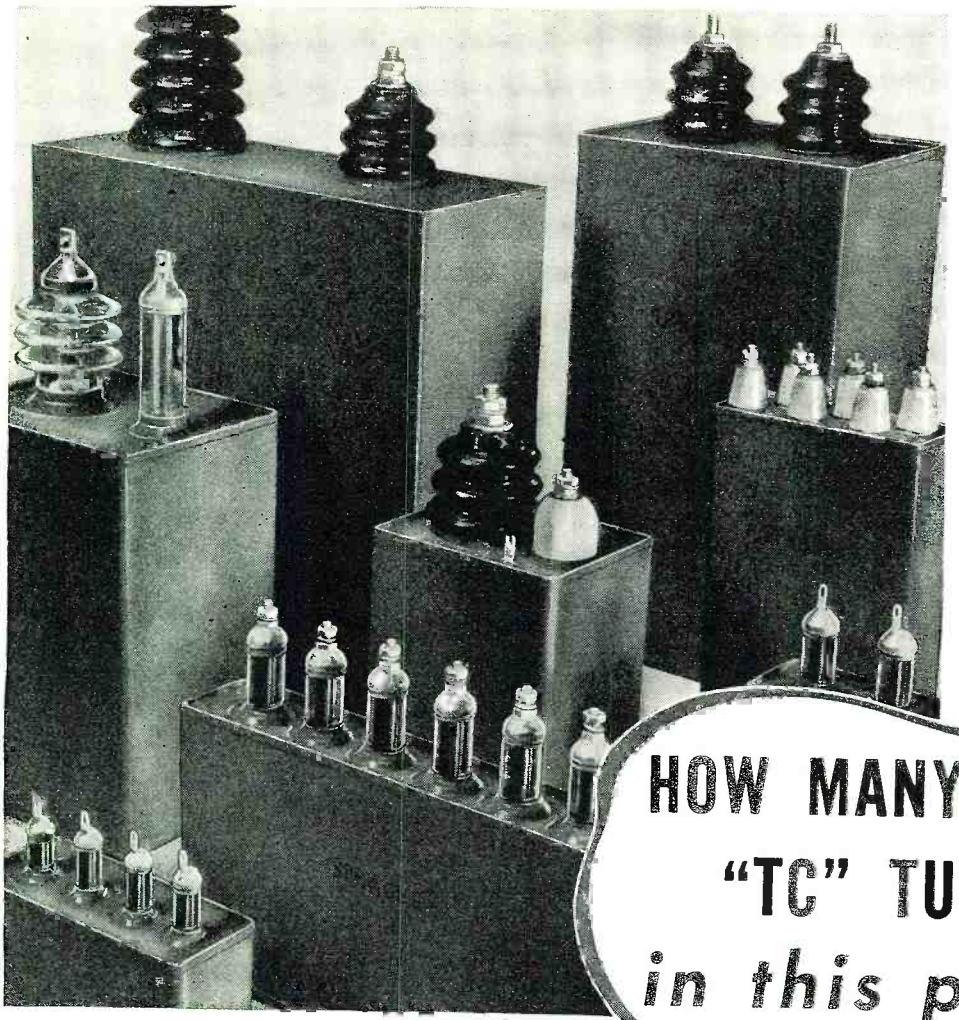
Please rush my FREE copies of "HOW TO MAKE MONEY IN RADIO, ELECTRONICS and TELEVISION," and "HOW TO READ RADIO DIAGRAMS and SYMBOLS."

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

Address .....

City ..... State.....

Tear off this coupon, mail in envelope or paste on penny postcard.



ARMY E NAVY

HOW MANY SPRAGUE "TC" TUBULARS *in this picture?*

THESE big energy storage capacitors are recent Sprague Electric Co. types developed for flash-photography, high-voltage networks, welding and other exacting wartime uses.

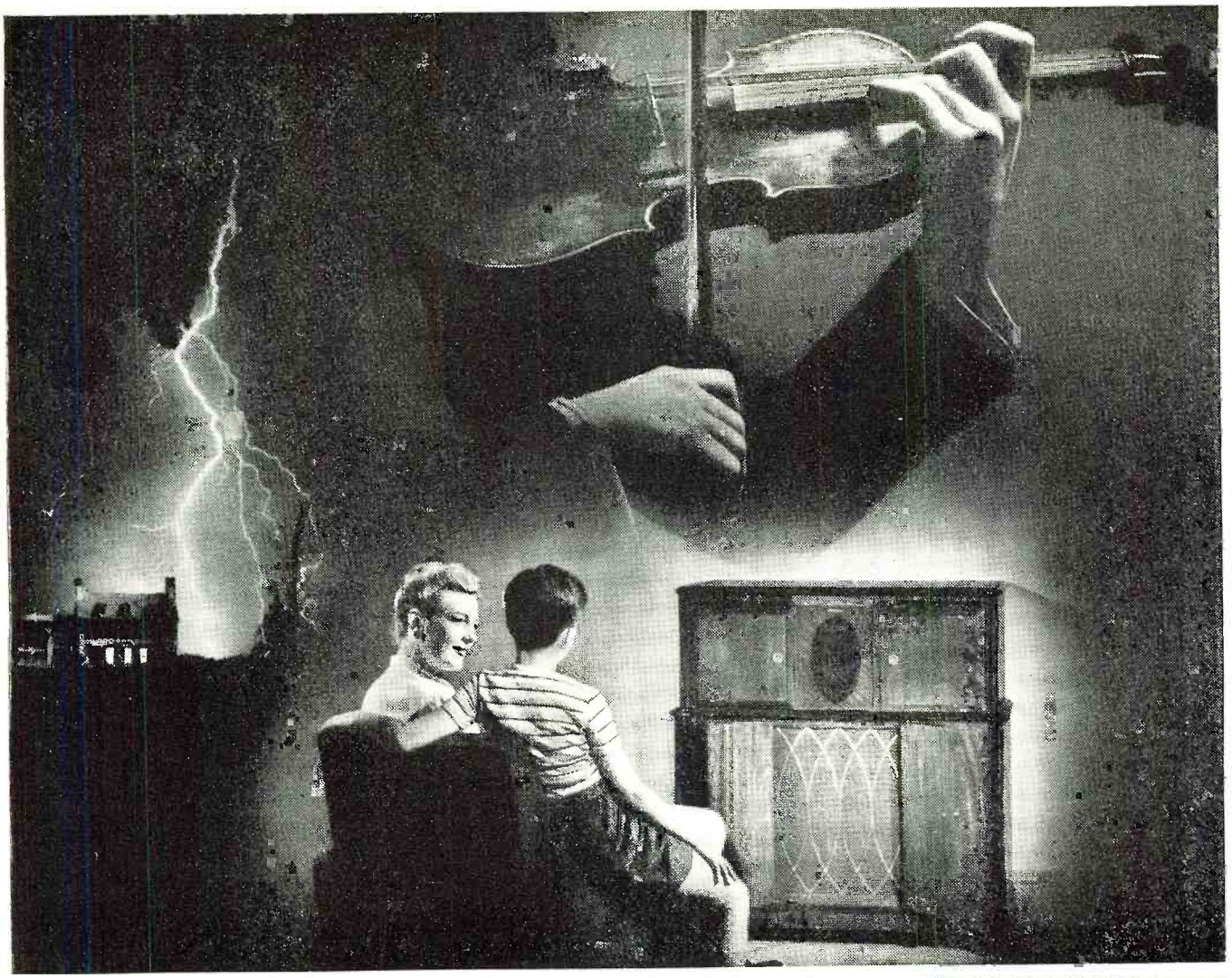
Consider thousands upon thousands of these giants in terms of the vast quantities of "TC" Tubular Capacitors and other service types that could have been made with the same investment of time and materials, and the Sprague wartime record looms even more impressive.

Every replacement type that has occasionally been missing from jobbers' stocks has been more than accounted for by the FIVE separate Army-Navy "E" citations that Sprague has achieved. Moreover, a constant and steadily increasing supply of Sprague Atoms and "TC" Tubulars still makes it possible to match 9 out of 10 replacement requirements "on the nose!"

As always—as long as the need exists—see Sprague TRADING POST on Page 93.

Sprague Products Company
North Adams, Mass.
(Jobbing Sales Organization for Products of the Sprague Electric Co.)

SPRAGUE



RCA Super-FM "soundproofs the air"... eliminates static and other interferences.

RCA Super-FM...storms can be seen but not heard

With RCA Super-FM radio, the most violent thunderstorm becomes a "polite little shower." It can be seen, but never interrupts broadcast reception.

The first time you hear Super-FM (Frequency Modulation) you'll hardly believe your ears! For all static, interference and other extraneous noises are miraculously eliminated.

During a thunderstorm you can listen to a delicate violin sonata—and think you're right in the broadcasting studio! Voices have a natural "in the same room with you" quality. You will agree that never before have your favorite symphonies, operas and popular tunes sounded so colorful, so pure, so full-ranged and so distinct on the radio!

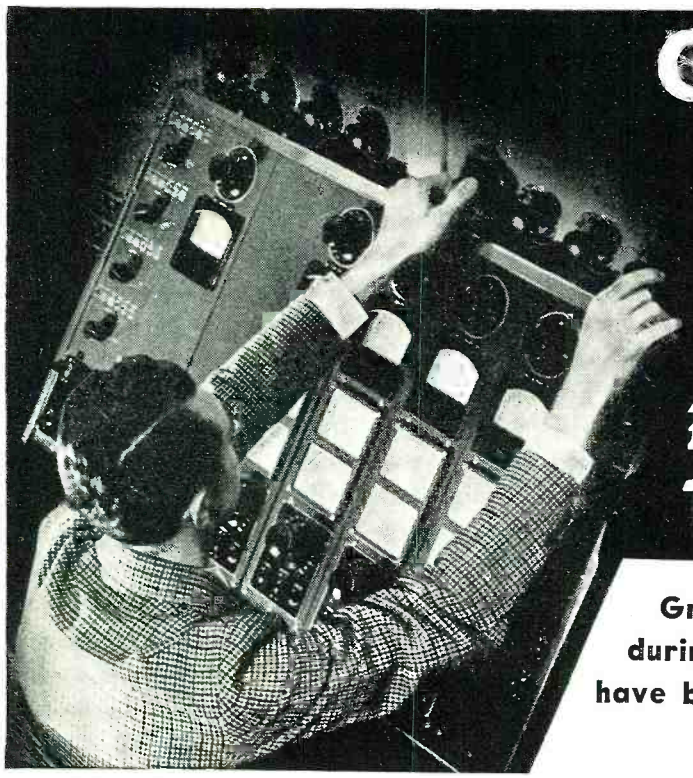
Super-FM is another "modern miracle" developed by an RCA engineer. You'll owe it to yourself to hear RCA Super-FM before you buy.

The same kind of "let's do it better" research that perfected Super-FM goes into all RCA radio products. And when you buy an RCA Super-FM radio, or television set, or Victrola—made exclusively by RCA Victor—you will enjoy a unique pride of ownership in knowing that you possess one of the finest instruments of its kind that science has achieved.

George L. Beers, Assistant Director of Engineering for the RCA Victor Division, listens to the RCA Super-FM that he developed. Super-FM provides greater ease in tuning and a higher degree of selectivity as well as freedom from noise and interference.

RADIO CORPORATION of AMERICA

RCA BUILDING, RADIO CITY, NEW YORK 20

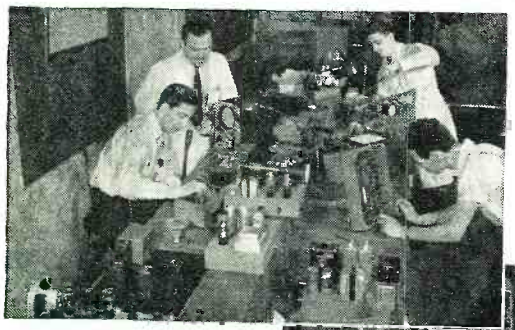


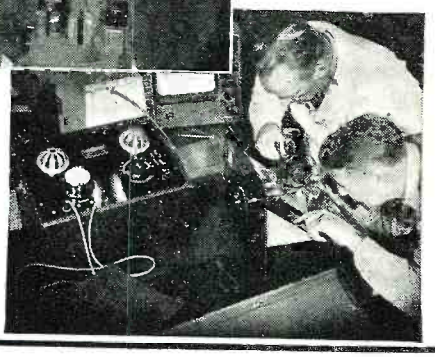
Get Ready for POSTWAR RADIO ELECTRONICS AND TELEVISION NOW!

Great strides of progress have been made during the war. New equipment, methods, uses have been developed. Keep in the lead yourself with modern

SHOP METHOD HOME TRAINING

BY A GREAT ESTABLISHED RESIDENT SCHOOL





NATIONAL SCHOOLS HAS BEEN BRINGING OPPORTUNITY TO AMBITIOUS MEN FOR MORE THAN A THIRD OF A CENTURY. Above and to the right are two departments in this great school where modern developments are analyzed to provide National students with first-hand knowledge of short cuts and trade secrets. For full details fill out the coupon.

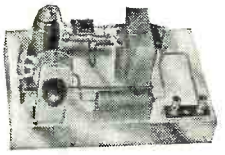
Take your place in the forefront of Radio, Television and Electronic progress. Get your share of the NEW business. War inventions and improvements—walkie-talkies, radar, aircraft control and communications—will quickly be adapted to civilian use. F.M. is winning almost universal acceptance and use.

Everywhere you turn new and important changes in the field of Radio are being put into operation every day. Television is rapidly being perfected. Electronics is being applied to industry and better living. **The successful technician** MUST KEEP UP WITH PROGRESS if he is going to be sure of his job—GET AHEAD IN BUSINESS.

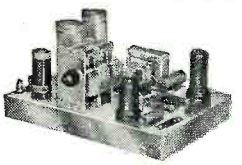
National Schools presents a Radio and Electronic training system geared to the rapid advancement of the industry itself. Here is an exclusive home training system based on the shop methods as practiced in one of the World's foremost vocational education centers—the actual shops and experimental laboratories of this National institution. **Send the coupon on the next page for complete details.** Only National can bring you this type of training for only National has the shops, equipment and experimental laboratories for the development and extension of the system.

Use This Modern Electronic Laboratory

The very essence of National Shop Method Home Training is EXPERIENCE. You get to know Radio and Television circuits by building them yourself. You get first-hand knowledge of how instruments work by a sound analysis and construction system.

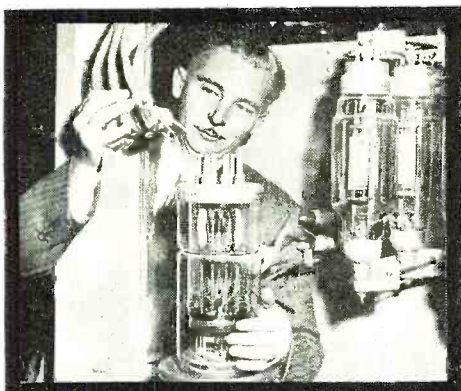


You build a beautifully toned, high fidelity, long distance modern superheterodyne receiver from the parts furnished with your course. In this way you have a thorough understanding of the superheterodyne principle.



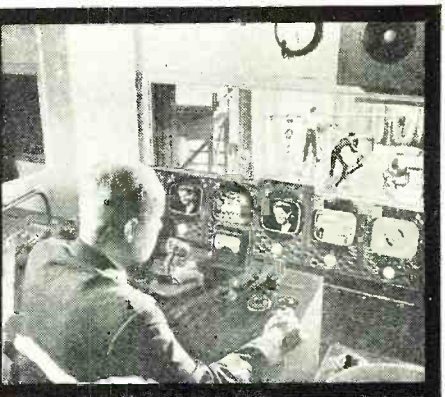
You learn modulation, beat frequency and signal generation by building yourself a small, operating radio transmitter with National parts. You get to know and understand the process of creating audible signals by electronic means by conducting experiments with a National Audio Oscillator.

You conduct cathode ray experiments to gain a first-hand knowledge of the operation, repair and maintenance of Television equipment. Hundreds of experiments may be performed to gain first-hand experience with your National laboratory equipment.



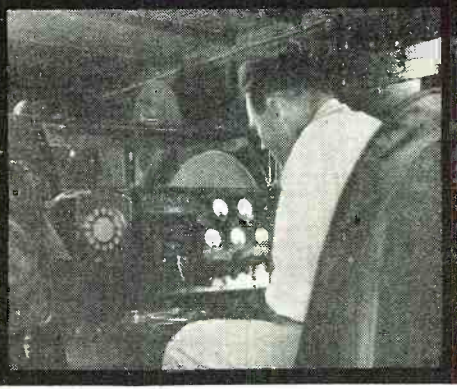
New Fields

Electronics is already a most important factor in industry. Many manufacturing processes depend on electronic controls — employ electronic processes. In medicine and agriculture too, electronics is being used extensively. Are you ready to cash in on this development in a field that is so close to radio?



New Equipment

Every day you learn of new types of radios and improved television—new electronic devices. Fac-simile, F.M., Radar, Sonor—all present new problems of manufacture, operation and maintenance that demand training and experience. Consider your advantages if you have the necessary preparation to tackle this work.



New Hook-Ups

The relatively simple wiring of the radio receiver of a few years ago is as out-of-date today as one of the first automobiles. The new Radio and Television sets, and Electronic devices demand a thorough knowledge of new principles. National brings its students the results of **continuous** research and improved methods.

NEW OPPORTUNITIES

Think what all this great progress in Radio, Electronic power and control and Television means to YOU PERSONALLY—you who are already in Radio or have a natural inclination toward it. The greatest opportunity of a lifetime is right within your grasp.

Compare the job you now have or expect to get when you are out of service or your present war job with the great future presented you by the broad field of Electronics.

Literally tens-of-thousands of technicians are needed in Radio and Television stations and communications companies all over the country—to operate, maintain and repair equipment. The man who **knows modern methods and equipment** is welcome almost at his own price.

Latest figures show that Radio represents a **5-billion dollar industry** and, in the opinion of experts, it is a **secure, well established, basic** type of business offering **steady employment.** Television, according to authorities, offers **half a million openings** right at the start. The man trained in modern Electronics CAN CHOOSE THE KIND OF INDUSTRY HE WANTS—THE PART OF THE COUNTRY HE PREFERS AND THE KIND OF POSITION MOST SUITABLE.

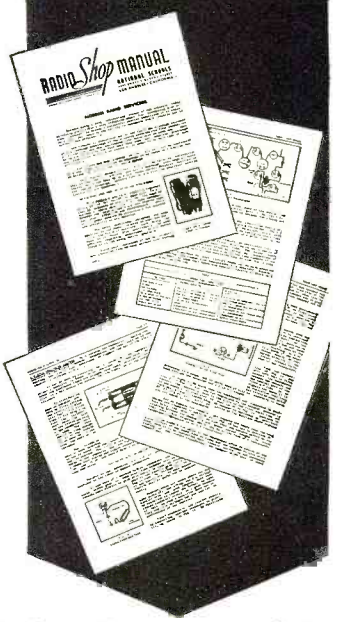
You Want Action

With this amazing speed-up training you can progress just as quickly as you wish—start taking advantage of your new found knowledge and experience in a very short time. Send the coupon below and learn the facts about this great educational development. Try out the FREE SAMPLE LESSON and see for yourself what you can accomplish so quickly and easily with the remarkable SHOP METHOD HOME TRAINING.

In a few months—perhaps only weeks—you may start making good money; maybe accept a BIG PAY JOB in industry—GET INTO A PROFITABLE, LIFETIME BUSINESS OF YOUR OWN, with little or no capital investment.

Take the first step now. Fill out and mail the coupon below.

FREE LESSON

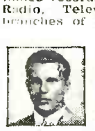


Get this BOOK

Here is an interesting forecast of the future of Radio and the opportunities present for you in this, and allied fields right now. It is profusely illustrated and describes the jobs waiting for trained men everywhere. Send the coupon below for your copy.

Here Are Some Samples of Success in Radio by National Graduates

National Shop Method Home Training wins good jobs, independence and security quickly. Take the word of National men who have established records in their favorite Radio, Television, or other branches of Electronics:



Joseph Grumich, Lake Hiawatha, New Jersey writes: "My latest offer was $5,800.00 as Radio Photo Engineer . . . but I'm doing well where I am now engaged. I am deeply indebted to National."

Here's a statement from R. R. Wright, Blackfoot, Idaho: "Due to my training at National I was selected to instruct in the laboratory work of Navy and Marines."

From O. K. Ivey, Washington, D. C., comes this endorsement: "I believe National offers the best course to be had . . . Keep up the good work."

Robert Adamsen, Kearney, Nebraska, National graduate, has two radio jobs — makes double pay as a radio instructor and as engineer at Station KGPW. He writes: "I am proud of my National training and appreciate the cooperative spirit."

Read what hundreds of other enthusiastic students have written about National Training. Send in your coupon today.

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA EST. 1905

MAIL OPPORTUNITY COUPON FOR QUICK ACTION

National Schools, Dept. 10-RN
4000 South Figueroa Street, Los Angeles 17, California

(Mail in envelope or paste on penny post card)

Mail me FREE the two books mentioned in your ad including a sample lesson of your course. I understand no salesman will call on me.

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

ADDRESS .....

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

Include your zone number

WHAT DO YOU WANT?

YOU TELL US!

WRITE NOW! You've had four years to dream about a new transmitter or a new receiver. Tell us just what you think it should be and what it should do. We've had four additional years of engineering and research during which we have better equipped ourselves to bring you the finest in communications equipment.

THE SIGN OF QUALITY

ESTABLISHED 1910

Send your suggestions to "Postwar Development"

DESK 12

HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., N. Y. C.

MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

Radar

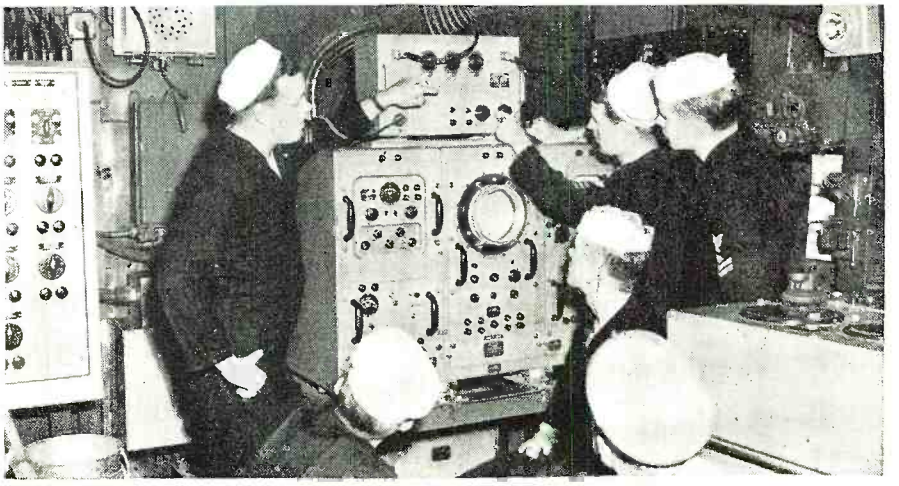
The Silent Weapon of World War 2

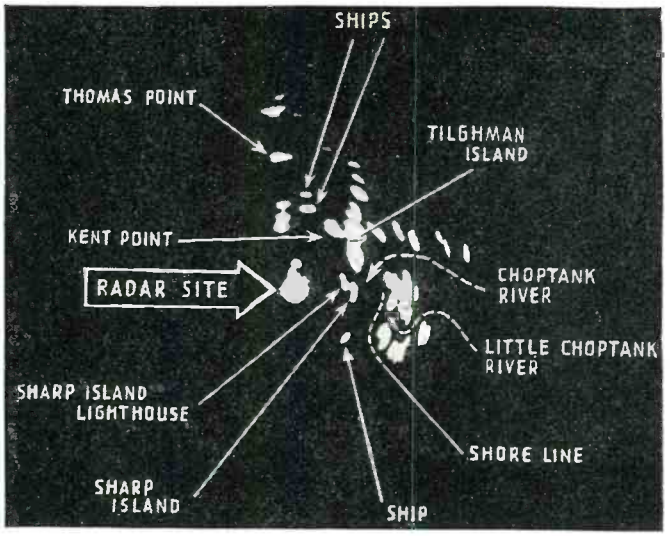
AN ELECTRONIC "eye" apparently developed independently by U.S., British, French, and German scientists in the 1930s, radar owes much of its rapid growth to the advent of war. First used in detection of surface objects in the near-distance under conditions of poor visibility, radar's range and versatility were quickly extended to provide long-range detection of air-borne, as well as surface objects, accuracy in fire-control, and identification of distant or unrecognizable planes and ships. To radar, the silent weapon of World War 2, goes much of the credit for England's doughty defense in the dark days of the "blitz", and also for "lighting the way" for our victories in the Pacific.

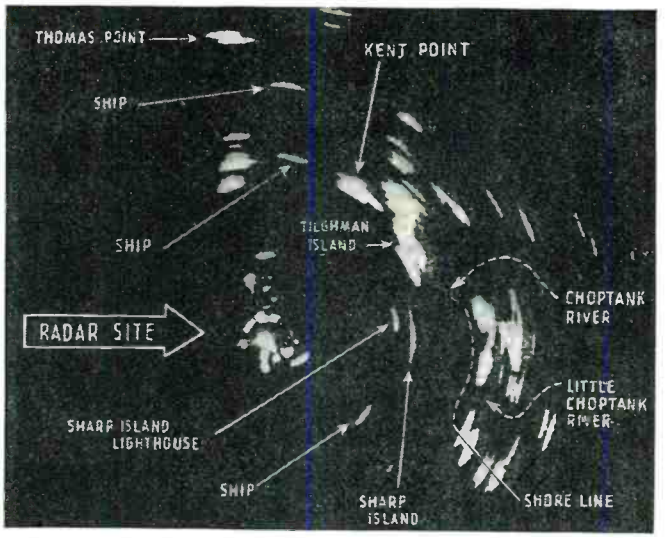
★ "Thinking cap" of the PT boats, the "radome" bulb, shown circled, houses the antenna of the radar set aboard the vessel. Invaluable to the hard-hitting PTs, because of their habitual tendency to operate under the cover of night, radar's electronic eye pierces the darkness, indicating the various targets and warning of immediate navigational dangers.

★ The trellis-work of this ship's radar, outlined against the sky, is in contrast to the small antenna on the wing of the General Motors Avenger torpedo-bomber shown in foreground. Close inspection of this plane installation will reveal the "teeth" of the antenna affixed to the terminal of the white strut. This installation is a Yagi-type antenna. The vessel is a Navy escort aircraft carrier, photographed while at sea.

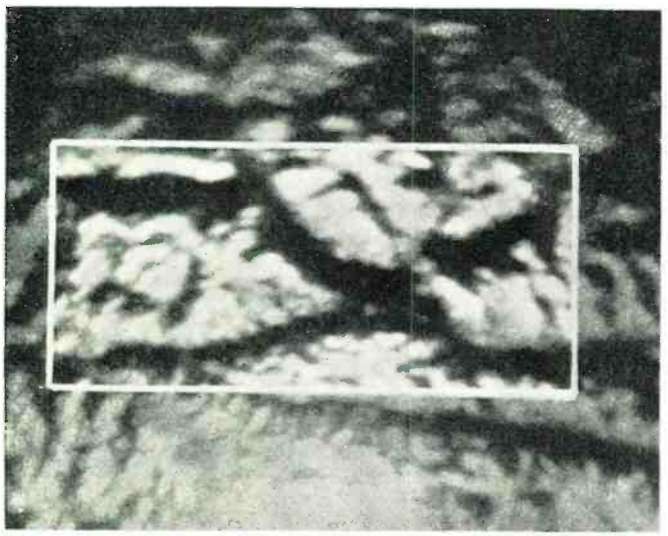
★ Enlisted men in a radar unit listen to instruction during shakedown cruise of a Navy warship. Instructors are also enlisted men chosen for their aptitude and actual experience.

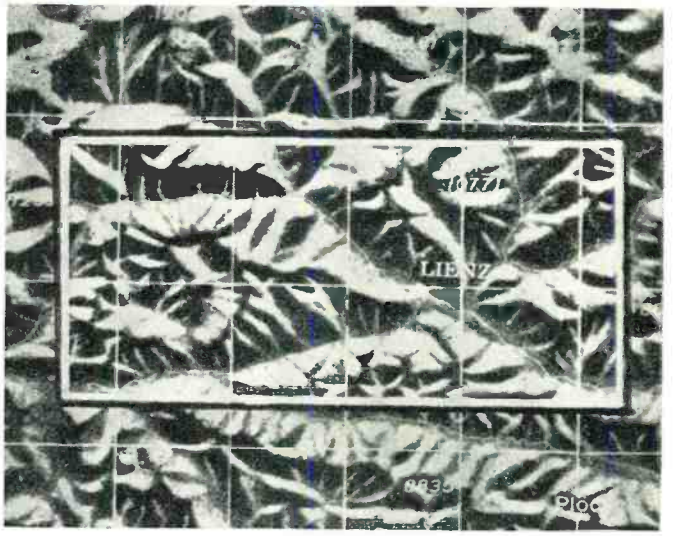






★ Radar equipment at the Naval Research Laboratory, Chesapeake Bay Annex, recently made this "search" of surrounding terrain. Lettered on the photographs of the PPI (Plan Position Indicator) scope are designations of points picked up by radar pulse. Compare the photograph (left) made with a considerably larger range with the photograph (right) made with a substantially lesser range, both of which represent scope of the same area. Notice how "pips" converge when the range is widened and diverge when the range is lessened.

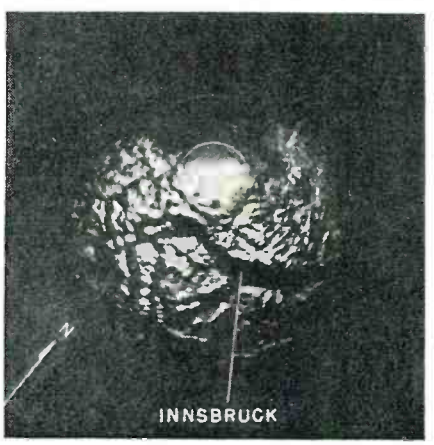


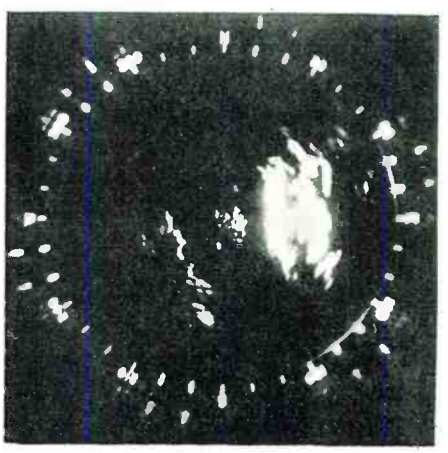


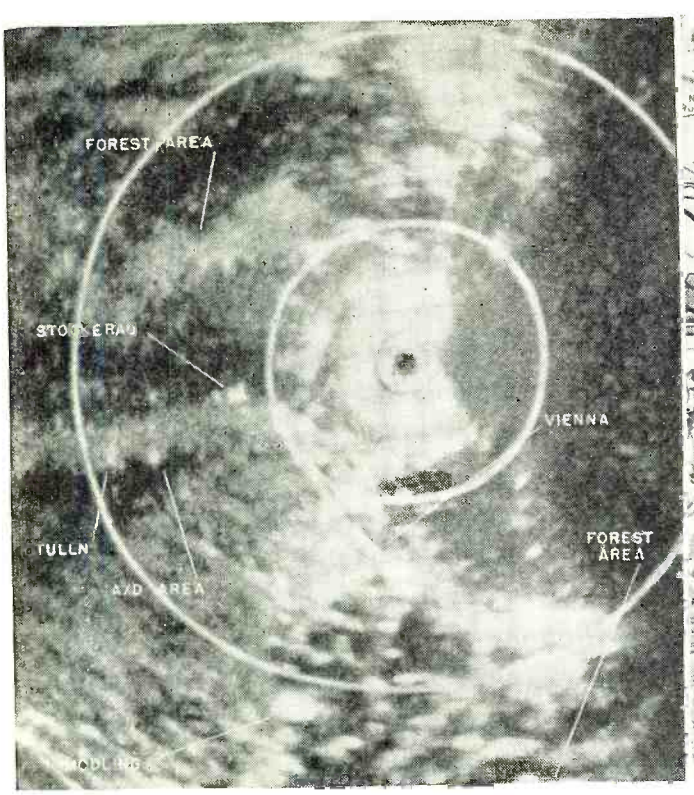
★ Radar takes a lot of the woe out of mountain flying. A navigator equipped with relief maps and scope pictures can determine his position without any trouble at any hour of the day or night, as the radar scope will show a pattern almost identical with his maps. Above photographs show scope picture (left) compared to same section on relief map (right).

★ This photograph of a ship's PPI (Plan Position Indicator) scope was taken during the invasion of Lingayen on Luzon. The cluster of white dots shown in the photograph represents warships in the bombardment group; the large white mass, the coast, headlands, and highlands of the island; behind the attack flotilla, transports and the other ships composing the large invasion armada throw light pips on the radar scope.

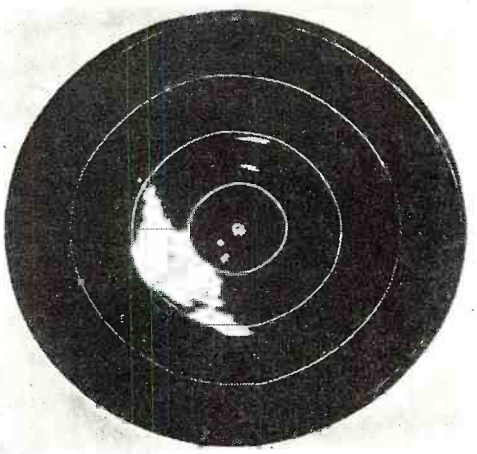
★ Radar's directional characteristics are such that its results can be minimized by contour of terrain below. These two pictures of Innsbruck, Austria, illustrate what directional approach can do. Picture at left made on approach from south, shows city. Picture at right made on approach from north, spots general contour of valley, but fails to show the city proper.





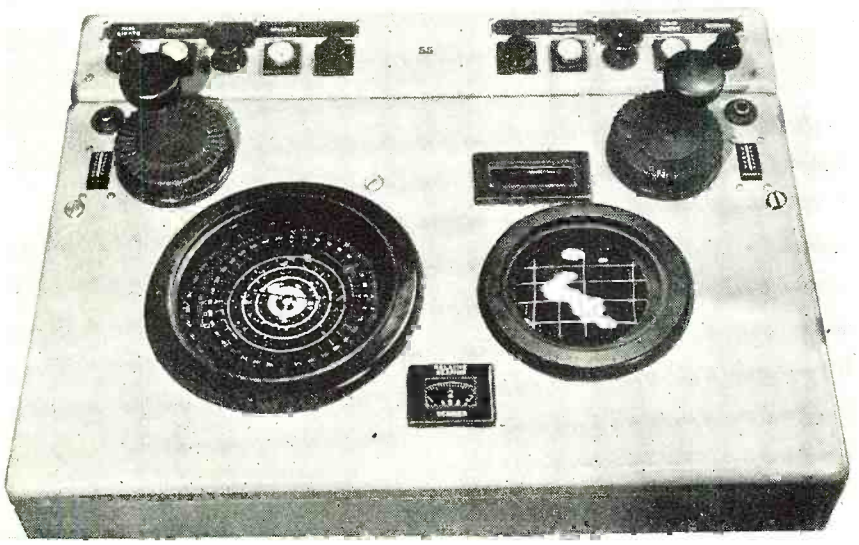


★ P-38 radar reconnaissance missions provide scope photographs for routes to and from the targets, as well as series of target runs, made from the cardinal points of the compass and from the logical axes of attack. The scope photographs made by reconnaissance planes are plotted on maps and reproduced for reference by Pathfinder operators during the actual bombing missions. In the photograph at left, forest areas around Vienna, Austria are resolved on scope in droopsnoot P-38. Returns are good enough to be used as check points in radar navigation. Map at right covers same area as shown on scope.

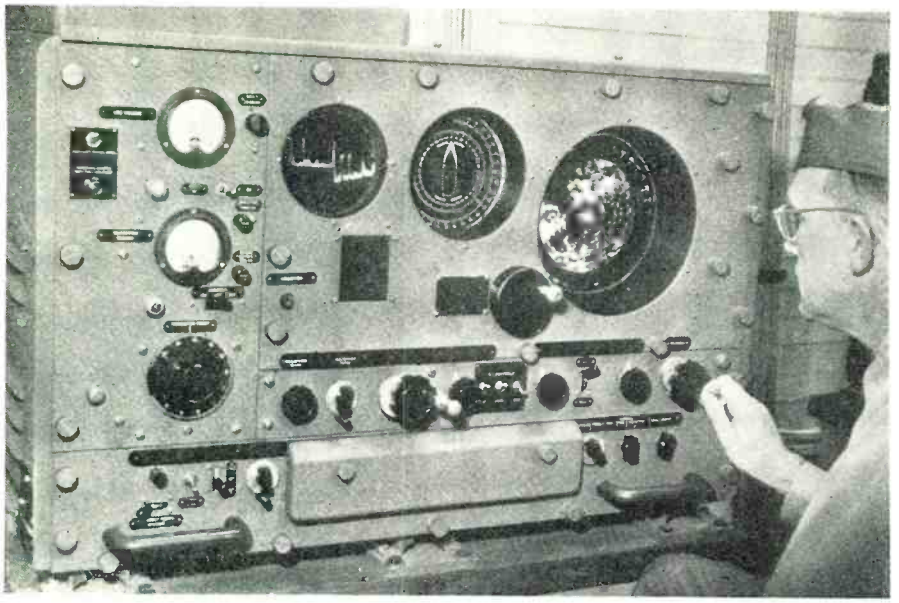


★ "Scope picture" of Oahu in the Hawaiian Islands made by a Navy plane on a radar test. Blob of light in center of the photograph marks the position of plane as shown on indicator of its radar; the island itself is the largest white area, with low points in the topography in black. The two "pips" between the inner and second circles are ships. →

★ Radar repeater unit which repeats information from main SG type radar so operator in remote position may have indication exactly the same as main unit. Units of this type enable several positions to simultaneously monitor main radar unit, thus eliminating much delay in transmitting information to all locations at one time and affording multiple checks.

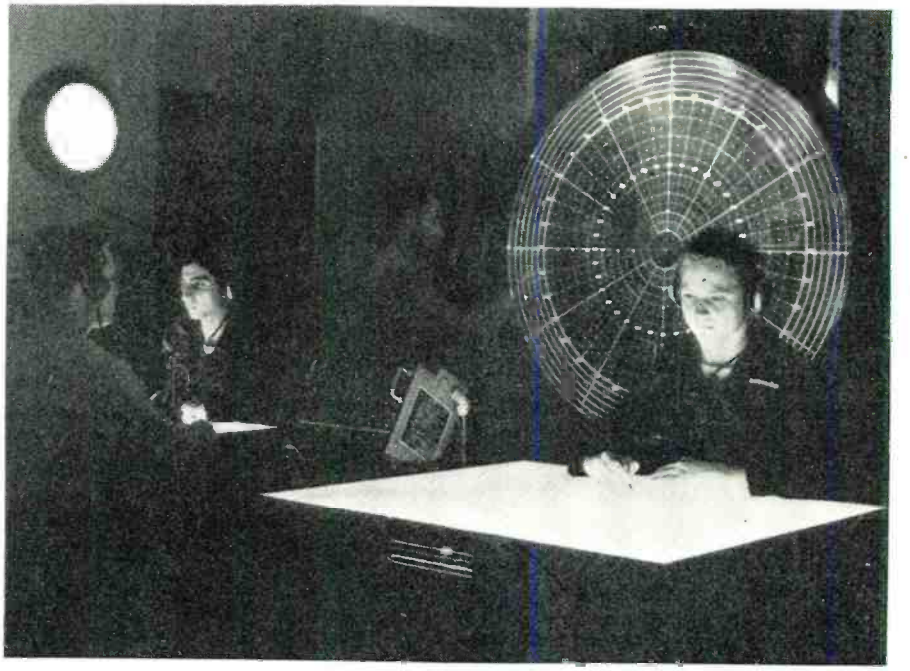


★ Radar photography experts consider this picture one of the best of its type. It was taken over the Munich area, with Munich proper shown as the light spot at the top.



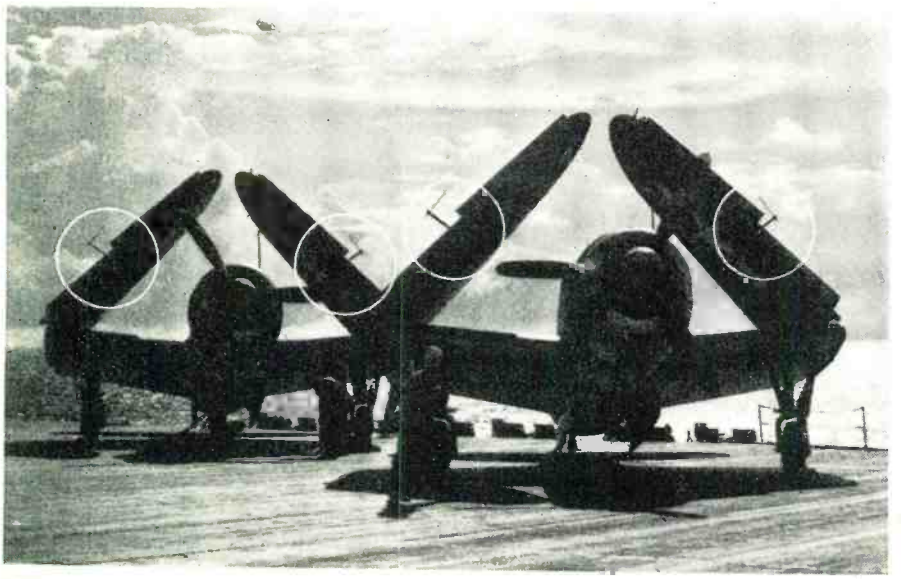
★ Operator using a type SG radar indicator to obtain the range and bearing of target. The relative bearing of operator's ship may be seen in center, just to the left of scope. Equipment of this nature is also used for plotting position of ship.

★ Closeup of a typical pattern as seen on an SG radar scope. A picture such as this affords the operator a complete picture of the territory in all directions from the ship, in spite of the fog or darkness, and may be quite readily compared with ordinary, conventional maps.

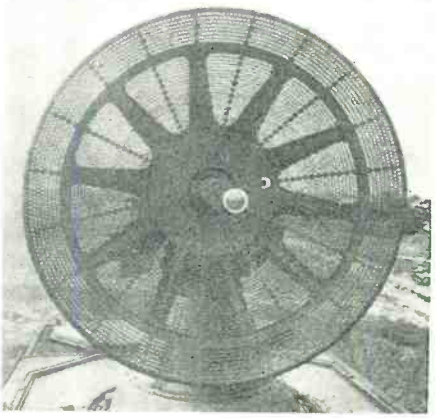


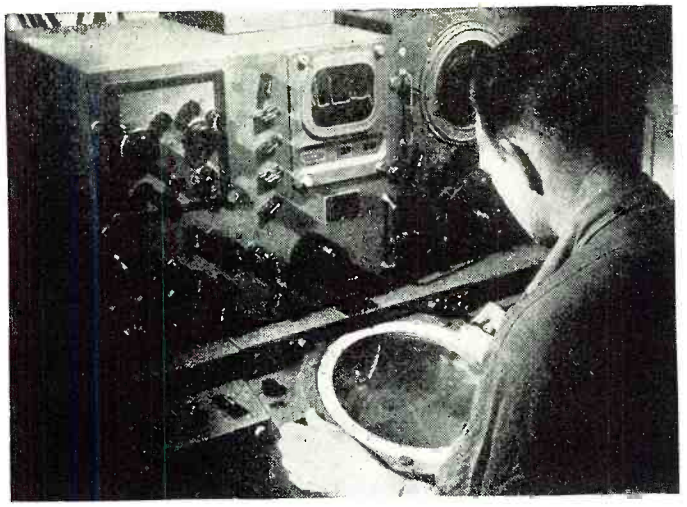
★ Study in black and white—radar training at a naval air station in U. S. Officers and men spend long hours, that will later pay dividends, studying intricacies of the "electronic eye" in simulated plot room.

★ The slim and angular "elbows" of radar antennas are silhouetted atop folded wings of these Curtiss Helldivers spotted on flight deck of a Navy Essex-class carrier somewhere at sea. Adding this equipment to Navy planes gave the effect of applying telescopes to the "eyes of the Fleet," as aircraft are often known.



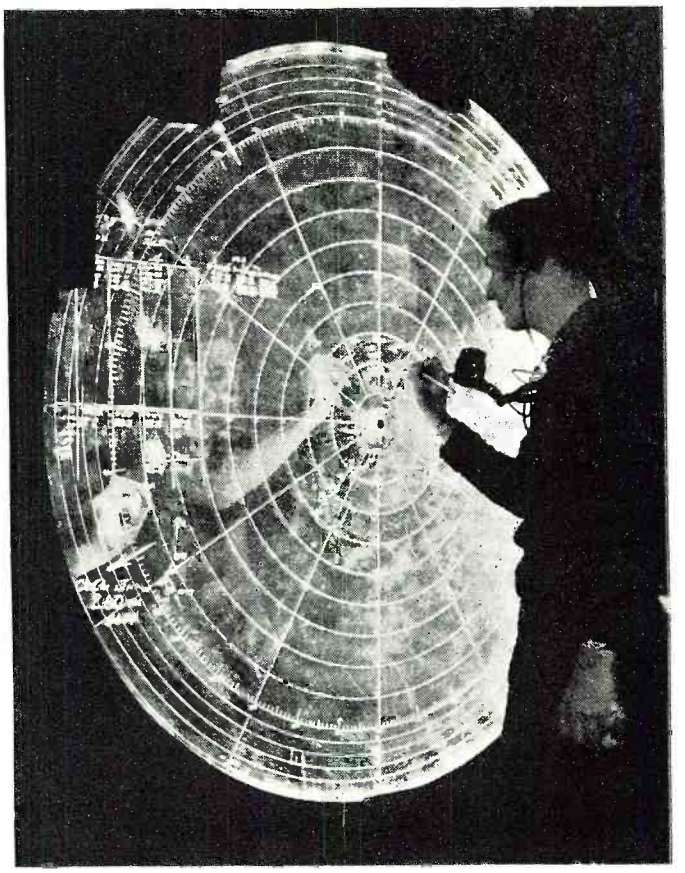
★ A typical parabolic antenna used with many types of radar equipment. By employing a parabolic antenna, very high gain and a highly directional beam are obtained.





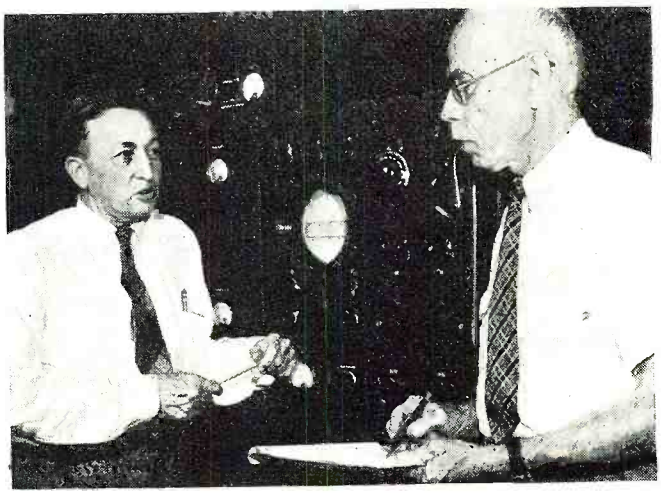
★ Through the electronic eye of radar, a Navy man determines distance and bearing of his "target" during experiments at the Naval Air Station, Anacostia, D. C. The indicator bearing the graph-like line in the center of the equipment is an A-scope; the large disc into which he is peering is a PPI scope—Plan Position Indicator.

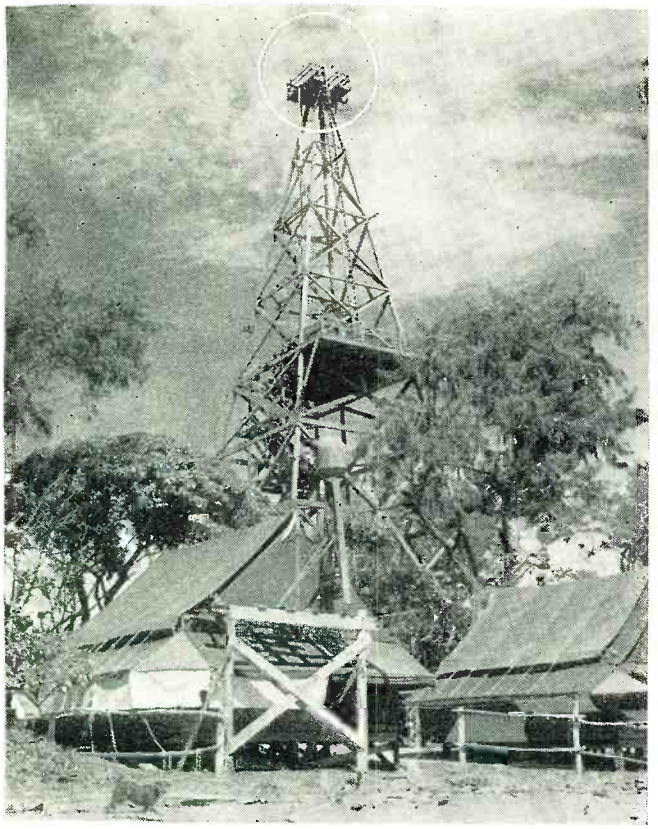
★ Radar equipped P-38 "Lightning" reconnaissance plane, its "droop snoot" nose crammed with special electronic devices, readies for a take-off. Trips like these precede visits of giant bombers against enemy industrial targets. Intensive preliminary planning characterizes reconnaissance trips of this nature since the plane carries no armament and is under orders to avoid combat. Pilot and radar operator agree on final details of flight plan which will be followed.



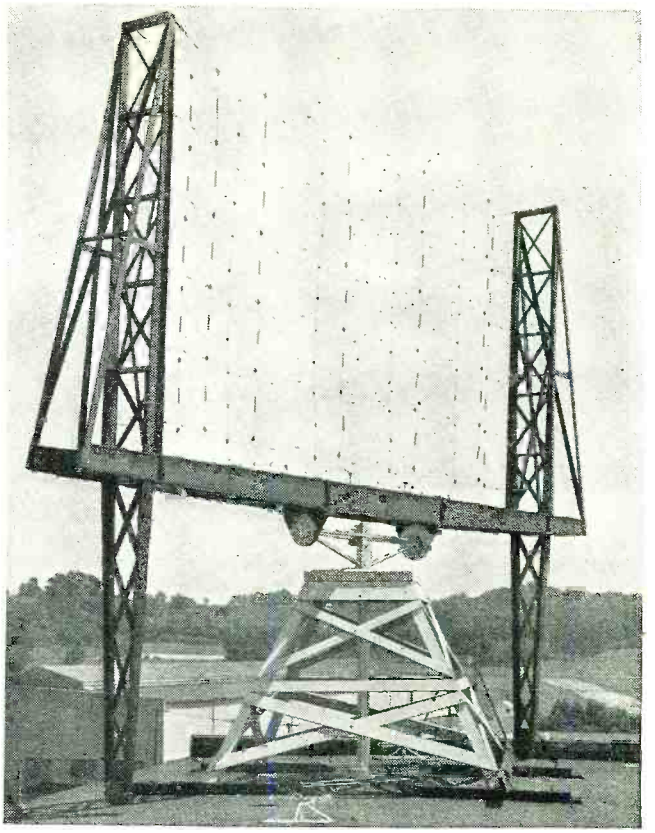
★ Information provided by radar's electronic eye is marked down on a vertical chart in the radar plot room of an Essex-class carrier during strikes against the Japs early in 1945. Behind the transparent expanse of the giant circle, other enlisted men can be seen working on various additional aspects of the incoming flow of information.

★ Pioneer workers in radar, Dr. A. Hoyt Taylor (right), Chief Consultant and Chief Coordinator of Electronics at Naval Research Laboratory, Anacostia, D. C., and his long-time associate, Leo C. Young, reminisce over the "scope" of radar's history beside the first radar set at the Research Laboratory. Few men know the history better. In 1922, while experimenting with communications equipment for the Navy, they made the initial discovery of distortion in radio reception caused by the intrusion of objects between transmitter and receiver. Working from this discovery, the two men and a number of associates and assistants made giant strides forward into the vast sphere of scientific fields covered by the word "radar" today. The equipment in the background, crude and elementary in comparison with the sets of today, was a breathtaking innovation when first used in 1937.





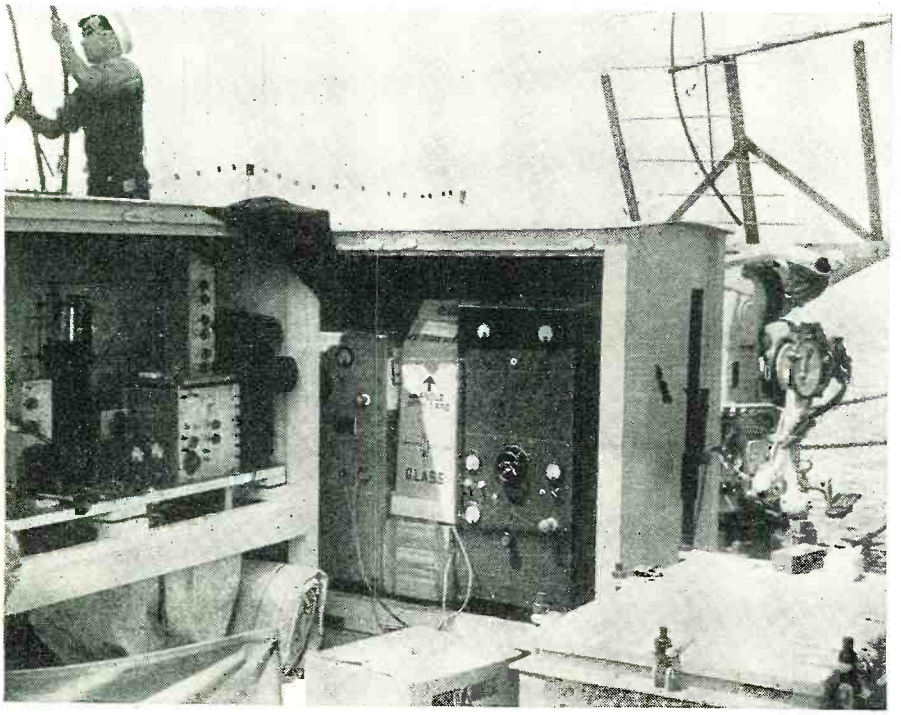
★ Instruction and improvements in radar are constant necessities in the Navy. At this station on Espiritu Santo, two types of radar antennas can be seen—one housed in a radome near the ground, the other installed on a towering "mast." By their use, Navy men on duty instruct or get instruction on latest in radar operations.

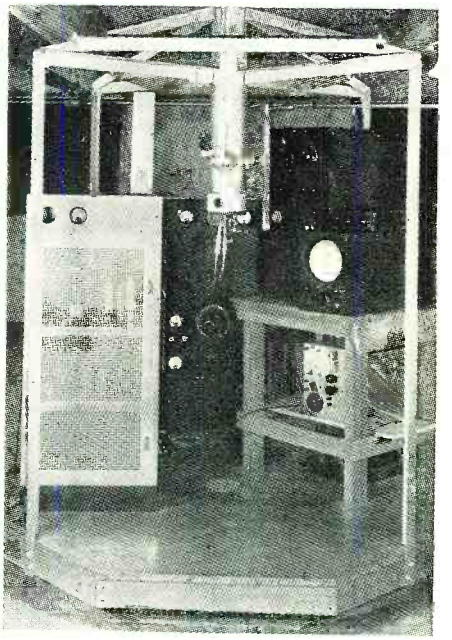


★ Close-up of the antenna of the first complete radar, installed "topside" of a building at Naval Research Laboratory in Anacostia, D.C. in the late 1930s. It is a "dirigible" antenna, meaning it is so mounted that it can be turned to allow for around the compass search. See photograph lower right for below-decks equipment.

☆ ☆

★ Photograph of the first radar installation on a ship. Shown in the upper right-hand corner is a Yagi-type antenna mounted to a five-inch gun on the old USS Leary in 1937. The antenna was swung about by moving the gun. The photograph was taken during epochal tests in Chesapeake Bay, when equipment marked a monumental milestone in radar's history.





★ Below-decks view of the first complete radar set. The "dirigible" mast in the very center of the photograph pierces the ceiling and its upper extension bears the mattress antenna of the radar. Thus the operator below can turn the mast to cover the compass while making a search. The antenna can also be tilted, with the handle visible on the side of the mast. This equipment was so heavy, compared to present sets, that in order to tilt and turn it, two men had to do the job.

New Type SIGNAL TRACER

Serviceman employing the CA-11 signal tracer to check receiver.

Commercially constructed unit.

By SHEPHARD S. LITT, 2LCC
Superior Instruments Co.

Design of a highly sensitive and portable signal tracer. Simplicity of operation makes this tester ideal for home receiver repair—an important factor to servicemen.

IN THE design of an efficient signal tracer, several points must be borne in mind. It must be sensitive, small, portable if possible, and not load or detune a circuit. In the past, signal tracers consisted of diode-vacuum tube voltmeter combinations with additional amplifiers (often tuned for radio frequencies) that were quite efficient, but bulky. It would take almost as long to set up one of these signal tracers with its maze of special cables as it did to find the trouble in a receiver. Because of the tuned amplifiers, these signal tracers would also require tuning. While a tuned amplifier is very efficient, a slight shift in signal frequency would mean retuning and sometimes actually losing the signal. For these reasons, signal tracers never did enjoy the amount of popularity that they should have.

Most of the objections to the older type signal tracer are eliminated by the new model CA-11 signal tracer manufactured by the *Superior Instruments Co.* and described herein. No tuned circuits are used and there is only one connecting cable.

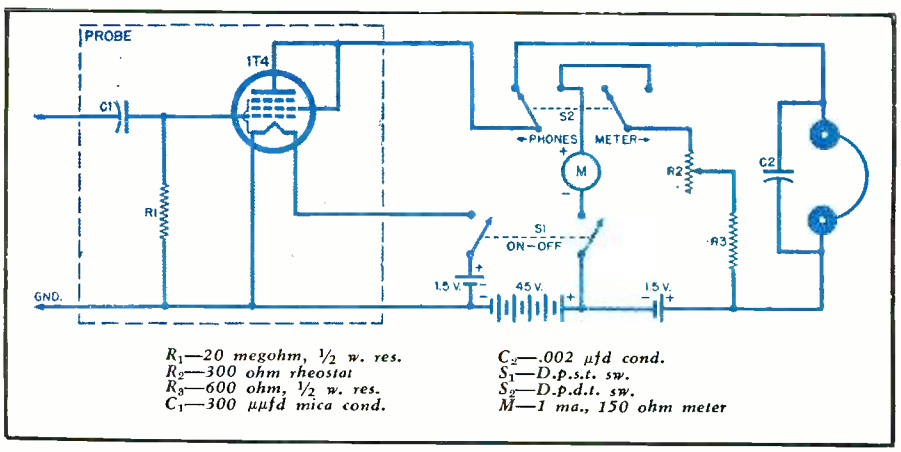
The circuit used is a 1T4 tube in a grid-leak vacuum tube voltmeter circuit, with provisions for insertion of phones.

The detector probe is composed of the 1T4 tube connected as a triode (screen grid and plate tied together) and a .0003 μfd. condenser and 20 megohm resistor. Both the .0003 μfd. condenser and 20 megohm resistor serve a dual purpose. D.c. is prevented from being applied to the grid of the 1T4 tube by the capacitor, which acts as a blocking condenser, while the resistor acts as a grid return and bias resistor. The condenser-resistor combination also operates to attenuate the lower frequencies, those below approximately 300 cycles. This cut-off frequency was chosen for several reasons.

Should a large 60 cycle or 120 cycle hum be superimposed on the signal, the low hum frequency would not mask the higher signal frequency. 400 cycles is also the usual modulating frequency of signal generators and it was, therefore, thought advisable to have the vacuum tube voltmeter pass this frequency. The graph (Fig. 3) shows the exact voltage required for full-scale deflection of the v.t.v.m. for the audio spectrum. It should be noted that the meter is not calibrated for voltage, but rather in relative signal value. V.t.v.m. sensi-

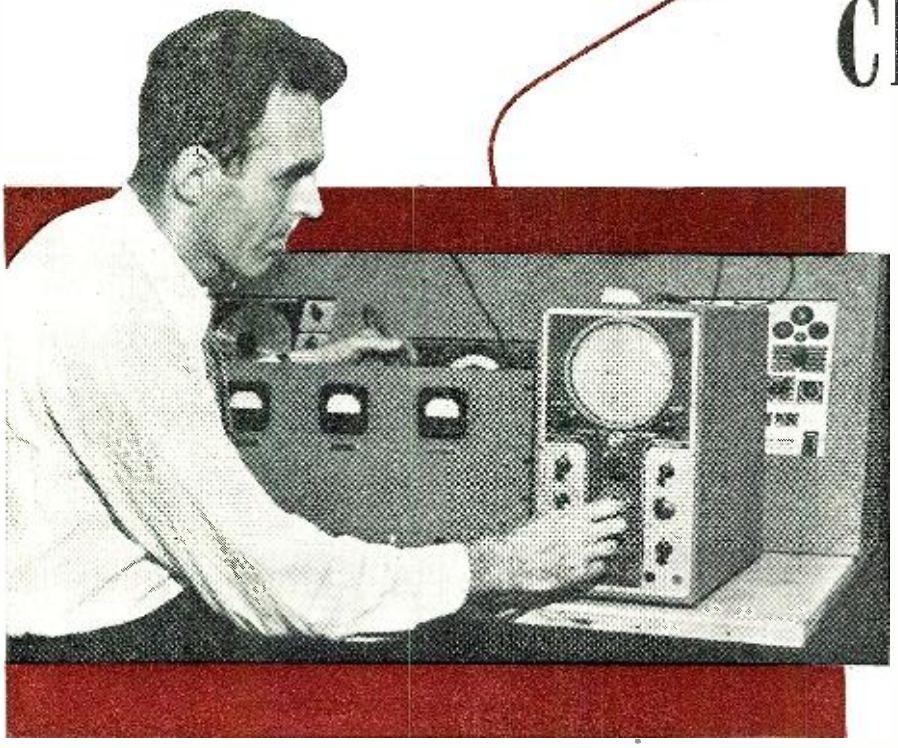
(*Continued on page* 132)

Fig. 1. Schematic diagram of the single-tube signal tracer. The unit is constructed in two separate parts, a detector probe and the battery and meter box.



R_1—20 megohm, ½ w. res.
R_2—300 ohm rheostat
R_3—600 ohm, ½ w. res.
C_1—300 μμfd mica cond.
C_2—.002 μfd cond.
S_1—D.p.s.t. sw.
S_2—D.p.d.t. sw.
M—1 ma., 150 ohm meter

The OSCILLOSCOPE Applied to Transmitter Checking



Radio technician applying the oscilloscope in checking transmitter.

With permission to return to the air, amateurs should recheck their transmitting equipment. The oscilloscope is an ideal instrument for this purpose. Follow the procedure outlined herein

By
MORRIS EDDY
and
ARTHUR HOWARD

IN A previous article, appearing in the September, 1944 issue of RADIO NEWS, we discussed the application of the oscilloscope to radio servicing. In this article, we will endeavor to demonstrate how the oscilloscope is used to check the operation of the transmitter.

The cathode-ray oscilloscope is the most valuable of all instruments in determining transmitter performance. It provides an instantaneous picture of what is actually happening inside the transmitter—thus, enabling the operator to determine the source of any possible defect in the apparatus. This versatile instrument is particularly suitable for r.f. or a.f. measurements, because it draws little or no power from the source. Where high speed analysis of performance is required, such as on the assembly line, the merits of the oscilloscope are once again realized.

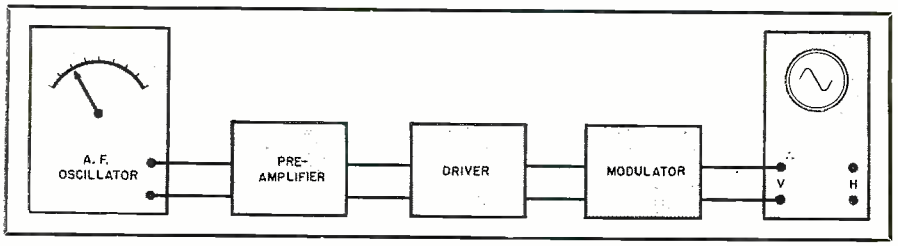
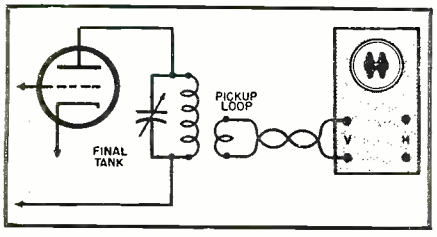


Fig. 2. Any defects in the speech-amplifier equipment can be easily checked by employing, along with the oscilloscope, an audio frequency oscillator, connected as shown

Fig. 1. When applying the oscilloscope to determine resonance of the tube circuit, the 'scope is loosely coupled as shown.



The following are some of the uses to which the oscilloscope can be put for determining the operation and securing maximum results from your transmitter.

Since it is possible for one to observe r.f. with an oscilloscope, it can thus be readily used as a resonance indicator. Should plate current meters be included in the transmitter, the use of the oscilloscope is not necessary. If meters are not included, the oscilloscope can be used as a temporary expedient.

To use it as an indicator for determining resonance, connect a coil of one or more turns of wire to the vertical axis of the 'scope by means of a twisted pair line. Any sweep frequency can be utilized. Place the coil near the tank circuit of the stage being tested and a band should appear on the screen of the 'scope. The width of this band can be regulated by the number of turns of the coil and its distance from the tank. The load of the stage, such as the link coupling, grid coil of the next stage, or the antenna tuner is left on the resonant stage being tested, so that actual working conditions are observed. Your next step consists of rotating the tank condenser slowly, until maximum bandwidth is observed on the oscilloscope. When this condition is reached, the stage is at its desired resonance. Fig. 1 shows the necessary hookup.

In the above manner, all stages of

the transmitter can be aligned and faults existing in a stage of a transmitter can be traced to that particular stage.

Neutralization Indicator

Because of the property of the oscilloscope of not drawing any appreciable power from a circuit, it makes a fairly sensitive neutralization indicator. In cases of emergency, it can be substituted for the regular indicating device.

To determine whether or not a stage is properly neutralized, turn on the filament of the chosen stage and apply excitation from the previous r.f. amplifier to its grid circuit. Be certain that the plate voltage is turned off. Use the same coil and twisted wire line as shown in Fig. 1. Hold this coil near the plate tank coil of the stage under test. Next, tune the condenser through resonance and, at resonance, no r.f. waves should appear on the screen, provided the stage is properly neutralized. If r.f. is present, adjust the neutralizing condenser with an insulated screwdriver until there is no r.f. remaining on the screen of the scope.

In push-pull circuits, both neutralizing condensers are adjusted simultaneously, i.e., step by step, until there is no r.f. present.

Checking Modulation Equipment

Any defects in the speech amplifier equipment can be determined with the use of the oscilloscope. Faults indiscernible to the human ear are made apparent with this instrument.

First, connect an audio oscillator to the input of the speech amplifier equipment in place of the microphone. Take the output off the final stage of the modulator. Next, synchronize the sweep oscillator of the 'scope with the audio frequency. Refer to Fig. 2 for the diagram.

By comparing the original waveform of the a.f. oscillator with that of the output of the final stage, you can determine the quality of your modulating equipment. If distortion is present, it can be traced down to the individual stage causing this condition.

To localize the distortion to the stage causing it, proceed as follows:

Connect an a.f. oscillator to the input terminals of the speech amplifier. Then, connect the oscilloscope successively to the output stage of each of the tubes in the amplifier, starting with the preamplifier stage, and working toward the output stage.

As we proceed in this manner, the gain of the amplifier will increase. To compensate for this, decrease the amplifier gain control of the oscilloscope. This is necessary in order to prevent overloading the oscilloscope. Once the faulty stage is located, it should be serviced accordingly.

Another trouble frequently encountered by the operator is phase distortion. This condition occurs when the phase relationship of two or more factors in the amplifier circuit is altered. This condition can be usually rectified by changing the circuit constant (RC values).

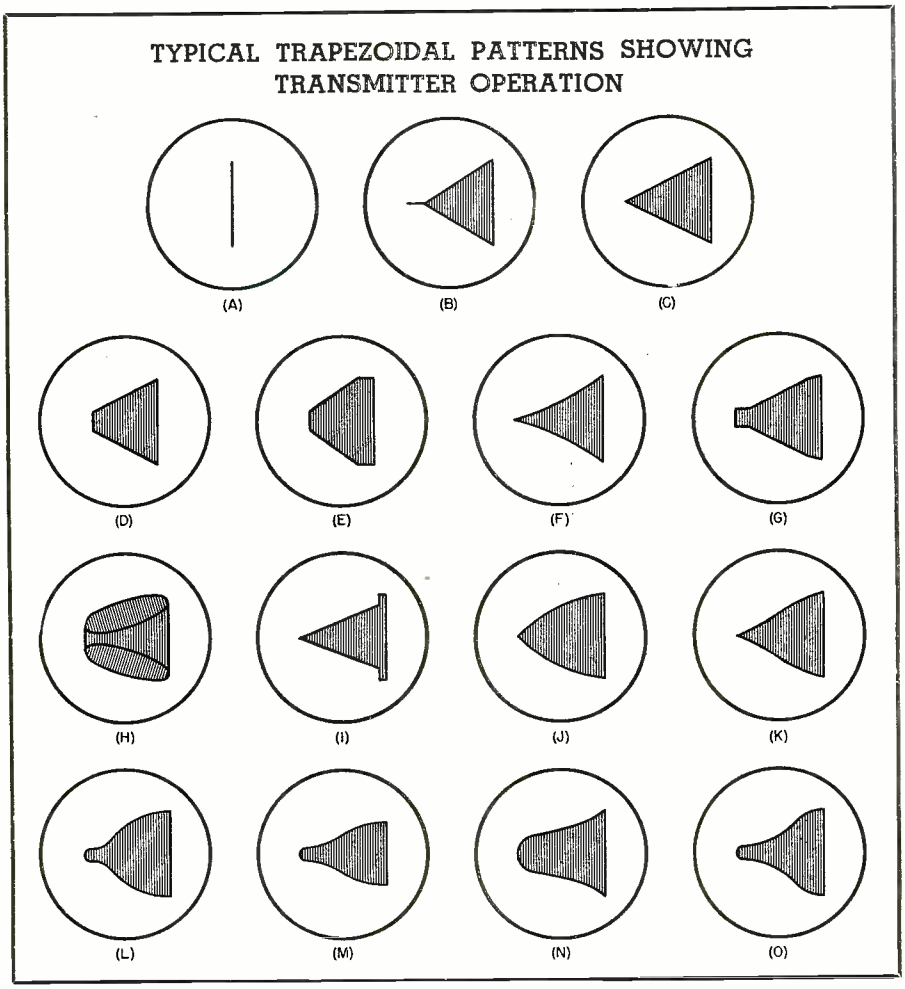
By using the above procedure, audio distortion, improper operation due to incorrect bias, phase distortion, etc., are readily detected. If desired, the over-all frequency response of the amplifier can be approximated by varying the audio oscillator frequency and noting the changes, if any, in the amplitude of the trace. It is essential that the output of the a.f. oscillator used be kept constant. For those wishing more accurate knowledge of the frequency response of the audio apparatus, a graph thereof should be made.

Modulation in Radiotelephone Transmitter

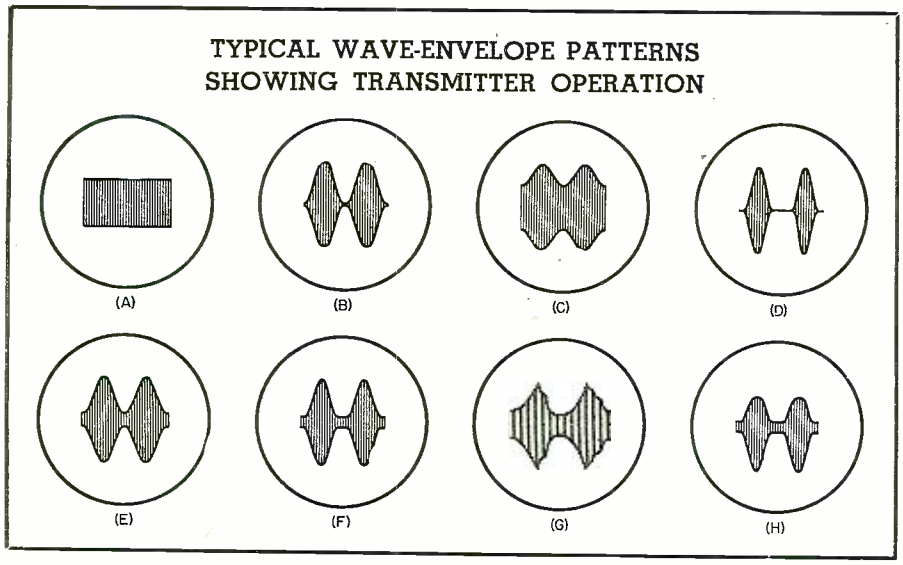
Perhaps the most frequent use of the oscilloscope is for observing modulation characteristics in radiotelephone transmitters. The oscilloscope can be utilized to disclose the modulation percentage, linearity, and power output available from the audio-modulator—without distortion.

Two types of patterns are regularly employed for checking the performance of radiotelephone transmitters. These are the wave-envelope and trapezoidal patterns. Each pattern tells much about the operation of the transmitter. For ordinary purposes, either one may be used. However, for a more exacting determination of performance, both types of patterns should be employed, thus getting a better delineation of the transmitter capabilities.

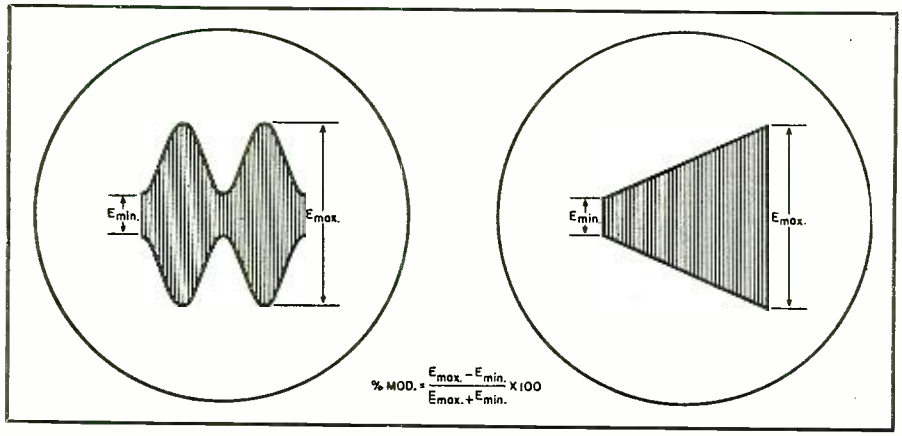
The wave-envelope pattern is the easiest to hook up and gives an over-



(A) Unmodulated carrier. (B) Over 100% modulation—distortionless wave. (C) Illustrating distortionless 100% modulated wave—ideal pattern. (D) Less than 100% modulation—wave contains no distortion. (E) Pattern illustrates two possible troubles. Insufficient r.f. grid excitation to modulated amplifier or lack of sufficient filament emission. (F) Pattern illustrates regeneration in class "C" stage, which is due to too much bias or improper neutralization. Note curved sides of pattern. (G) This trace is due to mismatched class "B" modulator to the class "C" load. (H) In this pattern we have a condition of phase shift. This is due to the fact that the audio voltages were not taken directly from the output of the modulator. (I) This pattern shows that parasitics are present on the positive modulation peaks in the modulated amplifier. (J) Insufficient excitation or bias applied to a triode (plate modulated zero bias) will cause this trace. (K) Approximately 100% modulated (grid or cathode) wave. (L) Approximately 100% suppressor modulated wave. It uses separate r.f. driver. (M) This trace shows a poorly regulated r.f. driver or it can also be the result of excessive excitation. (N) Diagram of a grid modulated phone wave. It is not properly neutralized and also lacks proper reactive load. (O) A suppressor modulated wave. Circuit uses an 802 or 804 and has a crystal in the grid circuit.



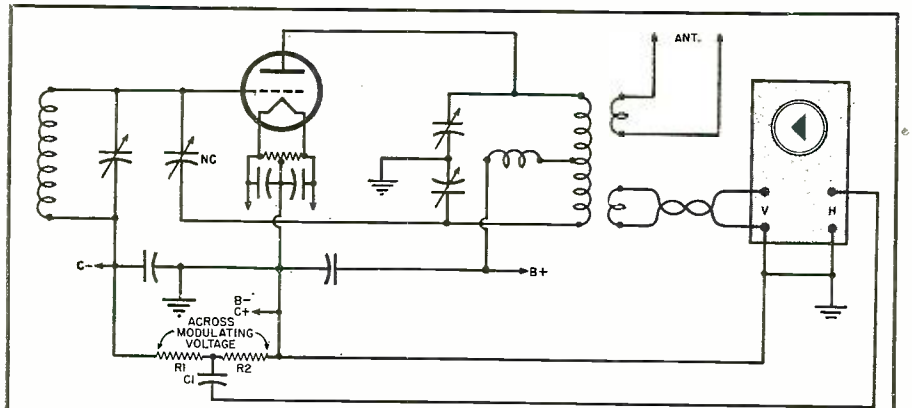
(A) Unmodulated carrier wave. (B) 100% modulation—ideal pattern to get. (C) Less than 100% wave. (D) Greater than 100% modulation (overmodulation). (E) This type of pattern is due to insufficient grid excitation to the final modulation stage. (F) This is a condition of overmodulaton (greater than 100%) with the addition of audio distortion. (G) When the plate circuit of the modulated amplifier is not at the proper resonance, the trace, as shown, will be the result. (H) This type of pattern is due to overloading or rectification in the oscilloscope's amplifier.



Method of determining modulation percentage of trapezoidal or wave-envelope patterns.

☆ ☆

Fig. 3. Diagram showing oscilloscope connections for obtaining trapezoidal patterns when checking grid, suppressor, or screen modulated type transmitters.



Values for voltage divider should be determined by trial, as they depend on the oscilloscope used.
Usual values are:
R_1—.5 megohm, 1 w. res.
R_2—50,000 ohm, 1 w. res. (low power)
R_2—10,000 ohm, 1 w. res. (high power)

For direct connection, R_2 is a potentiometer with C_1 attached to moving arm.
R_2—.2 megohm pot. (high power)
R_2—.5 megohm pot. (medium power)
R_2—.5 megohm pot. (low power)
(R_1 should be shorted when used on low power)

all picture of the audio amplifier, modulator, and modulated amplifier. Any change in the waveform of the speech amplifier will produce a corresponding change in the wave pattern.

The waveform should be sinusoidal if the modulator is functioning correctly. A change in the audio frequency of the oscillator will necessitate a corresponding change in the sweep circuit.

In contrast, when observing a trapezoidal pattern, changes in audio frequency or waveform of the audio oscillator will not produce a change in the general shape of the pattern, provided the modulation percentage is constant. Thus, the trapezoidal pattern indicates only modulation percentage and linearity of the modulated r.f. amplifier.

Typical wave-form and trapezoidal patterns illustrating different modulating conditions, etc., are included. These should be referred to and studied. For critical examination, the proportions as shown on the typical characteristic sheets should correspond closely with the waveforms and trapezoidal patterns appearing on the screen.

The great advantage of the trapezoidal pattern over the wave-envelope pattern is that a microphone can be substituted for the audio oscillator and the effect of the operator's voice will be noted. The figure expands and contracts horizontally as the operator talks, completing the triangle as one hundred per-cent modulation is approached. Overmodulation is indicated by a dashed horizontal line extending from the vertex of the triangle.

If the same process as outlined above is carried out with the wave-envelope pattern, a meaningless jumble appears across the screen, because the sweep circuit is not synchronized with the speech. This effect can be counteracted to some extent by the following method. Apply a strong synchronizing voltage, taken from the pre-amplifier stage, to the synchronizing jacks of the sweep oscillator. This measure should make the trace more constant. Individual waveforms separated by short, bright dashes indicate overmodulation.

To determine the 60 or 120 cycle hum level of the transmitter in question, using the wave-envelope pattern, proceed as follows:

No a.f. signal is fed to the speech amplifier so that the figure appearing across the screen is a band (like an un-modulated carrier). Then, adjust the sweep circuit to a submultiple of the power line frequency, such as 20 or 30 c.p.s. If ripples or humps appear across the screen, extraneous modulation due to the power line is occurring. On the other hand, the trapezoidal pattern indicates immediately whether there is appreciable hum or noise modulation of the carrier.

Methods of Connection

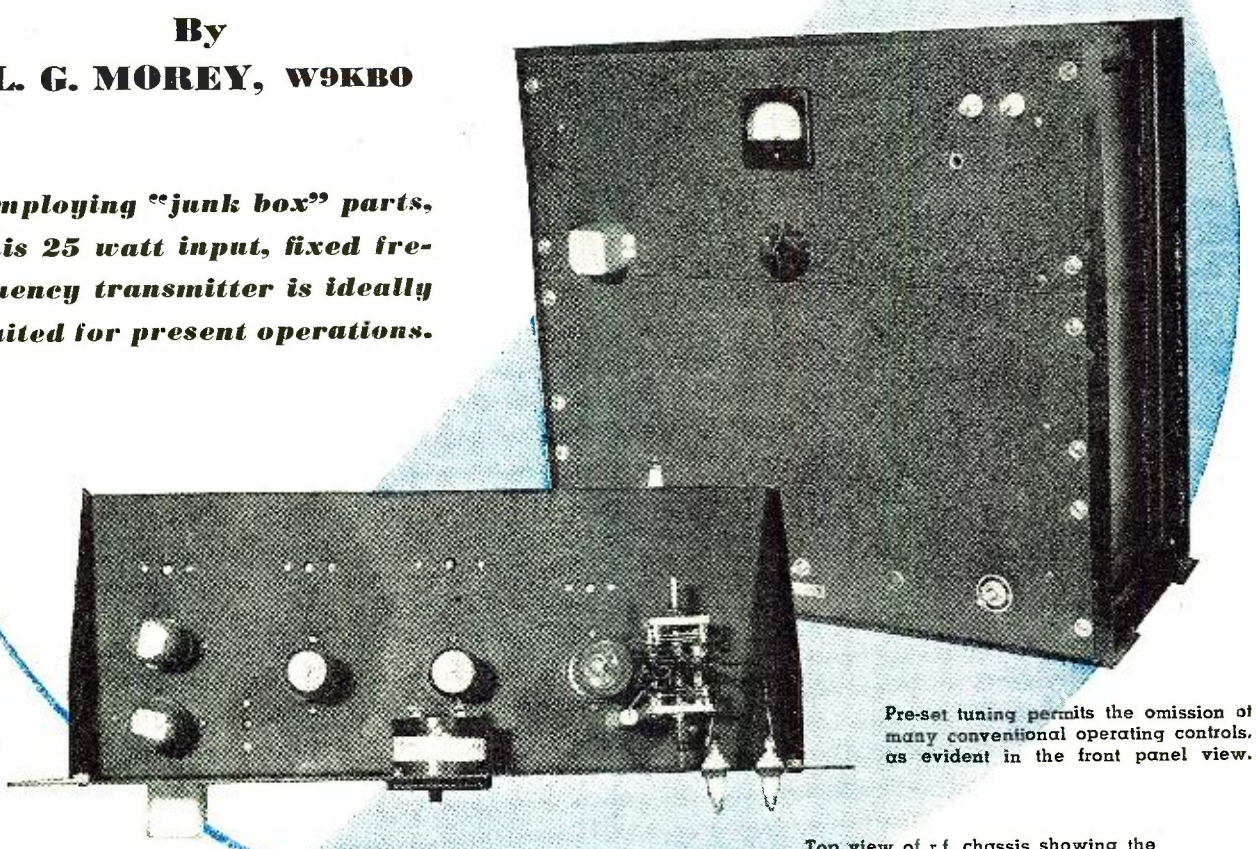
The connections for the wave-en-

(*Continued on page* 116)

112 MC. Crystal-Controlled TRANSMITTER

By
L. G. MOREY, W9KBO

Employing "junk box" parts, this 25 watt input, fixed frequency transmitter is ideally suited for present operations.



Pre-set tuning permits the omission of many conventional operating controls, as evident in the front panel view.

Top view of r.f. chassis showing the proper placement of component parts.

IN THE design of a station for WERS net control, some of the problems that beset the average amateur at present are rather easily surmounted by the large number of junk boxes available from which to choose parts. However, even with this large selection there must be many compromises. Seldom, if ever, is the final appearance the same as it would be if the standard catalog items were available.

The design and construction of the transmitter described was the result of the ingenuity of E. J. Stanley, W9DXU. Parts obtained from many amateurs and WERS operators were used in the final rig. Although there is little that is startlingly new in the completed unit, it is felt that it will serve as an indication of what can be done at the present time.

The power limitation of 25 watts imposed on WERS stations allows the choice of several tubes for the final stage. Among those available was an HK-24. This tube offered the advantages of low inter-electrode capacities, together with low grid driving requirements, with the possibility of using more plate voltage and so increasing the power at a later date. By experiment it was determined that a 6V6GT operated at 400 volts plate supply would furnish ample grid drive.

As this transmitter was to be used for net control, it was imperative that the frequency be stable, and this indicated either a very stable oscillator of the self excited type or the use of crystal control. Search of the available crystal indicated a large quantity of 7 mc. crystals in the hands of various members. The use of 7 mc. crystals required that the frequency be multiplied sixteen times to arrive at the output frequency.

Experiment showed that sufficient drive for the final stage could be obtained by the use of a tri-tet oscillator using a 6V6GT on 7 mc. with the plate circuit tuned to the second harmonic, followed by three 6V6GT doublers, capacity coupled, and the third one in turn, link coupled to the final. With 300 volts on the plates of the oscillator and first two doublers, the 6V6GT third doubler is driven sufficiently hard to push the final to 10 ma. grid current under load.

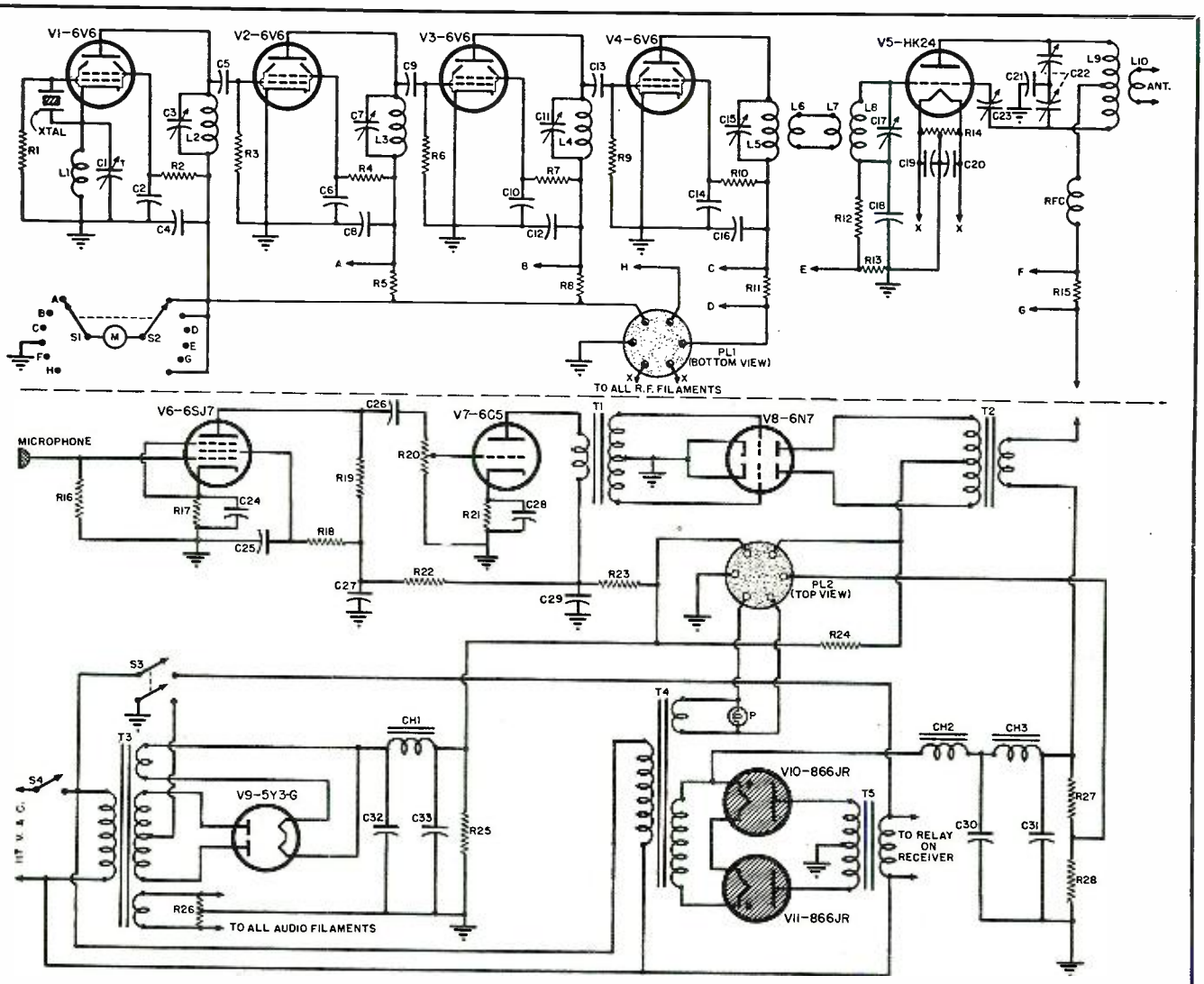
The entire transmitter is constructed in two sections with standard rack and panel construction and mounts in a homemade rack, welded from 1¼" angle iron. Sides for the rack, made of thin sheet metal, are

welded in place to give the effect of a cabinet enclosure. The lower section is constructed on a 7" x 17" by 3" chassis and contains the speech and modulator system, together with both power supplies. The front panel for this unit is 10½" x 19" and is made of 16 gauge steel notched to standard panel dimensions. Controls along the lower edge of the front panel are, from left to right, microphone input, gain control, send-receive switch, pilot light, and power switch. Parts are located on the chassis where most convenient. A general idea of the layout in this particular model may be obtained from the photograph of the lower portion.

The speech system consists of a crystal microphone, followed by a high-gain 6SJ7 which feeds the 6C5 driver for the class "B" modulator. A common power supply, consisting of a replacement type power transformer together with the 5Y3G rectifier and the filter circuit Ch_1, C_{32} and C_{33}, furnishes the plate power for the audio system and the first three tubes of the r.f. section, along with the filament current of the audio section. The plate supply for the r.f. final and V_4 driver is furnished by the transformer T_5. While this transformer has considerably more capacity than required, it was the only one available at the time this unit was constructed. If a 5R4GY rectifier is available it may be used to replace the pair of 866 Jr's used.

The switch S_3 is used as a standby switch, cutting the plate voltage of both the final power supply and the low voltage power supply. When the switch is thrown to the send position, the voltage appearing across the primary of T_5 is used to energize a normally closed relay mounted on the receiver. This relay is wired to the

Diagram showing the r.f. portion of the transmitter segregated by a dotted line from the modulator and power supplies.



R_1, R_2, R_3—50,000 ohm, 1 watt res.
R_4, R_7, R_{10}, R_{22}—20,000 ohm, 2 watt res.
R_5, R_8, R_{11}, R_{13}, R_{15}, R_{24}—25 ohm, ½ watt res.
R_6, R_9—100,000 ohm, 1 watt res.
R_{12}—4000 ohm, 10 watt res.
R_{14}, R_{26}—50 ohm, C.T. wirewound res.
R_{16}—5 megohm, ½ watt res.
R_{17}—3000 ohm, ½ watt res.
R_{18}—2 megohm, ½ watt res.
R_{19}—250,000 ohm, ½ watt res.
R_{20}—500,000 ohm, gain control pot.
R_{21}—2000 ohm, ½ watt res.
R_{23}—10,000 ohm, 10 watt res.
R_{25}, R_{28}—20,000 ohm, 50 watt res.
R_{27}—2000 ohm, 25 watt res.
C_1—10-70 μμfd. mica padder cond.
C_2, C_4, C_6, C_8, C_{10}, C_{12}, C_{14}, C_{16}, C_{18}, C_{19}, C_{20}—.005 μfd. mica cond.
C_3—50 μμfd. midget variable cond.
C_5, C_9—100 μμfd. mica cond.
C_7, C_{11}, C_{15}, C_{17}—25 μμfd. midget variable cond.
C_{13}—50 μfd. mica cond.
C_{21}—.001 μfd. 1000 v. mica cond.
C_{22}—15 μμfd. per section dual—.030" spacing variable cond.
C_{23}—Neutralizing condenser—National NC-600
C_{24}—5 μfd. 25 v. elec. cond.
C_{25}—.05 μfd. 400 v. cond.
C_{26}—.01 μfd. 400 v. cond.
C_{27}, C_{29}—4 μfd. 450 v. elec. cond.
C_{28}—10 μfd. 25 v. elec. cond.
C_{30}, C_{31}—4 μfd. 1500 v. oil filled filter cond.
C_{32}, C_{33}—8 μfd. 450 v. elec. cond.
T_1—Driver transformer—Single plate to P.P. grids
T_2—Modulation transformer—8000 ohm primary to 10,000 ohm secondary
T_3—375-0-375 @ 150 ma., 5.0 v. @ 3.0 a., 6.3 v. @ 5.0 a. power trans.
T_4—5.0 v. @ 2.5 a., 6.3 v. @ 2.0 a. fil. trans.
T_5—600-0-600 v. @ 200 ma. plate trans.
Ch_1—150 ma. filter choke
Ch_2, Ch_3—150 ma. filter chokes
RFC—Ohmite type Z, r.f. choke
S_1, S_2—2 pole 6 position meter switch
S_3—D.p.s.t. toggle sw.
S_4—S.p.s.t. toggle sw.
V_1, V_2, V_3, V_4—6V6GT
V_5—HK24
V_6—6SJ7
V_7—6C5
V_8—6N7
V_9—5Y3G
V_{10}, V_{11}—866 Jr.
M—0-100 ma. meter
L_1 to L_{10}—See coil table
P—6.3 v. pilot light

standby terminals of the receiver and disables the receiver when the transmitter is on. The additional socket mounted along the rear edge of the chassis is used as the terminal for this connection. All power connections from the power unit terminate in the six prong socket located near the center of the rear edge of the chassis. The standoff insulator mounted near the left hand side carries the plate lead for the final amplifier.

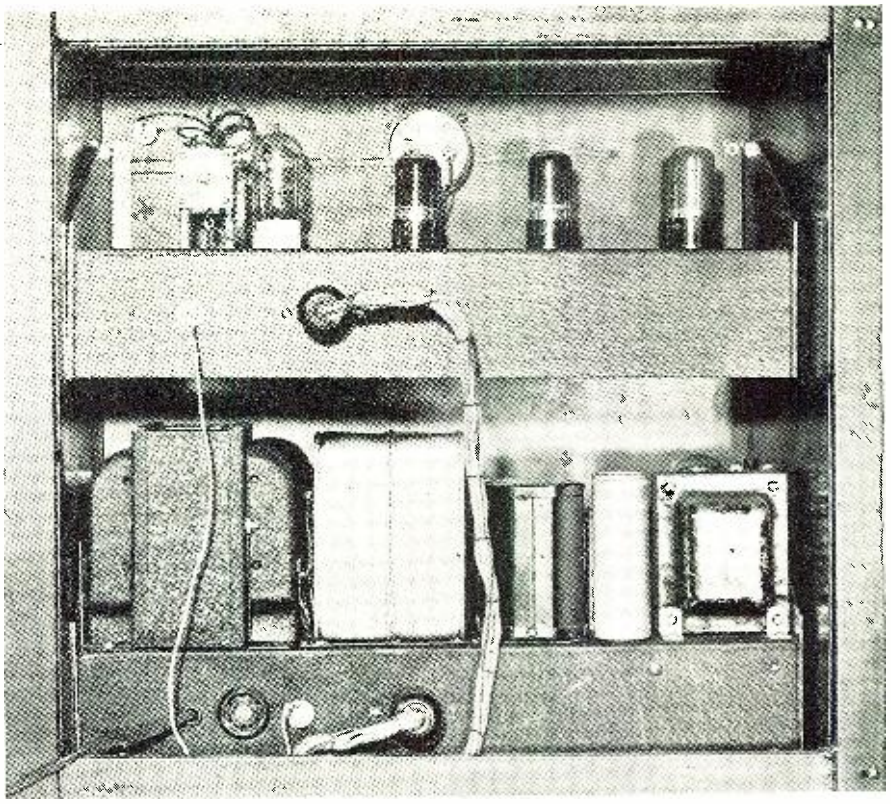
The upper deck contains the r.f. section mounted on a 7" x 17" by 3" chassis and uses a standard 7" by 19" front panel. To give more clearance for the tubes, the chassis is mounted so that it projects about one inch below the lower edge of the panel. The abbreviated shield can, at the left hand side of the panel, is used to cover the crystal holder to prevent "borrowing." A 0-100 ma. meter is mounted in the center of the panel with its meter switch below it. Antenna terminals are mounted in the upper right hand corner. The small hole located below these terminals is to allow screwdriver adjustment of the final tank condenser, C_{22}. While it is unusual to have a transmitter with no tuning controls on the panel, this unit was built to operate on a fixed frequency, and it was felt desirable to put the controls out of reach of the curious. In a transmitter for general use it would be preferable to bring the tuning controls out to the front panel.

In the top view of the r.f. section the holes allowing screwdriver adjustment of the tuning condensers may be seen near the front edge of the panel. R.f. coils in all cases are mounted directly on the tuning condensers, allowing the minimum of lead length. The neutralizing condenser, C_{23}, is of the type made for neutralizing 6L6's and is mounted above the chassis by means of its standoff insulator.

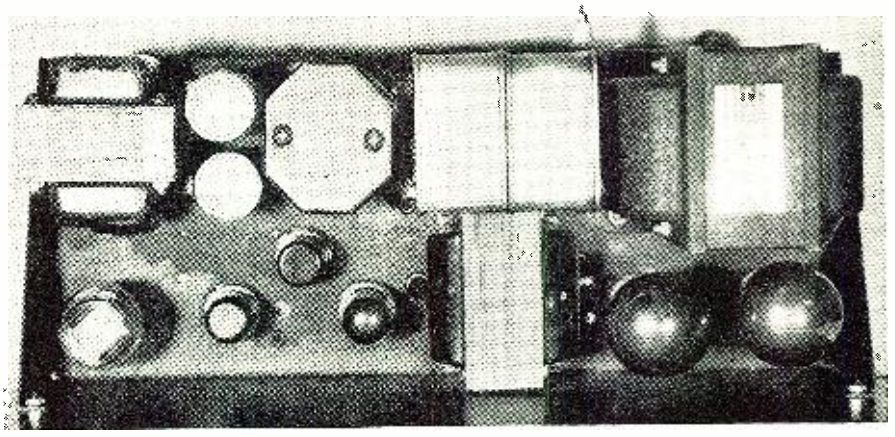
As meters are scarce items these days, only one meter was used in the entire transmitter and provision was made to switch it into the circuits it was desired to meter. This is accomplished by means of measuring the drop across the resistors located in the appropriate circuits. In the case of the doubler circuits this also includes the screen circuits, so this should be taken into account when measuring the plate current of these stages.

The power cable interconnecting the two units, as well as the lead carrying the modulated plate voltage for the final, are made of sufficient length to allow the units to be placed side by side on the bench for preliminary testing. If desired, they may be cut to the proper size when adjustments are completed.

When construction has been completed, the tubes should be placed in their proper sockets, leaving the plate lead to the final disconnected. After the tubes have had a chance to warm up, the plate voltage should be applied



Employing standard rack and panel construction, this rear-view photo shows the r.f. chassis top and modulator and power supplies bottom.



Top view of power supplies and modulator chassis. Transformers along with the other component parts are properly placed to prevent intercoupling.

and the stages tuned, starting with the cathode circuit of the crystal oscillator. The proper adjustment for this condenser is near minimum capacity. The plate condenser of the oscillator, C_3 should then be adjusted to give the maximum output on the second harmonic of the crystal. Varying the cathode condenser slightly should result in a position which will allow the plate condenser to be tuned through resonance with little effect on the crystal frequency. The optimum adjustment for the cathode condenser is that one which gives the desired output with as low a capacity setting as possible. This will result in low crystal current and consequently little heating and drift.

If an absorption type wavemeter is available, it will prove very useful in locating the proper harmonics. Lacking this piece of equipment it will be rather difficult to determine which harmonic is actually being used.

The plate circuit of the first doubler should now be tuned to the 28 mc. band. Resonance is indicated by a dip in the plate current of this tube. The dip on the third harmonic will not be as pronounced so it will be fairly easy to determine the harmonic to which the circuit is tuned.

After the first doubler has been tuned to the proper frequency, the same procedure should be followed for the second doubler, tuning its plate circuit to the 56 mc. band. In this case also, resonance will be indicated by a

(*Continued on page* 106)

ELECTROLYTIC CAPACITOR CHECKER

By
RUFUS P. TURNER
Consulting Eng., RADIO NEWS

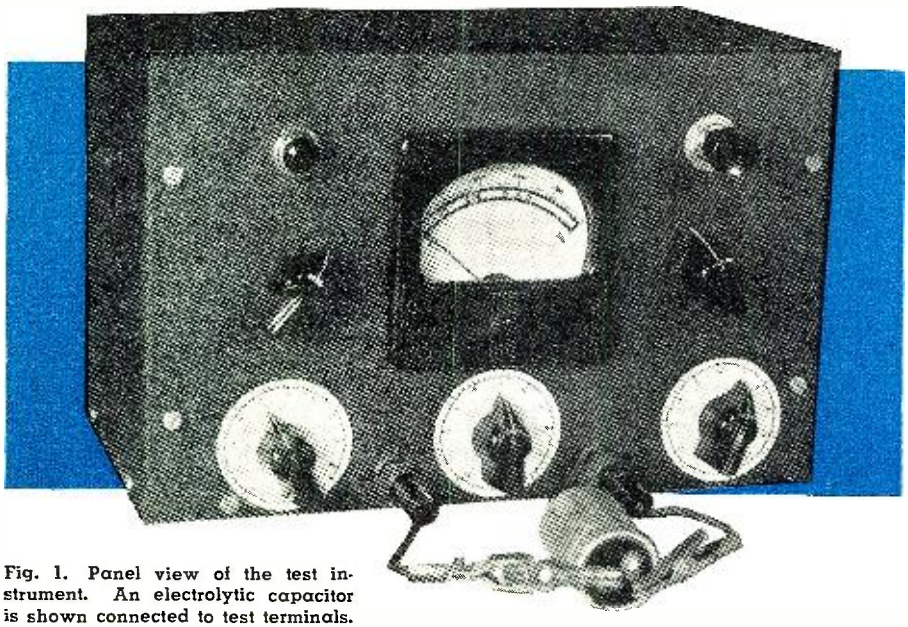


Fig. 1. Panel view of the test instrument. An electrolytic capacitor is shown connected to test terminals.

The construction and operation of an easy to read electrolytic leakage tester. Its scale shows GOOD-?-BAD similar to tube testers.

A RESPECTABLE percentage of capacitor replacements in receiver servicing are electrolytic. Some servicemen report that they replace more electrolytic capacitors annually than wax or mica types combined.

In a receiver, the normal position of electrolytic capacitors is in the power supply filter, but one or more of these units may be found in by-pass positions in the audio amplifier stages as well. In P. A. amplifiers, all of the by-pass and decoupling capacitors are apt to be electrolytic.

In all common by-pass and filter applications, capacitance values generally are not too important. Wide tolerances are permissible. Electrolytic capacitors so used often vary from one-half to twice their labelled capacitance without causing trouble in receivers or amplifiers. Capacitance measurements, whether alone or in combination with other tests, therefore, do little in themselves to satisfy the serviceman quickly as to the condition of an electrolytic capacitor.

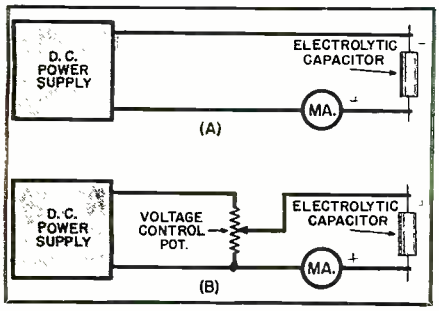
On the other hand, a leakage test made at the rated d.c. working voltage of the capacitor is much more useful in radio servicing for revealing quickly the condition of a questionable electrolytic capacitor. But relatively few operators possess equipment for making such leakage tests, and the few *satisfactory* instruments to be found in service shops rarely ever are portable.

A handy electrolytic capacitor condition checker must be capable of indicating *directly* either the actual leakage current in milliamperes or the condition of the capacitor as good or bad. In order to be most useful in servicing, no calculations should be required. Adjustments and manipulations must be kept to the minimum. The capacitor must be tested at its rated d.c. working voltage which must be supplied by the instrument and must be adjustable between 0 and 500 volts.

The instrument described in this article is a simple, but highly effective, leakage tester meeting the specifications just given. It supplies its own adjustable d.c. voltage in the range 0-500 and will accommodate all common sizes of capacitors between 2 and 100 μfd. Leakage indications are given on an English scale reading GOOD and BAD like the scale of a tube tester. The working current range is 0 to 17.7 milliamperes.

First, we shall discuss the theory of the leakage test and the basic test circuit, and then will describe the constructional details of the actual instrument.

Fig. 2. Block diagram of basic circuit.



How Capacitor is Tested

There is nothing complicated about a capacitor leakage test circuit. Nevertheless, it is a useful service tool. What is desired in such a set-up is to impress across the capacitor a d.c. voltage equal to the rated capacitor working voltage and to measure the resulting leakage current. This scheme is illustrated by Fig. 2A.

In order to accommodate the large number of electrolytic capacitors having different working voltages and different maximum permissible leakage currents, the test voltage may be made adjustable by means of a potentiometer in the output circuit of the d.c. power supply, and the range of the milliammeter may be made adjustable by means of a shunt rheostat. This arrangement is shown in Fig. 2B. The dial of the voltage control potentiometer may, if desired, be graduated in volts for direct reading without a voltmeter.

For use in these circuits, Chart 1 lists the maximum permissible leakage currents for various d.c. working voltages and rated capacitances. This table has been based upon recommendations by leading capacitor manufacturers for determining the maximum leakage values. These recommendations have been expressed as follows: Maximum leakage when the d.c. working voltage is between 0 to 99 volts should be .3 milliampere plus .01 milliampere per μfd.; for 100-199 v., .3 ma. plus .02 ma. per μfd.; 200-299 v., .3 ma. plus .03 ma. per μfd.; 300-399 v., .3 ma. plus. .04

ma. μfd.; and 400 v. and higher, .3 ma. plus .05 ma. per μfd.

When making a leakage test it is important to keep the capacitor connected in the measuring circuit and to maintain the test voltage for a few minutes until the leakage current stabilizes. The current is high when the voltage first is applied, in a number of cases, but decreases slowly, finally reaching a steady value. If the voltage alters during this period of current decay, it must be readjusted to the rated working value of the capacitor. For best accuracy, one capacitor manufacturer recommends that before taking the final leakage reading the d.c. working voltage be applied for 5 minutes plus 1 minute for each month the capacitor has been stored prior to the test.

Use of English Scale

Operation of the leakage tester in radio servicing and interpretation of its indications may be simplified by working out a series of special settings for the milliammeter shunt resistance. These selected settings will allow the circuit to be preadjusted so that each of the maximum permissible leakage values (Chart 1) always will be read at the same point on the meter scale. Thus, if an 8-μfd., 450-v. capacitor is being checked, the shunt rheostat is set to such a value that .7 ma. will deflect the pointer to some previously selected position on the scale—and when working, say, with a 20-μfd., 300-v. capacitor, the rheostat will be set so that this time 1.1 ma. will deflect the pointer to the same scale position.

The selected scale point may be labelled with a question mark. That portion of the scale between 0 and ? then may be labelled GOOD, and the portion between ? and full-scale, BAD. The leakage tester then may be read in the same manner as a tube tester.

In order to employ a simple 0-1 d.c. milliammeter as the indicating instrument without sacrificing any of the values given in Chart 1, the question mark must be placed at the .3-ma. point on the scale. The required range of the shunt rheostat then will be 6 to 1110 ohms. Photograph 1 shows the appearance of the special meter scale, and Chart 3 shows the precise manner in which it is marked off.

Complete Circuit

The complete wiring diagram of the electrolytic capacitor checker is given in Fig. 3.

The d.c. test voltage is supplied by two 25Z5 or 25Z6-G tubes arranged in a voltage quadrupler circuit. The quadrupler saves the space that ordinarily would be required by a 500-volt power transformer. The no-load output voltage of this section is 4 times the peak value of the power-line voltage, or approximately 650 volts d.c. for an a.c. line voltage of 115. However, the loading effect of the voltage control potentiometer, R_1, reduces the maximum obtainable d.c. voltage to approximately 500. Adjustment of R_1 makes available a filtered d.c. test voltage which is continuously variable from 0 to 500.

D. C. WORKING VOLTAGE	2 μfd.	4 μfd.	5 μfd.	8 μfd.	10 μfd.	16 μfd.	20 μfd.	30 μfd.	40 μfd.	50 μfd.	100 μfd.
0-99	.32	.34	.35	.38	.40	.46	.50	.60	.70	.80	1.3
100-199	.34	.38	.40	.46	.50	.62	.70	.90	1.1	1.3	2.3
200-299	.36	.42	.45	.54	.60	.78	.90	1.2	1.5	1.8	3.3
300-399	.38	.46	.50	.62	.70	.94	1.1	1.5	1.9	2.3	4.3
400 & HIGHER	.40	.50	.55	.70	.80	1.1	1.3	1.8	2.3	2.8	5.3

Chart 1. Maximum permissible leakage current (in milliamperes) of electrolytic capacitors between 2 and 100 μfd. and a d.c. working voltage of 0 to over 400 v.

The 25,000-ohm series resistor, R_2, limits the maximum current which may be drawn from the power supply to 20 milliamperes. This prevents damage to the tubes and to the voltage control potentiometer by short-circuited capacitors. The 0-1 d.c. milliammeter, M, is protected by a Type 4AG Littelfuse which will open at 1½ ma.

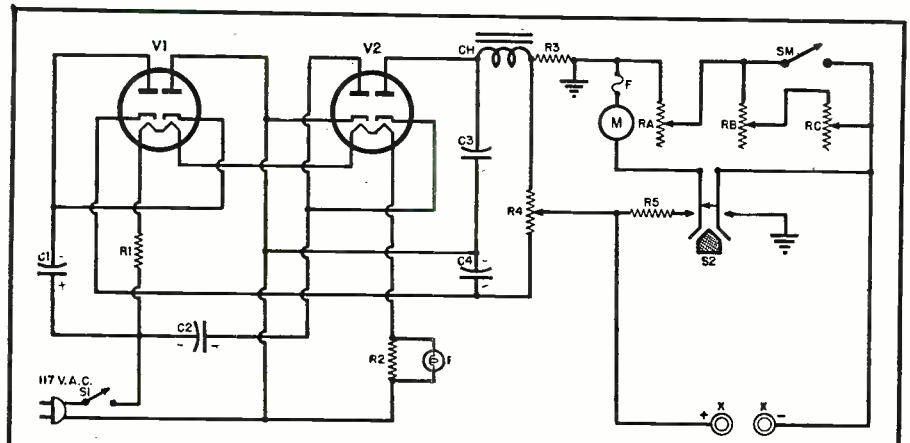
It has been stated already that the meter shunt rheostat must be adjustable from 6 to 1110 ohms. It is entirely possible to obtain this range in a single rheostat, but many of the resistance settings corresponding to the various maximum permissible leakage currents lie too close together to be set reliably on such a rheostat. For that reason, the shunt resistor has been separated into three series-connected rheostats, R_A, R_B, and R_C, having maximum resistance values of 10, 100, and 1000 ohms respectively. Several shunt settings must be made between 6 and 10 ohms on rheostat R_A, and it is essential when these settings are made that R_B and R_C be set exactly to zero. However, true zero setting seldom is obtained with high-resistance rheostats, so a switch, S_M, has been included in the circuit to short-circuit R_B and R_C when R_A alone is being used.

Working with the maximum permissible leakage current values given in Chart 1, a table of settings for the shunt rheostats, R_A, R_B, and R_C, and the switch, S_M, has been worked out and is given in Chart 2. These settings of the shunt rheostats and switch will place at the .3-ma. point on the meter scale the maximum permissible leakage values for corresponding capacitances and working voltages, as given by Chart 1.

The pushbutton switch, S_2, when depressed, connects the milliammeter as a 0-500 d.c. voltmeter across the output of the variable power supply. S_2 is a 2-pole, make-two, break-one, non-locking pushbutton. When reading the test voltage by this scheme, the shunt rheostats (R_A, R_B, and R_C) are cut out of the circuit automatically, while the milliammeter is connected to the test voltage points in series with resistors R_3 and R_5 which act as multipliers. If a test capacitor happens to be connected to terminals X-X, it is left in the circuit undisturbed, so that the voltage may be checked under actual load condi-

Chart 2. Instrument settings for leakage test. All resistance (R) values are given in ohms. These values are for use with a 0-1 d.c. milliammeter having an internal resistance of 100 ohms. For meters with movement resistances other than 100 ohms, divide the values given by $100/R_m$, where R_m is the new meter resistance.

D. C. WORKING VOLTAGE		2 μfd.	4 μfd.	5 μfd.	8 μfd.	10 μfd.	16 μfd.	20 μfd.	30 μfd.	40 μfd.	50 μfd.	100 μfd.
0-99	R_A		0	0	0	0	0	0	0	0	0	0
	R_B		0	0	0	0	0	0	0	75	60	30
	R_C		757	606	377	301	188	150	100	0	0	0
	S_M		open	open	open	open	open	open	open	open	open	open
100-199	R_A	0	0	0	0	0	0	0	0	0	0	0
	R_B	0	0	0	0	0	94	75	50	37	30	15
	R_C	757	377	301	188	150	0	0	0	0	0	0
	S_M	open	open	open	open	open	open	open	open	open	open	open
200-299	R_A	0	0	0	0	0	0	0	0	0	0	10
	R_3	0	0	0	0	0	63	50	33	25	20	0
	R_C	502	251	201	125	100	0	0	0	0	0	0
	S_M	open	open	open	open	open	open	open	open	open	open	closed
300-399	R_A	0	0	0	0	0	0	0	0	0	0	7.5
	R_3	0	0	0	94	75	47	37	25	19	15	0
	R_C	377	188	150	0	0	0	0	0	0	0	0
	S_M	open	open	open	open	open	open	open	open	open	open	closed
400 & HIGHER	R_A	0	0	0	0	0	0	0	0	0	0	6
	R_B	0	0	0	75	60	37	30	20	15	12	0
	R_C	301	150	120	0	0	0	0	0	0	0	0
	S_M	open	open	open	open	open	open	open	open	open	open	closed



R_1—196 ohm, 50 w. res.
R_2—42 ohm, 5 w. res.
R_3—25,000 ohm, 10 w. res.
R_4—10,000 ohm, 50 w. pot., Ohmite Model J
R_5—475,000 ohm, 1 w. (250,000 & 225,000 ohm, connected in series)
R_A, R_B, R_C—See text
C_1, C_2, C_3, C_4—16 μfd., 450 d.c.w.v. elec. cond.
Ch—10-henry, 75 ma. filter choke
F—Fuse, 1½ ma., Littelfuse, Cat. No. 1331
M—0-1 d.c. (meter res. 100 ohm)
S_1—S.p.s.t. sw., on R_4
S_2—Pushbutton sw., 2-pole, make-two break-one, non-locking Mallory 2007
S_M—S.p.s.t. wafer-type sw.
P—Pilot lamp, 6-8 v. .15 amp. Brown Bead
V_1, V_2—25Z5 or 25Z6-G

Fig. 3. Complete schematic diagram of the two-tube electrolytic leakage tester.

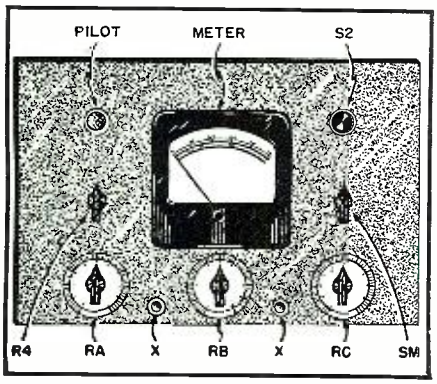
tions. The resistance values of R_3 and R_5 must be selected and checked closely so that these two resistors, acting together as the voltmeter multiplier, will show a total resistance value of 500,000 ohms. The top of the meter scale (See Fig. 1 and Chart 3) is graduated in volts.

The capacitor to be tested is connected to terminals *X-X*, the positive capacitor terminal to the positive instrument terminal. Since only a low value of limiting resistance is connected between the power supply and terminals *X-X*, the operator must exercise full caution to prevent touching the terminals, or the bare clips or prods of test leads connected to the terminals, while the instrument is switched on. The pilot light is a convenient, although not foolproof danger signal. The builder of the instrument should read closely the operating instructions given in the latter part of this article.

Heater voltage for the two tubes and the pilot light is supplied through the 196-ohm, 50-watt resistor, R_1, which may, if desired, be a line-cord resistor such as used in a.c.-d.c. receivers.

Only the necessary essentials have been included in this instrumental circuit. The checker has not been complicated by components and subcircuits that would add little real advantage to its performance. The simple circuit arrangement and lack of critical combinations makes it possible to build the instrument into close quarters. The carefully worked-out table of settings (Chart 2) makes it possible for any builder to calibrate the few controls himself in the easiest possible manner and without additional complicated test gear.

Fig. 4. Panel layout showing proper position of meter and operating controls.



Electrical Construction

Since the electrolytic capacitor checker is a d.c. instrument, the builder will not be concerned with coupling, hum fields, and similar considerations which complicate the assembly and wiring of a.f. and r.f. test instruments. For this reason, no set rules of arrangement and wiring need be followed. Shielding is not required, and the instrument may be built on a wooden panel and housed in a wooden case if metal is not available.

A heavy, flexible, insulated hookup wire may be used for wiring. Cabling the wire leads will enhance the appearance of the instrument's interior. Leads to and between rheostats R_A, R_B, and R_C and switch S_M must be of heavy conductor—at least No. 14—and must be as short as practicable.

Mechanical Construction

Because of the small size of required parts, the electrolytic capacitor checker may be made compact. The author's version of this instrument, shown in the photograph and in the front panel layout drawing, Fig. 4, is built into a small steel cabinet, 9" long, 6" high, and 5" deep. The steel chassis is 8½" long, 4¾" wide, and 1½" high. The author used a steel cabinet and chassis simply because these parts were on hand. Other builders may favor the carrying case style common to tube testers and set analyzers. Still others may prefer the store-counter type of construction.

Filter choke *Ch*, the fuse block for the meter fuse, and sockets for the tubes are mounted on the chassis. Capacitors C_1 to C_4 and resistors R_1, R_2, R_3, and R_5 are mounted underneath the chassis. Indicating meter *M*, the pilot light bracket, voltage control potentiometer R_4, shunt rheostats R_A, R_B, and R_C, pushbutton S_2, meter switch S_M, and capacitor terminals *X-X* are mounted on the front panel, as shown in the photograph and in Fig. 4.

Terminals *X-X* are the only panel-mounted parts which must be insulated from the panel. For this reason, they are protected by shoulder-type washers made of good-grade bakelite. It is convenient to employ plastic-top binding posts of different colors, such as red and black, for the positive and negative terminals.

The on-off switch, S_1, is mounted on the rear of the voltage control potentiometer, R_4, and is operated by the shaft of this potentiometer, the switch being opened when the potentiometer is in the zero voltage position.

Both the meter card and the scales for rheostats R_A, R_B, and R_C are made by drawing on thin white Bristol board with black India ink. The meter card in the author's instrument has been graduated 0-500 volts, as well as GOOD-?-BAD, in accordance with the calibration scale given in Chart 3. In this instrument, the scales of R_A, R_B, and R_C have been graduated (as may be seen from the photograph) in arbitrary units from 0 to 10, rather than in ohms. Settings of these dials and of switch S_M have been recorded on a chart cemented on the inside of the cabinet lid, all of the arbitrary dial figures having been listed to correspond to the resistance values in Chart 3.

Thus, when setting the instrument, a dial is turned to, say, 9, which means the same as a Chart 2 setting of 1000 ohms.

Calibration and Adjustment

The regular card of the milliammeter must be removed carefully from the instrument and a new one prepared according to Chart 3. This new card may be made from thin, white Bristol board if it is to be mounted by itself on the meter, or may be made of white paper if it is desired to cement it to the regular dial card. The regular card may be used as a template and pattern in preparing the special one.

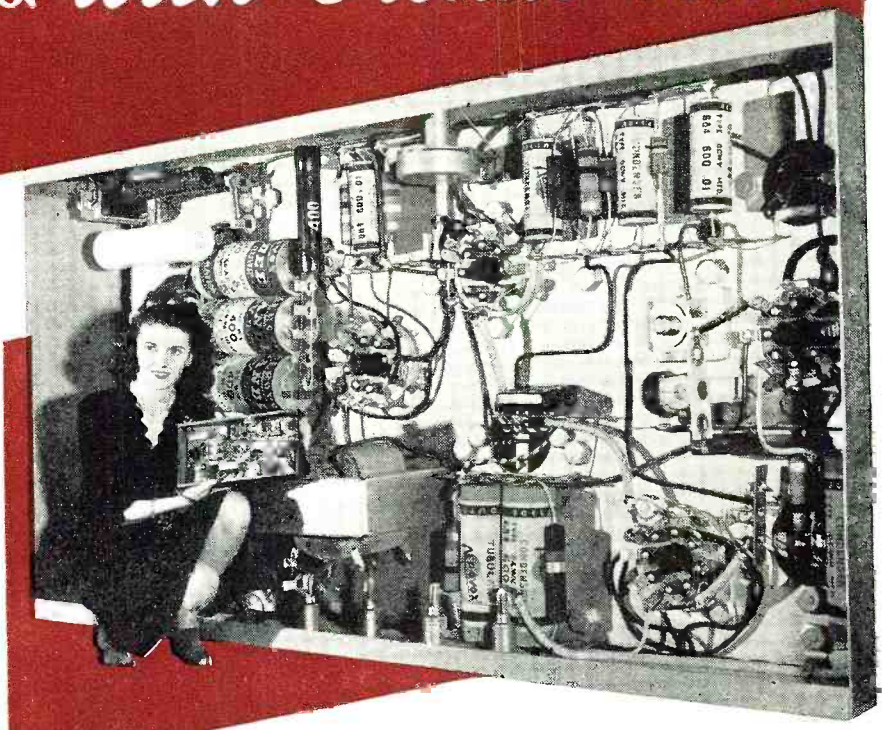
After mounting the special card in the meter and mounting the meter on the front panel of the checker, resistors R_3 and R_5 are adjusted carefully to the *exact* values given in Fig. 3. For this purpose, employ a Wheatstone bridge or a *good* ohmmeter.

Setting of rheostat R_A every 1 ohm from 0 to 10 ohms, of R_B every 10 ohms from 0 to 100 ohms, and of R_C every 100 ohms from 50 to 1000 ohms also must be determined by means of the

(*Continued on page* 153)

TRAINING *with Visual Aids*

By
CARL E. WINTER



Miss Hazel Fox, civilian employee of Ship's Service at Radio Chicago, holds normal sized receiver for comparison with the giant instructional model made by Visual Aids Department.

Instructional techniques used by the Navy to train their radio and radar repairmen can be used by civilian schools.

RADIO Chicago, the primary school of the U. S. Navy's Radio Technician Training Program, is doing a big and important job in the training of men to repair and maintain radar equipment, radio direction finders, u.h.f. equipment, and other such devices. When these men complete their radio technician training less than one year after entering the program, they are radio and radar technicians qualified to keep many types of the Navy's electronic equipment operating at top efficiency.

The thoroughness of the Navy training is, in itself, almost as great a scientific wonder as the marvelous equipment with which the students work. To assemble a conglomeration of men of all ages and backgrounds, possessing varying degrees of aptitude and general knowledge, put them through schooling comparable to some collegiate science courses, and within a year bring them to a mutual level of ability as highly skilled technicians in a field as abstractly theoretical as electronics, indeed requires a scientific approach. If any one method of instruction can claim credit for the rapid development of these potential radio technicians, that method would be the extensive visual aid program which is a vital adjunct to the teaching techniques used at these radio schools.

The training given radio technicians deals only with material associated with the theory and practice of radio and radar maintenance. This fact alone streamlines and differentiates the course from college engineering curricula, and the use of visual aids in presenting theory and practice to the student has been found to be of invaluable assistance in the transmission of new knowledge.

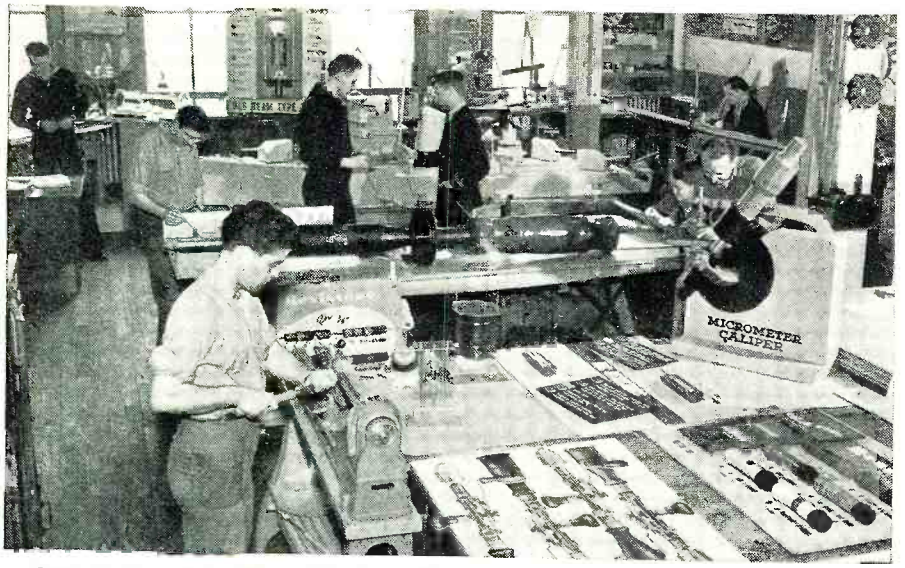
The results which have been achieved by means of visual aids in the field of adult education have aroused the interest of educators throughout the country.

The Radio Technician Training Program, as it is set up today, involves several educational helps which are of interest to the layman and educator alike. The first step in the program requires that the applicant for radio technician training successfully pass the special aptitude test which is designed to select only those best qualified and most likely to complete the prescribed course. This pre-selection of the students is accomplished by means of the well-known "Eddy Test". This test which was devised and developed by Captain William C. Eddy is not a measure of man's technical or mechanical background, but it does preclude a better-than-average working knowledge of high school mathematics and physics. While these two subjects receive the primary emphasis in the examination, it is also necessary for the applicant to understand certain phases of general science, shop practice, elementary electricity, and radio.

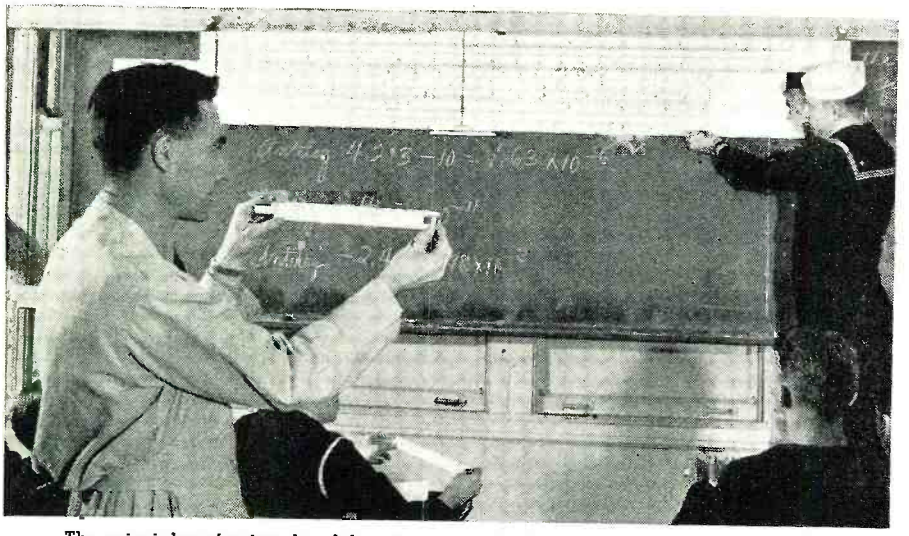
Lt. (j.g.) A. L. Rogers, W9OZE, Visual Aids Officer of Radio Chicago, holds a normal sized coil for comparison with the instructional coil made by visual aids.

The "Eddy Test" is roughly divided into five categories covering approximately 80 questions on mathematics, physics, shop practice, electricity, and radio. In the field of mathematics, it is necessary for the applicant to be able to perform simple mathematical operations such as cancellations, division, multiplication, addition of algebraic fractions, square roots, percentages, equations and logarithms, etc. The part of the test covering physics requires a working knowledge of heat, light, magnetism, sound, and other phases of general science. Shop practice covers the use of various tools including micrometers, hand tools, the reading of shop drawings, the correct use of files, screws, bolts, soldering irons, etc. The requirements for electricity and radio cover Ohm's Law, direct current circuits, elements of alternating current theory, basic receiver principles, vacuum tubes, and circuit components.

The test breaks down into 40% mathematics, 20% basic physics, 15% basic electricity, 15% basic radio, and 10% shop practice. The grades received by the students in these tests



Over-all view of the Visual Aid Model Shop located at Radio Chicago, Chicago, Illinois. In this shop are built all of the visual aids used to teach radio trainees.



The principles of using the slide rule are taught by means of a giant model while students make computations on their individual rules. Chief Radio Technician E. J. Tripler of Montrose, Colorado, is instructing the class on the small slide rule while the model on the wall is being set by Charles Barrett, Specialist (X) 3/C, of DeLand, Florida, a member of the Visual Aids Department for Radio Chicago.

★ ★

Laboratory where students are building five-tube superheterodynes as one of their projects before graduation. Note the large scale model of the receiver mounted on the wall for the guidance of the students in placing parts.

are entered as part of their Navy record and these records have resulted in a careful study of case histories and several revisions in the "Eddy Test", but basically the test remains about the same as it was at the time of its adoption in the early part of 1942.

Upon the successful completion of the "Eddy Test" and providing the candidate meets all of the physical and other requirements of the Navy, the student is sent to "boot" training where he must first of all become a sailor before he becomes a specialist. In boot training the student learns how to sling a hammock, how to tell port from starboard, and, in general, become a sailor. During this period, which lasts from five to twelve weeks, he can talk radio and dream radar to his heart's content but nary a radio tube or textbook does the candidate see.

Upon completion of "boot" training, the candidate enters pre-radio school, where during a month's course of intensive study he reviews high school algebra, learns the elements of electricity and the fundamentals of shop practices by means of lectures and laboratory classwork. In this school the student is first introduced to the visual aid method of instruction.

The use of the slide rule is taught by means of a giant nine-foot model of its familiar counterpart. This model is constructed to scale and is capable of being operated by the instructor. Problems worked by means of the slide rule are illustrated by the instructor, who makes the proper setting on the large scale model and the class then performs the proper operation on their individual rules.

In a similar manner, recognition of tools and the proper use of various shop equipment is taught. Sharpening of bits and twist drills becomes easier for the student because giant models of the grinding operation and cutting surfaces of the tools are available for comparison.

Thus, when the student completes his work at the pre-radio school, he is already familiar with many of the visual aids which he will meet time and again in primary and secondary schools.

In the primary schools, the student begins his work on radio equipment and associated test equipment in earnest. Each student, before his graduation from the primary school, is required to construct a complete five-tube superheterodyne receiver. The proper placement of parts and the general layout of the chassis are taught by means of a giant receiver which is exactly scaled to the original. The theory of radio operation is also taught by means of this gigantic receiver, which is large enough for a six-foot man to move around in comfortably.

In the courses in shop practice, the correct use of soldering irons, micrometers, and hand tools are continued at a high level by means of large scale models of each of these instruments. In specific instances, the use of visual

aids has cut the training time in almost unbelievable amounts. In one experiment involving the installation of an octal tube socket in a chassis and the soldering of wire leads from a resistor network to certain socket prongs, fifty-five minutes were lopped off the instruction time by the use of a visual aid. Before the adoption of this instruction technique, it was the practice of the instructor to lecture to the students for a one-hour period on the correct practices involved in performing this operation. By means of the oversized model constructed by the Visual Aids Department, the lecture time was cut to a five minute preliminary outlining of the problem to be done.

In similarly dramatic fashion, the operation of the oscilloscope and correct interpretation of patterns on its screen is taught to the students by means of a 20" oscilloscope which is easily visible to the entire class during the instructor's lecture-demonstration. Since most of the features of the more readily portable units are incorporated on this demonstration 'scope, the class is thoroughly familiar with the operation of all the controls when he begins work on the oscilloscope projects.

The testing of meters, which has always been considered an extremely difficult subject to teach to groups because of the small size of most meter parts, has been facilitated by means of model meters which are built eight times normal size. Every detail down to the last coil turn is duplicated faithfully by the model makers.

In addition to individual pieces of equipment, the student becomes familiar with several other types of visual aids during his course of study. Circuits of various pieces of equipment are "blown up" and built onto a demonstration board. In some working models the operation of a receiver may be demonstrated and the signal traced through the circuit by means of electrically operated indicating devices. Various types of tubes, both receiving and transmitting become familiar to the student because actual tubes are mounted on demonstration panels for his inspection. In addition to this familiarization process, the Visual Aids Department builds giant stripped-down models of the internal construction of the tube showing all working parts, without the glass envelope in place.

Great care goes into the construction of each unit turned out by the visual aids group so that every feature of the model closely resembles or duplicates the characteristics of the original, including solder joints, etc.

The great majority of the visual aids in use at Radio Chicago have been the handiwork of the Visual Aids Department connected with the school. From a small beginning in November of 1942, when the first artist was assigned to the school, this department has expanded until today it is a full-fledged organization working full-time on the job of preparing training aids for the Navy.

The pioneer artist, upon whom rested the responsibility of organizing the work, was Chief Specialist (X) Brander, who is now a lieutenant stationed at the Bureau of Personnel, Training Division, in Washington, D.C. By January, 1943, this department had grown to three staff artists and model makers who devoted their entire time to producing training aids for the rapidly expanding radio school. Today this department keeps twelve Navy men busy full-time preparing the various material for class-room instruction. A completely equipped workshop permits independent operation of the department. Many types of materials are used in the construction of the models, including plastics, wood, plywood, sheet steel, and non-priority material. The work of this department is now under the direction of Lt. (j.g.) A. L. Rogers, a peace-time radio amateur from Waukegan, Illinois.

In addition to the models used for training, the Navy is also a staunch champion of the efficacy of motion pictures and slide films in training operations. A Training Aids Library was set up at 1212 North Lake Shore Drive, Chicago, for the purpose of supplying films and projectors to supplement the visual aids.

By Navy contract, Burton Holmes Films, Inc. produced a 16 mm. sound movie in the laboratories of Radio Chicago entitled "Radio Technician Shop Practice". Upon completion of this standard 40 minute film, 3 more 16 mm. sound films and about 20 slide films (35 mm.) were produced in a similar manner under the supervision of Navy instructors at Radio Chicago.

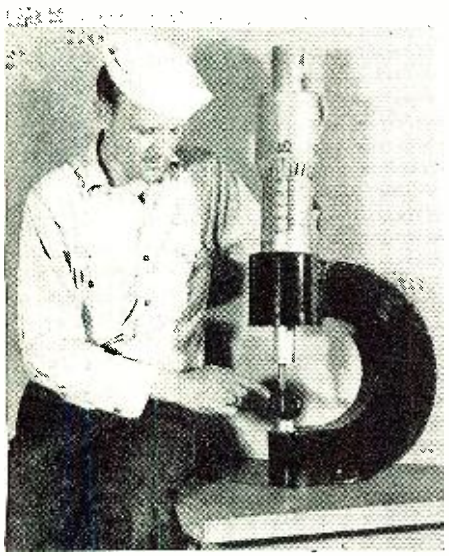
Thus in several different forms, the Navy is making use of various time-saving visual aids in the instruction of their radio technicians.

It seems certain that in the postwar era, schools and colleges will be quick to take advantage of what the Navy has learned laboriously. When students from all walks of life are brought together to learn the intricacies of any science or abstract subject, new and disassociated ideas must be presented to them in a simplified, easily grasped manner if utmost speed of instruction and intelligent comprehension is to be obtained.

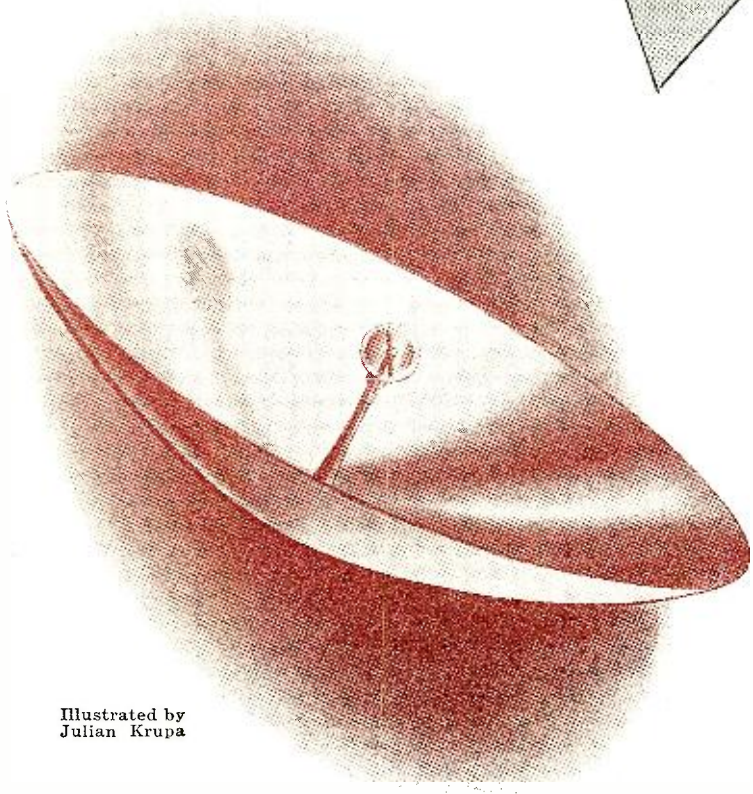
Visual aids have proved to be the ideal medium to achieve this end, for it is this method that has enabled Radio Chicago to prepare untrained naval personnel for the exacting task of maintaining the complex electronic equipment which is the voice, eyes, and ears of the U. S. Navy.

—30—

(Left) Jack Phillips, Specialist (X) 1/C of Long Island, New York, demonstrates the large sized micrometer used for instructional purposes. The normal sized unit is shown for comparison. (Center) Students are taught correct procedures for maintaining and servicing soldering irons from this giant model being supported by Francis Mair, Specialist (X) 1/C of Streatorville, Illinois. Mr. Mair is the head of the Visual Aids Department of Radio Chicago. (Right) The Du Mont twenty-inch oscilloscope is being used by Chief Ernest Sindelar, Chief Instructor of Radio Chicago, to instruct Charles O. Whitehead, Radio Technician 2/C, of Columbus, Mississippi, on correct operating procedure.



Practical RADAR



Illustrated by Julian Krupa

By JORDAN McQUAY

Part 5. The design of radar receivers capable of detecting weak echo signals. Conventional u.h.f. tubes, circuits, and design techniques are used throughout.

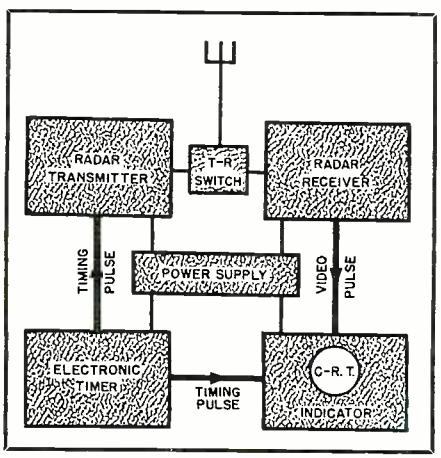


Fig. 1. Basic block diagram of a radar set.

A CONSTANT barrage of r.f. pulses from a radar set scans the air and land and sea, searching for targets in light or darkness, in any kind of weather.

The pulses travel at the speed of light until they strike a target, when the r.f. energy is reflected or reradiated at equal speed in all directions from the surface of the target. Some of this reflected energy returns to the radar set in the form of *echoes* which are picked up by the radar receiving antenna.

The receiver takes every weak echo from the antenna, amplifies it, detects the echo envelope, and then feeds the rectified signal to the indicator unit of the radar set.

Once the echo signals are received from targets, determination of the ranges and directions of the targets are based on the facts that radio-frequency energy travels at a constant velocity (about 186,000 miles-per-second) and that the antenna set of a radar set is movable and highly directional.

The range or distance to a target can be found by multiplying the velocity by one-half the time a single pulse requires to complete a round-trip cycle, known as a radar cycle. This *time* is measured electronically by the cathode-ray oscilloscope and immediately translated into terms of *distance*—in yards or miles.

The physical position of the antenna system then gives us two angular measurements, the azimuth or bearing, and the elevation angle of the target.

Knowing the range or distance, azimuth, and angle of elevation, we can locate accurately the position of any object in space or on land or water.

The reception and detection of echoes from distant targets is an important job in the over-all function of a complete radar set (Fig. 1).

Because reflections from any target are scattered at random in all directions, the few echoes that return to the radar set are very weak. Yet these signals must be accepted by the receiver and amplified sufficiently so they can be observed as visual signals on the time base of a cathode-ray oscilloscope.

This ability of the receiver to detect and amplify extremely weak echo signals is a measure of the effectiveness of the radar equipment; the weaker the acceptable echo signal, the greater the workable range of the radar set.

Radar receivers employing, for the most part, conventional types of u.h.f. tubes and circuits require a fairly wide bandwidth input, at the same operating frequency as the radar transmitter. Except in this one respect, the radar receiver needn't differ greatly from other u.h.f. receivers. Therefore, much of the published and known theory of u.h.f. receiver operation is applicable to radar receivers.

The Superheterodyne

A radar receiver must supply considerable amplification, with inherent stability and extreme sensitivity. For this purpose a superheterodyne circuit logically offers itself.

Special types of high-frequency tubes with low interelectrode capacitances are used in the r.f., local oscillator, and i.f. stages. And a large number of i.f. amplification stages may be expected in a radar receiver. These and other u.h.f. refinements give stability of operation at ultra-high frequencies, as well as a high degree of sensitivity. Even when the receiver employs as many as six or eight stages of i.f. amplification, there is considerable stabilization.

The block diagram of a basic su-

perheterodyne receiver suitable for radar is shown in Fig 2.

It functions much in the conventional manner, with some important exceptions. The input to the receiver is broadly tuned with provisions for changing the input bandwidth; the intermediate frequency is measured in megacycles and the output of the receiver is a video signal containing a wide range of component frequencies.

A number of other circuit conditions must be considered in addition, if the radar receiver operates at ultra-high frequencies. High amplification by any one r.f. stage is seldom possible and there are considerable losses in the process of conversion to an intermediate frequency. The shortness of interconnecting leads becomes important. Interlocking of amplifier and local oscillator tuning becomes more difficult to avoid. All r.f. and i.f. circuit elements must be well shielded. Tuned sections of transmission lines are often used as "tank" circuits, and special types of u.h.f. tubes must be used in the r.f., local oscillator, and i.f. stages of the receiver.

In general, as the frequency of operation is increased, the physical structure and electrical design of radar superheterodyne circuits becomes more radically altered.

All of this is necessary to preserve the shape of the reflected echoes, while they are being detected and amplified.

It's a big job for the radar receiver.

Often the simple diagram (Fig. 2) may become quite complicated, as shown in Fig. 4, where as many as 20 or 25 separate and distinct stages compose the complete receiver.

But regardless of the total number of stages in a radar superheterodyne, the receiver can be conveniently divided into five principal parts; the radio-frequency amplifier stages, the mixer or frequency conversion stage, the i.f. amplifier stages, the (second) detector stage, and the video amplifier stages.

Problems of Noise

Like other u.h.f. receivers, the radar receiver is faced with the eternal problem of noise disturbances generated within the circuits of the receiver itself. If it were not for this problem, any number of amplification stages could be used to increase the amplitude of the echo signal, no matter how weak, by any desired amount.

These noise disturbances actually are random, minute voltage variations due to any of several circuit conditions—usually associated with radio-frequency amplifier stages of the receiver.

The effect of these noise voltages depends not so much upon their individual amplitudes, but upon the power relation between the echo signal and the *collective* noise. If the amplitude of the noise voltages is not less than the amplitude of the echo signal, the echo cannot be recognized at the output of the receiver.

For this reason, the noise voltages must be kept as low as possible; *i.e.*, the signal-to-noise ratio must be kept high. The lower the noise level, the weaker the acceptable echoes—and the greater will be the working distance of the radar set. Thus, internal noise in the early stages of the receiver directly affects the useful range of the equipment.

There are three different kinds of noise disturbances in the r.f. section of a receiver; noise due to thermal agitation, noise due to shot effect, and hum or induced noises.

Thermal agitation—the random motion of electrons in a conductor—is caused primarily by either high conductor resistance, or high operating temperature.

Shot effect—the irregular emission of electrons by the cathode of the r.f. amplifier tubes—is caused by low filament operating temperatures, resulting in a low space charge within the tube.

Stray electrostatic or electromagnetic fields often induce hum and other extraneous noises into a u.h.f. circuit. This is a form of modulation and generally exists when units of the r.f. stages are not properly shielded.

While it has not been possible to eliminate the noise disturbances caused by these three effects, most of them have been minimized by improved u.h.f. design and the use of special tubes.

GLOSSARY OF RADAR TERMS

Antenna array—A symmetrical arrangement of dipoles with directional characteristics.

Antenna reflector—See reflector.

Antenna switch—See T-R switch.

Azimuth—Bearing or angular direction relative to true north.

Beam width—The width in azimuth of the pulsed r.f. energy beam.

Bearing—See Azimuth.

Blocking oscillator—Tuned-grid, tuned plate r.f. oscillator in which the grid circuit controls the pulse duration.

Carrier frequency—The ultra-high frequency at which a radar transmitter operates.

Cathode follower—Distortionless, impedance-matching, isolating stage.

Charged line—A pulse-shaping network which reflects a steep-sided rectangular pulse of a duration determined by the electrical constants of the line.

Clamping circuit—A circuit which holds either the positive or negative amplitude extreme of a wave form to a given reference level of voltage.

Crystal mixer—Mixing two frequencies by using the non-linear characteristics of a crystal.

Cut-off limiting—Limiting action of an amplifier when operated beyond the point of plate current cut-off.

D.C. restorer—See clamping circuit.

Delay circuit—Network or circuit which introduces a time or phase delay of a wave form.

Differentiator circuit—A short time constant (RC) circuit and amplifier which produces an output voltage with an amplitude proportional to the rate of change of the input voltage. A circuit used to sharpen a wave form Sometimes called a peaking circuit.

Dipole—A half-wave, center-fed radiating element.

Duty cycle—The fraction of a complete radar cycle during which energy is transmitted.

Echo—That part of the r.f. pulse reflected back to the radar set by a target.

Electronic timer—The component of a radar set that originates the pulse recurrence frequency, and synchronizes the operation of other components with the radiation of r.f. pulses by the transmitter.

Elevation angle—The angle of the target with respect to the radar set and the horizontal plane of the earth.

Envelope—The general outline of a wave form.

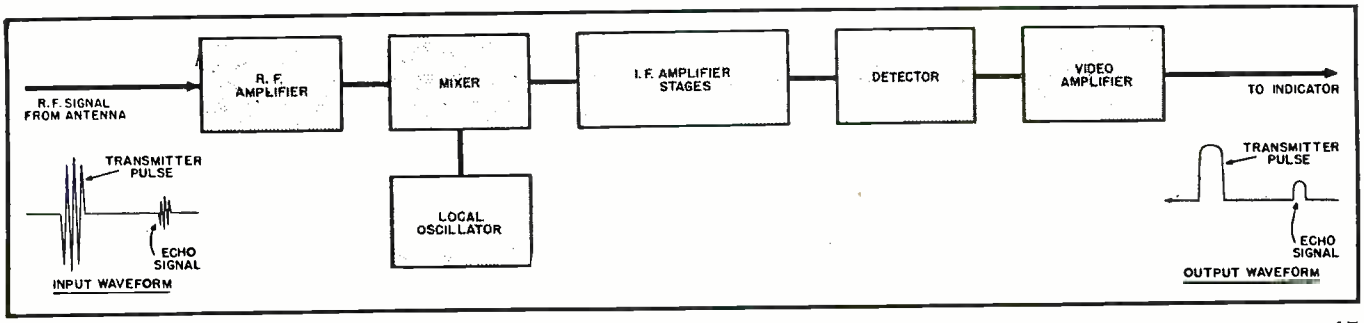
Gate—A rectangular wave used to switch a circuit on or off electronically during certain portions of the radar operating cycle.

Grass—Static or noise appearing as intermittent, minute interruptions of the oscilloscope time base.

Ground return—That part of the r.f. pulse reflected by the ground surrounding the radar set.

(Continued on page 149)

Fig. 2. Basic block diagram of radar superheterodyne receiver.



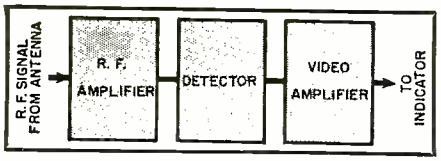


Fig. 3. Basic block diagram of superregenerative receiver.

Atmospheric "noise," or static, is another contributing factor to the sensitivity of the radar superheterodyne. A fairly wide input bandwidth would be required by most receivers, since the video output of the receiver must contain a wide range of frequencies, *i.e.*, be rich in harmonics, for faithful reproduction of the echo pulse. This wide bandwidth admits a greater amount of spurious external "noise" and atmospherics, which usually must be contended with unless some form of *variable* input bandwidth is used in the first r.f. stage of the receiver.

Considerable noise may be minimized or even eliminated by dividing the superheterodyne receiver *physically* so that the r.f. stages and mixer are located near the antenna system, and the i.f. and video stages are located elsewhere, near the main components of the radar equipment.

Parts of the receiver may often be distributed throughout the radar set so that their physical identity becomes lost. However, for purposes of our discussion we will assume the receiver to be a complete component, consisting of the r.f. amplifier, frequency conversion, i.f. amplifier, and video amplifier stages.

R.F. Amplification

Probably most radar superheterodyne receivers use one or more stages of r.f. amplification, but at extremely high frequencies of operation this may be difficult.

However, we can assume that at least one stage of r.f. amplification is generally used—sometimes two or three stages—providing a considerable degree of pre-selection.

Because of noise disturbances, screen grid tubes are impracticable for r.f. amplification in radar superheterodynes. Inductive reactance of the cathode leads causes degeneration in the circuits associated with such tubes.

Grounded-grid triodes offer advantages as r.f. amplifiers at the lower frequencies of radar operation. If the input signal is applied to the cathode, the plate-to-grid capacitance of the tube then acts only as a plate load, instead of the conventional feedback circuit. This absence of plate-to-grid capacitance is due to the shielding action of the grounded grid.

At higher frequencies the Lighthouse tube has found considerable use as an efficient r.f. amplifier. But in the extremely high ranges, r.f. amplifier stages are seldom used in superheterodynes.

All of the u.h.f. circuit techniques discussed earlier in this series on "Practical Radar" can be applied to this stage of the receiver. Every piece of connecting wire, no matter how short, acts as some portion of a transmission line. Lumped inductance and capacitance are of far less importance than distributed inductance and capacitance, and coaxial cables or wave guides are used to transfer r.f. energy over any appreciable distance in the set.

Resonant circuits of the r.f. stages are of the fixed tuned type; that is, the stages are adjusted to a given frequency of operation, depending upon the carrier frequency of the radar transmitter. Tuning can be accomplished by variable condensers.

R.f. chokes used in the plate and filament leads of the r.f. amplifier tubes prevent leakage of the signal into the power supply. Because of the high operating frequencies involved, low values of inductance are required. The chokes may be formed from the interconnecting leads which supply voltages to the different tube elements, a few turns being sufficient for this purpose.

Every portion of the r.f. amplifier stage must be well shielded, and the complete stage also shielded from the rest of the superheterodyne.

These, and many other "trick" u.h.f. techniques, could be employed in radar receivers, in an effort to supply as much undistorted r.f. amplification as possible to the echo signal before it is passed to the frequency conversion stage of the radar superheterodyne.

Frequency Conversion

Mixing or frequency conversion could be accomplished in a radar receiver by means of a separate local oscillator in a somewhat conventional circuit. However, it should be noted that the output of this mixing stage, the intermediate frequency, needs to be considerably higher than in the usual u.h.f. superheterodynes.

At the lower operating frequencies of the r.f. spectrum, any of several types of high-frequency tubes can be used as the "mixer" with a stable local oscillator supplying the mixing frequency.

Link coupling between the mixer and local oscillator, and between the mixer and the first i.f. amplifier stage, would obtain the optimum degree of energy transfer between these stages. This method of coupling prevents interaction between the circuits due to heavy loading, such as would occur with other types of coupling.

Radio-frequency chokes would be as efficient in the power leads to the mixer stage as in the r.f. amplifier stages previously described.

The local oscillator might use any type of stable oscillatory circuit, and the tuning can be adjusted over a slight range of frequencies. The local-oscillator frequency may be slightly higher or lower than the r.f. signal, by an amount which represents the "difference" or intermediate frequency.

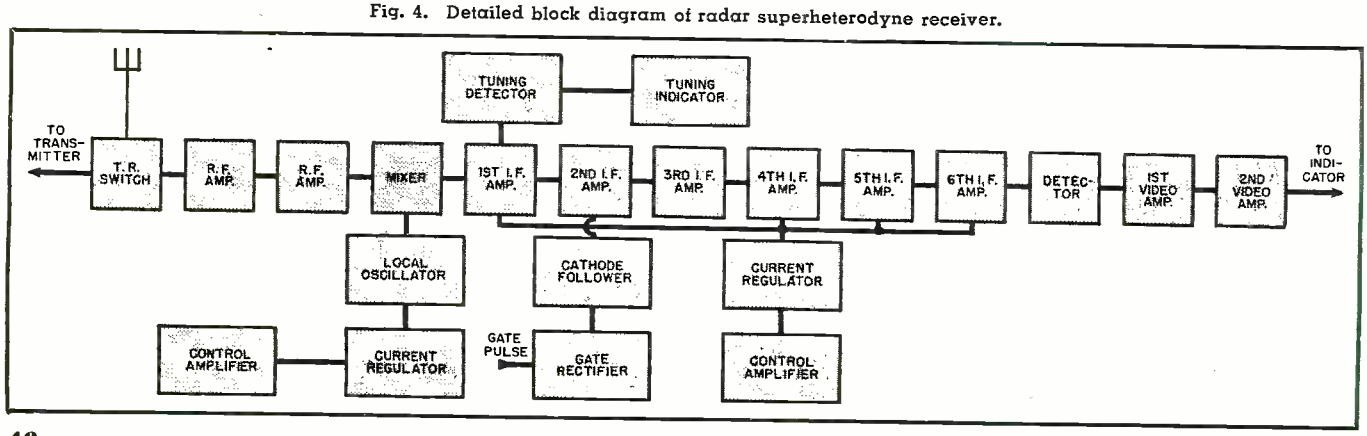
Frequency conversion at the higher operating frequencies of the u.h.f. spectrum becomes much more difficult and requires something of a new philosophy of "mixing."

One type of local oscillator capable of generating a high frequency for mixing purposes is known as the Klystron tube [Sperry] functioning in a very simple circuit. Also known as a refiex Klystron, this tube can generate radio waves of very short length.

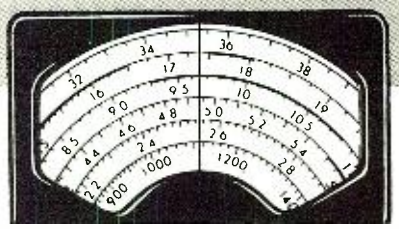
The Klystron tube consists essentially of a cathode, a control grid, a repeller electrode, and a resonant cavity. The tube operates on the velocity-modulation principle, in which the transit time of electrons between the resonator and the repeller is utilized. Oscillations take place within the resonant cavity when properly phased electrons pass between the resonator grids. This phasing can be affected by the accelerating voltage

(*Continued on page* 151)

Fig. 4. Detailed block diagram of radar superheterodyne receiver.



International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

FIJI CALLS

From the far-away South Pacific, the Fiji Radio Service reports:

VPD2, 6.130, Suva, capital of Fiji, normally 10,000 watts, but now using only 500, takes its programs from local broadcast station ZJV (920 kc.). Actually, VPD2 is an extension of ZJV designed to cover outlying islands not served by ZJV. Hours of operation are restricted at present:

Daily, except Sunday, 4:15-5 p.m., news bulletins at dictation speed, followed by BBC news relay, 4:45 p.m.

Sunday, 2-6 a.m., special programs in Fijian and English; BBC news relay, 2 a.m.

Tuesday, 4-5 a.m., news bulletins and commentaries in Fijian; native music.

Radiations of VPD2 are omni-directional. When conditions become normal, VPD2 will revert to former schedules on high power with increased time on the air, and will provide a greater variety of service.

VPD2 is heard in various sections of America (recently reported heard in Ontario, North Carolina, West Virginia).

As an interesting sidelight, Paul M. Wilson, Ensign, USMS, Amateur Radio W4HHK, writes: "Early this year I had the pleasure of visiting Suva and seeing one of their radio stations, ZJV. The engineers were very courteous and showed me through the station. Before leaving I gave them one of my amateur QSL cards and in return received two from them—one bearing the call letters of the standard broadcast station, ZJV, and one from VPD2, short-wave. The cards are very attractive. My time ashore being limited, I was unable to visit VPD2, located outside Suva. VPD2's QSL card states there are three transmitters, frequencies used and times of operation not being given."

Communications should be addressed to Fiji Radio Service, Amalgamated Wireless (Australasia) Limited, Wireless Station, Suva, Fiji.

* * *

NEW

New Zealand is about ready to begin regular short-wave overseas transmissions to the Pacific and the western coast of the United States. "This service will operate for several hours daily," says the National Broadcasting Service, operator of the new stations.

(EDITOR'S NOTE: Since more than ever before the ears of the world are tuned to the Pacific and Asia, ISW this month is devoted primarily to broadcasts from Asia and Oceania. The rapid turn of events in the war will, no doubt, change the entire schedule of Japanese transmitters. It is difficult to predict as to how these many stations will be operated under Allied control. For this reason, all reference to these stations will be omitted until more detailed information is obtained. All reference of time may be assumed to be EWT unless otherwise indicated.)

Tests have been made with two 10 kw. transmitters; eventual power is to be 100 kw. Calls and frequencies are expected to be:

ZL1, 6.080; ZL2, 9.540; ZL3, 11.780; and ZL4, 15.280.

Whether these transmissions will be heard in the East depends on a number of factors, but the reliability with which I have been picking up ZLT7, 6.715, Wellington 5 kw., here in West Virginia, leads me to believe the new 10 kw. transmitters will come through satisfactorily. The 9.540 frequency is the best bet for the East, providing, of course, it is radiating at a time when Australia's VLC5 is off the air.

Inquiries should be addressed to James Shelley, Director, National Broadcasting Service, P. O. Box 3045, Wellington (C.1.), N. Z.

* * *

CHANGES

Veteran monitors on the West Coast (Balbi, Dilg) report that, in general, Far East transmissions have been coming through somewhat erratically. There are reasons to believe that reception from that quarter will become even worse as winter comes on.

"Australia offers no problem; will be good all winter. VLC7, 11.84, will likely replace VLC4, 15.315, 9:55-10:45 p.m. to East Coast, and 1:10-1:45 a.m. to West Coast, beginning about October 1.

"Reception of Indian stations varies. Several are heard on East Coast that

(*Continued on page* 84)

The short-wave listening post of D.R.D. Wadia, "Panorama", Malabar Hill, Bombay 6, India, one of the oldest members of the International Short-Wave Club and a VAC holder. Mr. Wadia has membership in the Heard All Continents Club and has collected verifications from throughout the world. He uses a National NC200.

ULTRASONIC COMMUNICATIONS

An analysis of the principal factors and equipment involved in conveying intelligence at ultrasonic frequencies through mediums such as liquids, gases, or solids.

By ROBERT G. ROWE

IN ORDER to convey intelligence or to "communicate" through a medium, be it a liquid, gas, or solid, it is expedient first to establish in the medium, as a "carrier", some form of periodic wave motion which can be propagated to and detected at a remote point in the medium. Secondly, it is necessary to modify the existence or character of this wave motion in some pre-arranged, decipherable manner, or "modulate" the wave motion. Obviously, modifying the existence of the wave may be accomplished by alternately starting and stopping its generation; whereas, modifying its character may be accomplished by changing its amplitude, frequency, phase, or velocity. However, since the velocity of a wave in a homogeneous medium is fixed, the other aforementioned forms of modulation are relied upon.

In the art of radio communication, such "carrier" waves are electromagnetic in character, transmitted through the ether at a uniform velocity and modulated to carry intelligence by code or telephone.

In the art of sonic communication, such carrier waves are "compressional" in character, wherein the propagating medium suffers a sort of rectilinear deformation, which may be transmitted through various liquids, gases, and solids at velocities determined by the characteristics of the medium, and modulated to carry intelligence. While electromagnetic and sound waves may be essentially different in character, they are alike in that they may each be propagated in suitable media. Quite obviously, the most universal form of sonic communication may be exemplified by a conversation between two or more people. The vocal cords, as well as the configurations and appurtenances of the oral cavity, cooperate to represent the compressional wave generator, which is both amplitude and frequency modulated. The air represents the gaseous medium through which such modified compressional waves are transmitted at a velocity of some 1100 feet-per-second. The human ear represents the receiver, which is capable of detecting and, perhaps, demodulating these compressional waves.

In the art of ultrasonic communication, so designated by virtue of the fact that the human ear will not respond to the higher frequencies, such waves still are compressional in character and may be transmitted through liquids, gases, and solids. It will be appreciated that ultrasonic communication, while not popularized, has been known and used for many years. The early work of Langevin, Florisson, and others describes and discloses means and apparatus to communicate through a water medium via ultrasonic waves. Part of this work was directed toward submarine detection and signalling, as well as echo depth sounding, in which the principles involving the use of compressional water waves are truly the forerunners of the present-day principles involving the

MEDIUM	FREQ. (k.c.)	DISTANCE (FT.)
WATER	10	1,312,400
WATER	100	13,124
WATER	500	525
WATER	1000	131
AIR	10	722
AIR	100	7.22
AIR	500	0.157
AIR	1000	0.072

Table 1. The distance sound travels before its intensity is reduced to one-half.

Fig. 1. Two types of reproducers (loudspeakers) that can be used to communicate via a 20 kc. ultrasonic sound beam. (A) The magnetostriction reproducer and (B) the piezoelectric reproducer. Photographs of these units are shown in Figs. 2 and 4 respectively.

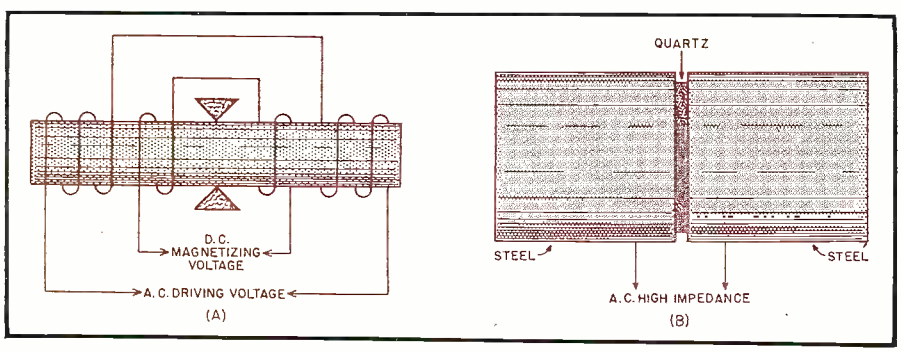
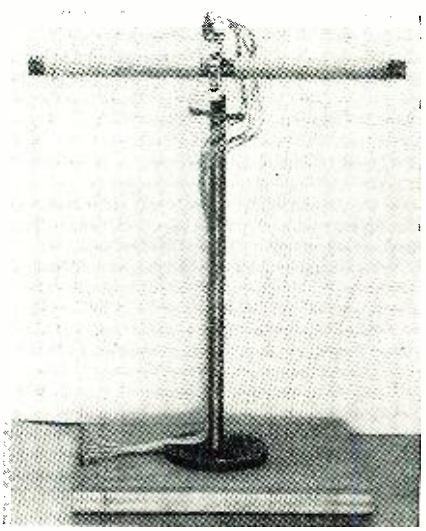


Fig. 2. The magnetostriction reproducer.



use of electromagnetic "ether" waves for radar. Early forms of "absolute altimeters" for avigation also employed sound waves, but their velocity was too low to render them practical for the vehicular velocities encountered in practice.

Compressional waves, in passing through any medium, are absorbed to an extent dependent upon the frequency of the waves, the nature of the medium, and the distance travelled. All mediums have a certain "compressibility" and "viscosity" whereby all of the compressional energy imparted to displace the medium is not returned to the wave but is partially transformed into heat. From Rayleigh[1], the amplitude A of plane waves at a distance x from the generator, is:

$$A_x = A_o\, e^{-KN^2X} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where A_o is the original amplitude, e is the base of the natural logarithms (2.718), K is a coefficient depending upon the density, compressibility, and viscosity of the propagating medium, and N is the frequency of the wave motion. By inspection, the amplitude of the wave at a distance is inversely proportional to the square of the frequency, so that high frequency compressional waves fade out in much shorter distances than low frequency waves.

The factor K for a water medium has such a relatively low value that appreciable distances may be covered by compressional water waves at frequencies of from 20 to 50 kilocycles. The factor K for an air medium has a much higher value so that air distances must be measured in feet rather than in miles. The relative efficiency of the two mediums, as well as the effect of frequency, may be seen by examination of Table 1, which shows the approximate range at which the original sound intensity has been reduced to one half[2].

A redeeming feature of ultrasonic sound waves, like high frequency electromagnetic waves, is that they are easily directed and formed into a cone or beam by conveniently small radiators. Provided that the vibrating surface producing the wave is moving like a piston with all surface elements in phase, the directivity of the reproducer may be roughly calculated from

$$\text{Sin } \theta = .61 \frac{\lambda}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where θ is the half-apex angle of the cone, λ is the wavelength and r is the piston radius[3].

With the foregoing considerations in mind, various apparatus for communicating via a 20 kilocycle ultrasonic soundbeam has been constructed and employed. The frequency generator to produce the carrier wave consists of a commercial audio oscillator and ten-watt audio amplifier. In order to amplitude modulate the carrier wave, provision is made for plate modulating the output tubes of the ten-watt amplifier, in accordance with conventional AM radio transmitter practice.

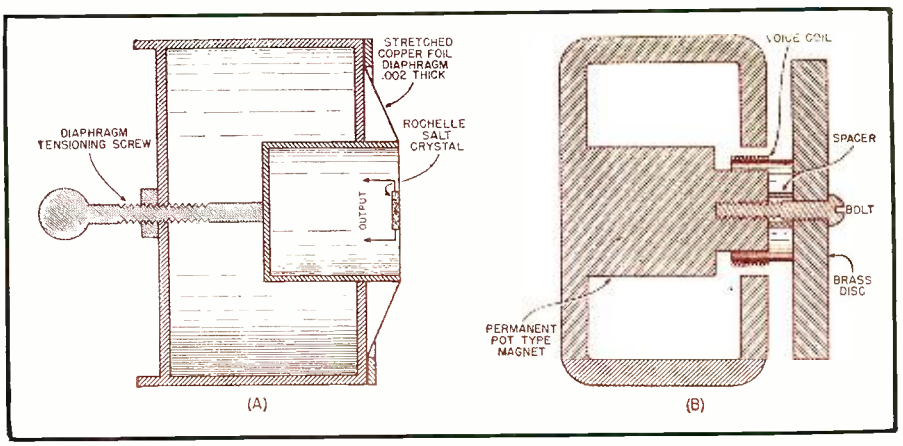


Fig. 3. (A) Mechanical arrangement of the mechanically resonant microphone. (B) Cross section view of the dynamic reproducer. Photographs shown in Figs. 6 and 5 respectively.

Three general types of reproducers or "loudspeakers," namely magnetostrictive, piezoelectric, and dynamic, have been used. With regard to these reproducers, magnetostriction refers to that phenomenon in which there is a change of length in a bar of ferromagnetic material attending magnetization. If the magnetic field is alternating (at 20 kilocycles in this case), the amplitude of longitudinal vibration in the bar will be maximum when the frequency of the applied field is equal to the fundamental elastic period of the bar. In accordance with the formula:

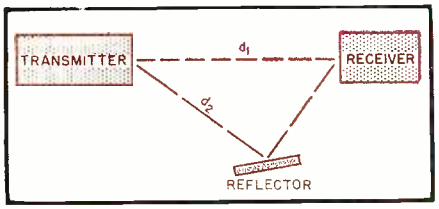
$$f = \frac{1}{2l}\sqrt{\frac{E}{d}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where f is the frequency in cycles per second, l is the length of the bar in centimeters, E equals its modulus of elasticity in dynes per-square-centimeter and d its density in grams per-cubic-centimeter, the length of a bar for resonance at 20 kilocycles is approximately 5 inches. This reproducer is shown in Figs. 1A and 2, clamped for support at its nodal midpoint and strongly magnetized by an additional direct current magnetic field. In general this simple type of magnetostriction reproducer is unsatisfactory because of extreme eddy-current heating. Further, this particular bar, having an o.d. of one-half an inch, has a poor match with the air load. Better loading may be obtained with the addition of a larger diameter thick disc at one end.

The piezoelectric reproducer, illustrated in Figs. 1B and 4, consists in a 3.5 megacycle X-cut quartz plate cemented between two identically di-

(*Continued on page* 118)

Fig. 7. When sound-waves along paths D_1 and D_2 arrive at the receiver out of phase, as can occur as shown in diagram, fading and phase distortion occur.



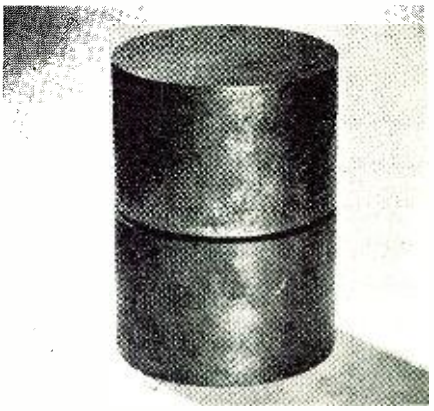


Fig. 4. The piezoelectric reproducer.

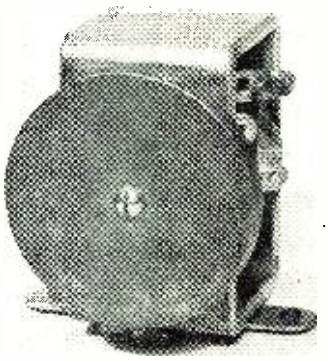


Fig. 5. Dynamic reproducer.

Fig. 6. Mechanically resonant microphone.

Practical RADIO COURSE

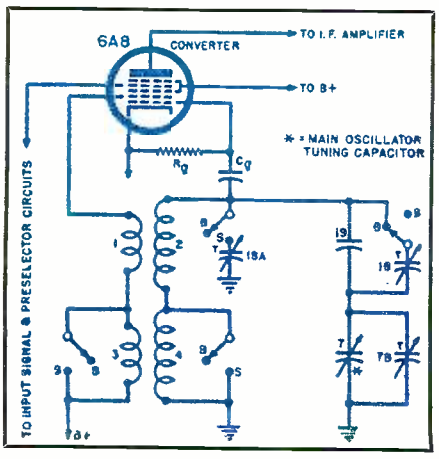
By ALFRED A. GHIRARDI

Part 38. Covering the special oscillator pre-selector tracking problems that exist in multi-band, manually-tuned receivers, and methods employed in solving them.

QUITE a variety of oscillator tuning and band-switching circuit arrangements have been developed and used in multi-band manually-tuned receivers. Unfortunately, space restrictions make it impossible to present all of them here. However, descriptions of two general arrangements that have been widely used (with only slight modifications) in the receivers of various manufacturers—one mostly in 2-band receivers and one in 3-band receivers—will serve to outline the general way in which the oscillator tracking and band-switching problems have been solved for each tuning band.

Fig. 1 illustrates a popular oscillator tuning coil, band-switching, and oscillator-preselector tracking arrangement that has been used in many 2-band receivers employing a tapped-coil system for multi-waveband coverage. For reception on the 540 to 1720 kc. broadcast-band tuning range provided in this particular receiver, the four band switches shown are thrown over to the *"B"* contact. This places

Fig. 1. Band-switching, tuning, high-frequency trimmers, and low-frequency padder arrangements employed in oscillator of a two band receiver using tapped coil system (Philco model 42-322).



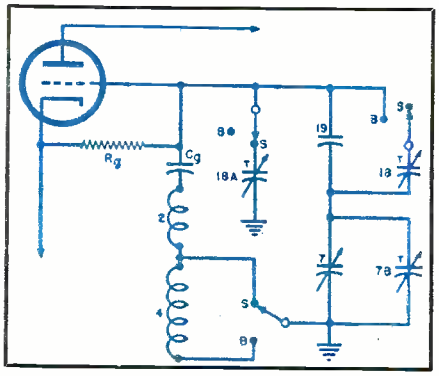


Fig. 2. Leaving portion 4 of the tuning coil open, as shown, when the short-wave band is being used has disadvantages over that of shorting the coil, illustrated in Fig. 1, as discussed in the text.

the full tickler winding (*1* + *3*) in the plate circuit (the second grid acts here as the plate of a triode oscillator), and the full secondary winding (*2* + *4*) in the tuning circuit. The full secondary is tuned by a combination made up of fixed low-frequency padder *19* shunted by adjustable broadcast-band padder *18*, all in series with main oscillator tuning capacitor 7 shunted by its broadcast-band, high-frequency trimmer *7B*. (Notice the similarity between this circuit arrangement and that of the fundamental "padder" circuit illustrated in Fig. 3 in the installment of this series that appeared in the September 1945 issue of RADIO NEWS.)

The manufacturer's aligning and tracking instructions specify that broadcast-band, high-frequency trimmer *7B* and the similar one on the preselector tuning capacitor section (not shown) are to be adjusted at a preselector frequency of 1500 kc. to obtain correct oscillator-preselector tracking at the high-frequency end of the broadcast-band. The broadcast-band, low-frequency adjustable padder *18* must be adjusted at a preselector frequency of 580 kc. in order to correctly tie down the oscillator tracking at the low-frequency end. Tracking will then be close and satisfactory all over the broadcast band.

For reception on the 8.7 to 15.5 mc. short-wave band provided in this receiver, the four band-switches shown are thrown over to the *"S"* contact. This shorts out portion *3* of the tickler coil and portion *4* of the secondary, leaving only portion *1* of the tickler and portion *2* of the secondary in the circuit. Padder *18* is now out of the circuit and adjustable short-wave high-frequency trimmer capacitor *18A* is shunted across the tuning coil *2*. Fixed series padder *19* still remains in series with the main tuning capacitor 7 that is shunted by its broadcast-band trimmer *7B*. Short-wave high-frequency trimmer *18A*, and a similar one across the short-wave preselector tuning coil (not shown), are to be adjusted for correct tracking at a preselector frequency of 15 mc. No means for adjustment of the padder capacitance is provided or necessary for the short-wave band.

A somewhat similar band-switching and oscillator tracking arrangement is used on many 3-band receivers that employ the tapped-coil system for multi-waveband coverage.

Why Unused Portions of Tapped Tuning Coils are Shorted by Band-Switch

We will digress from our discussion of oscillator tracking for a moment, to consider an important detail in connection with the use of tapped tuning coils in multi-band receivers. It will be noticed that the lower portion, *4*, of the full oscillator tuning coil is shorted out by the ganged waveband switch when it is set for short-wave operation, as is also the lower portion, *3*, of the plate tickler coil. The tuning coil might have been tapped, of course, and its lower end left ungrounded; then the lower terminal of main tuning capacitor, 7, could have been arranged to be switched either to the lower end of tuning coil *4* for broadcast-band reception, or to the tap for short-wave reception, thus leaving the unused portion of the tuning coil open as shown in Fig. 2.

At first thought it would appear that leaving the unused portion of the tuning coil open would be better than shorting it, since experience has taught us that even one or two shorted turns in a tuning coil are undesirable. However, there is good reason for shorting coil *4*, as we shall see. If an appreciable part of the coil is left open, the capacitance (both distributed and due to circuit wiring, shields, etc.) across this portion of the coil is likely to resonate it to a frequency in or near the desired short-wave band. If this occurred, it would greatly reduce both the sensitivity and selectivity over part of the short-wave band. In addition, coil *3* would most likely resonate at one frequency and coil *4* at a different frequency. This would throw the oscillator so badly out of track with the preselector circuits that it is doubtful if any signal at all would be received at certain frequencies. Spoiling the oscillator tracking is much more serious than spoiling the alignment of the preselector tuned circuits with each other. Another important thing to consider is that if the resonant frequency of the unused open portion of the oscillator coil happened to fall in the desired short-wave band, it is probable that the energy absorption would be so great that the oscillations would stop entirely. Now, if one unused turn of a coil is shorted it is very serious, for a comparatively large current will flow in the shorted turn and this will absorb power from the remainder of the coil and also seriously alter its effective resistance and inductance. If two unused turns are shorted, the effect is *less* serious because while the total voltage induced in the two turns is almost twice as great, the inductance of these two turns is *four* times as great as for one turn (inductance is nearly proportional to the *square* of the number of turns). Consequently the inductive reactance and impedance will be proportionately greater, and the current flowing in the two shorted turns is only *half* what it was in one turn. Accordingly, when there are a large number of unused turns on a coil, the effect of shorting them, as was done in the circuit of Fig. 1, is usually negligible, so the band-switch circuit in multi-band receivers employing tapped coils is always designed to short *all* unused turns on the coils.

Fig. 3 illustrates the tapped-coil system employed in the preselector and oscillator of the 3-band *Stromberg-Carlson* 58 receiver. Note that the waveband switches are of the "shorting" type, designed to short out *all* unused coils when in either of the short-wave band positions, S_1 or S_2.

Oscillator Tracking and Band-Switching in Multi-Band Receivers Employing Separate Coils for Each Band

Most multi-band capacitor-tuned receivers, especially those designed to provide reception on 3 or more frequency bands, employ an individual preselector and oscillator tuning coil for each band, as illustrated in Fig. 4. In some of these, the secondary of each individual preselector and oscillator tuning coil is shunted with its own individual adjustable high-frequency shunt trimmer capacitor, and the tuning circuit of each oscillator coil has, in addition, both a fixed and an adjustable low-frequency series padder (the adjustable padder is usually omitted from the tuning coil for the highest-frequency waveband). For each waveband, the circuits and ganged waveband switches are arranged to switch the proper preselector and oscillator tuning coils and individual trimmer and padder capacitors into the circuits as units.

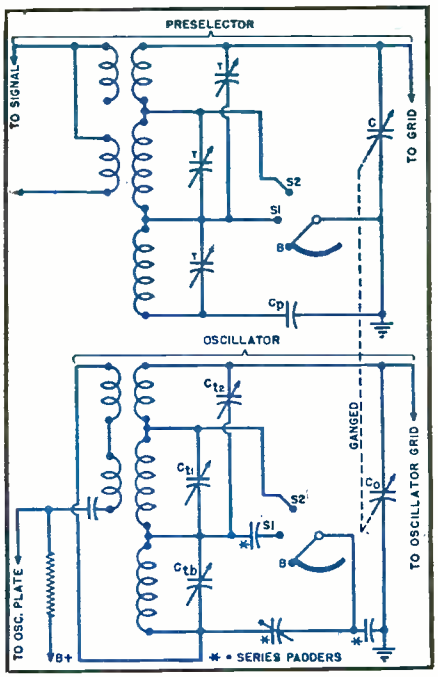


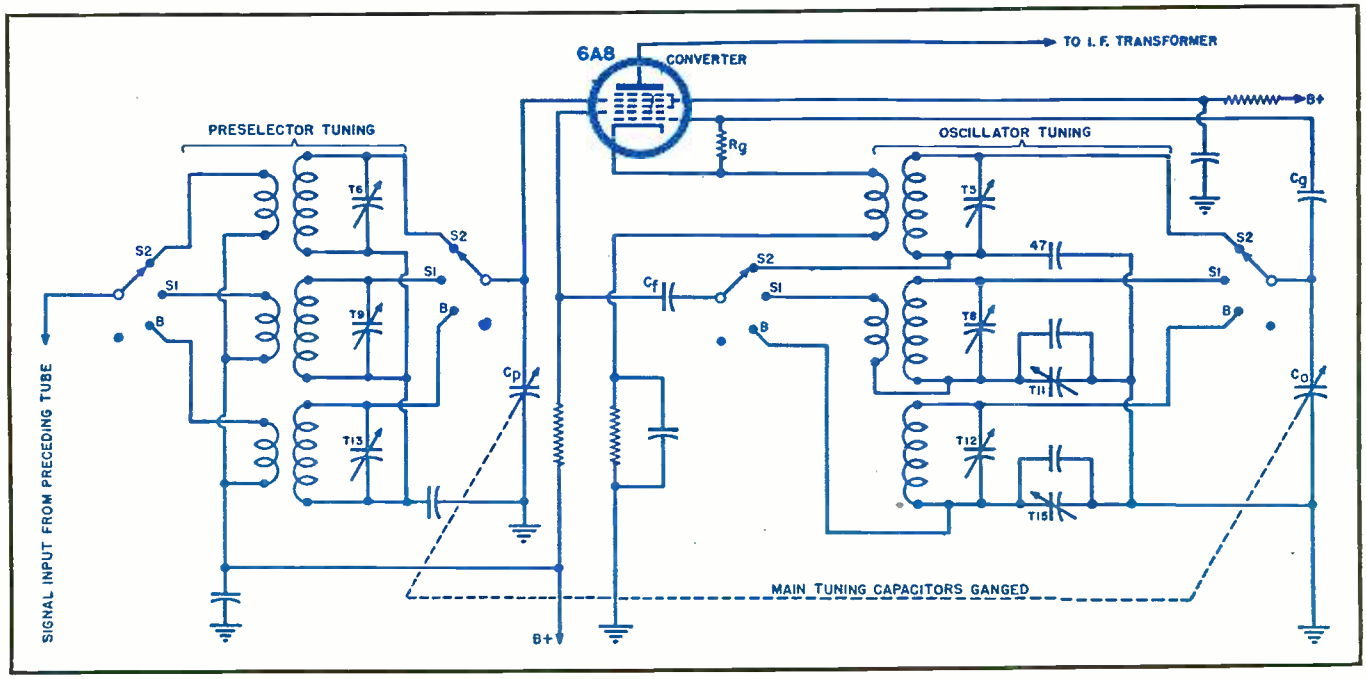
Fig. 3. Preselector and oscillator circuit arrangement employed in 3-band receiver, using tapped-coil system with coil-shorting type band switches (Stromberg-Carlson 58).

Fig. 4 illustrates a typical preselector and oscillator tuning and switching arrangement of this type, as used in the *Fada* model 290 series receivers which provide reception on the regular broadcast band and on two short-wave bands. Capacitors C_p and C_o are the main preselector and oscillator tuning capacitors, respectively, and are ganged together for single tuning control.

B is the broadcast-band position of

(*Continued on page* 158)

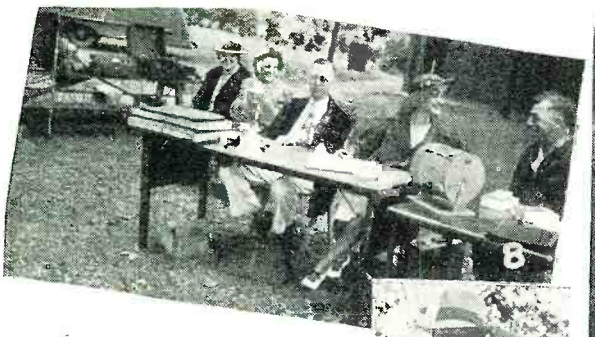
Fig. 4. Tracking arrangement provided in typical 3-band receiver (Fada model 290 series), employing individual tuning coils, high-frequency trimmers, and low-frequency padders for each of the three bands.

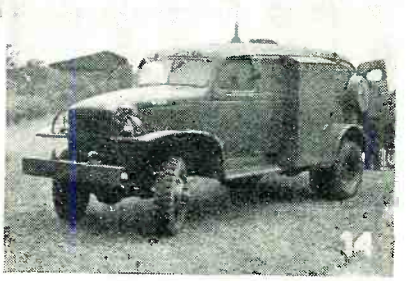


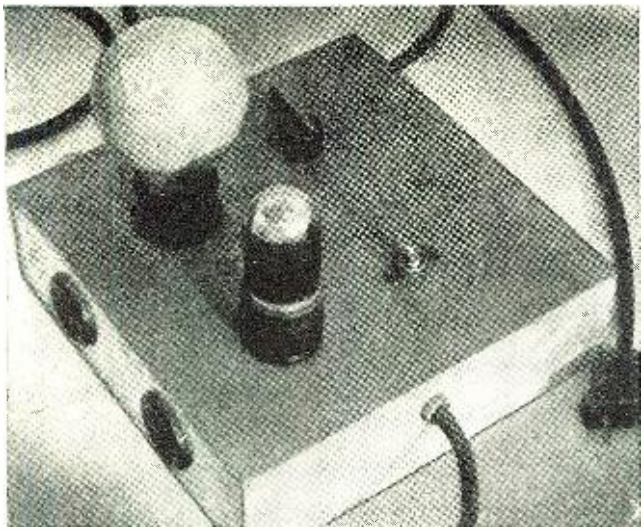
Hamfesters Picnic

ON Sunday August 5, the Hamfesters Radio Club of Chicago held their 12th Annual Picnic at Dolton, Ill. In spite of wartime conditions and bad weather, the picnic was attended by over 500 persons. Demonstrations of WERS in connection with the CAP were held, using the 112 mc. band to contact planes flying overhead. As is traditional with the Hamfesters, a pie eating contest was held along with the usual games, races, softball game, and other events. Highlight of the day was the prize drawing in which several prizes were given to the lucky ticket holders. Copious quantities of the amber fluid along with many yards of hot dogs, cases of pop, and pounds of hamburger were consumed by the hungry crowd. Now that amateur operation is gradually being resumed it is felt that the club will soon be back to its prewar membership of 400 and arrangements have been made to hold meetings at the former clubrooms at Viking Temple. Plans are already under way to make the 1946 picnic the biggest amateur event ever held.

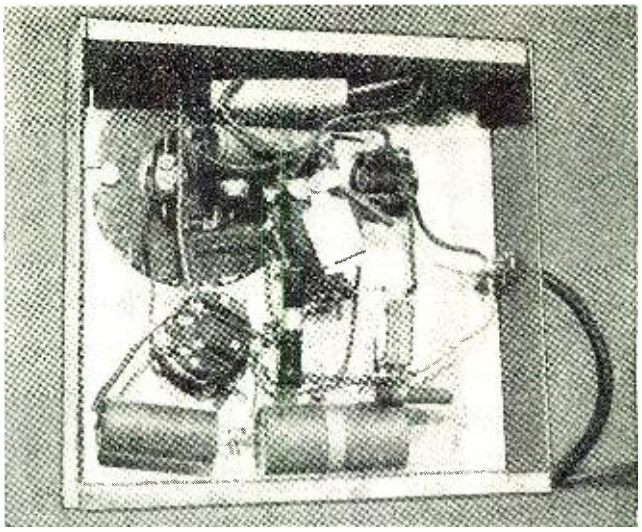
(1) Command Staff trailer used by the communications section of CAP. (2) The "thirsty" parked near the bar. (3) Most cars had 112 mc. mobile equipment like this typical set-up in W9KBO's car. (4) Major Al Knodell, W9TLQ, and Major Masterton, W9BYQ, of the CAP examine a "handie talkie". (5) Lt. Frank Ryan of CAP talks it over with W9HXW, Prexy of Hamfesters. (6) W9YQH and W9KBO discuss old times. (7) W9JRG holds a QSO. (8) The registration desk was set up to handle a large crowd. (9) "Doc" Kelly, W9MDO, and Higgins, W9A1O, compare notes. (10) W9LRM and W9GET quaff a few. (11) W9FWU gets a few pointers from W9LGU. (12) George Ashton, W9PNV, tries a "handie talkie." (13) Blueberry pie was the main course at event. (14) Hallicrafter's "299" was on display.







A 40-watt electric-light bulb is used for R_4. For better engineering practice, use a standard line-dropping resistor.



Bottom view of the one-tube electronic timer. A more compact unit may be obtained by employing a smaller chassis.

ELECTRONIC TIMERS

By SAMUEL A. PROCTOR

The design and construction of several electronic timers that provide time intervals from .1 second to several minutes.

THIS device was conceived to meet the need of any operation requiring some simple, inexpensive, and reasonably accurate control of time intervals from .1 of a second to several minutes.

The controlling factors are so arranged that changes in applied voltage have opposing effects on the time interval which contributes to the high degree of accuracy, making it suitable for all operations similar to the timing of photographic prints.

Operation

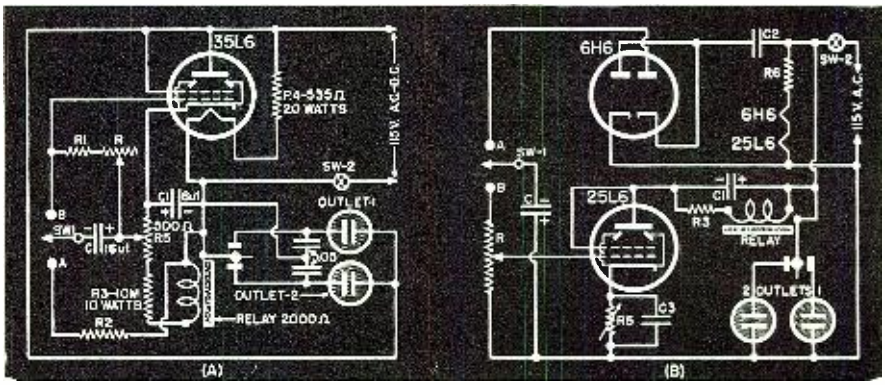
Closing Sw_2 turns the instrument on (Fig. 1A). Normal position for Sw_1 is at A, and when in this position, condenser C is charged by the rectified IR drop across the circuit composed of R_5, R_3, and relay; current in this circuit energizes the relay, holding it closed and applying power to outlet-2. In this position, voltage on the control grid of the tube is low and its conductance is high.

Throwing Sw_1 to position B, places condenser C in another circuit composed of C, R_1, and R. This is a closed RC circuit and the condenser C begins to dissipate its charge through the associated resistors in the circuit. The IR drop thus developed is applied to the grid of the tube.

This voltage is negative with respect to tube's cathode and considerably higher than cutoff. In this condition the tube passes no current and the relay releases its armature, which is the arm of a s.p.d.t. switch, energizing outlet-1. The relay remains in this position as long as the negative voltage on the grid is high enough to keep tube current below the required amount to close the relay. As a result of the condenser discharging through the resistor network, the grid voltage drops low enough to allow the tube to pass sufficient current to energize the relay, breaking circuit to outlet-1 and making circuit to outlet-2. The length of time the tube is in a nonconducting condition is determined by the capacity of the condenser C, the resistance in the CR circuit, the quantity of charge in the condenser, and the characteristics of the tube. Only one of these factors is a variable, resistance R, a variable resistance of high ohmic value and the higher we make it the longer it will take C to

(*Continued on page* 66)

Fig. 1. Diagram of 1- and 2-tube electronic timers. 25L6, 35L6, or 50L6 tubes are all interchangeable in these circuits, providing the filament dropping resistor is changed.



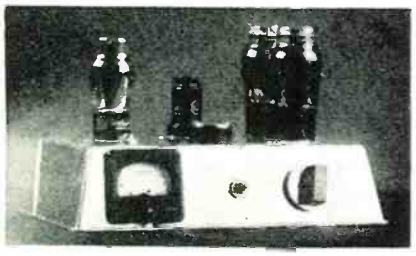
C—16 μfd. low-leakage type 150-v. elec. or paper cond.
C_1—8 μfd. @ 150-v. elec. cond.
C_2—16 μfd. @ 150-v. elec. cond.
C_3—25 μfd. @ 25-v. elec. cond.
R—500,000-ohm pot.
R_1, R_2—10,000-ohm, ¼-w. res.
R_3—10,000-ohm, 10-w. res.
R_4—535-ohm, 20-w. res.
R_5—500-ohm, screwdriver adjustable pot.
R_6—280-ohm, 30-w. res.
SW_1—S.p.d.t. toggle sw.
SW_2—S.p.s.t. toggle sw. or mounted on pot. R.
Relay—S.p.d.t. sw., 2000-ohm, 10-ma. max.

THE ROAD TO HAMDOM

By

S/Sgt. GEORGE MOBUS, W9UAO

Hams "to be" will find these valuable facts of the utmost importance.



The use of a cake pan for the chassis offers the beginner a neat and attractive type of construction. Many an amateur can look back to his first assembly with pride.

SO YOU want to become a radio amateur—a ham! Well, that is a laudable ambition. It takes brains to be a ham operator! Skill is a prerequisite also and if you do not want to be a lid (that is, a ham who advertises his short-comings), you need plenty of ordinary common sense.

Perhaps you are a young fellow in school. More than likely you are one of the thousands of guys and gals who are wearing the uniforms of the armed services and have received training in some phase of military communications and your radio appetite has been whetted by the experiences you have had.

Regardless of who you are or what you are, you are possessed of one desire, that is to capture the thrill of communicating by radio—two way—through your own station.

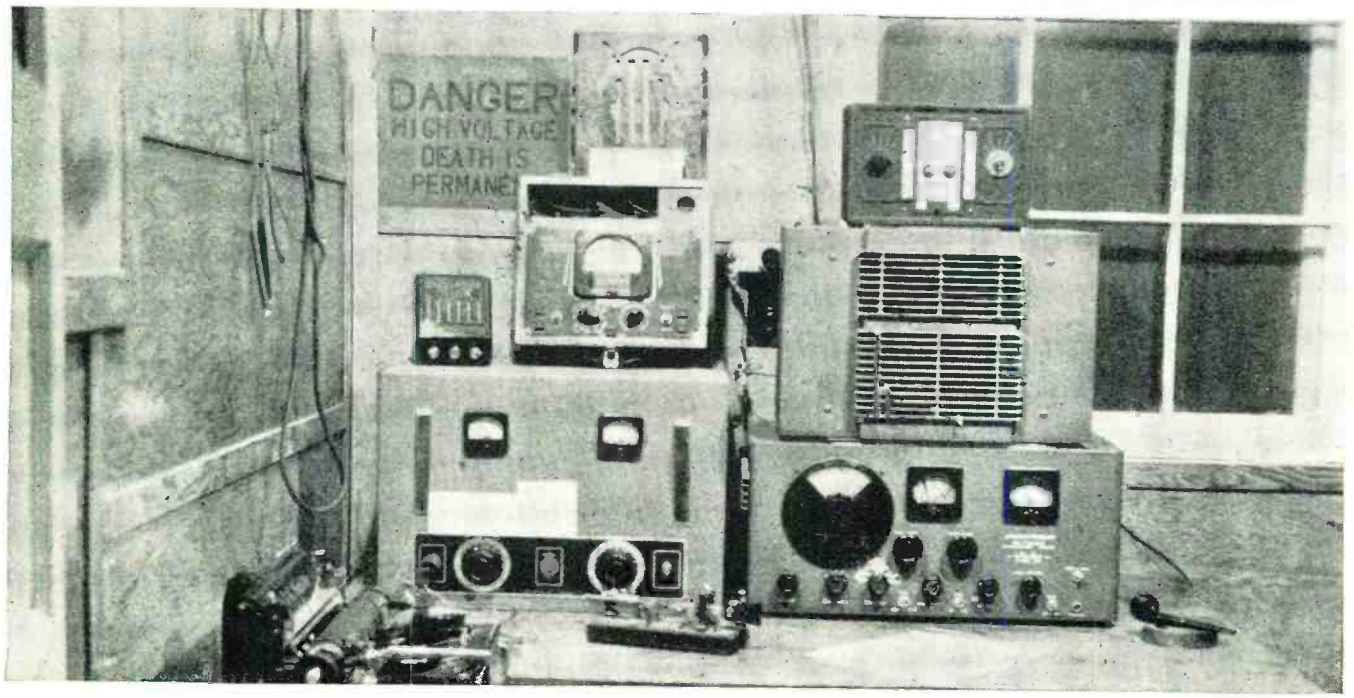
There are a lot of thrills in this fast-moving, action-packed world of ours today. However, it is not necessary to go "a-roamin'" to find one of the greatest. The radio amateur has the world at his finger-tips. No need for him to stir out of his cozy "shack"! A switch thrown—a dial turned, and Juan Valdivieso in Lima—Wang Lin in Canton—Tommy Atkins in London—all are with him. Distance and language are no barriers to the radio ham. Amateur radio is international. By the use of a few easily learned "Q" signals, standard throughout the world, an English speaking ham can converse intelligibly with a Chinese ham whose sole knowledge of the English language consists of the word *okay*.

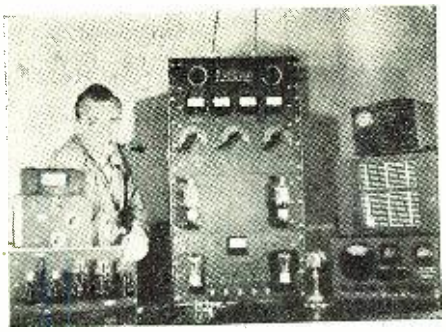
This *kick* that a radio ham gets from communicating with far-away places is not the only benefit he derives from his hobby. A sense of accomplishment, to a large degree, is his if he has, with his own hands and with his own "know-how," planned and constructed his station.

Yes, there are hams and there are hams! I knew a fellow once, in school, who worked hard to get his code speed up, studied the question and answer book till he had it memorized and upon passing the exam received his class "B" ticket. His old man laid out the cash for a powerful, all-band xtal transmitter, a communications receiver as big as the kitchen stove, and an antenna system WLW would be proud to have in their back yard. This guy had a couple of pals, skilled in radio, who were kind enough to install and tune up the equipment and in no time flat he was sitting back and collecting QSL cards from all over the world.

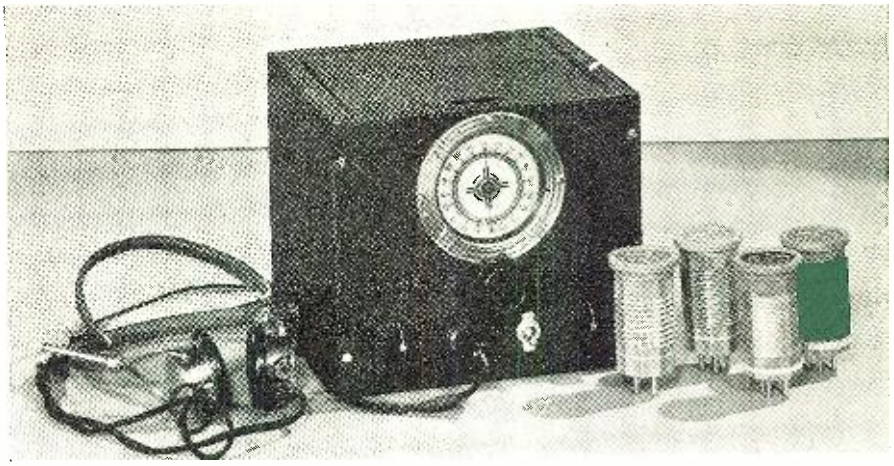
There was another fellow who was bitten by the bug because he got too near a radio-parts catalog. This budding bane of the "BCL's" built himself a crystal set and in time, progressing through the one, two, and three tube stages, gradually increased his knowledge and desire to get on the air and set about doing so by building up a simple transmitter, a t.r.f. re-

Convenience of all operating controls with sufficient equipment to indicate performance, characterizes this deluxe ham station.





Neatness and a well planned layout characterize this medium powered ham station.



A receiver of the simple regenerative type, designed especially for the beginner.

ceiver, a monitor, and putting up a flat-top. This fellow had a good working knowledge of the gear he was intending to use and had no trouble passing the exam. When his license arrived he went on the air and words cannot describe the thrill that was his when he first heard his call being answered. He had taken a conglomerate mass of parts, panels, tubes, and wire and with his two hands and his personal "savvy" of radio, constructed a radio station of his own.

Which of these two men, do you think, felt the greatest sense of achievement and pride in his hobby?

Without hesitation, I would say that the ham with the home-grown rig had, to the greatest degree, that fine inner feeling of satisfaction which comes with the realization that he has really accomplished something remarkable. He feels, and rightly so, that he is a scientist and an engineer.

Insofar as radio being remarkable —I, personally, will never cease to marvel. When the mercury-vapor rectifier tube glows as the key is closed or the modulation meter swings over in response to my voice and I realize that someone, miles away, is listening to me I consider it a miracle. Not a miracle that the rig is in working order but rather a miracle that such a thing as radio transmission and reception is possible. I will always remember the pleased sensation I had when, with my first phone transmitter. I would throw the switch on to transmit and two "miraculous" things happened. The hall light, outside the room, went out and the porch light went on.

Not many hobbies pay off dividends as does amateur radio. The ranks of high-salaried radio engineers, designers, and operators are filled with men who have come up via the ham band route. The War and Navy Departments have given recognition to amateur radio by bestowing, in many cases, the higher ranks and grades to their radio-men whose records show ham experience.

How can a beginner in this hobby obtain the valuable knowledge and experience that will so much benefit him in the pursuit of pleasure and livelihood? Certainly not by regarding his endeavors in amateur radio as pure play. He has been given the opportunity to use certain portions of the radio spectrum as his play-ground but in taking advantage of this opportunity he has assumed a responsibility. A part of this responsibility lies in his contributing to the advancement of the art. Surely all will agree that the man who has learned the whys and wherefores of radio transmission and reception by planning and building his own station will be more likely to fulfill his responsibilities than will the man who starts out with little knowledge and considers amateur radio only as a sport with which to while away a few hours each day.

There is much to be said for factory-built equipment. My mouth has watered many a time as I stood and gazed on those beautiful transmitters with their glossy panels and gleaming meter faces. And those wonderful receivers. What they won't do for a weak signal!

Yes, this type of equipment is fine to own and a joy to operate, but a ham should graduate to the stage of ownership of such gear. The beginner in the ranks of hamdom, the fellow who really wants to learn something, should start out by building up his own station—lock, stock, and barrel. Or, rather, transmitter, receiver, and antenna.

What does it take to go "on the air"? Not much. You can work wonders with a twenty-five watt transmitter. As for the receiver, I have seen three tube circuits that, when built up into a receiver, will do more than a number of the superhets of a few years ago. The power supplies are simple enough. You will need at least two—one of 500 to 600 volts output for the transmitter and another of about 250 volts for your receiver. A few dollars will buy the required amount of wire and insulators for both your transmitting and receiving antennas or, for that matter, you can use your transmitting antenna for both purposes.

You will need also a gadget known as a monitor. This piece of equipment will keep you informed at all times as to whether or not your signal is within the limits of the band of frequencies allotted by the FCC for amateur communications. It will also allow you to hear your own signal and give you a constant check on its quality and the quality of your fist. Nothing elaborate is needed to fulfill the FCC requirements for keeping a continuous check on your frequency. FCC amateur regulation 12.135 reads as follows: "The licensee of an amateur station shall provide for measurement of the transmitter frequency and establish procedure for checking it regularly. The measurement of the transmitter frequency shall be made by means independent of the frequency control of the transmitter and shall be of sufficient accuracy to assure operation within the frequency band used."

Now, some ideas and advice on the construction of your equipment and the assembly of the station.

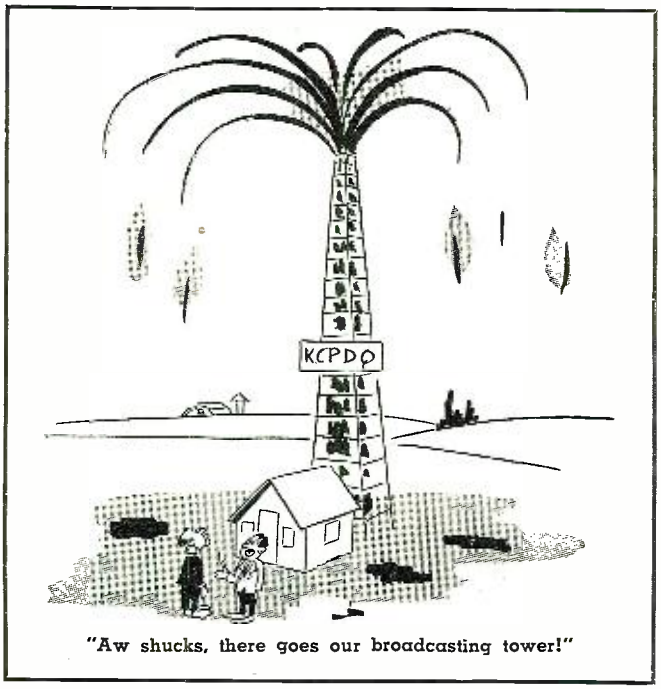
There is a trend among the more advanced amateurs toward the use of rack and panel assembly. This is good practice since it embraces compactness and neatness plus the desirable feature of short wiring. This type of design is a bit more difficult for the beginning constructor to achieve, however, and also is not so practical for the simple one-stage transmitter. A favorite among both newcomers and oldtimers in ham radio is the "breadboard". This style of design is time-tested. While it may not give you the compactness of rack and panel it more than makes up for this lack by the ready accessibility of all component parts and the simplicity in construction. Care must be taken in the placement of parts on the board since some degree of shielding is desired and also due to the fact that one or two points of high-voltage are bound to be exposed. It cannot be over-emphasized that a radio transmitter, even though it be comparatively low-powered, is a potential lethal machine. If it is found impossible to completely eliminate exposed high-voltage points it is advisable to at least make them as inaccessible as conditions will permit. In addition, the posting of a DANGER—HIGH VOLTAGE sign, lettered in red, near the equipment will successfully prevent strangers, unfa-

(*Continued on page* 155)

By CARL COLEMAN

D. H. OWENS shipped recently aboard a cargo vessel. . . . J. Telle and C. Wischmann were in at the big town a short while ago and visited their old pals before shipping again aboard their respective ships. . . . O. Halan has taken out a tanker assignment. . . . J. Verberg shipped out on a freighter. . . . Bob Alving called in at the Gulf recently and then reshipped out aboard his old cargo craft. Bob must like that one. . . . A. Duval arrived from a rather extended voyage aboard his freighter and was in port for some time during the recent wet summer weather. . . . Fred Howe, ROU general secretary-treasurer, sends in a nice letter with some of the latest "dope" therein and reports that everything is going very well and that ROU now has over 3300 members with new men coming in every day. Says shipping is excellent and that they are assigning between sixty and seventy men each week and, from all indications, expect to continue to do so for some time to come. Fred says the shortage of radio officers is somewhat eased but that the experienced fellows are still in demand in the marine field. ROU also reports that good progress is being made in the airways—with agreements already in force with American Export Airlines and Northeast Airlines. At present negotiations are also under way with several other airline outfits. Fred comments that this will be a great field for radio officers now that the war is over and it should not be overlooked. It will provide high wages and excellent working conditions for the ambitious radio officer. Fred also reports new shipping agreements with Marine Transport and Barber Asphalt tankers with the new tanker pay scale having been made retroactive to October 1944. New cargo agreements have already been signed with about fifteen outfits. Mr. Howe wishes us to call your attention to the new west coast office which was opened this last spring at 105 Market Street in San Francisco with representative Ralph D. Finch in charge. Mr. Finch was with ROU in New York for over a year. S. E. Douglass has been assigned to the Boston office which has been reopened after a long period of time. The office is at the same old stand at 170 Summer Street.

U. S. MARITIME COMMISSION reports that for the first time since November, 1942, the production of merchant ships from American shipyards fell below the 100 mark. . . . WSA reports that the November, 1942, output was eighty-nine ships; largest amount was during December, 1943, with a total of 219 ships, and 2,058,893 tons. With V-J day now here it looks as though the shipbuilding throughout the country will taper off somewhat slowly. However, it appears that for many months, if not at least several years, we will have good shipping. The nations overrun by the axis powers and the powers themselves are going to need a lot of food, building materials, etc., for a long time to come until they can get their own factories rebuilt and in operation again. From some of the reports it will take some time for this work to be completed. Of interest to us naturally, good shipping means more jobs for marine radio officers and, as a rule, the better the shipping is the better the pay. More good news for marine radio oprs. came recently with the Matson Navigation Company announcement that a greatly expanded fast freighter service between the mainland and Hawaii will be effected as soon as commercial shipping can be resumed. The new program will cost about twenty million dollars it was reported. All of the company's old freighters will be disposed of and faster equipment will be obtained in order to cut the travel time between the main ports of the west coast and the Hawaiian Islands.



"Aw shucks, there goes our broadcasting tower!"

J. LINE was in port a short time ago but made rather a quick turn around this trip. . . . Nice letter from Carl Amato up in the islands where he is with AACS. R. Johansen took out a cargo assignment from the big town. . . . J. Bruglen also went out on a freighter. . . . Leif Hvidsten still reports from the South Pacific, the last jumping off point, but expects to return to these parts before long. . . . T. Tofer was recently assigned to a tanker.

Nice letter from Bill Chamberlain who is RM2C with the Navy in the Pacific and wants info regarding merchant marine. . . . Likewise, J. Watson who is also in the Pacific and looking for some dope on Gallups Is. radio school. . . .

Jack Watt, Roscommon, Mich., is looking for an active organization or union in his locality composed of Broadcast Station operators or engineers (maintenance) holding commercial tickets. Anyone with info regarding this point, kindly contact Jack, address as above. We have already notified a couple of organizations to get in touch with you, Jack.

THE FM business seems to be picking up with still more applications to FCC for permits. Among the latest, Radio Projects of New York has requested authority for two new ones. one to be located in Queens and the other on Staten Island. Very little news from the boys in broadcast work.

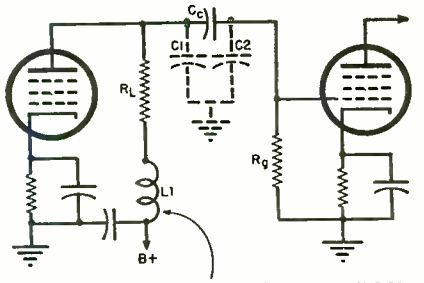
THE U. S. armed forces trained about 500,000 radiomen during the war, this includes some 5000 by WSA. Many of this group are operators but the majority (in the forces) are technicians. . . . Now that radar conditions have opened up, the boys are beginning to learn some of the details and the "how does it work" problems are being cleared up. Installations have already started aboard some of the merchant marine vessels and it is apparent that it will soon be aboard

(*Continued on page* 108)

VIDEO AMPLIFIERS

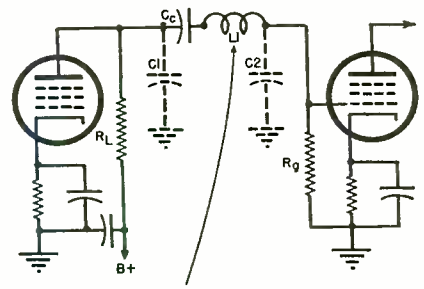
By EDWARD M. NOLL
Television Tech Enterprises

Part 9. An analysis of the design of wide-band video amplifiers. Special tubes and circuit design are necessary for high definition television reception.



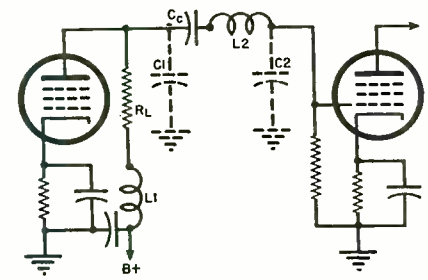
SHUNT PEAKING COIL BROADLY RESONANT WITH C1 & C2 TO EXTEND HIGH FREQUENCY RESPONSE

(A)



SERIES PEAKING COIL ISOLATES C1 & C2-PERMITS HIGHER R_L AND LARGER SIGNAL ACROSS Rg AT HIGH FREQUENCIES

(B)



(C)

Fig. 1. High frequency compensation. (A) Shunt peaking. (B) Series peaking. (C) Combination of shunt and series peaking.

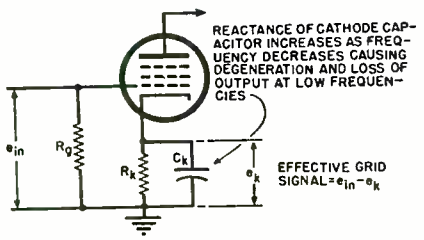


Fig. 2. The effect of the cathode capacitor on the output gain at low frequencies.

★ ★

THE video amplifier is a resistance-coupled amplifier with necessary refinements to extend its frequency range. Video amplifiers used in critical television transmitter or test equipments have a linear response from almost zero cycles to as high as five or ten megacycles. The ordinary audio amplifier is lucky to have a linear response from one hundred cycles to six thousand cycles. A high-definition television receiver will have a linear response from 20 cycles to four megacycles; the smaller television receiver from 30 cycles to 2 or 2½ megacycles. A set with a large picture tube generally has a video amplifier with a broad response because the tube can more fully utilize the high-frequency components of the signal. In so doing, a sharp, well-defined picture appears on the fluorescent screen.

In the resistance-coupled amplifier and in the video amplifier, capacity limits both the high- and low-frequency characteristics. Low-frequency degeneration is caused by the increasing reactance of the series coupling capacitors and cathode by-pass capacitors; high-frequency degeneration, by the decreasing reactance of distributed shunt capacity (tube input and output capacities, wiring capacity, and parts capacity to ground). The video amplifier has the following features:

1. High mutual conductance tubes.
2. Tubes with low input and output capacities.
3. Low value plate load resistors.
4. Large value by-pass and coupling capacitors.
5. High-frequency compensating circuits.
6. Low-frequency compensating circuits.
7. An occasional direct-coupled stage (no interstage coupling capacitor).
8. Proper positioning of component parts to reduce distributed capacity.

The effects of capacity on the high- and low-frequency limits can best be demonstrated with simple mathematics. For example, the effects of shunt capacity on 1000 cycles and 1 megacycle can be clearly demonstrated by calculating the output voltage of a vacuum-tube circuit which has two milliamperes of alternating plate current. See Fig. 5. Output voltage, of course, is equal to the alternating component of plate current, times the load impedance. Consequently, in a plate circuit using a 100,000-ohm load resistor and having a total distributed capacity of 40 μμfd., the output voltage for a 1000-cycle, 2-ma., component of plate current is:

$$e_o = i_p \times Z_L$$

$$e_o = .002 \times \frac{R_L \times X_d}{\sqrt{R_L^2 + X_d^2}}$$

$$e_o = .002 \times \frac{10^5 \times 4 \times 10^6}{\sqrt{(10^5)^2 + (4 \times 10^6)^2}}$$

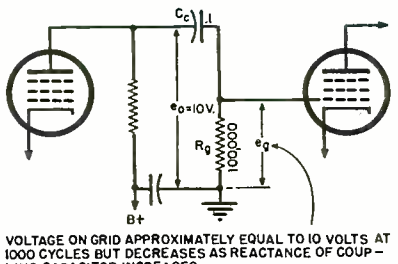
$\therefore e_o = 200$ volts approx.

Output voltage for a 1-megacycle, 2-ma., component of plate current is:

$e_o = i_p \times Z_L$
$= 8$ volts approx.

This represents a voltage differential of 192 volts, or the gain of the stage drops 96% at one megacycle in comparison with the gain at 1000 cycles. It is clear how little the shunt capacity affects the lower frequencies (output determined primarily by the

Fig. 3. Loss of gain at low frequencies.



VOLTAGE ON GRID APPROXIMATELY EQUAL TO 10 VOLTS AT 1000 CYCLES BUT DECREASES AS REACTANCE OF COUPLING CAPACITOR INCREASES

Fig. 4. Low frequency compensation.

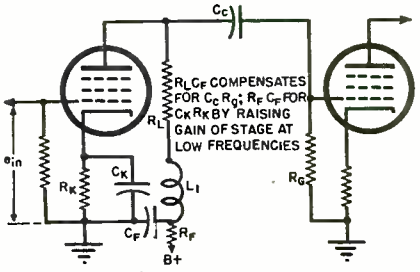
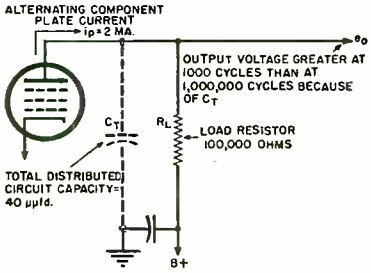
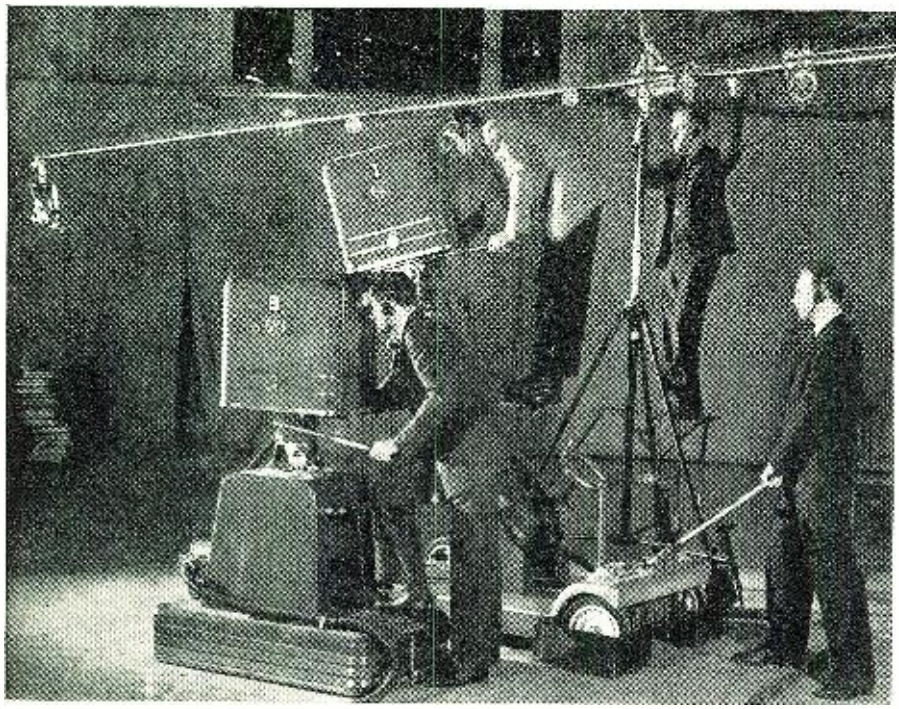


Fig. 5. Loss of gain at high frequencies.





Camera and boom at General Electric's television station WRGB at Schenectady, N. Y.

value of the resistor at these frequencies), but how dominant it becomes at the high frequencies.

If the value of the plate resistor is reduced to 4000 ohms, the effect of the shunt capacity is minimized. Now, under the same conditions, the output for a 1000-cycle component is:

$$e_o = i_p \times Z_L$$

$$e_o = \frac{.002 \times 4000 \times 4 \times 10^6}{\sqrt{4000^2 + (4 \times 10^6)^2}}$$

$$= 8 \text{ volts approx}$$

The output for a one-megacycle component is:

$$e_o = i_p \times Z_L$$

$$= \frac{.002 \times 4000 \times 4 \times 10^3}{\sqrt{4000^2 + (4 \times 10^3)^2}}$$

$$= 5.65 \text{ volts approx.}$$

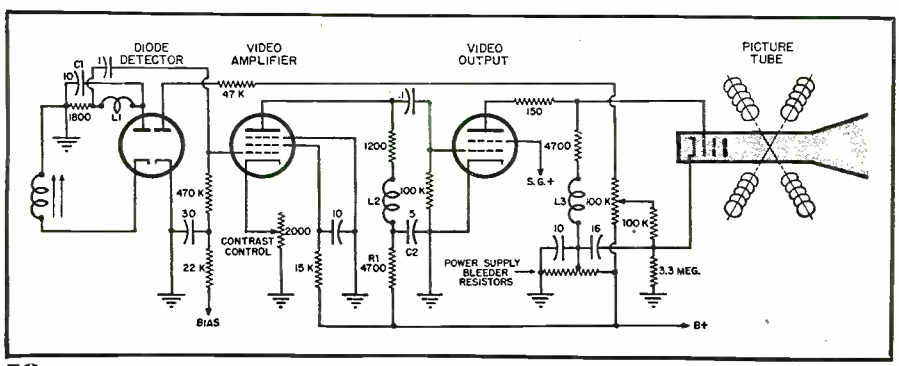
This represents a voltage differential of 2.4 volts, or 30.3% drop in output voltage at one megacycle. Although the response has been leveled off, the gain is much less. Therefore, a tube with a high mutual conductance (measure of how effective a tube is in converting a grid voltage variation to a plate current variation) is used to obtain the greatest possible variation in plate current. The greater the plate current variation, the greater will be the output voltage developed across the low plate resistor, which must be used, of necessity, to prevent high-frequency degeneration. Thus, response can be improved by keeping shunt capacity to a minimum and reducing the value of the load resistor. Gain can be increased by keeping shunt capacity to a minimum (permitting insertion of a higher load resistor), and by using a tube with a high mutual conductance.

A similar example can be used to demonstrate low-frequency degeneration by series coupling capacitors. See Fig. 3. In this circuit, the coupling capacitor has a value of .1 μfd. and the grid resistor a value of 100,000 ohms. Now, at 1000 cycles, the reactance of the coupling capacitor is approximately 1600 ohms, and there is only a tiny voltage drop across the capacitor of the series resistor-capacitor voltage divider, consisting of the coupling capacitor and grid resistor. Thus, if 10 volts appears in the output, e_o, of the preceding stage, this voltage, almost in its entirety, appears on the grid of the next tube. However, if the frequency of the 10-volt output signal is thirty c.p.s., the reactance of the coupling capacitor is approximately 53,000 ohms, which is more than one-half the resistance of the grid resistor. Consequently, a greater portion of the 10-volt output signal appears across the capacitor.

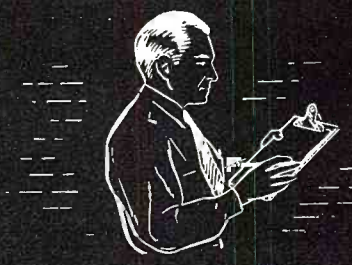
The low-frequency response can be improved in two ways; by increasing the value of the capacitor (increased capacity reduces reactance at all frequencies), or by increasing the value of the grid resistor so that a greater percentage of the total voltage applied to the series combination appears across the resistor even at low frequencies. These methods are subject to a number of limitations. For instance, the value of the grid resistor may not be increased beyond a certain safe value, set by the manufacturer, to prevent faulty operation caused by excessive gas currents. Another limitation is the fact that certain tubes in television circuits draw a limited amount of grid current. The excessively high grid resistor would develop too large a negative bias. Capacitor value can not be increased too much for the d.c. leakage increases, and the increased capacity to ground of the physically larger capacitor reduces the high-frequency response.

A second factor which causes low-frequency degeneration is the increasing reactance of the cathode by-pass capacitor as the frequency decreases. For example, if a 10μfd. by-pass capacitor shunts a 400-ohm cathode resistor, Fig. 2, the capacitor's reactance is 16 ohms at 1000 cycles, but, at 30 cycles, it jumps to 530 ohms. The cathode by-pass capacitor is actually a filter capacitor, as it levels off and fills in any audio frequency variations appearing across the cathode bias resistor. Now, to be an effective filter, the reactance of the capacitor at the prescribed frequency must not be greater than 1/5 the value of the resistor it shunts. In our example, this reactance is only 16 ohms at 1000 cycles and, consequently, it effectively filters any 1000-cycle variation attempting to appear across the cathode resistor. However, at 30 cycles, this reactance is even larger than the value of the cathode resistor, seriously reducing the effectiveness of the filter action. Thus, at 30 cycles, there is a considerable variation across the cathode resistor. Since the effective signal voltage appearing on the grid of the tube is measured from grid to cathode, this variation, e_k, across the cathode resistor, subtracts from the grid signal, e_{in}, reducing the effective grid signal to some value less than e_{in}. Consequently, less output appears in the plate circuit at 30 cycles than at 1000 cycles (e_{in} equal at both frequencies) at which freq. e_k is negligible.

Fig. 6. Schematic diagram of G.E. model 90 video amplifier. Frequency compensation is obtained by properly utilizing various inductors and capacitors.



Enduring Accuracy in Vital R.F. *Applications*



OHMITE
RESISTORS & CHOKES

The unique characteristics of these Ohmite units have made them especially suitable for many r.f. applications. Proved by use before war came . . . they are performing vital functions today in the production and operation of critical equipment. Tomorrow—they will be more popular than ever!

GLASS-SEALED NON-INDUCTIVE DUMMY ANTENNA RESISTORS—for testing and measuring power output accurately. 100-watt and 250-watt sizes in variety of resistances.

R. F. PLATE CHOKES—single-layer wound on low power factor steatite cores, with moisture-proof coating. Built to carry 1000 M.A. 5 stock sizes from 2½ meters to 160 meters.

PARASITIC SUPPRESSOR—small, light, compact non-inductive resistor and choke, designed to prevent u.h.f. parasitic oscillations.

NON-INDUCTIVE VITREOUS ENAMELED POWER-SIZE RESISTORS—Useful in wide variety of radio frequency applications. 50-watt, 100-watt and 160-watt stock sizes in many resistances.

Ohmite Engineers are glad to assist you on any resistance-control problem.

OHMITE MANUFACTURING CO.
4883 FLOURNOY STREET • CHICAGO 44, U. S. A.

SEND FOR STOCK UNIT CATALOG 18

FREE—Helpful Catalog No. 18. Gives valuable data and information on stock resistors, rheostats, chokes, tap switches and other units. Write for your copy. Address Ohmite Mfg. Co., 4883 Flournoy St., Chicago 44, Ill.

Be Right with

OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES

A high-frequency compensating circuit, Fig. 1, inserted in the plate circuit of a video amplifier, can be used to sustain stage gain at the same level that it is over the middle range of frequencies, in spite of the decreasing reactance of distributed shunt capacity. The presence of the inductor in the plate circuit, Fig. 1A, forms a low Q resonant circuit with the total distributed capacity and effectively equalizes the stage gain up to the desired top frequency for which the amplifier is designed. Another way of looking at the same so-called "shunt-peaking coil" system is that the increasing reactance of the inductor L_1, as frequency rises, balances the effects of the decreasing reactance of the total distributed capacity C_t $(=C_1+C_2)$, maintaining, through a broadly resonant condition, the plate impedance essentially constant. Series peaking and combination series-shunt peaking, which perform similar tasks, are shown in Figs. 1B and 1C.

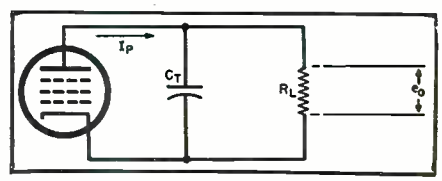
With series peaking, a greater gain is obtainable because, in calculating the value of the load resistor, only the plate circuit distributed capacity must be considered, the series inductor L_1 effectively isolating the plate circuit distributed capacity C_1 and the grid circuit distributed capacity C_2. Consequently, a higher value load resistor can be used without impairing high-frequency response, because the reactance of the distributed capacity does not become appreciable as quickly. The increase in load resistance causes an increase in stage gain. Furthermore, the inductor L_1 and grid circuit distributed capacity C_2 form a broadly resonant series circuit at the high-frequency limits, developing an appreciable voltage across C_2 and R_g, and therefore, on the grid of the tube.

In Fig. 1C, combination series-shunt peaking is used, effectively combining the advantages of both series and shunt peaking. A still larger value of load resistor can be used, increasing stage gain a bit more.

How to Improve Low-Frequency Response

With low-frequency compensation, the actual gain of the stage is increased at lower frequencies to compensate for the loss of signal across a grid-coupling capacitor, or low-frequency degeneration caused by insufficient cathode filtering. A typical low-frequency compensated stage is shown in Fig. 4. Capacitor C_f has an increasing reactance as the frequency decreases and, in combination with load resistor R_L, causes the plate impedance and stage gain to be greater

Fig. 7. Equivalent output circuit at high frequencies. C_t is the deciding factor.



MORE TUBES RELEASED SOON!

Get Your Share of RCA Tubes—*Order Now*

As the war ends, RCA is immediately ready to make larger and larger quantities of tubes for civilian requirements.

Since it will take some time to satisfy all new set requirements, your customers will have to depend on you to keep their old sets working.

Be sure to make the most of this opportunity by assuring yourself of a supply of RCA tubes. They have been, and will continue to be, *best sellers*—because they carry the *best-known name in tubes.*

Your RCA distributor will see that you get your share of any increased quantities of RCA tubes if he knows your requirements well in advance. You stand to gain a lot if you order your next 60 days' supply of RCA tubes from him *today.*

And remember, it's good business to do business with RCA. It pays to have the RCA name selling for you.

Listen to "The RCA Victor Show," Sundays, 4:30 P. M. EWT, NBC Network

RCA

62-6686-96

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • HARRISON, NEW JERSEY

LEADS THE WAY..In Radio..Television..Tubes
Phonographs..Records..Electronics

In Metal, Miniature, or Glass,
THE FOUNTAINHEAD OF MODERN
TUBE DEVELOPMENT IS RCA

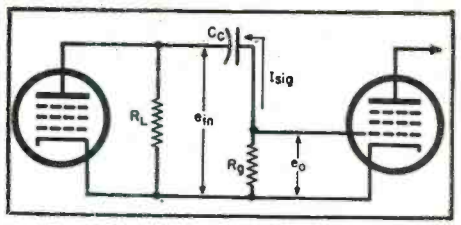


Fig. 8. Equivalent output circuit at low frequencies. C_c is the deciding factor.

at lower frequencies. Thus, the loss in signal across C_c at low frequencies is compensated for by a greater plate voltage signal, keeping an essentially constant signal across the grid resistor R_g with a decrease in frequency. Likewise, the combination of R_f and C_f perform the same task with respect to cathode degeneration by raising the plate impedance of the stage in proportion to the loss of signal through degeneration at low frequencies.

G.E. Model 90 Video Amplifier

The first frequency compensation encountered in the model 90 video amplifier (Fig. 6) is the diode peaking coil, L_1, which, in conjunction with the i.f. by-pass capacitor C_1, plus distributed capacities, forms a broadly tuned resonant circuit to keep the diode response essentially linear up to the high-frequency limit. Shunt peaking, inductors L_2 and L_3, is used in the plate circuits of the video amplifier and video output stage. Capacitor C_2 and resistor R_1 form a low-frequency compensating combination in the plate circuit of the video amplifier. Low-frequency response is held up by the large coupling capacitors; high-frequency response, by the low-value plate resistors. Since there are no cathode bias resistor-capacitor combinations to cause degeneration in the video amplifier, no correction on this count is necessary.

Phase Distortion

Phase distortion in the audio amplifier is not noticeable unless it is severe; the same amount of distortion in a video amplifier seriously impairs its picture sharpness. The reason it is so noticeable is because the beam moves at such a high velocity across the screen that if one frequency component of a signal is delayed a number of microseconds with respect to another, the beam has already sped on an appreciable distance. Thus, if two different frequency components of a signal were originally transmitted with their peak amplitudes occurring at the same instant, phase distortion (referred to as non-linear phase delay) would cause one signal to reach peak amplitude before the other on the grid of the picture tube. Therefore, peak amplitude of one frequency component would be displaced with respect to the other on the picture-tube screen, causing the picture to blur.

Phase distortion can also alter the waveform of a rectangular pulse, for the pulse is composed of a fundamen-

(*Continued on page* 148)

THROUGHOUT our service to the Armed Forces, Eastern has always delivered every piece of equipment to the highest Government standards. Now Eastern's wartime "proving ground" is converted to simulate normal *peacetime conditions* in our laboratories, assuring you of precision, quality and performance.

Every product bearing the Eastern trade mark will conform to the most exacting requirements. The Eastern Amplifier line will include standard items and many exceptional innovations. For complete details, write our Sales Manager, Department 10-E.

Buy War Bonds

EASTERN AMPLIFIERS

U. S. Reg'n. Applied For

EASTERN AMPLIFIER CORPORATION
794 EAST 140th STREET • NEW YORK 54, N. Y.

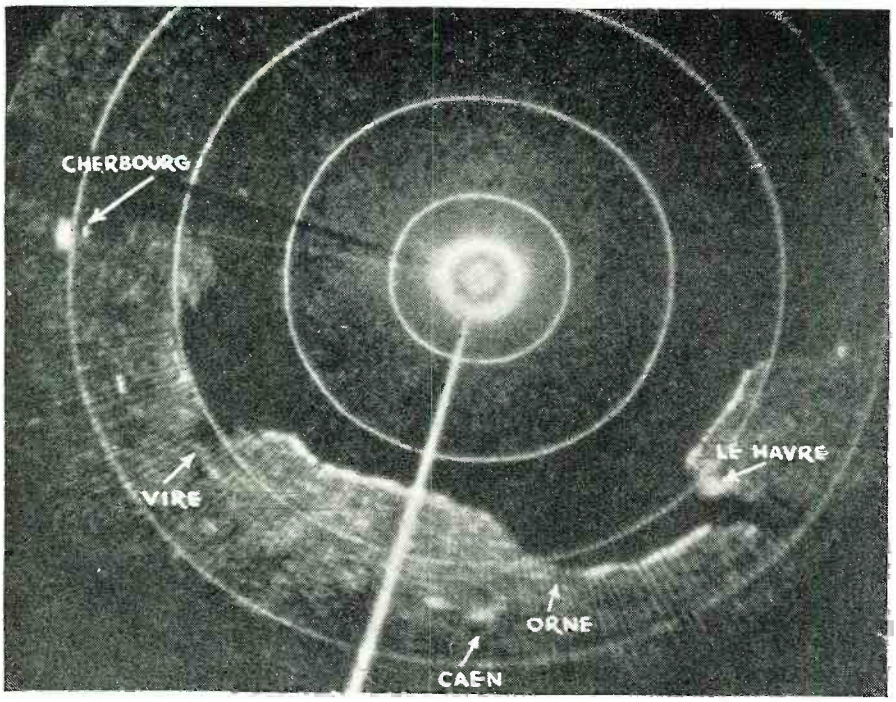


Fig. 1. Normandy beaches looked like this in the radar scopes of Eighth Air Force bombers during the pre-invasion reconnaissance flights. Despite solid clouds, coastline and built-up areas of the various towns showed up clearly.

Radar Plots the Invasion

By EUGENE MASON

Presenting for the first time historical radar photos of the Normandy beachhead invasion. Radar has proven to be the greatest technical development of this war.

RADAR'S most extensive use is to portray sea and ground formations far beneath high-altitude bombers and reconnaisance planes. Scanning the earth with its electronic beam, radar draws accurate maps of the land and sea beneath the plane—despite darkness, clouds, or rain. Shown here, for the first time, are actual pictures seen by radar operators in their oscilloscopes, miles above the French coast before and during the European invasion.

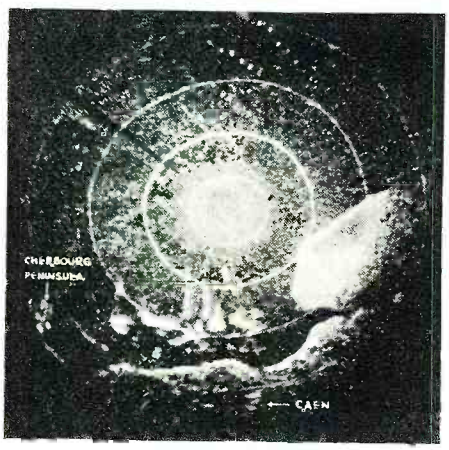
Every dot or blur of white has some significance in understanding a radar scope picture. Because each dot of white indicates an object on the ground reflecting the radar pulses. Thus large cities show up brighter than the surrounding countryside. White dots in the English Channel are boats, ships, or low-flying aircraft. Small dots visible inland usually indicate man-made structures. The brilliant white blotch in the center of these pictures shows the position of the plane when the photograph was taken. Concentric circles indicate the range from the plane.

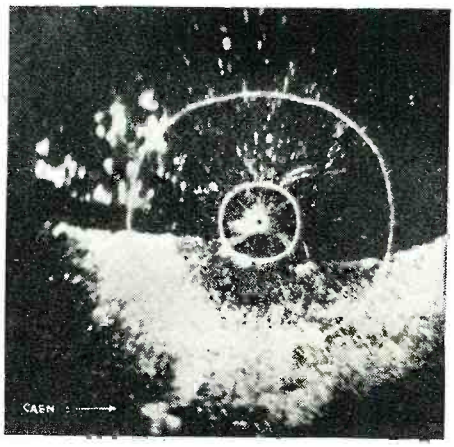
The Normandy beaches looked quiet and peaceful (Fig. 1) during a pre-invasion reconnaisance flight. The cities of Le Havre and Cherbourg are clearly visible in the scope. And the characteristic French seacoast is strongly etched.

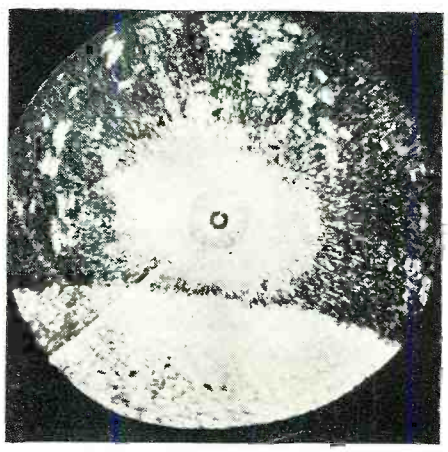
The same beaches on D-Day (Fig. 2) look much different. Every dot on the oscilloscope represents one or more invasion craft in the Channel. A few of the white blobs represent planes flying low over the water. Seen from a height of many miles, the radar-equipped plane was about 35 miles from the French coast, its position indicated by the brilliant center spot. Strong elements of the invasion fleet are massed just off shore. But in every direction can be seen the great mass of sea and air power thrown into the D-Day offensive.

The radar-equipped plane has passed over the invasion fleet (Fig. 3) and, at a lower altitude, is about to cross the coastline. The plane, on a

Fig. 2 (left). Same beaches on D-Day as those shown in Fig. 1. Plane has moved to within thirty-five miles of the coast, its position indicated by bright spot in center of scope. Invasion fleet (smaller blobs and grains) is clearly visible massed just off shore. Fig. 3 (center). Even though pilot and bombardier can see nothing, radar operators can tell them just where they are and when to drop their bombs. The photograph shows that the plane has just passed over the invasion fleet and is about to cross the coastline. Fig. 4 (right). Radar operator has turned a switch to obtain a magnified exact picture of a small part of the coastline.







FIRST AGAIN!

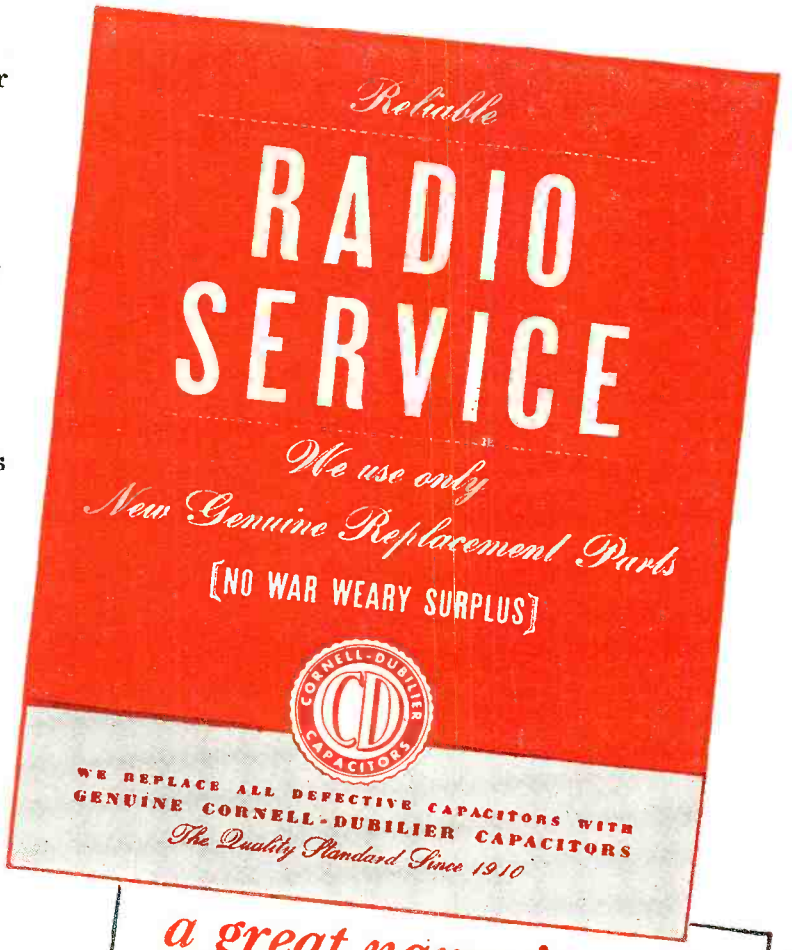
CORNELL-DUBILIER *THE TOP NAME IN CAPACITORS*

GIVES YOU THIS TIMELY SELLING TOOL

Your customers are tired of inferior merchandise. They certainly won't want shoddy, war-weary surplus. So get off to a good start in the competitive days ahead by sticking to the standard of quality in capacitors . . . Cornell-Dubilier. Put this card in your window, as a mark of reliable service and as proof that you stand by standards.

FREE

See your C-D distributor today, he will give you one of these handsome, colorful 11x14 displays. If your distributor can't supply you, write to Cornell-Dubilier, New Bedford, Mass. Dep't A.



CORNELL-DUBILIER IS READY WITH ALL 3

- COMPLETE LINE
- NATIONAL ADVERTISING
- SALES HELPS

a great name in radio

CORNELL DUBILIER

the greatest name in capacitors

bombing mission ahead of the newly established bridgehead, will use radar to locate strategic military objectives. Even though the pilot and bombardier can see nothing, the radar operator can tell them where they are.

Before crossing the coastline, the radar operator flips a switch on his set to obtain a greatly magnified picture (Fig. 4) of the actual bridgehead. The many white dots and blurs —though difficult to distinguish near the center of the scope—are clearly discernible as invasion barges, boats, and ships.

These are historic pictures—tiny white blobs of light on the face of an oscilloscope that attest to the might of Allied sea and air power.

—30—

Electronic Timers

(*Continued from page* 53)

discharge to the point where the tube's conductance will allow sufficient current to flow to activate the relay. This feature provides stepless control over the length of time outlet-1 will be energized.

Accuracy of the instrument will be dependent, somewhat, on line voltage, but the nature of the circuit makes it self-compensating over a reasonable variation in line voltages, since the time interval is a function of both an RC circuit wherein

$$T = RC \log E \frac{1}{1 - \frac{E}{e}}$$

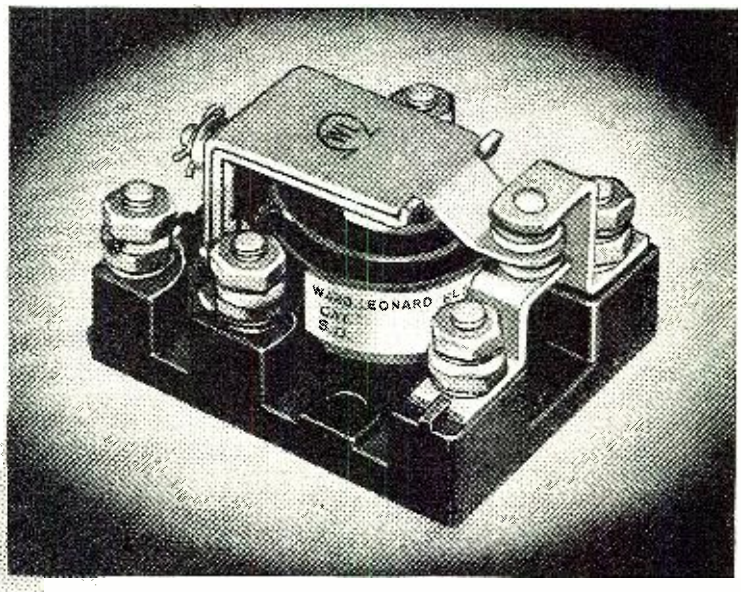
where E = initial voltage and e = voltage after the time interval T. Then to keep T constant for a given value of C and R, e must increase or decrease with E. The other controlling factor is the conductance of the tube which varies inversely with E; then to keep T constant, conductance must increase as E decreases, and since conductance of a vacuum tube is a function of grid voltage, which in turn is determined by Q, *i.e.* $(e = Q/C)$, this factor works out of phase with the CR circuit in its effect on the time interval. An increase of T in one factor is offset by a decrease of T in the other.

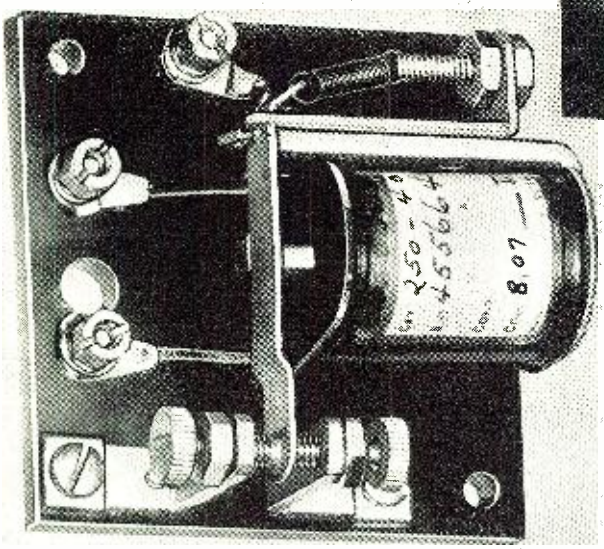
For purposes of calibration, compensation for changes in components, and wide variations in line voltages, R_5 is in the circuit. It functions to control the point at which the tube conductance will allow sufficient current to flow to activate the relay, and when adjusted to maximum time interval of any particular instrument, all other time intervals will be as accurate as the original calibration.

The associated schematic gives all parts and their functions. Part values will be determined by requirements that any particular instrument is built to fulfill. If values shown in this schematic are used, the time interval can be anything between .1 of a second and 35 seconds. —30—

2 NEW RELAYS

Here are two of the new types of Ward Leonard Relays that are being made available to the trade through Radio and Electronic Parts Distributors.





BULLETIN 250 RELAY will operate on minute fluctuations of current, and is easily adjustable to meet circuit or application requirements. It is available for operation on either A.C. or D.C.

BULLETIN 105 RELAY is useful for controlling small transmitters, public address systems, compressors, and similar devices.

Sturdily built on a molded phenolic base.

Compact in size, Single Pole unit measures 1 7/8" wide x 1 15/32" long x 1 1/2" high; Double Pole unit measures 2 1/2" wide x 2 3/4" long x 1 3/4" high.

Single Pole or Double Pole contacts.

Available for A.C. or D.C. operation.

New catalogs giving complete data on Bulletin 250 Relays and Bulletin 105 Relays are available. Write for your copy now.

WARD LEONARD ELECTRIC CO.

Radio and Electronic Distributor Division

47 West Jackson Blvd., Chicago, Ill.

ARMY E NAVY

WL **WARD LEONARD** ACCEPTED MEASURE OF QUALITY

RESISTORS RHEOSTATS RELAYS

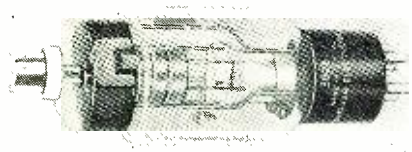
WHAT'S NEW IN RADIO

New products for military and civilian use.

The products described herein are available, in most cases, only through high priority ratings. It is suggested that readers apply for further information on company letterheads, stating full details as to priorities available.

HIGH VOLTAGE RECTIFIER

Chatham Electronics announces a new high voltage rectifier now available. This new rectifier incorporates many of the desirable features of both the mercury vapor and high vacuum types. Xenon gas fill and special features of construction make possible



high peak inverse voltage rating, constant voltage drop, heavy current capacity, and a wide ambient temperature range.

The tube is particularly designed to withstand severe mechanical shock and vibration and may be operated in any position. It operates through an ambient temperature range of —75°C. to 90°C. and the element structure is supported by three heavy gauge rods and additionally supported by contact, through shock absorbers, with the glass bulb.

Characteristics of the tube up to 150 c.p.s. include filament voltage 2.5 volts a.c., peak inverse voltage 10,000 volts, peak anode current 1.0 amp. at 10,000 volts, peak anode current 2.0 amp. at 6500 volts, average anode current 250 ma. at 10,000 volts, average anode current 500 ma. at 6500 volts. Characteristics of the tube up to 500 c.p.s. include peak inverse voltage 6500 volts, peak anode current 2.0 amps., average anode current 500 ma.

This tube is a product of *Chatham Electronics,* 475 Washington Street, Newark 2, New Jersey.

SPINTITE TORQUE TOOL

A new tool featuring torque limiting action and torque settings calibrated in inch ounces is now being offered by *Skyway Precision Tool Company.* It is the Skyway Tork-Tite in a popular spintite style of convenient length, weight, and grip, incorporating a shaft contained in a light housing and floating in bearings.

This design makes possible torque tightening in sensitive inch ounce settings, for it is impossible to bind the tool by improper use at an angle to the work and thus alter torque. The torque limiting action eliminates possibility of over tightening and guarantees accuracy.

This new spintite torque tool is presented in two models with either fixed or adjustable torque setting. The adjustable model is quickly set to a designed torque reading in the handle and secured with a positive locking device.

This tool is particularly adaptable in fields where sensitive and definite torque accuracy is required for assembly or laboratory work.

Details of this tool may be obtained from *Skyway Precision Tool Company,* 3217 Casitis Avenue, Los Angeles, California.

WHEATSTONE BRIDGE

Industrial Instruments, Inc., is now offering a resistance limit bridge working to plus/minus .1%, known as model LB-3. This modified Wheatstone bridge uses a sensitive built-in galvanometer to provide for the high and low indication, respectively. The high and low limit dials cover a range of plus/minus 11% in .1% steps.

The zero on the galvanometer scale acts as a reference point when in normal operating position. Relays incorporated in the instrument provide for speedy test operation, either from a switch on the panel or one built into the test fixture. A receptacle on the panel provides connections between external switch and internal relays.

This new bridge may be used to check resistors between 1 ohm and 3 megohms. External resistance standards corresponding to the nominal values of the resistors under test are required. For most measurements the galvanometer and internal 3 volts d.c. source will be found satisfactory. For measurement of resistors above several thousand ohms, and particularly when the resistance range is increased above 1 megohm, an external battery is recommended. For low resistance measurements particularly below 10 ohms, a more sensitive external galvanometer may be desirable, although most measurements between 1 and 10 ohms may be made satisfactorily by using an external 1½ volt battery.

This new modified Wheatstone bridge is manufactured by *Industrial Instruments, Inc.,* 17 Pollock Ave., Jersey City 5, N. J.

SOLDER FLUX

Battelle Memorial Institute, Columbus, Ohio, has developed a new solder flux which makes possible the easy soldering of many difficult-to-solder combinations of metals.

According to the institute, this new solder flux is more effective than common rosin fluxes and can be used safely in such applications as electrical equipment and can manufacturing. Although the raw flux has an acid reaction, complete neutralization takes place at soldering temperatures. Its residue is non-corrosive, non-conductive to electricity, soluble in water, and non-hygroscopic, making the flux adaptable to a wide variety of industrial soldering.

This flux may be used in soldering copper, steel, silver, brass, various alloys, and various electroplated parts, such as nickel-plate, silver-plate, and cadmium-plate.

SELF TIMING INTERRUPTER

A new flasher-interrupter unit which incorporates distinctive design features is being manufactured by *Electronic Testing Laboratories.*

This new self timing interrupter comprises a miniature but heavy duty relay, an electro-thermal timing device and a non-inductive resistor unit. The unit is extremely compact and all components are incorporated in a single assembly which is light in weight (only 7 ounces). Four studs are provided for mounting on panel, bracket, shelf, etc., with elastic stop units assuring immunity to shock and vibration. The unit is expressly designed to withstand 10 G's in aircraft applications. The flasher-interrupter is normally furnished in open design.

Interruptions can be controlled through a range of from 60 to 80 per minute by varying the current through

IN TUBE MANUFACTURE ALL SMALL DETAILS ARE LARGE TO Federal

From slender filament to anode block . . . *all* tube construction details, however small, are important to Federal. That is why this experienced and longtime manufacturer uses the illustrated high-magnification metallograph as part of its test equipment for checking raw material quality.

An example is the micro-photo inset. Here is shown oxide-free, high conductivity copper used for copper-to-glass seals . . . after the material has been reduced to a fine grain, non-porous structure through Federal's special metal-processing methods.

But whether copper, molybdenum or tungsten . . . they all are subjected to the same exclusive treatment and put through the same searching scrutiny . . . assurance that only the finest materials go to make up Federal tubes.

This exacting test is another good reason why Federal tubes are better tubes. Transmitting, rectifier, industrial power . . . they have a reputation that is deserved because they are *built to stay*.

Federal always *has* made better tubes.

FEDERAL TELEPHONE & RADIO — FTR

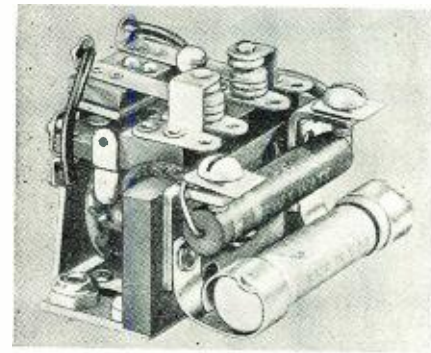
Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

the thermal unit. Operating voltages include all standard a.c. and d.c. ranges and frequencies. Other voltages and frequencies supplied on special order. Normal actuating current is approximately 200 ma.

This unit is available in the following contacts: d.p.d.t. 15 amps. (non-inductive) at 32 volts d.c. or 115 volts a.c., or at 5 amps. (non-inductive) to 220 volts a.c.; s.p.d.t.d.b. 25 amps. (non-inductive) at 32 volts d.c. or 113 volts a.c., or at 7.5 amps. (non-inductive) to 220 volts a.c.



Applications for this flasher device include aircraft identification lighting, control circuit as well as marine, industrial, automotive, and railway signalling devices. Its use is suggested whenever a predetermined number of interruptions are desired in any electrical or electronic circuit.

Further information will be furnished upon request to *Electronic Testing Laboratories,* 44 Summer Avenue, Newark 4, N. J.

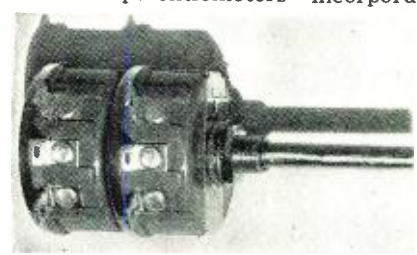
WIRE-WOUND POTENTIOMETERS

Produced to Army and Navy specifications, new wire-wound potentiometers used in all major electronic equipment are announced for the first time by *Trefz Manufacturing Company.* This series of PWW-5 wire-wound potentiometers is fully approved under Bureau of Ships RE13A492C specifications, on basis of test performed.

The excellent linearity of both single and dual units makes them readily adaptable to applications using calibrated dials or in circuit arrangements where close series or parallel tracking is a requirement, according to the manufacturer.

Wattage rating is exceptionally high for a standard size unit. An electronically welded instrument spring maintains positive continuity between center terminal and wiping contact.

These potentiometers incorporate



an approved phenolic case which is completely dust proof. When specified, a sealing washer can be furnished

WE HAVE YOU IN MIND, *Mr. Radio Dealer*

A Personal Message from the President of Templetone

TEMPLE RADIO ELECTRONICS

TEMPLETONE RADIO MFG. CORP.

TEMPLETONE BUILDING
NEW LONDON CONN

To you who have already joined the fast-growing circle of authorized Temple Dealers — and to the many other progressive merchants who will follow suit — greetings, and a hearty welcome into the Temple family.

To have earned the Temple Franchise evidences your high standing, integrity, experience and ability, and we at Templetone look forward with confidence to the major role you will play in the Temple picture.

Above all, you are our "front-line", our one and only actual contact with the public — the final judge and eventual purchaser of Temple Radios. To you is given the all-important role of completing the sale. To us is assigned the vital responsibility of providing invitingly-priced, top-value merchandise and sound, far-seeing promotional support that will multiply, over and over again, those completed sales — and multiply, over and over again, your profits. All this — and more — are pledged you from Templetone. Every resource at our command, all of our vast facilities, all of our forward thinking and planning have YOU, Mr. Retailer, foremost in mind.

Both Templetone and its Distributors look forward to serving you, confident that our association will lead to a long and mutually profitable relationship.

Sincerely,

Oscar Dane

Oscar Dane,
President
TEMPLETONE RADIO MFG. CORP.

Temple RADIO

Where FM will also mean Finest Made

between the case and the cover making a hermetically sealed potentiometer when used in conjunction with a water tight panel bushing.

These potentiometers are available with a resistance range of from 1 ohm to 150,000 ohms in both linear and tapered types and shafts can be supplied to the purchaser's specifications. They may also be supplied with switches and with an off position.

Full details of these units may be obtained from the *Trefz Manufacturing Company,* 38-11 Main Street, Flushing, N. Y.

VEST POCKET RADIO

An innovation in radio set convenience and utility is the new vest pocket radio planned for early production by the *Sentinel Radio Corporation.*

This new radio will be several times

smaller than the smallest camera or personal type radio sets heretofore manufactured and can be inconspicuously carried in vest pocket, shirt pocket, or handbag. It can easily be be carried on the golf course, to ball games, on shopping tours, in fact anywhere and everywhere, and can be operated without disturbance to anyone.

The speaker of this new vest pocket radio will be of the approved hearing aid type. The complete unit includes radio, batteries, and tubes all within a compact case.

The vest pocket radio will be in production by the *Sentinel Radio Corporation,* Evanston, Illinois, as soon as existing production restrictions are lifted.

FM RECEIVER

John Meck Industries, Inc. has announced the development of an FM receiver which will provide reception on the new 90 to 106 megacycle band. This new set will also cover the present broadcast band of 42 to 50 megacycles as well as the band of 88 to 92 megacycles assigned for non-commercial educational uses.

Purchasers of this new FM receiver will have the advantages of a set ready for reception without changes or adjustments when stations are changed to the new band. This will eliminate costly conversions or the necessity of sending sets back to the factory or to the serviceman for adjustments to the new wave band.

This new FM receiver, which is expected to be in production at an early date, is a product of *John Meck Industries, Inc.,* Plymouth, Indiana.

PLUG CONNECTOR

Buchanan Research Laboratories, Inc., has developed a new type of plug connector with multiple-fingered spring inserts providing uniform pressure on long-wiping contacts.

This line, known as lok-plug connector, is available in from one through eighty circuits but practically any number of single or multiple circuit connections can be furnished, on special order, in any vertical or horizontal arrangement desired. Circuits are marked to denote single or multiple types.

Connectors in all sizes are furnished for surface or flush mounting and they are available for simple snap-on installation and ready removal without use of holding screws. Plugs accommodate all wire sizes from No. 26 through No. 12. Size ten wire uses larger plug bore. To facilitate circuit identification, insulation sleeves are available in six solid colors and in numerous color combinations. Butting against the molded receptacle, these sleeves make each connector a completely dead-front unit.

Further information may be obtained from *Buchanan Electrical Products Company, Inc.,* 2 West Jersey Street, Elizabeth, N. J., manufacturer and distributor of this new plug connector.

VACUUM-TUBE VOLTMETER

In keeping pace with the advances made in design of all types of electronic equipment, *Supreme Instruments Corporation* announces its Model 565 Vacuum-Tube Voltmeter.

For the first time, a probe designed for measurement of r.f. voltages has been built which is small enough to be held in the hand as a test lead. This probe contains a high frequency diode of the miniature type and can be used for the measurement, with negligible frequency error, over a frequency range of 50 cycles to 100 mc.

The design of the d.c. voltage measurement circuits is unusual in that

shielded leads are used, each of which has installed in it a 20 megohm isolating resistor which also acts as part of the multiplier resistors. A very high

MAKE MONEY REPAIRING RADIOS
AND OTHER ELECTRONIC EQUIPMENT

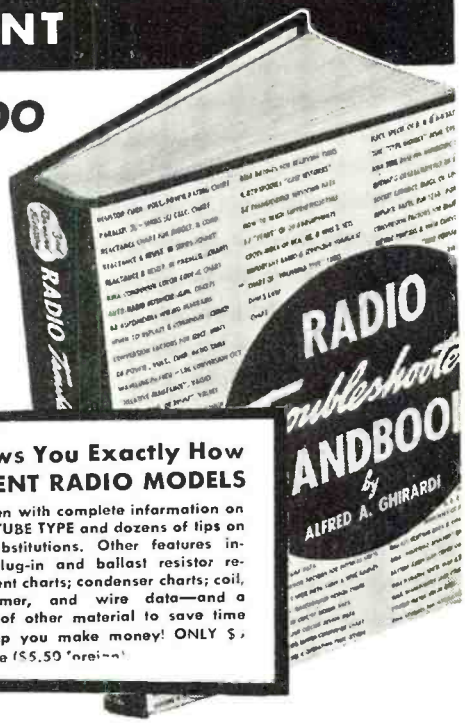
GHIRARDI TELLS YOU EXACTLY *WHAT* TO *DO* . . . EXACTLY HOW TO DO IT

If you like to epair radios at home in spare time, Ghirardi's RADIO TROUBLE-SHOOTER'S HANDBOOK offers you a new, fast way that makes the work easy—without a lot of previous experience or scarce, expensive test equipment. Or, if you are a professional radio man, it helps you repair two sets in less than the time you'd normally take for one. It is the ideal book for training new helpers, for substituting tubes and parts in these days of shortages, for repairing cheap sets quickly and profitably—in short, for repairing radios better, faster and more profitably than you may have thought possible.

4 LBS. OF FACTUAL, TIME-SAVING MONEY-MAKING SERVICE DATA

RADIO TROUBLESHOOTER'S HANDBOOK isn't a "study" book. It rolls up its sleeves and goes to work for you the minute you get it. It can easily pay for itself the first time you use it! Simply look up the make, model, and the trouble symptom of the Radio you want to repair . . . and go to work. No useless testing! No lost time or motion! The HANDBOOK'S clear instructions tell you exactly what the trouble is likely to be . . . and EXACTLY how to fix it. Actually, this big 4 pound, 744-page, manual size HANDBOOK brings you factual repair data for practically every radio in use today—over 4,800 individual makes and models!

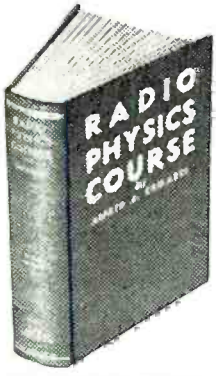
In addition, there are hundreds of pages of helpful repair charts, tube charts, data on tuning alignment, transformer troubles, tube and parts substitutions, color codes, etc.—all for only $5 ($5.50 foreign) on an ABSOLUTE 5-DAY MONEY-BACK GUARANTEE



This "Automatic Teacher" Shows You Exactly How to REPAIR OVER 4,800 DIFFERENT RADIO MODELS

Over 400 pages of the RADIO TROUBLE-SHOOTER'S HANDBOOK include specific common Trouble Symptoms, their Causes and Remedies for practically every Radio Receiver in use today. IN ADDITION, there are hundreds of pages including i-f alignment peaks for over 20,000 superhets; a big data section on i-f transformer troubles—and the most up-to-the-minute TUBE CHART you've ever seen with complete information on EVERY TUBE TYPE and dozens of tips on tube substitutions. Other features include plug-in and ballast resistor replacement charts; condenser charts; coil, transformer, and wire data—and a wealth of other material to save time and help you make money! ONLY $5 complete ($5.50 foreign)

COMPLETE BASIC RADIO-ELECTRONIC TRAINING FOR BEGINNERS



36 COURSES IN ONE

Easily worth $50 or more if broken into "course" form and sent to you in monthly lessons.

All the Basic Science of Radio-Electronics in One Big 3½ lb. Book—No Monthly lessons to wait for.

$5 ($5.50 foreign).

Train NOW for the most interesting of all postwar futures—RADIO-ELECTRONICS! Ghirardi's 972-page RADIO PHYSICS COURSE BOOK gives you all the basic training you need—at a price you can afford to pay! Actually, this big book has started more people in Radio-Electronics than any other book or course. It is more widely used for home study—and more widely used in U. S. Signal Corps and Navy Schools and in civilian schools and colleges than any other book of its kind!

NO OTHER COURSE LIKE IT!

Ghirardi's RADIO PHYSICS COURSE book with its 500 illustrations and 856 self-testing review questions makes it surprisingly easy for you to learn at home without an instructor. Nothing is omitted, nothing condensed. Everything is made as easy as A-B-C. Ask any radio man! You'll be amazed how quickly you'll master the subjects that other courses and books make seem very complicated. Begin today. Examine this truly great book for 5 full days—and get every cent of your money back if you're not more than satisfied.

EVERY CONCEIVABLE SERVICE SUBJECT

Explains circuit and operation of all types of essential service instruments: How and when to use them; How to build your own; Preliminary trouble checks; Trouble-shooting; Repairs; Obscure radio troubles; Aligning and neutralizing; Auto and Marine Radios; Interference reduction; AVC and QAVC circuits, etc., etc.

LEARN *PROFESSIONAL* SERVICE WORK AT HOME WITHOUT AN INSTRUCTOR!

Study now for a good job as a professional Radio-Electronic Service Expert. It's easy to learn from Ghirardi's big 1300-page profusely illustrated MODERN RADIO SERVICING book that costs you only $5 complete. This one big book covers all phases of the work! Explains all necessary test instruments . . . even how to build your own if you prefer; how to trouble-shoot all makes of radios, analyze electronic circuits, test components, make adjustments, repairs, etc., etc.—all step-by-step. Even explains how to start a successful Radio-Electronic Service Business of your own. Sold separately for $5 ($5.50 foreign), or see MONEY-SAVING COMBINATION OFFER in coupon.

5-DAY MONEY BACK GUARANTEE

Technical Division, MURRAY HILL BOOKS, Inc.,
Dept. RN-105, 232 Madison Ave., New York 16, N. Y.

Enclosed find $.....for books checked; or ☐send C.O.D. (in U. S. A. only) for this amount plus postage. If not fully satisfactory, I may return the books at the end of 5 days and receive my money back.

☐ RADIO TROUBLESHOOTER'S HANDBOOK $5 ($5.50 foreign)
☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
☐ RADIO PHYSICS COURSE $5 ($5.50 foreign)
☐ THE ELECTROLYTIC CAPACITOR (See advertisement in adjoining column) $3. ($3.25 foreign)

☐ **Special MONEY-SAVING COMBINATION:**
Both Modern Radio Servicing and Troubleshooter's Handbook $9.50 for the two ($10.50 foreign).

Name.....
Address.....
City & Dist. No.....State.....
(Please print or write plainly)

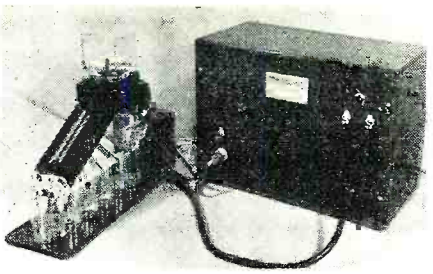
input impedance of 80 megohms on the 1 volt range and 40 megohms on the 500 volt range makes it possible to make voltage measurements, with negligible error, in circuits having extremely high impedance. In addition to these features the use of a balanced bridge type of circuit using nearly 100 per-cent degenerative feedback eliminates errors due to line voltage shift and grid current in the tube which operates the meter. The meter is completely isolated from the input circuit and any damage which might result from an accidental application of a high voltage to a low voltage range.

Voltage ranges of 0-1, 0-2.5, 0-10, 0-100, 0-250, and 0-500 d.c. and a.c. voltage ranges of 0-1, 0-2.5, 0-10, 0-100, and 0-250 are provided by means of push-button selection.

AUTOMATIC BALL GAUGE

Jack & Heintz, Inc., has developed a new electronic ball gauge to provide perfectly sized and perfectly matched balls for better and more accurate bearings, and to sort them faster.

When fed commercial balls, which have already been graded to a toler-



ance of 1/20,000 inch, this automatic machine sorts them into groups five times more accurate. As many as ten size selections can be made, each group being separated by only ten millionths of an inch.

Operation consists in filling the plexiglass hopper and removing the sorted balls. One operator can handle four machines easily and four machines sort more balls, more accurately, than thirty-two skilled operators using the conventional measuring equipment.

This automatic ball sorter is a development of *Jack & Heintz, Inc.*, Cleveland, Ohio.

FINGER TOOLS

A new finger tool designed for all types of assembly work, especially adaptable for radio, automotive, electrical and aircraft, will soon make its appearance on the market, the *Faso Manufacturing Company* has announced.

This new Touch-n-Grip finger tool combines the advantage of the sense of touch with the grip ends of wrenches, screwdrivers, etc., in forming a small compact tool that enables the user to reach into snug, narrow, remote, or invisible working areas to touch and grip the work spot instantly, and simultaneously hold a nut, bolt, or screw in true fixed

(*Continued on page* 122)

All of the well known Utah qualities of workmanship and design go into Utah vibrators, yet they cost no more than ordinary vibrators.

- ★ 70 vibrator replacement types.
- ★ 39 different hook-up diagrams.
- ★ Servicing 3651 different auto and farm radio models.
- ★ More than a million radio sets are equipped with Utah

utah

There is a Utah vibrator for every replacement requirement!

UTAH RADIO PRODUCTS COMPANY • 820 ORLEANS STREET • CHICAGO 10, ILLINOIS

Utah Electronics (Canada) Ltd., 300 Chambly Road, Longueuil, Montreal (23) P. Q. • Ucoa Radio, S. A., Misiones 48, Buenos Aires.

TEMPERATURE CONTROL in the Design of Stable Oscillators

The ideas presented herein may well apply to various types of self-excited u.h.f. and v.h.f. oscillators for frequency stabilization.

By LYLE C. TYLER
Radio Engineer

ONE of the requirements in the design of a stable oscillator is close control of the temperature of the frequency determining elements of the circuit, whether that is a quartz plate or the LC tank of a variable frequency oscillator. In order to attain a close control of temperature, considerable attention should be given the design of the controlled compartment.

Let us take, for example, a metal box lined with celotex or balsa wood within which is a heater and thermostat as in Fig. 1B. The thermostat is set to operate at a given temperature. The ambient temperature outside the box is somewhat lower. Now, if the ambient temperature is increased, the temperature inside the box will increase, not necessarily the same amount, even though the box is heat insulated and the thermostat is assumed to control the temperature. The temperature of various spaces within the box will probably not be uniform. Added insulation will not correct the fault, but only slow up the rate of change of temperature with a change of ambient temperature. The reason for the performance of this type oven is that the thermostat will control only the temperature immediately surrounding the controlling element of the thermostat. However, as will be explained later, the temperature of the controlling element can be adjusted to give the desired control provided the heater is correctly arranged and other design problems are properly considered.

If these components are rearranged, the heater and thermostat placed outside the box to be controlled, the heater distributed evenly on all sides of the box, and then all surrounded by an outer box as in Fig. 1A, a much greater amount of control can be attained for the reason that all sides of the box will be close to the same temperature as the controlling element of the thermostat. We can consider the box walls, the space between the box and the thermostat, the space between the thermostat and heater, and the space between the heater and ambient temperature as thermal impedances, Fig. 1C. By correct adjustment of these various thermal impedances, the temperature at B can be maintained very close to a constant value, even though the ambient temperature, T_A and the power in the heater varies within limits.

Fig. 1C illustrates how these impedances are arranged. The impedance Z_W should be high enough to smooth out the heat cycles from the heater, which will cause the temperature at B to be maintained without fluctuations due to on and off periods of the heater.

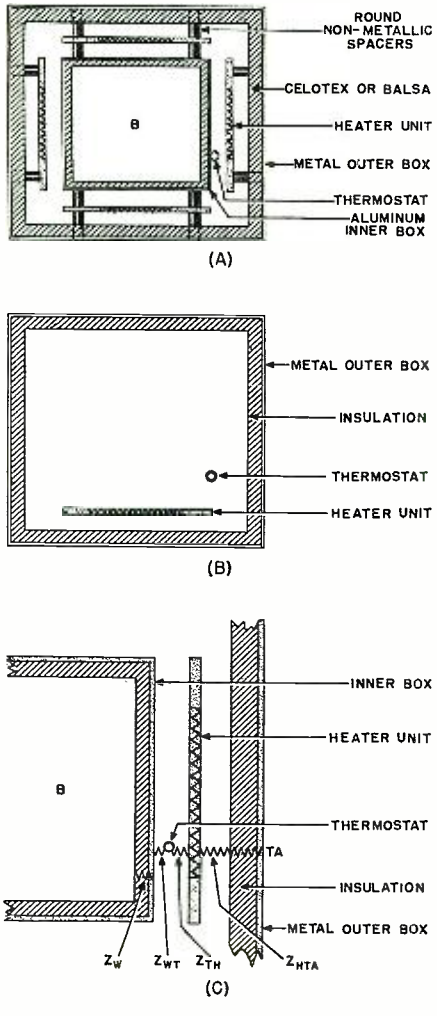
The impedance Z_{WT} should be as low as possible, that is so the wall of the box will be maintained at the temperature of the thermostat, which will be approximately equal to the temperature inside the box. The type thermostat used determines how this is accomplished. This will be treated in more detail later.

The impedance Z_{TH} should also be as low as possible in order that the thermostat on-off cycles will be short.

The impedance Z_{HTA} should be as high as possible for economical reasons, that is, the better the insulation in the walls of the outer box, the shorter the "on" time of the heater will be, as less heat will be dissipated through the walls of the outer box.

In the design of an oven of this type, the first thing to consider is the size and material of the inner box, B. It should be made just large enough to conveniently hold the components to be temperature controlled. An aluminum box lined with balsa wood or celotex will provide an effective shield electrically. Aluminum, being a good thermal conductor, will equalize the temperature inside the box, while the

Fig. 1. The construction of temperature control enclosure. (A) Sectional rear view showing suggested type of construction and placement of components. Front and rear heater units not shown. (B) Type of arrangement which would give poor control. (C) Illustrating how spaces between components may be shown as thermal impedences.



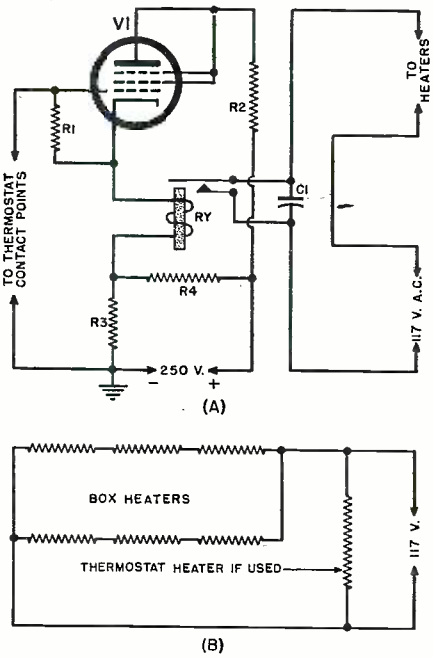


Fig. 2. (A) Relay circuit diagram for use with mercury thermostat. (B) Heater connections used in example described in text.

MR. RADIOMAN: You Can Use These "Tools" To Build a Better Job and a Secure Career in RADIO-ELECTRONICS

CREI Home-Study Training in Practical Radio-Electronics Engineering Combined With Your Own Experience Assures You of Post-War Security and an Interesting, Profitable Career

What's ahead for *you* in the field of Radio Electronics? One thing is certain. Now that Victory is won, Radio-Electronics will surge forth as one of America's foremost industries, offering promising careers for radiomen with modern technical training.

But, you won't be able to merely step into the job of your choice, for now it will be "the survival of the fittest." Employers will once again be "choosey." Only the best qualified men will be selected for the best jobs.

NOW is the time to take the time to prepare yourself for these important career jobs in radio-electronics engineering. CREI can show you the way by providing you with the "tools" to build a firm foundation of ability based on a planned program of technical training.

In our proved home-study course, you learn not only *how* . . . but *why!* Easy-to-read-and-understand lessons are provided well in advance, and each student has his personal instructor who corrects, criticizes and offers suggestions on each lesson examination. This is the successful CREI method of training for which more than 10,000 professional radiomen have enrolled since 1927.

Your ability to solve tough problems on paper and then follow-up with the necessary mechanical operation, is a true indication that you have the *confidence* born of *knowledge* . . . confidence in your ability to get and *hold* an important job with a secure, promising post-war future. These jobs are waiting today for radiomen with up-to-date CREI technical training. Investigate now the CREI home-study course best suited to your needs, and prepare for security and happiness in the coming New World of Electronics! *Write for all the facts now.*

Servicemen—
Discharged Veterans

CREI RESIDENCE TRAINING NOW AVAILABLE UNDER PROVISIONS OF "G.I." BILL

CREI now offers Residence School courses in Radio-Electronics Engineering, Broadcast & Television Engineering and Broadcast & Television Servicing under the Serviceman's Readjustment Act of 1944 ("G.I." Bill). Classes now in session. Enter at any time. Write for details.

Those interested in CREI residence school should write for information about the CREI Priority plan.

WRITE TODAY FOR FREE 36-PAGE BOOKLET

"Your Opportunity in the New World of Electronics"

TELL US ALL ABOUT YOURSELF, so that we can intelligently plan a course best suited to your needs. If you have had professional or amateur radio experience let us prove to you that we have something you need to qualify for a better radio job. To help us intelligently answer your inquiry—PLEASE STATE BRIEFLY YOUR BACKGROUND OF EXPERIENCE, EDUCATION AND PRESENT POSITION.

CAPITOL RADIO Engineering Institute

HOME STUDY COURSES IN PRACTICAL RADIO-ELECTRONICS ENGINEERING FOR PROFESSIONAL SELF-IMPROVEMENT

Dept. RN-10, 3224—16th Street, N. W., Washington 10, D. C.

Contractors to U. S. Navy—U. S. Coast Guard—Canadian Broadcasting Corp.
Producers of Well-trained Technical Radiomen for Industry.

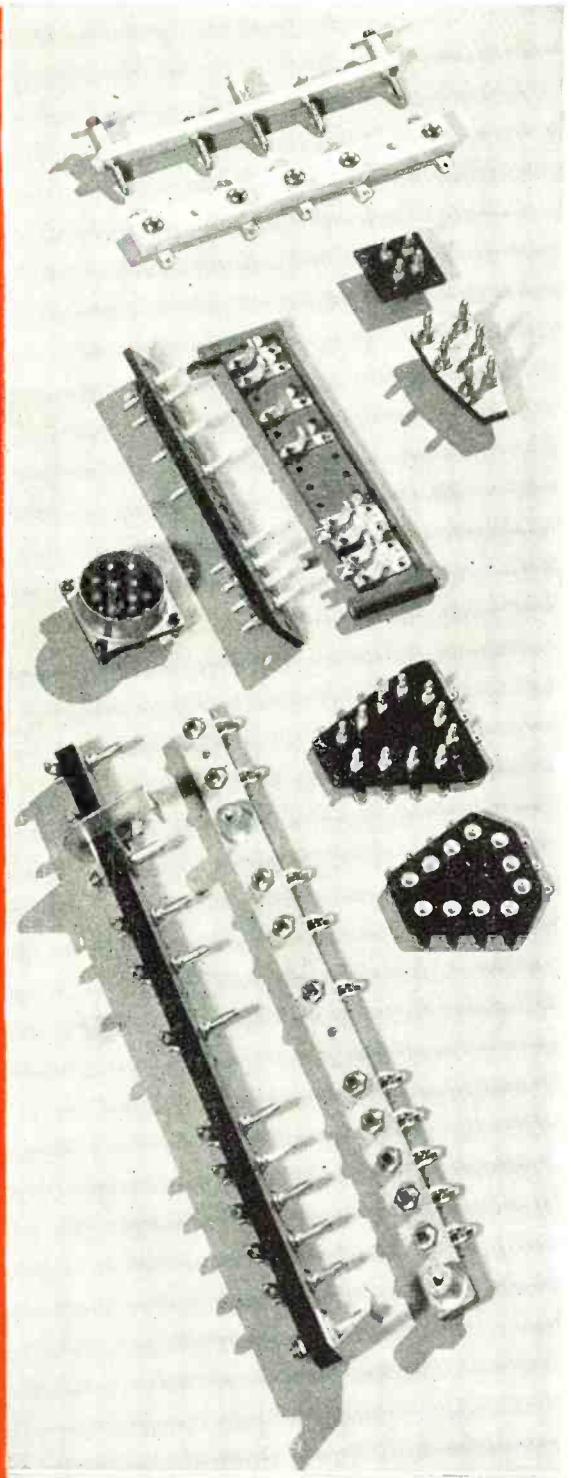
balsa or celotex will provide the necessary thermal filter. Necessary wire leads from the components should be brought out at a convenient place through as small an opening as possible.

The temperature at which the components are to be maintained is next considered. The highest ambient temperature at which the equipment will operate is determined. The temperature rise within the box caused by heat dissipation of the components mounted within is determined. This can be found by experiment as follows:

The inner box, B, is constructed and all component parts are mounted within it. The box is then subjected to a temperature equal to the highest ambient temperature, T_A, at which the equipment will operate. The components are then operated normally. After approximately one hour, measure the temperature within the box, B. Call this T_B. The temperature rise, T_R, will be T_B-T_A and the operating temperature, $T_O = T_R + T_A + 2$. If crystals only are to be temperature controlled and one crystal is to be operated at a time, T_R can be assumed to be 5 degrees centigrade. If all component parts of a variable frequency oscillator (except the tube) are to be controlled within the box then T_R should be 10 degrees centigrade. The operating temperature of the box, T_O, is then $T_R + T_A$. All temperatures are expressed in degrees centigrade. Note that the factor 2 is used only if T_R is determined experimentally. If T_R is assumed 5° C. or 10° C. in the specific cases as above, this factor is already considered.

Having determined the operating temperature of the box, the next step is to select the thermostat. The thermostat selected should have a small operating temperature differential. The mercury type is usually the best for this application, although it is usually more expensive than other types. It is fragile and must be handled with care. One type mercury thermostat has the thermometer scale engraved on the stem which, of course, would save the price of a separate thermometer. Other types of thermostats include the bimetallic and the snap-disc. These, as a general rule, will not operate on as small a temperature differential as the mercury type, but can be made to operate satisfactorily with special treatment, as will be explained later.

The operating point of the thermostat should be equal to or above the operating temperature of the box. If a mercury thermostat is used, a relay will have to be used to handle the heater current, as the contacts of this type thermostat will not handle any appreciable current. A suggested circuit for the relay is shown in Fig. 2A. The relay, RY, should have d.c. resistance of approximately 5000 ohms and operate on a current of from 2 to 4 ma. The contacts should be capable of handling the full heater current



A WISE TREND

A few years ago plugs and jacks were uncommon except for a few applications in radio and test equipment. Today the trend to greater use of plugs and jacks is fast becoming standard practice in radio and electronic industries.

Keeping up with this trend, Johnson has designed many new plugs to meet industries special requirements, as well as supplying standard plugs which are being used in an increasing number of new applications.

The use of plugs on components is growing more popular, speeding production, facilitating easy replacement and interchanging of parts.

Plug and jack assemblies make it possible to remove sections of equipment for repair and maintenance without disturbing the wiring, and in police, fire, railroad and similar installation, units which fail may be quickly replaced with little delay in operation.

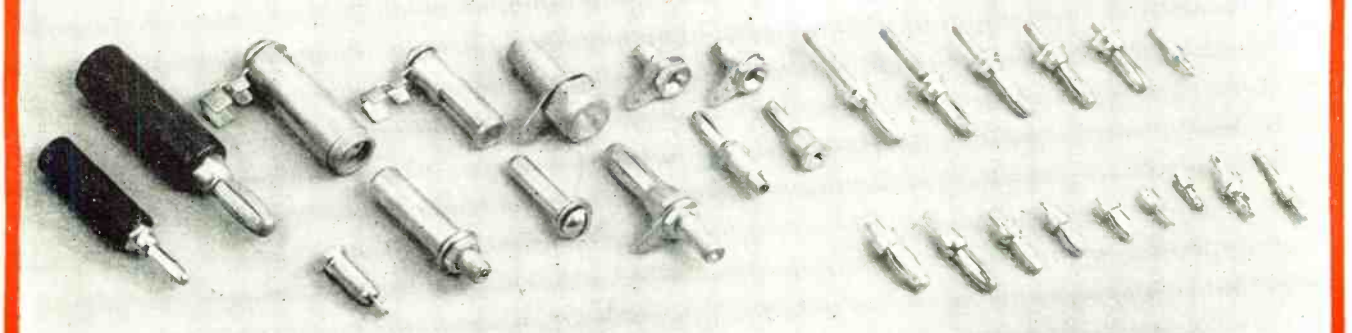
Let Johnson, a pioneer in the manufacture of plugs and jacks, supply you with a plug and jack combination or assembly to meet your requirements.

Send us your problem.

Ask for catalog **968-Z**

JOHNSON

a famous name in Radio



E. F. JOHNSON COMPANY • WASECA • MINNESOTA

without arcing. Any bimetallic or snap-disc type thermostat used will handle the heater current without the aid of a relay. However, more attention will have to be given this type to keep the operating temperature differential at a minimum. This can be done with the use of a separate thermostat heater adjusted so the on and off periods will be short, and the temperature of the wall of the box *B* will remain as nearly constant as possible through the thermostat cycle. This will especially be necessary if the operating temperature of the thermostat is higher than the desired operating temperature of the box.

It should be noted that while Fig. 1A shows the correct *effective* placement of the thermostat with respect to the heaters and the box, it may be *physically* placed at any convenient location within the outer box provided the thermostat heater is adjusted so as to cause the thermostat to maintain the correct temperature at the wall of the box *B*.

All heaters used, including the thermostat heater, should be the open type with as little thermal storage capacity as possible. This is important if a non-fluctuating constant temperature is to be maintained. Heaters for the box should be the open "grill" or "card" type placed so that each unit will be parallel to and approximately one inch from its respective side. The heater unit area should be at least ¾ the area of the box side. The thermostat heater may be wound so as to surround or be adjacent to the controlling element. The size and power of the thermostat heater will have to be determined by experiment.

The total heating power of the box heaters should be considered next. The power used will depend partly on the amount of insulation used in the outer box. The heater power should be adjusted high enough to maintain the correct operating temperature of the box when operated at the lowest ambient temperature to be encountered, and low enough so "over-shooting" of operating temperature will not occur when operated at the highest ambient temperature. It will be found that the actual heating power is not critical if the thermostat heater is correctly adjusted. As a matter of fact, the heater power can vary or the ambient temperature can vary within reasonable limits and the correct operating temperature of the box can be maintained if the thermostat heater is correct.

Correct adjustment of the heater power and thermostat will be indicated by short "on" and "off" periods of the thermostat (complete thermostat cycle), no "over-shooting" of operating temperature during the warm-up period, and no "over-shooting" when the heater power or ambient temperature is increased within limits. With an increase in ambient temperature, the "off" time should remain constant and the "on" time should decrease. If the "off" time increases appreciably with an increase in ambient temperature, an effort should be made to reduce the thermal impedance between the thermostat heater and the thermostat controlling element. The shorter the thermostat cycle, the smaller the thermal smoothing impedance Z_w can be, that is, the insulation thickness of the inner box. For thermostat cycles of 1 minute or less, insulation may not be necessary in the inner box *B*, to maintain a non-fluctuating temperature within the box.

As an example of the performance that may be expected, we will assume an inner box, *B*, to be 5 inches outside dimension all sides, made of 1/16 inch aluminum, and lined with ¼ inch thick celotex. This box will contain one crystal. The outer box of metal will be 9 inches inside dimension, all sides lined with ½ inch thick celotex. See Fig. 1A for suggested type of construction. The inner box operating temperature is assumed to be 55°C. Six heater units of the open "grill" or "card" type will be used, each having a rating of approximately 50 watts. These will be connected series-parallel (Fig. 2B). Each unit will then dissipate approximately 5½ watts, making a total heater power of 6 x 5½ or approximately 33 watts.

A mercury thermostat which will make contact at 55°C. will be used. The mercury bulb is placed between the heater and the inner box wall as close to the wall as possible. If the thermostat is not also a thermometer, the thermometer bulb should be placed in the same effective location. At an ambient temperature of 25°C., the initial warm-up period when the thermostat will start operating will be approximately one to one and one-half hours and the temperature within the box will stabilize after four hours. The temperature at the thermostat bulb should not vary more than .2°C. over a complete thermostat cycle, approximately 1½ minutes, and the temperature within the box should remain constant through an ambient temperature range of from 10°C. to 50°C. A twenty per-cent line voltage change should not affect the inner box temperature, if the ambient is constant.

Due to the wide variety of applications, operating conditions, and requirements of an oven of this type, no rules or formulas can be set forth for use in its design and, therefore, a certain amount of "cut and try" will have to be used in each individual case. The methods and results as outlined herein are based on fundamental principles and actual experience of the author.

It should be noted that if any control shafts are used for components within the inner box, those shafts should be of non-metallic material such as bakelite or fiber. Any parts used that will be in contact with both the inner and outer box should be non-metallic, the reason being obvious in that a metallic part would furnish a low thermal impedance path between the inner box and the ambient temperature.

—30—

Reaching the Ruralist

By JOHN LATIMER

How a rural serviceman maintained a profitable enterprise regardless of wartime problems.

AT MURPHY, Carthage, New York, goes after the rural inhabitants—rather than the city folks. It's true that he can't personally visit the farm house to service an offending farm radio, but he does the next best thing.

He has arranged with a nearby feed mill to allow farmers to leave radios needing service attention there. Murphy visits the mill once weekly, picks up the ailing sets, repairs them and returns them to the mill for pickup by the farmer. The farmer pays the miller who, in turn, turns over the money collected to radioman Murphy. Murphy pays the miller 5% on all money collected—not an unfair commission, nor an extravagant one. Murphy and the feed dealer have a cooperative advertising setup as well. On all postcards and direct mailing pieces the miller sends out—mention is always made of the fact that radio repair can be speedily arranged for at the mill.

Murphy uses a series of radio spots just before and after the daily noontime farm program. In addition he parks his service-shop truck at the public market thrice weekly in the spring and summer. Farmers bringing produce to sell can lug along their radios for prompt service.

He is the first radioman in this section of the country to build up a wartime business in farm intercommunication sets. He has actually designed and constructed to meet individual farmhouse specifications over a score of such setups with outlets in farmhouses, barns, and other strategic farm points. Murphy sends each farmer a letter outlining the advantages of a "farm radio hookup" and follows up the letter with a personal visit to the farmhouse. He spends one full day a week in paying visits to farmers—the purpose of which is to persuade them to install an "intercommunication outfit" with all the trimmings. Also he has been an enthusiastic seller of "radio-ear" units, to place in the barn so that intruders would be spotted with ease. He secured a large number of such items just after the war broke out and consequently can still fill orders.

Murphy does provide credit for the farmer on all radio service. Half of the service bill must be paid when the set is returned, and the balance in 2 or 4 weekly installments, depending upon the amount outstanding. To date Murphy reports he has lost less than 5% due to poor credit risks. In many instances farmers place their radio service bill on their feed account. Under this plan the feed dealer pays Murphy spot cash and lets his rural customers pay him as they can.

Murphy finds that a "record rental library" works well for him. He rents a collection of 50 records to a farm family—2 weeks for $1.50, 4 weeks for $2.50. 100 records are loaned out—$2.50 for a fortnight, $4.00 for a full month. Murphy has several thousand records on hand which he purchased for a few pennies each in past years. Rental of these platters to ruralists assures him of a small and steady profit and at the same time provides him with an entry into their homesteads.

This radioman has a bulletin board in his shop on which are placed photographs of rural lads and lassies in the service. Farm folk come into the servicenter on Saturdays and weekends to leave photos of their loved ones for insertion on the board and also to inspect its contents.

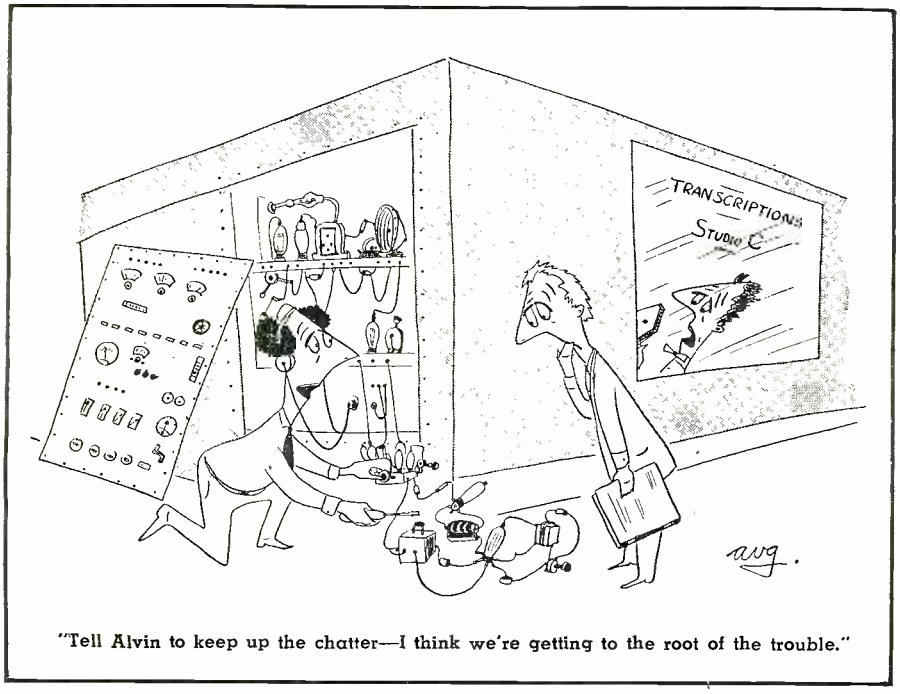
He changes the board's photographic display every other week. He finds it a source of steady store traffic so far as rural patronage is concerned.

Each rural service patron is provided with an itemized list of all repairs made and the date of such repairs — stamped in so that no changes can be made. The farmer must bring or send in that invoice the next time the set refuses to play. If the cause for the set's defunct condition is traced to any item listed on a previous invoice and the interval between service calls is less than thirty days the second repair session is free. A 30-day period is all that Murphy can guarantee, what with the quality of replacements he's getting these days.

Murphy has an unusual sideline worth mentioning — the rental of 16-mm. motion projectors and accompanying films. Because his is a small town, there is no photographic dealer available. Murphy has a number of 16-mm. projectors and several sound outfits. Farmers can rent either silent or sound installations for a week at very reasonable rates. With country roads as they are, Murphy finds that farm families enjoy holding several brief, but entertaining shows on their premises during a "snowed-in" period. Also Murphy cooperates with the local Farm Bureau who will loan the farmer agricultural films while Murphy provides the visual sound apparatus.

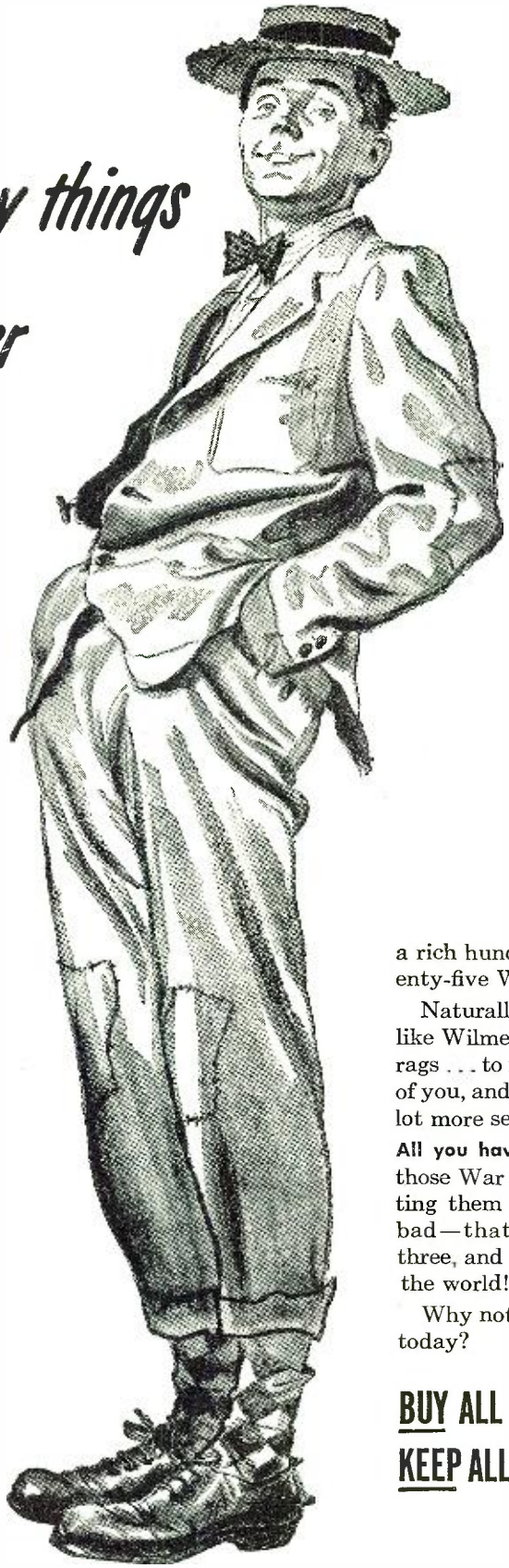
He also makes sound movies of farms which can be shown later on and as a matter of record has made a dozen or more such epics during recent months. A number of farmers band together and finance such a "celluloid record" of the "farm front."

Summing it up, radioman Murphy makes his living from "down on the farm" and is doing nicely at it. Farmers need radios in tip-top operative condition so that they can keep up with news, weather, and crop reports. Murphy provides efficient radio service to meet this situation. —30—



"Tell Alvin to keep up the chatter—I think we're getting to the root of the trouble."

There are two funny things about Wilmer



The first is Wilmer's getup.

The second is that he doesn't care if he *does* look like a castoff scarecrow.

Because Wilmer's a lot smarter than he looks. While he's making more than he's ever made before—he's doing right by his country. The dough he'd spend for a fancy wardrobe goes right smack into War Bonds . . . and for this Uncle Sam is mighty proud of him.

And Wilmer's doing right by *himself*, too. Because in a few short years he's going to be able to do something he's planned on. He's going to send Wilmer, Jr. to college—and in clothes that won't be any fugitives from a scarecrow, either.

He's going to be able to do it because Uncle Sam is going to give him back a rich hundred bucks for every seventy-five Wilmer's *lending* now.

Naturally, you don't have to look like Wilmer . . . or tramp around in rags . . . to make your country proud of you, and your own future a whole lot more secure.

All you have to do is keep getting those War Bonds—and then forgetting them till they come due. Not bad—that four dollars for every three, and the safest investment in the world!

Why not get an *extra* War Bond today?

BUY ALL THE BONDS YOU CAN

KEEP ALL THE BONDS YOU BUY

ZIFF-DAVIS PUBLISHING COMPANY

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

International Short-Wave

(*Continued from page 47*)

are inaudible or 'only weak' on West Coast. Frequencies and schedules change often. Best reception from India is during autumn and winter on the 7- and 6-megacycle bands; also on the 11-megacycle band some days (evenings).

Schedules for the two 100-kw. transmitters operated by *All India Radio* (Delhi) for October and November are:

TRANSMITTER 1—9-10 p.m., 7.300 (Oct.), 7.275 (Nov.), non-directional; 10:30-10:45 p.m., 11.760 (Oct.), 15.190 (Nov.), non-directional; 12 midnight-2 a.m., 15.190, North-East (Tokyo) Beam; 2:30-4 a.m., 7.275, non-directional; 5-5:45 a.m., 15.190 (Oct.), 11.760 (Nov.), North-East (Tokyo) Beam; 6-6:45 a.m., 15.190 (Oct.), 11.760 (Nov.), East (Burma) Beam; 7-10 a.m., 7.275, North-East (Tokyo) Beam; 10:15 a.m.-12 noon, 6.190 (Oct.), 6.150 (Nov.), non-directional; 12:15-2:15 p.m., 6.190 (Oct.), 7.275 (Nov.), West (Mid-East) Beam; 4-4:15 p.m., 6.190 (Oct.), 7.275 (Nov.), East (Burma) Beam; 6-6:45 p.m., 6.190 (Oct.), 7.275 (Nov.), East (Burma) Beam.

TRANSMITTER 2—8:30-10 p.m., 6.190, non-directional; 10:30 p.m.-1:25 a.m., 15.160, East (Burma) Beam; 1:30-5:30 a.m., 15.160, East (Burma) Beam; 5:45-8 a.m., 11.790 (Oct.), 9.630 (Nov.), East (Burma) Beam; 8:30-10:25 a.m., 7.290 (Oct.), 7.300 (Nov.), East (Burma) Beam; 10:50 a.m.-12 noon, 6.150 (Oct.), 6.190 (Nov.), non-directional; 12:15-2:15 p.m., 7.290 (Oct.), 6.190 (Nov.), West (Mid-East) Beam; 3:30-4:15 p.m., 7.290 (Oct.), 6.190 (Nov.), West (Mid-East) Beam; 6-6:45 p.m., 7.290 (Oct.), 6.190 (Nov.), West (Mid-East) Beam.

* * *

REPORT FROM INDIA

D. R. D. Wadia, Bombay, India, writes he is one of the oldest members of the International Short-Wave Club and also a VAC holder. Using a National NC200, during the last two years he has logged Rome, KGWI, KWID, KGEI, WNBI, WBOS, and other U. S. stations; PRL8, Switzerland, YV5RM, OPM, FZI, ABSIE, AFHQ (Africa), British Mediterranean Radio, British Army Test Stations, Leopoldville, Ceylon, H. Q. Southeast Asia Command, Cairo, the BBC, German, and Japanese stations. These transmitters were picked up on the loudspeaker, signal strength varying from R-3 to R-9, Mr. Wadia reports.

* * *

REPORT FROM AUSTRALIA

From Adelaide, South Australia, Rex G. Gillett, DX Editor, the South Australian Radio Call, writes that an average of 120 square inches of space is devoted to DX notes per issue, with a circulation averaging 30,000. "All the leading DXers in Australia and New Zealand subscribe to Radio Call, and according to reports received, it is a very popular publication."

"Verifications from stations have only been sought for the last two years," he continues, "and consequently, only 150 have been received so far. Countries verified are Cuba, Ceylon, India, Java, New Zealand, New Caledonia, Ecuador, Canada, Costa Rica, Guatemala, Mexico, Chile, Mozambique, French Equatorial Africa, U. S. A., Fiji, Gold Coast, Switzerland, Syria, Senegal, Hawaii, Haiti, and, of course, Australia. In addition to being DX editor of Radio Call, I send regular reports to Radio and Hobbies, and Australasian Radio World in Sydney, Tune In in New Zealand, and not so regularly to Listener In in Melbourne."

Gillett is a member of the New Zealand DX Radio Association, Australian DX Radio Club (Melbourne and Adelaide branches), All Wave All World DX Club, New Zealand Radio and Hobbies Club, Universal Radio DX Club, and Victory Radio Club (U. S. A.).

Gillett uses a "standard 5-valve commercial receiver".

* * *

BEST BETS FOR BEGINNERS

AUSTRALIA—VLC5, 9.54, Shepparton, 8-8:45 a.m. to East Coast, news at 8, 8:35 a.m.; believed strongest year-round SW signal from abroad. VLG4

To Save Life

RAYTHEON TUBES ARE USED IN NEW ELECTRONIC STETHOSCOPE

The conventional "acoustic stethoscope," used by doctors since the horse-and-buggy days, now gives way to a revolutionary electronic stethoscope called the "Stethetron."

Human lives are saved by making diagnosis easier and more accurate with the "Stethetron" made by The Maico Company, Inc. Of particular interest to you is that miniature Raytheon High Fidelity Tubes are used in this remarkable device because of their complete dependability and precision performance.

This is just one more example of the superiority of Raytheon Tubes—the line that *you* should feature to give your customers the best possible service.

Feature Raytheon Tubes now—for greater profits—and watch for the Raytheon merchandising program designed especially for established radio service dealers who want to lead the field in postwar volume in their communities.

Increased turnover and profits, plus easier stock control, are benefits which you may enjoy as a result of the Raytheon standardized tube type program, which is part of our continued planning for the future.

Raytheon Manufacturing Company

RADIO RECEIVING TUBE DIVISION

NEWTON, MASSACHUSETTS • LOS ANGELES • NEW YORK • CHICAGO • ATLANTA

RAYTHEON
Radio Tubes

Devoted to Research
and the Manufacture of Tubes for the New Era of Electronics

ALL FOUR DIVISIONS HAVE BEEN AWARDED ARMY-NAVY "E" WITH STARS

Listen to
"MEET YOUR NAVY"
AMERICAN BROADCASTING CO.
Every Monday Night
Coast to Coast
181 Stations

(or VLC7), 11.84, Shepparton, 9:55-10:45 p.m. to East Coast, news at 10:30 p.m.; also 1:10-1:45 a.m. to West Coast, news at 1:15 a.m.; first of these transmissions heard best on West Coast, last heard well in East, also. VLC4, 15.315, scheduled same as VLG4; both transmissions on 15.315 heard well both West and East. VLC6, 9.615, Shepparton, 11-11:45 a.m. to West Coast, news at 11, 11:30 a.m.; excellent in West, generally, good signal in East.

CHINA—XGOY, 9.805 (announced, but actually heard on 9.810), Chungking, dual 7.153, 6:35 a.m.-noon or 12:45 p.m., news at 6:35, 9, 11:10 a.m.; some mornings 9.805 (actually, 9.810) is heard in East the first hour or so of transmission. (See "Changes.")

INDIA—VUD7, 6.19 (also reported as 6.15), Delhi, 10:50 a.m.-12 noon, news at 10:50 and BBC news relay at 11 a.m.; relays General Forces Program from BBC, 9-11 p.m., news at 9 p.m. VUD5, 7.275, Delhi, 9-11 p.m., news at 9:30 p.m. VUD8, 15.350, Delhi, scheduled 8:30-10 p.m., news at 9:45 or 9:50 p.m.; heard almost nightly in East with good signal.

OTHER IMPORTANT TRANSMISSIONS FROM ASIA AND OCEANIA

*(*Indicates stations heard almost daily in the U. S.)*

AUSTRALIA—*VLW6, 9.68, Perth, 6:30-11:30 a.m., news at 7, 9, 11 a.m.

*VLC6, 9.615, Shepparton, 5-6 a.m. to Philippines (English); 9-10:15, 10:35-10:45 a.m. to Asia, news at 10, 10:35 a.m.; good in East.

*VLG4, 11.84, Melbourne, dual *VLC6, 11-11:45 a.m., news at 11, 11:35 a.m.; only fair in East.

*VLG3, 11.71, Melbourne, dual *VLC4, 15.315, Shepparton, 11 p.m.-1 a.m. to Australian National Forces; play recordings, news generally at 12 midnight; VLC4 sends excellent signal to East.

VLG3, 11.71, Melbourne, dual VLC7, 11.84, Shepparton, 2-2:40 a.m. to Tahiti (French only).

*VLG3, 11.71, Melbourne, 2:55-3:25 a.m. to Britain; fair in East.

VLG10, 11.760, Melbourne, 5-6:15 a.m. to Asia (English).

VLG4, 11.84, Melbourne, 5:30-6:15 a.m. to Forces in Southwest Pacific (English); heard some days in U. S.

*VLG, 9.58, Melbourne, 10:35-10:45 a.m. to Forces in India (English); heard some mornings in East.

VLG5, 15.23, Melbourne, dual VLC2, 9.68, Shepparton, 12:15-12:45 p.m. to Britain; heard occasionally in the U. S.

CEYLON—*ZOJ, 11.81, Colombo, 7:30-10:45 a.m., news at 8:30, 10:30 a.m.; heard on West Coast, only occasionally in East; letter verifications are being received.

ZOJ, 15.275, Colombo, opens at 11 p.m. with news; news also at 12:30 a.m.

ZOH, 4.900, "Colombo Radio," Colombo, relays long-wave, 5:55 a.m.-12:20 p.m., news at 9, 11 a.m.

CHINA—*XGOA, 9.730 (actually heard on 9.725), Chungking, 12:30-1:45 a.m., 5:30-10:15 a.m., news at 10 a.m.

XGOA, 5.918 (actually heard on 5.910), Chungking, 10:15 a.m.-12:45 p.m.

XGOY, 11.900 (actually heard on 11.905), dual 7.153, Chungking, 7-8 p.m., news at 7:30 p.m.; formerly heard in East but not recently; XGOY, 11.900, also scheduled 5-6:30 a.m.

XPSA, 6.990, Kweichow, 12:30-2:10 a.m., 6-11 a.m.

XGCA, 9.625, Kalgan, 7-8:45 a.m.; fair signal to West Coast only.

FIJI ISLANDS—*VPD2, 6.130, Suva, daily, except Sunday, 4:15-5 p.m., news bulletins at dictation speed, followed by BBC news relay, 4:45 p.m.; Sunday, 2-6 a.m., special programs in Fijian and English; BBC news relay, 2 a.m.; Tuesday, 4-5 a.m., news bulletins and commentaries in Fijian; native music. Good signal to East Sunday mornings, 2-6 a.m.

GUAM—*KU5Q, 17.82, 15.90, 3-11 p.m. to networks, irregularly. On 12.25, 9.67, 9.33, 3-8 a.m. to networks; heard with powerful signal in East on 12.25; good signal in West on 12.25 and 9.67.

HAWAII—*KRHO, 17.80, Honolulu, 7:30 p.m.-3 a.m., news on the hour; heard well in East.

*KRHO, 9.65, Honolulu, 12 noon-2:45 or 3 p.m., news on the hour.

*KRHO, 6.120, Honolulu, reported schedule, 3:15-11:45 a.m.

A POSTWAR PROJECT FOR YOU...

SUPERSTANDARD RECEIVING TUBES

SUPERSTANDARD—above standard; a term coined by Hytron for a standard receiving tube completely redesigned to give improved performance in special electronic applications

Receiving tube design is often a compromise. Ruggedness, dependability, long life—the very qualities most desirable in industrial electronics and aviation—have often been sacrificed for reduced cost and power consumption in broadcast receivers. Low filament current may be poor economy in an industrial tube. A standard 6SJ7GT may be objectionably microphonic in sound equipment. Vibration, jars, shocks, and inadequate maintenance in the factory may play hob with a standard receiving tube.

STANDARD—SPECIALLY SELECTED—NOW HYTRON PROPOSES SUPERSTANDARD

HYTRON IS CONVINCED: Standard receiving tubes are not right for special electronic applications. Special selection of standard tubes leads to embarrassing replacement problems—does not guarantee permanence of characteristics specially tested, long life, or suitability for operation at not-too-conservative maximum ratings. Hytron prewar ceramic-based low-loss GTX tubes were but a step in the right direction. The Navy "ruggedized" tube program points the way. Complete redesign of many receiving tubes is mandatory. A tube listing at a dollar in electronic equipment costing thousands and controlling huge production lines is false economy which has already dealt industrial electronics many an unnecessary black eye.

MAY WE HAVE YOUR OPINION?

1 Do you agree that special selection merely results in replacement problems?

2 How many thousands of hours of life should *SUPERSTANDARD* tubes have?

3 What degree of vibration and shock should *SUPERSTANDARD* tubes be capable of withstanding?

4 For what characteristics not now tested should *SUPERSTANDARD* tubes be production tested?

5 Would you be willing to pay a premium price for *SUPERSTANDARD* tubes to attain trouble-free operation?

6 Should Hytron concentrate on developing *SUPERSTANDARD* tubes usable for many special purposes, and avoid trick and highly specialized tubes?

7 How closely should a *SUPERSTANDARD* tube adhere to fundamental characteristics of a standard receiving tube it supersedes?

8 Do you believe *SUPERSTANDARD* tubes should have special bases to avoid replacement by inferior standard receiving tubes?

9 Should *SUPERSTANDARD* tubes have new type numbers, or the old standard type numbers with a special suffix (e.g., 6SJ7GTS)?*

10 Have we omitted pertinent questions you believe important?

NEMA and RMA are now working on type designation systems.

The Hytron SUPERSTANDARD tube is as yet an idea—a postwar project for YOU. You who use the tubes can spark the program—can make it come to life. Hytron will put its postwar engineering drive behind the SUPERSTANDARD tube, if you will help. Let us know the improvements of specific characteristics your experience has proved desirable. Drop a line today to our Commercial Engineering Department.

OLDEST MANUFACTURER SPECIALIZING IN RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE

INDIA—VU7MC, 6.065, Akash Vani, Mysore, scheduled 3:30-4:30, 7:30-11:45 a.m., 9:30-10:30 p.m. In the future other autonomous native states such as Hyderabad and Baroda may have their own SW services. Baroda's proposed transmitter has not yet been installed due to the war.

*VUD4, 9.59, Delhi, 8-11:30 a.m., news at 9:30, 11 a.m.

*VUD5, 7.275, Delhi, 8 a.m.-12 noon; news at 9:30, 10:50, 11 a.m.; also heard 9-10:30 p.m., news at 9:30 p.m.

*VUD6, 9.635, Delhi, 10:50 a.m.-12:30 p.m., news at 10:50, BBC news relay, 11 a.m. QRM'd by CBFX, Montreal, but sometimes gets through to East; heard well in West.

VUB2, 6.150, Bombay, 8:55 a.m.-12:30 p.m.; fair signal to West Coast.

VUC2, 9:530, Calcutta, reported schedule is 3-6 a.m., with fair signal on West Coast.

IRAN—EQC, 9.680, Teheran, reported from Australia as heard 6-7 p.m., closing with clock chimes, a foreign language announcement, and a brisk piece of music. An English language talk concludes at 6:15 p.m., after which bright recordings are played. Seldom heard in U. S.

IRAQ—YI5KG, 7.090 (also reported as 7.085), Baghdad, scheduled 9 a.m.-4:10 p.m.; heard occasionally in U. S., with popular recordings at 12:15 p.m. Reported heard "weak" on West Coast, 10-11:30 a.m.

NEW ZEALAND — *ZLT7, 6.715, Wellington, special National Broadcasting Service news summary for Pacific troops, 5:30-5:40 a.m. Can be heard most mornings in East now; better in West. Operated by Post & Telegraph Department, with 5-kw. power.

PHILIPPINES—WVLC, 7.795, Manila, reported heard after midnight and at 5 a.m. Has been heard calling San Francisco on 8.890 at 9 a.m. Reported heard on 9.792, 6-7 a.m., with the "Philippine Hour." An alternate frequency reported is 18.560.

PY, Press Wireless, 9.305, reported heard 12:30 a.m. and 5-6 a.m.

AHITI—FP8AA, Papeete, 12 midnight-1 a.m., Tuesdays and Fridays; reported good in West, audible some mornings in East.

U.S.S.R. (Asiatic) — RW15, 5.94, Khabarovsk, 2-10 a.m., Home Service only.

Khabarovsk, 13.190, reported heard irregularly, 6:55-7:15, 9-10 p.m.

Komsomolsk, *9.565, dual 8.81, 3-10 a.m. and 11 p.m.-1 a.m., news at 7:40 a.m. on 9.565 only; the 9.565 transmitter reaches the East with a good signal most mornings.

Komsomolsk, *15.230, relays Radio Centre, Moscow, some days, 7:40-8:45 a.m. and 6:47-7:25 p.m., news usually at 7:40 a.m., 7 p.m. Heard both in West and East.

Komsomolsk, 15.110, relays Radio Centre, Moscow, irregularly.

Komsomolsk, 11.885, relays Radio Centre, Moscow, 7:40-8:45 a.m., 6:47-7:25 p.m., news usually at 7:40, 8 a.m., 7 p.m. Heard in East occasionally.

Petropavlovsk, 6.07, relays Radio Centre, Moscow, 7:40-8:45 a.m., news at 7:40 a.m.; also heard irregularly at other times. Fair signal reported in both East and West, irregularly.

ACKNOWLEDGEMENTS

This month our thanks go to:

ARIZONA—Ying Ong; CALIFORNIA—Balbi, Dilg, Gould, Noyes, Foster, Curtiss; COLORADO—Wooley; DISTRICT OF COLUMBIA—Government of India Information Services, Chinese Embassy, Legation of Switzerland, Information Bulletin, Embassy of the U.S.S.R., Royal Norwegian Information Service, Netherlands Information Bureau, Royal Egyptian Legation; ILLINOIS—Hester, Gutter; MASSACHUSETTS—Harris, Florentine, Cotter; NEW JERSEY—Simpson. NEW YORK—Leo T. McCauley (Consul General) Consulate General of Ireland, American-Swedish News Exchange, Inc., Belgian Government Information Center, BBC, Australian News and Information Service, Kulze, Richards; OHIO—Hoiermann; OKLAHOMA—Brewer; PENNSYLVANIA—Bornholdt; RHODE ISLAND—Underwood; TEXAS—Freund; VIRGINIA—Howe, URDXC; WASHINGTON—Hanson; WEST VIRGINIA—Gonder; AUSTRALIA—Gillett, Suffolk, Radio Call; BAFFIN ISLAND (Arctic Circle)—Bettelon; BRITISH GUIANA—de Freitas, ZFY; CANADA—CBC

HOGARTH'S PLANS ARE WELL IN HAND

Hogarth's well aware of the future new possibilities for Echophone. There will be Echophone equipment for use on the citizens' radio communications service band. It is certain to be low in price, high in performance and completely dependable. The present EC-1 covers from 550 kc. to 30 Mc. on three bands . . . electrical bandspread on all bands . . . self-contained speaker . . . 115-125 volts AC or DC.

ECHOPHONE

"The Ears of the World"

**Citizen's radio communications service band, 460-470 Mc., recently proposed by the F.C.C.*

ECHOPHONE RADIO CO., 540 NORTH MICHIGAN AVE., CHICAGO 11, ILLINOIS

RCA Radio-Engineered Batteries for All Types of Sets... and a Complete Line of RCA Dry Batteries

WHEN!—

RCA Radio-Engineered batteries will come to you as soon as civilian radio batteries are released in quantity... and as soon as possible after you order them.

That day may be just around the corner. *Now* is the time to get ready.

Listen to "THE RCA VICTOR SHOW," Sundays, 4:30 P.M., EWT, NBC Network

WHERE!—

You'll be able to order RCA *Radio-Engineered* batteries, as well as tubes, from your tube distributor. RCA batteries will be sold *only* through authorized tube distributors.

WHAT TO DO ABOUT IT

Mail this coupon to your tube distributor *today*. It's your reservation for a personal preview of RCA's battery plans for you. He will send you a complete explanation, telling just what to do to get set for big profits from RCA batteries.

MAIL THIS RESERVATION TODAY!

62-6736-103

DEAR MR. TUBE DISTRIBUTOR:

I'm interested in increasing my battery profits, and I should like information concerning the new line of RCA *Radio-Engineered* batteries. Please mail me all details of the RCA battery plan as soon as possible.

Name.....

Company.....

Address.....

.....

(Montreal, Quebec), Bromley, Pimbert (Toronto Ontario), Harrison, British Columbia; CHINA—T. Y. Penn, Deputy Director General, Central Broadcasting Company; INDIA—The Indian Listener, Wadia; NEW ZEALAND—National Broadcasting Service; TURKEY—Radio Branch, Turkish Press Dept., Ankara.

* * *

LAST MINUTE TIPS

VQF2, 6.985, Kuching, Sarawak (in Borneo), recently heard 12:30-1:45 a.m., music, talks in English; signed off with "God Save the King." Was Jap-controlled, but sign-off indicates it is again in Allied hands. CJA2, Montreal, Canada, heard at 8 p.m. calling GDB, London, approximately 13.760. SPW, 13.635, Warsaw, Poland, heard twice recently, 9-10:15 p.m. ZOY, 7.050, Accra, Gold Coast, 2-3 p.m., news at 2 p.m. New USSR station heard in Russian, 11-11:15 p.m. on approximately 13.450. (Sutton, Ohio). Probably an Asiatic Russian.

ICD, approximately 16.50, Rome, Italy, heard with good signal early in August; messages; said they were "using new transmitter and new studios," and that speech-inverting equipment was expected by August 15. Radio France, 9.520, dual 9.613, 9-10:45 p.m., news 9:30 p.m., asks for "comments and criticisms," address: Radio France, French National News Service, 501 Madison Ave., New York 22. (Gonder, W. Va.)

OIX2, 9.500, Lahti, Finland, heard signing off in English (woman announcer) at 4:50 p.m. Said they were on "exactly 9 and one-half megacycles."

KIO, 11.680, Kahuhu, Hawaii, heard at 8:50 a.m. relaying Manila.

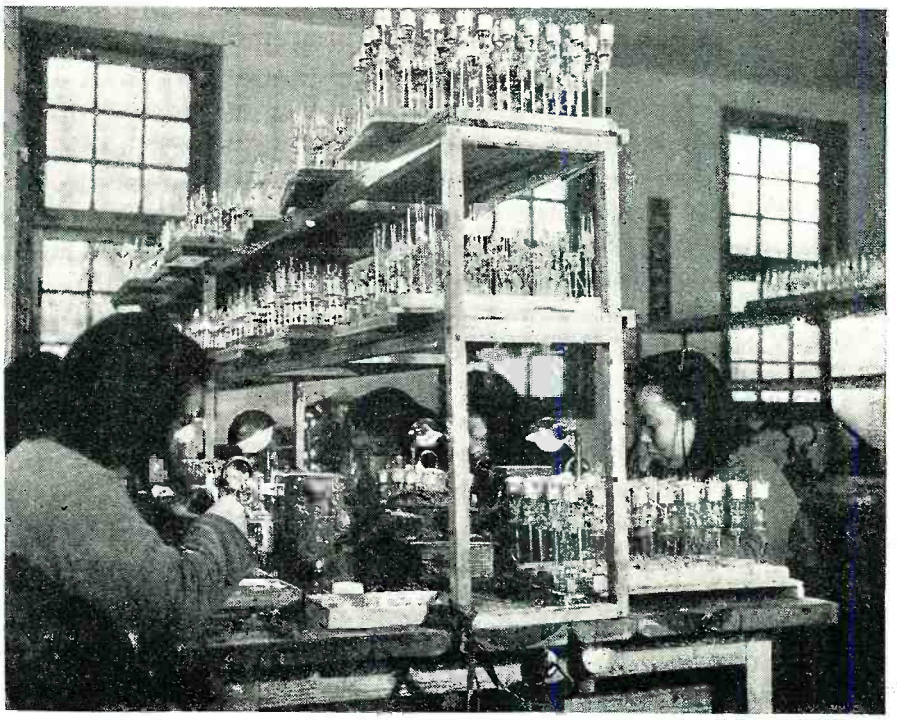
LRA5, 17.720, Buenos Aires, Argentina, heard in English, 5-5:15 p.m., then in Spanish or Portuguese, 5:15-5:27 p.m. sign-off, a recent Friday.

HEF4, 9.185, Bern, has replaced HER3, 6.165, to North America, 9:30-11 p.m., dual 7.380, news at 9:45 p.m. A new Bern frequency of 15.875 has replaced HEO4, 10.342, 3:20-3:50 p.m., news at 3:30 p.m. All Swiss signals are good. (In mid-August, HEF4 was drifting to approximately 9.52.)

VLQ2, 7.215, Brisbane, Australia, heard 3:30-9:30 a.m., news at 4, 7, 9 a.m.; good signal in East. VLC6, 9.615, Shepparton, has news and sports results at dictation speed, 5:45 a.m.; good, copyable signal in East.

CFCX, 6.005, Montreal, Quebec, has CBC news at 7 a.m. Announcement heard of current schedules of the CBC International Service from the powerful (50,000-watt) Sackville, N.B., short-wave transmitters, is now confirmed by a press release from Montreal. These transmitters put Canada on the air 12 hours daily, 7 a.m.-7 p.m. (noon to midnight in the United Kingdom and Western Europe, recently reverted to ordinary summer time after having been on double summer time during the European war); many new entertainment programs in Eng-

This picture was taken in the battery factory of the Central Electric Works near Kweilin, China, before the Jap forces occupied the city. The photograph shows the rather crude method employed in the manufacture of radio tubes. Similar to American industries, girls do the intricate assembly work. The city of Kweilin was recently retaken by the Chinese forces. However, there is considerable doubt as to whether production at this plant has been resumed. The radio industry in China has always been rather crude. Chinese officials aware of this fact have recently made plans to adopt American production methods to facilitate expanding the radio industry in China. Provisions have been made to send a group of engineers to this country to study our production methods.



SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

Five times cited for distinguished wartime service.

. . . NOW, in Peace

you can count on Sprague—just as the nation counted on Sprague in war!

FOR SALE—Riders 1 to 7 $35. Want pocket portable radio. Pvt. A. Ignal, 2333 Grand ave., Bronx 53, N. Y.

FOR SALE OR TRADE—Library of 18 radio and electronic books. Cash or will trade for camera, photo eqpt. or Christy & Pacific appliance course. Sgt. James Stern, 408 S. Tejon st., Colorado Springs, Colo.

URGENTLY NEEDED — Original test sheet or copy for 'O' Radiotecknic laboratory tube tester. Theodore Vanderwonde, Box 531, Randolph, Wisc.

WILL TRADE—Chicago Industrial Instrument #431 V-O-M complete for small table radio a-c or ac-dc. Edward Schuman, 65 E. 53rd st., Brooklyn 3, N. Y.

FOR SALE—Triplett #677 d-c voltmeter, #675 d-c milliammeter; 673 a-c voltmeter; #678 ohmeter $15 ea.; sig. gen. 43; Jensen 15" speaker with power supply and Philco record player. Elizabeth Beebe, Vivian st., R.F.D. #2, New London, Conn.

FOR SALE—American 2-button carbon mike; Shure crystal; Turner 999 Dynamic mike; Lektrophone contact mike with built-in volume control and amphenol plug; Signal electric drill, etc. John Archibald, 1722 Melville st., Bronx 60, N. Y.

WANTED—Complete set Riders, new or used. Donald McClish, Box 87, Mesick, Mich.

WILL TRADE—2 ac-dc radios, need slight repairs. Want 3 or 4-tube set with short-wave plug-in-coils. T. Prince, Box 871, Uniontown, Pa.

FOR SALE—Philco all-wave sig. gen. $20; Supreme tube tester with adapters $25; Green Flyer phono motor $15; power transformers and other parts and tubes. Clarks Radio Shop, Corinna, Me.

WANTED—Signal generator. Will pay cash. Edward Dowse, 329 Reed ave., Salt Lake City, Utah.

FOR SALE—Over 100 new tubes at 40% off ceiling. Send for list. G. H. Doty, 1036 S. Broadway, Dayton 8, Ohio.

WILL TRADE—6F6-G, 6L7, 6U5, 6C5, 12SK7, 12SA7, 50L6 and 6SC7GT/G tubes for Riders 12, 13 or 14. Shigeo Akada, 3307-A, Newell, Calif.

FOR SALE—N. R. I. tester, parts for 10w amplifier, and 16mm movie camera. Want 35mm camera. Pvt. S. W. Reed 3rd, PIAT Co. X, 55 S.A.W., A.A.B., Santa Ana, Calif.

WANTED—1st class serviceman, real opportunity for right man. Southern Radio Service, Thomasville, Ga.

FOR SALE—Bogan 70-watt amplifier with built-in phono; 2 Turner 33D mikes; 4 Utah 12" speakers; 3 outdoor all steel baffles; 2 indoor baffles; all sightly used $200. Carl L. Ding, 213 W. Emerson st., Princeton, Ind.

FOR SALE—Tubes at wholesale prices. Write for list. Will pay cash for Riders #2. J. T. Matthews, 1000 Decker st., Monongahela, Pa.

WANTED—Motorola Wireless record player, WR3. Will sell Weston R.F. ammeter CV382, $6. M. Kelly, 708 Newington ave., Baltimore, Md.

URGENTLY NEEDED—Any kind radio and technical radio books. P.F.C. Joseph Geviado, 913077 U.S.M.C., M.N.-F.O.T.D.—O.T.U. 2—N.A.A.S., Kingsville, Texas.

FOR SALE—Clough-Brengle CRO 3" scope; Jensen M-10 AC 14" auditorium speaker; RCA 2MV 97-B oscillator and PA audio and power transformers. J. J. Bressler, 25 Dongan Place, New York 34, N. Y.

WANTED—10" & 12" record changer. Cash or will trade Univex Mercury f3.5, carrying case, tripod, range finder and extinction meter. Jack Ferdim, 1247 Grant ave., Bronx 56, N. Y.

FOR SALE — Sprayberry radio servicing course; Olympian C melody saxophone, Pioneer gene-motor; Jewell set analyzer and Philco #38 console with tubes. Want Riders 2, 6 and 8. Clifford Lessig, 24 Eighth st., Frenchtown, N. J.

WILL TRADE—Astronomical telescope; midget radio, electroscope for testing radium, etc. Want portable typewriter. F. Madlinger, 1704 Palmetto st., Brooklyn 27, N. Y.

WANTED—New or used 1-crystal pickup replacement cartridge, 3-hole mount, and crystal pickup. Monroe Hill, Apt. 2, 1909 N. E. 6th st., Oklahoma City, Okla.

FOR SALE—Triplett professional all-purpose tester #1175-B, with test leads and instruction book. Want late Hickok tracemeter or Rider chanalyst. Robert F. Young, 729 W. Dominick st., Rome, N. Y.

URGENTLY NEEDED—1¼ and 1½ watt Neon test bulbs. J. T. Necklem, Colonel, c/o G.S.C. I.N.P.—EB. 2105 Axton road, Mansfield, Ohio.

FOR SALE—Sensitive d-c relays, coil resistance 8000 ohms, single pole, double throw, 2 amps. at 115v. a-c $1 ea. Joseph F. McDonald, P. O. Box 123, New Hyde Park, N. Y.

WILL TRADE—17-jewel Gruen watch for set analyzer or multimeter in good condition. W. H. Elkins, 389 Cambridge ave., Memphis 5, Tenn.

WANTED—25Z5 rectifier tube. Don Beckerby, Wolf Point, Mont.

FOR SALE—Instructograph code transmitter 5 to 40 w.p.m. with basic tapes, three advanced tapes, headphone, tube oscillator and key, $25. Pfc. Don E. Calkins, Hq. & Serv. Co. TAS, Fort Knox, Ky.

URGENTLY NEEDED—1A7, 1N5, 1H5, 1T5, 6G6, 117Z6, 1A5 tubes and Rider's-Lee-Bovee Radio Service, Rt. 4, Anoka, Minn.

SELL OR TRADE—Stock of tubes to trade for 1S4, 6A7, 25D8, 25Z6, 35Z5 tubes or will pay cash. Roger F. Cain, Savannah, Mo.

FOR SALE—Capacitor analyzer, $20 and 6B5, 45, 12SA7, 1N5GT, 6V6, 12SQ7 tubes. Leyden Radio Sales & Service, 9651 Franklin ave., Franklin Park, Ill.

WANTED—Two 25Z5 tubes. Cash or will trade. Ray Jay, 207 Brown st., Milton, Ore.

FOR SALE—Clough Brengle sig. gen. with built-in motor-driven condenser "Wobbulator" 100KC to 30MC on fundamentals & higher on harmonics; recalibrated and with circuit diagram $40 or will exchange for Riders 10, 11, 13 and 14. Philip P. Goldstein, 288 ave. P., Brooklyn 4, N. Y.

FOR SALE—Superior condenser tester BR-44 and 1 ea. 25L6, OZ4, 12SK7, 32L6, 6J7, 6U7, 6L6; two 24, 78; three 6K7, 80, 25Z5, 43 and four 27. Tubes $14. Walter Socka, 8 Tonasmy ave., Schenectady 8, N. Y.

WANTED—Signal Generator 120 KC to 260 MC. David's Radio Service, 319 Los Angeles st., Bellflower, Calif.

WILL TRADE—Slightly used Remington shaver. Want V-O-M or what have you. Cpl. W. A. Seeger, c/o Postmaster, San Francisco.

FOR SALE—Janette rotary converter 110v d-c to 110 a-c, 500 watts. Wilbur Gastonguay, Box 345, Topanga, Calif.

URGENTLY NEEDED — V.T.C.; LS-22, LS-21 or LS-19 interstage audio transformer. James G. E. DuBois, 1081 Jackson ave., St. Louis 5, Mo.

WILL TRADE—Used Webster recorder and phono changer; transmitter tubes and parts, receiving tubes; Meissner F.M. converter; 30-watt amplifier and Kainer horn. Want Hickok 510X-530 tube tester and 592 Supreme analyzer. R. Voigt, 4365 Miller road, Flint, Mich.

WANTED—Set tester, tube tester or combination; also sig. gen. What have you? F. M. Millington, 1519 W. Compton Blvd., Clearwater, Calif.

FOR SALE—500w transmitter with receiver. Tony Zucco, 3rd st., Cresson, Pa.

WANTED—Hickok sig. gen. #188x and late tube tester. S. Marsh, 1308 Rosedale ave., Chicago 40, Ill.

WILL TRADE—RCA auto radio #67M3. Want phono-recorder unit or amplifier. Robert F. Bullock, P. O. Box 132, Branch, Ark.

YOUR OWN AD RUN FREE!

For three wartime years, the Sprague Trading Post helped radio men sell, trade or buy needed materials. Now, with the advent of Peace, this free advertising service will continue as long as the need exists.

We'll gladly run your ad free in the first available issue of one of the 5 magazines in which the Trading Post appears. All we ask is that it be written clearly and concisely, that it be confined to radio materials, and that it fit in with the spirit of this service.

As always we know we can count on you to use Sprague Condensers and Koolohm Resistors—*and to ask for them by name!*

HARRY KALKER, Sales Manager

Dept. RN-105, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing distributing organization for products of the Sprague Electric Co.

SPRAGUE CONDENSERS
KOOLOHM RESISTORS

TM. REGISTERED U. S. PATENT OFFICE

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements.

lish and French to Canadian occupation forces have been inaugurated, with broadcasts to United Kingdom, France, Czechoslovakia, Holland, and Germany, being increased. Schedule: CHTA, 15.22, 7 a.m.-4:30 p.m.; CHOL, 11.72, 4:45-7 p.m.

A letter from Brazzaville indicates that FZI is due to "take a back seat" in favor of Radio France, Paris. On 9.440, Brazzaville is still heard with excellent signal throughout the U.S., news in English at 2:45, 4:45, 6:15, 7:25 p.m. The last two are also heard on 11.97.

ZFY, 6.000, Georgetown, British Guiana, sends a good signal to East, 3:45-8:15 p.m. ZFY's studios and offices were burned in February; modern, air conditioned, sound-proofed, better-equipped studios are to be built. In the meantime, ZFY has been using a temporary studio set up in a Masonic lodge room. (de Freitas, ZFY.)

RNB, Leopoldville, Belgian Congo, is now heard on 9.750, instead of former 9.783, news at 8:15 p.m. Still relays BBC, 9:15 p.m.-12:45 a.m. A letter from the Belgian Government Information Center, New York City, states there are no short-wave stations in Belgium at present, and that Leopoldville will shortly discontinue its independent programs and only relay Brussels. Brussels has been reported from time to time recently as on the air, however, on 11.925, fair until 3:30 p.m., announcing as "Radio National Belge." Also reported on 11.930 and 17.845.

The Royal Norwegian Information Service, Washington, reports the Jeloey short-wave broadcaster is in operation on experimental wavelengths only and has no regular service. Details from Oslo are promised shortly.

Most BBC frequencies come through from London with excellent signal strength. The 31-meter band is alive with London transmitters at night. Tuning across the 31-meter band after midnight and before 1:30 a.m., the General Forces Program and Pacific Service transmitters are all over—9.51, 9.60, 9.64, 9.69. Have word of a SW station at Lusaka, Northern Rhodesia, on 7.22, around 1 p.m.; identifies in English; uses several native languages, woman announcer. Moscow is heard well in Chicago at 12 noon EWT on 15.75 and also irregularly in evenings on same frequencies; sometimes is very strong.

As many may know, "Deutcher Kerzwellen Sender Atlantik" ("Radio Atlantic") was operated from England; this was revealed after V-E day. (Gutter, Illinois.)

CKRO, 6.150, Winnipeg, Manitoba, scheduled 10 p.m.-1 or 1:05 a.m. (Hester, Illinois.)

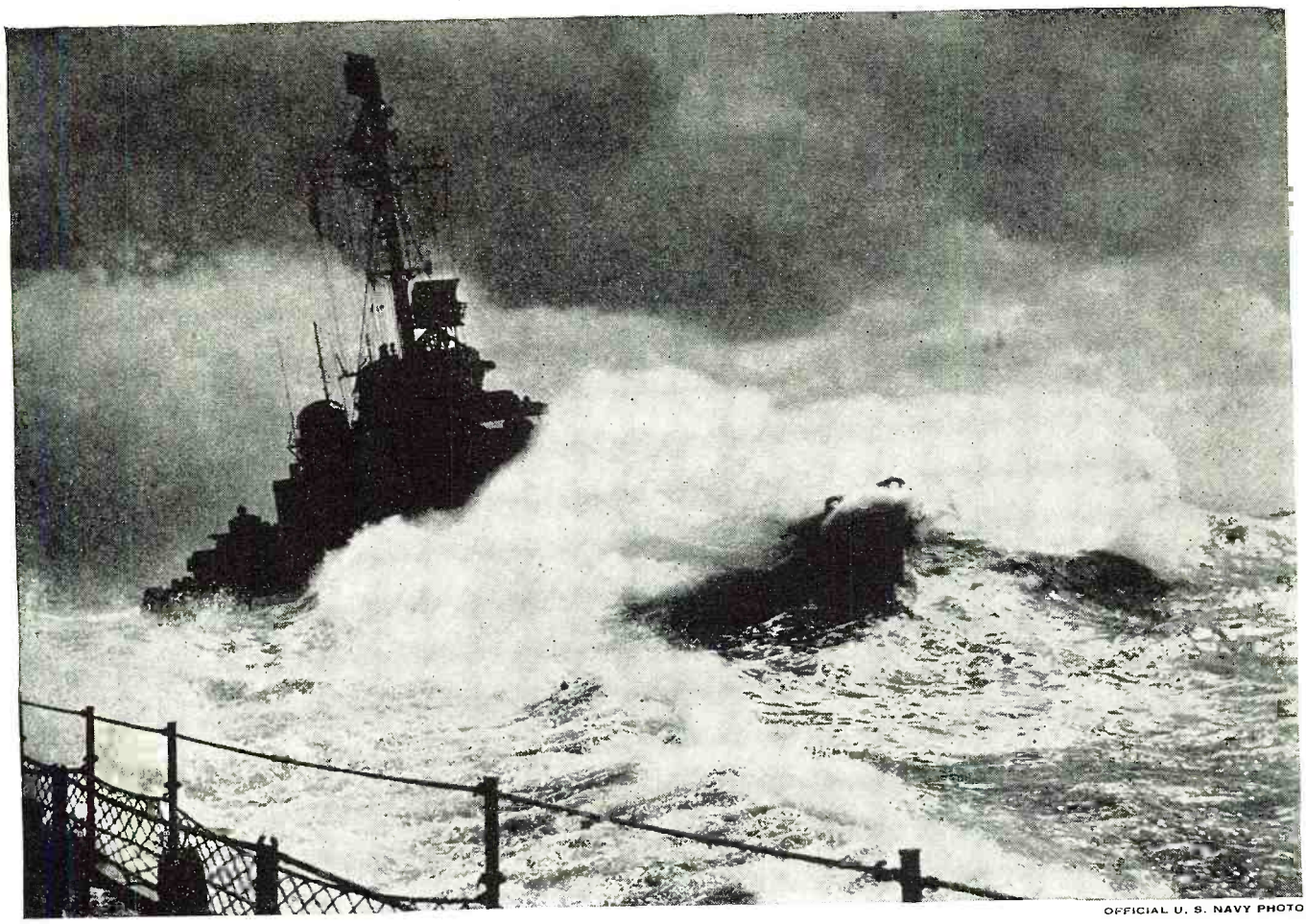
As of August 1, English language transmissions from Radio Centre, Moscow, were listed by the USSR Embassy, Washington, as: 7-7:40 a.m., 11.83, 15.75; 7:40-8:20 a.m., 6.07, 9.56, 10.44, 11.63; 8:20-8:45 a.m., 11.83, 15.75; 12 noon-12:30 p.m., 11.83, 15.75; 6:47-7:25 p.m., 7.03, 11.83, 15.75; 8-10 p.m., 7.03, 9.46, 11.95. Reception in the East is erratic, best bets being 15.75 and 9.565, mornings, and 15.23, 6:47-7:25 p.m. (although not listed by the Embassy, have been hearing this one almost daily).

AFN, 6.080, Paris, new 100-kw station operated by Armed Forces Network in the European Theatre, now scheduled midnight-8:05 p.m., when has twenty minutes of operational notes at dictation speed. Sign-off at 8:05 p.m. is with National Anthem. Excellent signal here in East, some QRM.

VLW6, 9.680, Perth, Australia, heard with excellent signals in East, mornings, world news at 7 a.m. followed by ABC news. Announces this is the "nightly ABC Service."

ZNR, 12.115, Aden, heard again, 12:15-1:15 p.m. "Omdurman Radio," 13.200, Anglo-Egyptian Sudan, heard 12 noon-2 p.m. Vienna has been heard recently on 7.140 at 4:30 p.m. The summer schedule of Ponta Delgada, Azores, 4.040, is 4-6 p.m. CP5, LaPaz, Bolivia, reported back on 6.205. HJAG, Barranquilla, Colombia, is back on 4.975. PRJ4, 4.825, Parnaiba, Piaui, Brazil, has returned to this frequency from 9.205. HI3X, 12.105, Ciudad Trujillo, Dominican Republic, has returned to this frequency from 11.850, heard 6:10-10:40 p.m. HC1AC, 7.200, Quito, Ecuador, "La Voz de la Democracia," is heard with strong signals until 12:15 a.m.; HC1BS, 9.355, Quito, is heard 9 a.m.-midnight, HC2RL, 6.635, Guayaquil, is reported returned to the air.

(*Continued on page* 130)



OFFICIAL U. S. NAVY PHOTO

Any port in a storm ... but there are no ports

More than one sailor has said, "It's a helluva place to fight a war!"

That's a miracle of understatement when you know the Pacific as well as the U. S. Navy knows it.

They know how many thousands of miles you have to go before you reach the fighting fronts.

They know there's almost continual rain and bad weather to hamper operations after you get there.

And they know there are no good ports!

Think of the thousands of ships, and the millions of tons of supplies it takes to keep our fighting forces moving toward Japan.

Imagine, if you can, the problem of handling those ships and supplies with no port facilities.

There are no giant cargo cranes...no miles of docks and warehouses...nothing but beaches, and human backs, and a refusal to call any job impossible.

Remember, too:

It takes 3 ships to do the supply job in the Pacific that 1 ship can do in the Atlantic.

It takes 6 to 11 tons of supplies to put a man on the Pacific battleline, and another ton per month to keep him supplied.

It takes a supply vessel, under ideal conditions, half a year to make one round trip.

Add up those facts, multiply by the number of sailors, soldiers, and marines for whom the Navy is responsible.

Maybe you'll begin to realize what "no ports" can mean in the rough, tough waters of the Pacific.

Maybe you'll see that we have *two* reasons to be proud of the U. S. Navy. *First*, the way they've sunk the enemy's ships.

Second, the way they sail *your* ships ...taking the worst the Pacific can hand them...but keeping the supply lines open ...keeping the attack *on schedule!*

SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

★

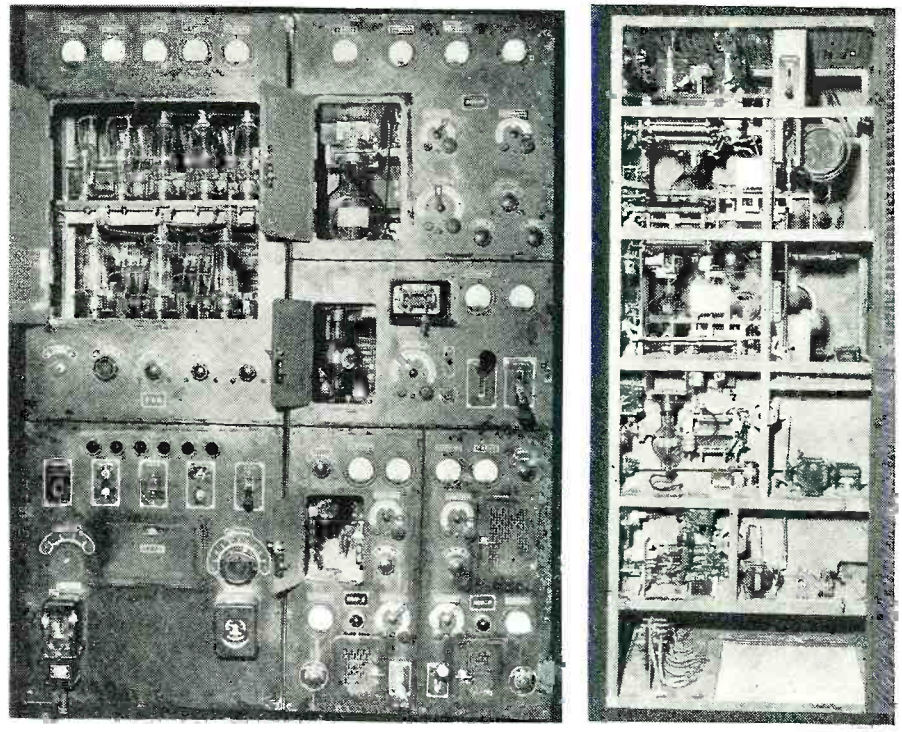
Division of the Sperry Corporation

LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS
CLEVELAND • BROOKLYN • HONOLULU

MAKERS OF PRECISION INSTRUMENTS FOR THE ARMED FORCES

CAPTURED 1000 Watt JAP TRANSMITTER

This transmitter, like all radio equipment produced by the Japs, has the appearance of being copied direct from American models.



Front panel view of Jap 1 kw. transmitter shows power supply racks toward the left and r.f. section on the right. Side view shows r.f. section of transmitter. From top to bottom, antenna tuning, power amplifier, driver, buffer doubler, and oscillator.

SHERMAN to the contrary, war sometimes has advantages, at least for former civilian radiomen in the signal corps. T/5 John M. Young, of Springfield, Missouri, for example, found that it gave him the opportunity every ham dreams about, to have a one-kilowatt transmitter put in his lap with the privilege of playing around with it all he pleases, finding out what makes it tick, and making it tick some more.

The set was a Japanese 1000-watt CW transmitter captured on Luzon by the U. S. Army Signal Corps. It was, by far, not the best or largest we had captured, but it was the only one of its kind we had found.

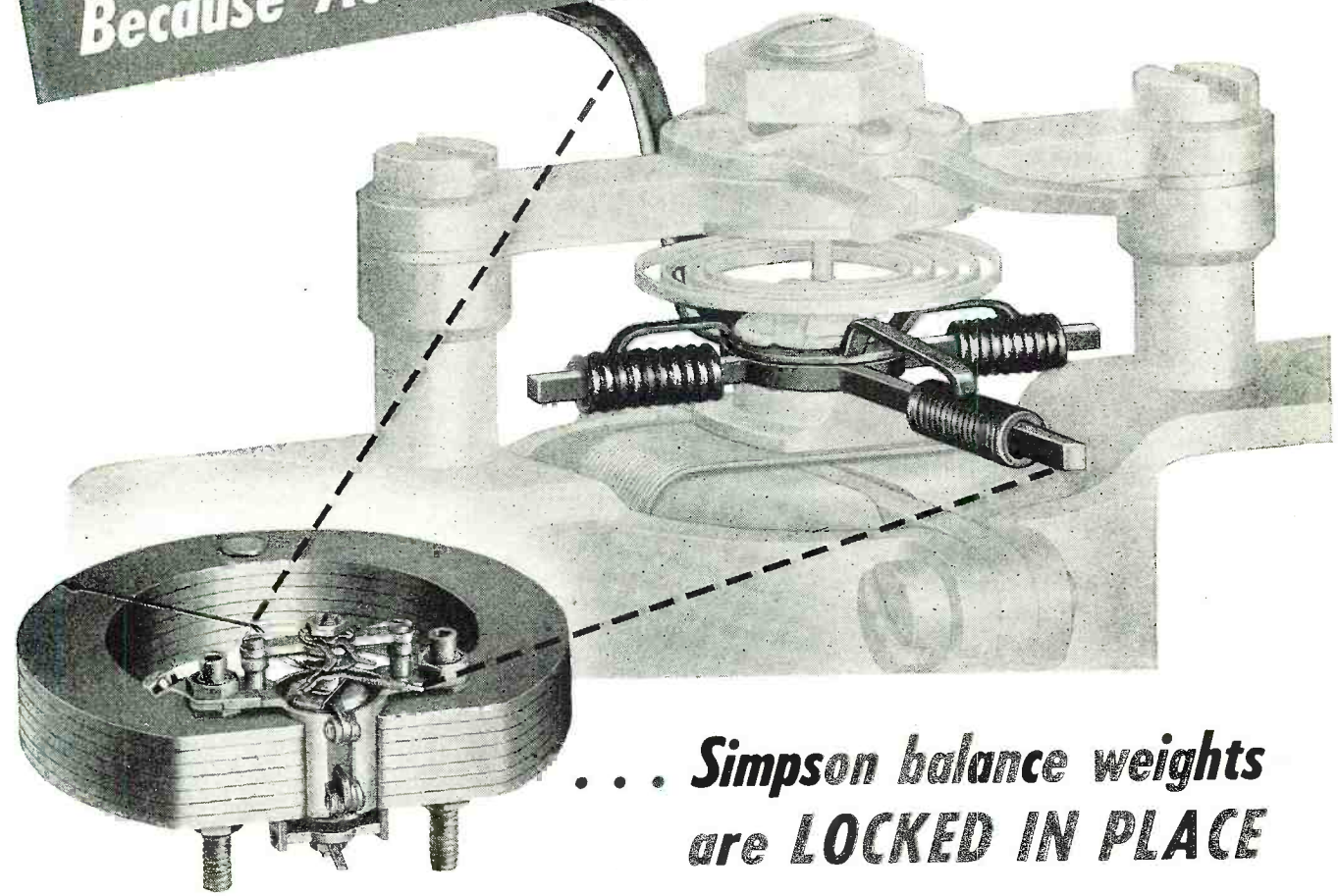
From the front panel, it looked like a transmitter that might have been designed in America about ten or twelve years ago. It came in two separate cabinets about six feet high and four feet wide, the r.f. section and the power supply. It was a conventional exciter, buffer-doubler, driver and power amplifier, all single-ended and capacitively coupled with a link coupling from the final stage to a pi-network antenna matching arrangement.

The interior revealed coils, resistors, condensers, and potentiometers of a design also about ten years old. The use of heavy aluminum castings, glass stand-offs, and connecting shafts from the front panel, was evident throughout. Each of the multitude of doors on the front and side was protected by an efficient interlock of a wedge-contact type. It had no forced air or water cooling arrangement. Flat discs mounted on wooden coil forms and heavy variable condensers served their purpose. The heavy construction of the condensers, especially in the driver and power amplifier stages, could take a fair amount of arcing.

All tube filaments had voltage regulators on the primary side of the transformers. They were variable resistors, a sliding arm over resistance wire wound on a wooden form, somewhat similar to the laboratory type variable resistor.

Of its six meters, five were Japanese

Because Accuracy Hangs in the Balance



. . . Simpson balance weights are LOCKED IN PLACE

PERHAPS it's the smaller details, like these balance weights, that best illustrate the value of Simpson's 35 years of experience.

Though only tiny coils of wire, these balance weights have an important function—to offset the weight of the pointer so the moving assembly will swing in perfect balance. If the instrument is to stay accurate, they must stay in place.

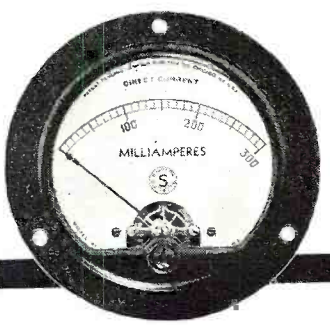
So Simpson has devised a method of locking these balance weights in position. This construction not only defeats vibration and shock, it permits even greater initial accuracy and makes possible faster, more efficient production.

Such refinements come from a greater knowledge of the problems of instrument manufacture, and a greater fund of practical experience which can be applied to their solution. This is the simple reason Simpson Instruments are writing such an outstanding service record in posts of vital responsibility. This, too, is your guarantee of the ablest translation of today's advances in tomorrow's instruments.

SIMPSON ELECTRIC COMPANY
5200-5218 Kinzie St., Chicago 44, Illinois

Simpson

INSTRUMENTS THAT STAY ACCURATE



Buy War Bonds and Stamps for Victory

and one, the driver and power amplifier filament voltages, was a *Weston,* model 476, 0 to 15 a.c. voltmeter, manufactured in America.

The exciter provided for either crystal control or master oscillator operation. It was divided into two electrically separate sections, low and high frequency. Choice was made with a heavy-handled knife switch that resembled a high power switch. It incorporated four crystal sockets for each section, but there appeared a peculiarity. Two of the sockets were of the double pronged, plug-in variety while the other two had circular bases. Evidently the lack of standardization in Japanese crystal manufacture necessitated designing the transmitter to utilize existing crystals. It had no insulation or temperature control in the crystal compartment. Only a temperature compensating resistor circuit gave it any semblance of stability. The tube was the equivalent of a 47, but its workmanship and results were below American standards.

The buffer-doubler employed an American type 860 tube. Its circuit design was conventional and matched the rest of the rig in being out-moded. The only peculiarity of this stage was two knife switches on the front panel that shorted out fixed coils and condensers. The handles were large and again similar to a power switch.

The driver also used an American type 860 with the same features found in such a single-ended stage a decade ago. Keying of the screen grid of this circuit left the oscillator and buffer-doubler constantly excited. The keying relay was sluggish but ruggedly built. It could key up to about 150 words a minute.

The power amplifier, with its American-type 861 tube, was elementary with a crude feedback circuit for neutralization.

The power supply was a three-phase, 220-volt bridge rectifier using six 820 type, mercury vapor rectifiers for the plate power and bias supply from two 866's in full wave, single-phase rectification. Wire wound bleeder resistors, in banks, looked serviceable, but showed sign of sweating. Transformers and filter condensers appeared adequate. The transformers had a lot of iron in them, and the workmanship of the winding was passable.

An overload relay of the magnetic coil variety was reset by a toggle switch. The time delay was a clock arrangement, which could be set for any desired time. Fuses were cartridge type.

The potentiometers and switches were heavy and sluggish.

The Japanese had made this transmitter work for them, so why not make it work for us? That, again, was the job of signal corps technician, John Young. With typical ingenuity, he cannibalized a power transformer from another captured set, and wound some copper tubing to replace the driver and power amplifier coils that were missing. Tubes, found separately, were put to use. Young tried hit-and-miss methods with the foreign dials and the meters began to respond. Reflected impedance kept knocking the exciter off frequency. It was a touchy job, since no provisions had been made to lower the plate power during tuning. 861's were hard to get, at that stage of the operation, and the current carrying capacity of the Jap counter-part was uncertain. The danger of drawing too much current and burning out the tube was considerable.

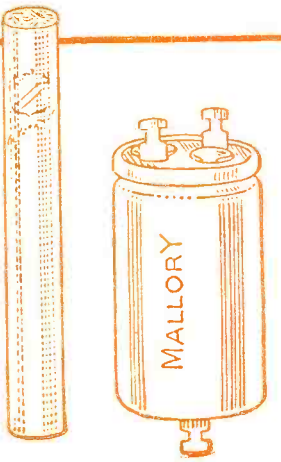
Finally, after tuning each stage and constantly retuning the preceding stages, the transmitter was ready to go on the air. The link coupling to the antenna proved inadequate, so Young tapped into the power amplifier tank directly. It worked.

Our own superior equipment was being installed by then, and though the Jap transmitter's frequency was unstable and its design outmoded, it was employed as a stand-by.

This set does not typify Japanese signal equipment. Although the Japs haven't surpassed us, the U. S. Army Signal Corps today is using a good deal of captured equipment to supplement its own supply. A high degree of skill and constant training on the part of signal corps personnel has made this equipment serve the vast Southwest Pacific communications system.

-30-

DUALS
with Lugs



They're GOOD *and* SMALL

Smaller than a cigarette—*smaller, in fact, than some of the smallest cardboard capacitors made!* But aluminum-cased, hermetically sealed! Long-lived, dependable! That's the story of the new Mallory Duals.

Notice those lugs at top and bottom! They eliminate broken leads, difficult skinning operations . . . make handy anchors for other wiring.

Notice especially the bottom capacitor in the upper left-hand picture. That's the Mallory "TCS," each section of which is independent of the other. It will replace units of common negative, common positive or separate section construction—yet it's the *smallest* separate section unit ever made!

These Mallory Dual Capacitors are part of a *complete new line,* including pint-sized single units too. Get acquainted with the entire family! See them—buy them at your nearest Mallory distributor.

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

More than ever—
ALWAYS
INSIST ON

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

VIBRATORS • VIBRAPACKS* • CONDENSERS
VOLUME CONTROLS • SWITCHES • RESISTORS
FILTERS • RECTIFIERS • POWER SUPPLIES

ALSO MALLORY "TROPICAL"* DRY BATTERIES, ORIGINALLY DEVELOPED BY MALLORY FOR THE U. S. ARMY SIGNAL CORPS, NOT PRESENTLY AVAILABLE FOR CIVILIAN USE.

*Trademarks

Within the INDUSTRY

DON R. CANNON has been named sales manager of *The Radio Craftsmen*, of Chicago, manufacturers of radio and electronic equipment.

Mr. Cannon joined the company after serving for more than two years as the production supervisor for the Dayton Signal Corps Procurement District at Dayton, Ohio.

Prior to his service with the Signal Corps, Mr. Cannon was the midwest manager for the *Electric Auto-lite Company*, Storage Battery Division.

At the same time, Byron L. Friend, partner of the company, announced the appointment of Edward E. Schultz, Jr., formerly of *Press Wireless*, to the post of chief engineer for the company.

* * *

W. G. H. FINCH, formerly assistant chief engineer of the *Federal Communications Commission*, has been promoted to Captain. Captain Finch had been a Lt. Commander in the Naval Reserve for some time before the outbreak of war and was made a Commander in 1942.

Captain Finch relinquished his post as president of Finch Laboratories, which he founded in 1935, to volunteer for active duty with the United States Navy. He is now on the staff of Commodore J. B. Dow, U.S.N., in the research and design branch of the electronics division of the Bureau of Ships.

* * *

ELWOOD R. BERKELEY has been appointed divisional manager in charge of radios and major appliances of *American Wholesalers*, distributors for *The Crosley Corporation*.

Mr. Berkeley previously served as sales promotion manager of the *Premier* division of the *Electric Vacuum Cleaner Company* of Cleveland. Prior to his association with *Premier*, Mr. Berkeley spent approximately two years with the *Nash-Kelvinator Corporation* and before that time, served for six years in the merchandising of major household appliances for the *Hecht Company* of Washington, D. C.

* * *

RADIO PARTS AND ELECTRONIC EQUIPMENT SHOWS, INC., a newly formed corporation, is sponsored by Radio Manufacturers Association (Parts Division), Association of Electronic Parts and Equipment Manufacturers, Sales Managers Club, Eastern Division, and National Electronic Distributors Association.

The purpose of this new corporation is to conduct postwar national and regional exhibitions or conferences for the benefit of member exhibitors in the radio and electronic industry.

At the initial meeting of the Board of Directors held at the Stevens Hotel in Chicago, the following officers were elected: president, H. W. Clough, *Belden Manufacturing Company;* vice-president, Charles Golenpaul, *Aerovox Corporation;* secretary, Jerome J. Kahn, *Standard Transformer Corporation,* and treasurer, Sam Poncher, *Newark Electric Company.* J. Arthur Kealy, of the law firm of Ungaro & Sherwood, Chicago, corporation attorney and active in the radio industry, was appointed general counsel.

The corporation has planned to hold an industry show as soon as practicable following the lifting of travel and other restrictions. Present plans also include the appointment of a show manager on a full-time basis to handle the direction and manifold details in connection with the conduct of the type of shows planned.

* * *

OSCAR HAMMARLUND, founder of *Hammarlund Manufacturing Company, Inc.,* and a communications pioneer, died August 25 at his home in Brooklyn at the age of 83. Mr. Hammarlund was born in Stockholm, Sweden and came to the United States in 1882 to accept a position with the *Elgin Watch Company.* In 1886 he joined *Western Electric Company* as superintendent of their Chicago plant. He subsequently worked for *Gray National Tel-autograph Company* where he was closely associated with Elisha Gray, co-inventor of the telephone, in the development of the technique of transmitting actual writing over wires. He founded the *Hammarlund Company* in 1910. The company manufactures radio apparatus and components which have been used by the Armed Forces in World War II.

* * *

BENDIX AVIATION CORPORATION has formed a new division known as *Bendix International* to handle their foreign trade program. With the exception of the United States and Canada, they will handle, throughout the world, the products of the seventeen divisions of the corporation.

Charles T. Zaoral, who joined the corporation in January as coordinator of foreign affairs, will be general manager of this new division. Other ap-

Another "First"!

25,000 volts accelerating potential on a cathode-ray tube...

DuMONT MULTI-BAND

TYPE 5RP CATHODE-RAY TUBE

Cylindrical flat-face tube. Approximately the size of conventional 5-inch tubes. Deflection-plate leads brought out through neck instead of base. Shunt input capacities and cross-coupling effects reduced to minimum. Second anode and intensifier leads brought out through envelope to facilitate high-voltage operation.

We repeat: 25,000 volts accelerating potential on a cathode-ray tube! That's front-page electronic news. Likewise cathode-ray history in the making.

The DuMont Multi-Band Tube (Type 5RP) permits recording at writing rates in excess of 2500 km/sec (using a 35 mm camera with f:1.9 lens) corresponding to sine wave transients at 40 megacycles!

This is a hot-cathode, permanently-sealed, high-vacuum tube. Subdivision of the intensifier element provides a controlled gradient allowing a total accelerating potential of 25,000 volts to be employed, with only slightly reduced deflection sensitivity. Greatly increased brightness with small spot size results in a writing rate far exceeding that heretofore obtainable.

Yes, DuMont pioneering continues.

Literature on request.

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK

pointments to this new division include: F. A. Stanton, foreign patent counsel, who represented Bendix in Paris for many years; L. B. Coates, division comptroller, formerly of the central staff; Paul Moss, sales manager; Harold McEnness, assistant sales manager. Fernando Jose Cardenas, formerly with *Westinghouse, General Electric,* and *Sylvania,* is manager of central and South American territories.

Bendix International has established headquarters at the corporation's New York office, 30 Rockefeller Plaza.

* * *

HARRY E. FOSTER of *Foster Agencies* was elected president at the annual meeting of the *Radio Executives Club of Toronto.* He succeeds C. W. Wright, founder of the club and president for the past two years.

Mr. Foster is supported by Vice-President Walter Elliott, *Elliott-Haynes Ltd.,* Secretary Art Benson, *Canadian Broadcaster,* and Treasurer Walter Enger, *McKim Advertising Ltd.*

* * *

JAMES T. WATSON has been elected vice-president of *Maguire Industries, Inc.*

Mr. Watson was president of the *Meissner Manufacturing Company* which has been purchased by *Maguire Industries, Inc.* The *Meissner* company will operate as a *Maguire* division under the management of Mr. Watson.

The *Meissner Manufacturing Company,* founded in Chicago in 1922, became a part of *Maguire Industries, Inc.,* New York, late in June of this year. The firm was started by James T. Watson and its early business consisted entirely of the manufacture of coils which were sold to radio set manufacturers and servicemen. In 1936, the plant and executive offices were moved to Mt. Carmel, Illinois.

* * *

JAMES KNIGHTS COMPANY of Sandwich, Illinois, has announced the opening of a Chicago sales office, headed by E. H. Aberdeen, located at 175 West Jackson Boulevard.

Mr. Aberdeen has been active in the *James Knights* sales department for some time. He is now working with radio-electronic manufacturers in the development of improved postwar applications for *James Knights* crystals and other products manufactured by this company.

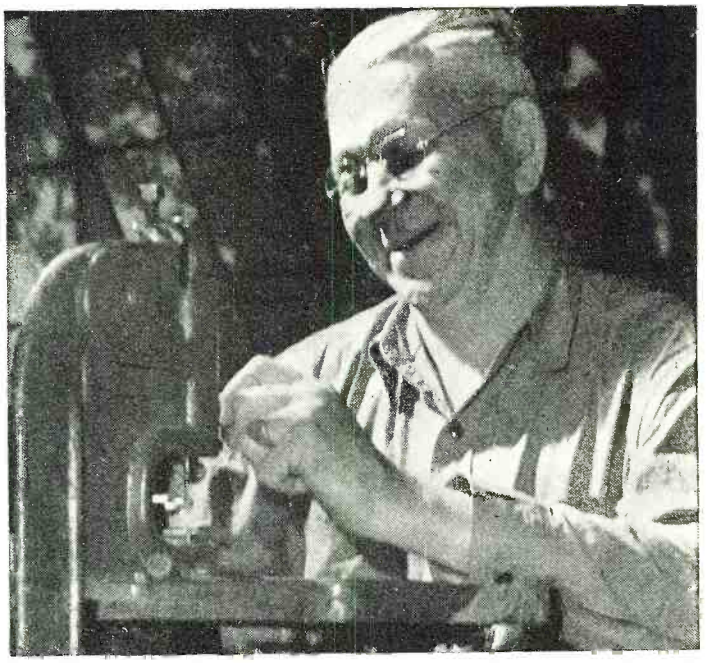
* * *

ELECTRONIC LABORATORIES, INC. of Indianapolis through its Board of Directors has announced the election of new officers and several promotions in the company.

The new chairman of the Board of Directors is Norman R. Kevers, formerly president of the company. William W. Garstang has been elected president. He was formerly vice-president and general manager. Three

PRECISION
is a hobby
in MT. CARMEL, ILL.

Yes, precision is the hobby of the men and women who make up Meissner's famed "*precision-el.*" The high quality electronic equipment that their skilled fingers produce each day is proof enough that they enjoy the work as thoroughly as they enjoy their after-hours hobbies. You'll find more proof in the photographs on this page.

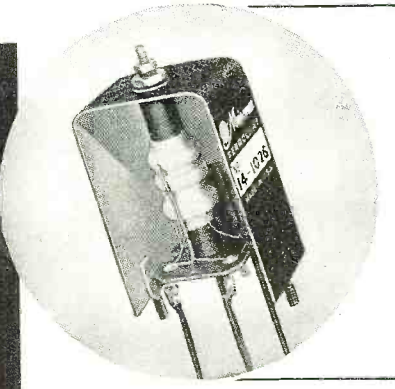


It could be a new grandson or a 3-pound bass that brings a smile like this, but it's not! It's pride in a precision electronic job well done. It's a reason for higher quality in Meissner products.

This "precisioneer" takes the same interest in his work at Meissner as he does in his home. He proves it with a smile that is typical of *precision-el* — as typical as the precision quality of Meissner products.

Baseball broadcast? Not on your life. But it's a "homer" for this member of Meissner's laboratory staff. The satisfied smile means that the instrument he's testing is "on the Meissner quality beam."

Here's a member of Meissner's *precision-el* whose smile is contagious. Delicate adjustments properly made are the reason. Higher quality in Meissner electronic equipment is the result!



Replace Broadcast Band Coils Easily

These Adjustable-Inductance Ferrocart (iron core) coils will replace Antenna, RF or Oscillator coils without the trouble of locating "exact duplicates" because they are continuously variable in inductance over a wide range. The inductance of the old coil is easily matched by simple screwdriver adjustment. Ferrocart iron cores add gain and selectivity to the receiver. Available shielded or unshielded, shipped with complete instructions. Order by number. 14-1026 Univ. Ant. Coil; 14-1027 Univ. R.F. Coil; 14-1028 Univ. Osc. Coil. Price $1.50 each.

MEISSNER

MANUFACTURING COMPANY • MT. CARMEL, ILL.

ADVANCED ELECTRONIC RESEARCH AND MANUFACTURE

Export Division: 25 Warren St., New York; Cable: Simontrice

vice-presidents were named, Walter E. Peek, sales manager; Paul H. Frye, chief engineer; and Harry C. May, works production manager. Thomas D. Scheidler, treasurer, and William J. Lochhead, secretary, were previously elected.

* * *

EDGAR N. GREENEBAUM, JR., has been appointed manager of the newly acquired Chicago office of *Emerson Radio and Phonograph Corporation.*

Mr. Greenebaum formerly served three and one-half years as assistant to the commanding officer of the Wright Field Corps Procurement District. Prior to his work at the signal corps, Mr. Greenebaum represented *John Plain and Company* of Chicago as buyer and merchandise manager for five years, in addition to serving as merchandising consultant on phonograph records for *Sears, Roebuck and Company* headquarters.

The new office of *Emerson Radio and Phonograph Corporation* is located in the American Furniture Mart, 666 Lake Shore Drive.

* * *

ADMIRAL CORPORATION has appointed *R. U. Lynch, Inc.,* as distributor of the company's radios, refrigerators, home freezers, and electric ranges for the Rhode Island territory, according to an announcement by Wallace C. Johnson, manager of field activities.

* * *

JOHN MECK INDUSTRIES, INC., has announced the formation of *Audar, Inc.* This separate corporation will manufacture and sell public address systems and audio amplifiers as an affiliate of *John Meck Industries, Inc.*

John S. Meck is president of this new corporation, E. W. Applebaum, treasurer and general manager, and Russell G. Eggo, secretary.

Sound equipment, formerly manufactured by the *Meck Company,* will now be produced by *Audar, Inc.*

* * *

J. B. ELLIOTT has been named general manager of the *RCA Victor Home Instruments Division* of the *Radio Corporation of America.*

Mr. Elliott entered the radio field in 1926 as a branch manager for the *Brunswick Radio Corporation.* He joined *RCA Victor* in 1935 and a year later was appointed district manager for the New England area. In 1939 he was appointed assistant field sales manager at the company's headquarters in Camden, and a year later became sales manager of the radio, phonograph, and television department. Mr. Elliott now returns to *RCA Victor* from *Schick, Inc.,* where he was vice-president in charge of sales and advertising.

In his new capacity, Mr. Elliott will be located at the *RCA Victor Division's* headquarters in Camden and will direct all activities connected with the design, engineering, production, distribution, and sales of *RCA Victor* radios, television home receivers, and Victrola phonographs.

* * *

BENJAMIN SEUTTER, night traffic superintendent of *Press Wireless* and one of the most widely known veteran wireless telegraph operators in America, died recently after an illness of several weeks. He was 51 years old.

Mr. Seutter had been with *Press Wireless* since 1931. He was a holder of world's records for rapid radio reception, had served with the United States Navy, and was the first operator to receive a radio S.O.S. from an airplane. At one time he was on the staff of a transatlantic radio receiving station of the *New York Times.*

* * *

HARADEN PRATT, vice president and chief engineer of the *American Cable and Radio Corporation,* has been elected chairman of the Radio Technical Planning Board. He will take office October 1 and succeeds Dr. W. G. R. Baker, vice-president, *General Electric Company,* who has been chairman since the RTPB was organized in September, 1943.

Mr. Pratt is also vice-president and chief engineer of *Mackay Radio and Telegraph Company, All America Cables & Radio, Inc., The Commercial Cable Company;* vice-president, *Federal Telephone and Radio Corporation,* and is Fellow, director, secretary, and past president of Institute of Radio Engineers.

At the time of his selection to the chairmanship of the RTPB, Mr. Pratt was delegate of the Institute of Radio Engineers to the RTPB and chairman of the Panel on Radio Communications of that group.

* * *

RADEL MANUFACTURING COMPANY, Cleveland, has recently been organized by Sidney Ludwig, formerly chief engineer of *Ward Products.* This new company will manufacture a complete line of automobile radio aerials, and radio parts and equipment.

* * *

E. S. GOEBEL has been appointed acting director of field sales in the Communications and Electronics Division of *Galvin Manufacturing Corporation.* Mr. Goebel will be in direct charge of the activities of all field salesmen.

Norman Wunderlich resigned as sales manager on July 1.

* * *

HENRY F. DEVER has been elected president of the *Brown Instrument Company,* a wholly-owned subsidiary of the *Minneapolis-Honeywell Regulator Company.* He succeeds Charles B. Sweatt.

Mr. Dever, who has been serving as vice-president in charge of engineer-

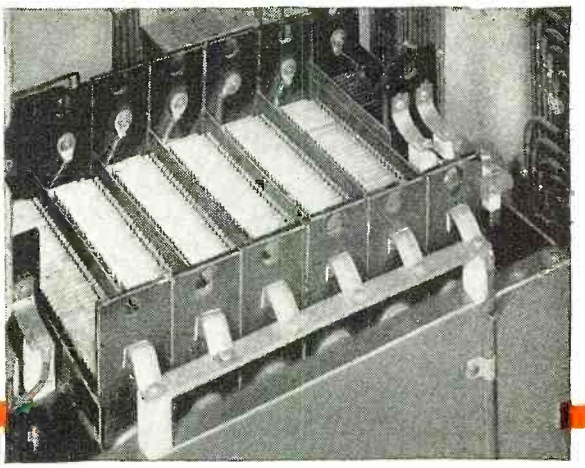
"Metal Rectifiers are more dependable . . . have longer life" ★

Henry Hulick, Chief Engineer, WPTF, Raleigh, N. C.

Mr. Hulick has ample proof that surgeproof metal rectifiers increase the dependability of transmitter operation. For a Westinghouse 50 HG transmitter has been in service at WPTF since June, 1941

These efficient rectifiers are an exclusive Westinghouse feature . . . used in the 50 HG unit as bias rectifiers for speech, input stages, power amplifier and modulator and plate rectifier in the exciter. Their life is virtually unlimited. Tube replacement cost is completely eliminated and the threat of unpredictable rectifier tube failure is erased. No complicated relaying is required; they can be connected to the power circuit instantly.

Metal rectifiers are just one of many outstanding Westinghouse developments in modern transmitter design that feature extra dependability and uninterrupted performance. Ask your nearest Westinghouse office for the complete story of Westinghouse transmitters . . . 5, 10 and 50 kw AM; 1; 3, 10 and 50 kw FM. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-08119



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

XXV RADIO'S 25th ANNIVERSARY KDKA

★ "I prefer metal rectifiers in all practical positions. They are more dependable, require less servicing, are not as erratic and have longer life."

(Signed) *Henry Hulick*

ing for *Minneapolis-Honeywell*, will also assume the responsibilities of E. B. Evleth, general manager of *Brown Instrument*, who has requested that he be relieved of his duties because of ill health.

* * *

COLBY H. KNAPP has been named supply sales manager for *Stromberg-Carlson Company's* telephone division according to an announcement by Lloyd L. Spencer, vice-president in charge of sales.

Mr. Knapp joined the company in 1927 and has served as assistant Chicago supply manager, Chicago supply manager, radio and telephone representative in the states of Illinois and Iowa, telephone sales representative in Indiana and Wisconsin, and Chicago office manager and cashier. During the war period he was a member of the priorities department at the main office in Rochester, N. Y.

Mr. Knapp will continue to make his headquarters at the company's Chicago branch office located at 564 West Adams Street.

* * *

EDWARD H. FRANK has been named office manager for the *Westinghouse* lamp division's northwestern district headquarters in Chicago.

Mr. Frank joined *Westinghouse* in 1916 in the St. Louis office of the lamp for the central district office in Pittsburgh since 1940. He succeeds George A. Olsen, who has joined the *Westing-*division and has been office manager *house Electric Supply Company* in Milwaukee, Wisconsin.

—30—

112 Mc. Transmitter

(*Continued from page 37*)

dip in the plate current although it will not be so pronounced due to the greater circuit losses.

The tuning of the third doubler is similar, although in this stage the dip in plate current will be very slight. This plate circuit should be tuned to the 112 mc. band in this case. This will complete the preliminary tuning of the exciter stages.

The meter should now be switched to read the grid current of the final, and the tuning of the final grid circuit adjusted to give the maximum reading. It will probably be necessary to re-adjust the tuning of the third doubler slightly as the final grid is varied. If sufficient drive is not obtained the links around both the third doubler tank and final grid should be adjusted.

The final amplifier is now ready for neutralizing. The plate circuit of the final should be tuned through resonance, at the same time watching the grid current. Proper neutralizing is obtained when the final can be tuned through resonance without affecting the grid current. It will probably be necessary to retune the grid circuit as the neutralizing condenser is adjusted. When neutralizing is perfect, all stages should be retuned for maximum output.

Plate voltage should now be applied to the final by connecting the lead from the modulator. With no antenna connected, the plate current of the final at resonance should dip to about 10 to 15 ma. A 25 watt bulb should now be connected across the antenna terminals and the loading adjusted to give maximum output by varying the coupling of the output link. As the legal limit of input power for WERS work is 25 watts and the plate voltage is 500 volts, the maximum plate current will have to be kept below 50 ma.

A microphone can be connected to the input, and the gain control adjusted for proper level. The lamp bulb should increase in brilliancy as the microphone is spoken into, 100% modulation being indicated by a nominal increase in brilliancy. If operation appears satisfactory, the output frequency should be checked by means of a reliable wavemeter or well shielded receiver. The antenna may now be connected and the output link again adjusted for proper loading, and the transmitter is ready for use.

Table I. Coil data providing necessary electrical and mechanical requirements.

COIL	FREQ	TURNS	WIRE SIZE	DIAM.	LENGTH
L_1	7 mc.	8	#20 p.e.	¾″	Close wound
L_2	14 mc.	11	#20 p.e.	1″	½″
L_3	28 mc.	7	#12 tinned	⅞″	¾″
L_4	56 mc.	4⅛	#12 tinned	⅝″	⅝″
L_5	112 mc.	2	#12 tinned	⅝″	½″
L_6	Link	2	#20 push-back	⅝″	At "cold" end of L_5
L_7	Link	2	#20 push-back	⅝″	At "cold" end of L_8
L_8	112 mc.	2	#12 tinned	⅝″	½″
L_9	112 mc.	4	#12 tinned	1″	1⅛″
L_{10}	Output	2	#20 push-back	⅞″	At center of L_9

SYLVANIA NEWS
RADIO SERVICE EDITION

October *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

Radio servicemen looking for a simplified explanation of the science of electronics are urged to add to their reading list *A Primer of Electronics* by Don P. Caverly.

Simplified Language

It gives you, without formulas or much mathematics, just what you want to know about electronic principles and how they are applied in working devices.

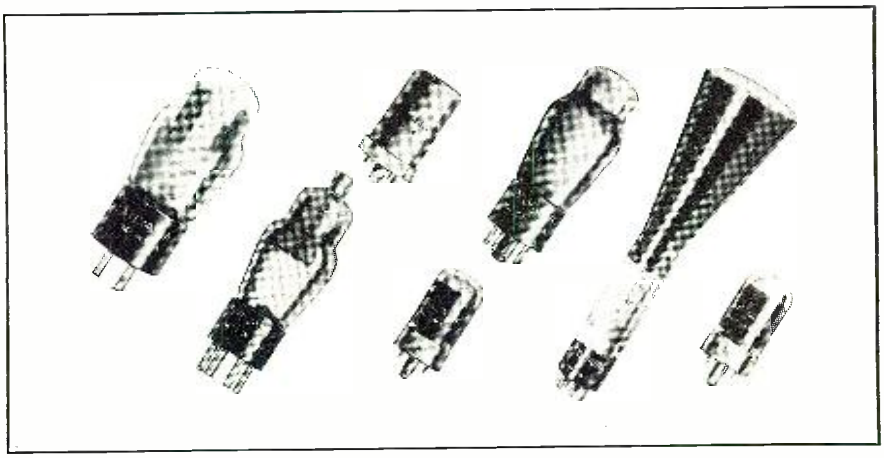
Here is an especially clear and simple explanation of electronics and electronic tubes and circuits, written by a Sylvania engineer for all concerned with the application, servicing, operation, or manufacture of industrial or household devices based on this science. Basic enough for beginners, yet technically authoritative and complete.

Has Many Illustrations

Containing 235 pages of concise, easily understood language, the book is further clarified by having 125 specially prepared drawings and photographs. It is published by McGraw-Hill and is available for $2.00 from your Sylvania distributor or, as a Sylvania service, directly from us.

RADIO SERVICEMEN CAN NOW OBTAIN FORMER GOVERNMENT TUBES

(*Sylvania Tested and Guaranteed*)



Sylvania Electric announces the following tube types available to radio servicemen.

Several of the types released are of particular interest to amateurs and experimenters. With this market in mind, Sylvania has inserted similar announcements in representative "ham" publications.

The current list is as follows:

38—Well known standard output pentode.

39/44—Well known standard R.F. Amplifier.

2X2/879—The standard high voltage, low current rectifier for oscilloscope use.

7C4/1203A—A small lock-in diode rectifier suitable for use in vacuum tube voltmeter probes. 6/3 volt 150 ma. heater.

7E5/1201—A lock-in triode for use as a low power oscillator or amplifier up to 750 mc. 6.3 volt 150 ma. heater.

46—Standard power amplifier. Suitable for Class B or C amplifiers and used in many amateur transmitters.

OD3/VR150—Radio servicemen recognize this well known voltage regulator.

EF-50—A 9 pin completely shielded R.F. Amplifier somewhat similar to Type 7W7. Heater rating 6.3 volts at 300 ma.

1626—A transmitting triode requiring 12.6 volts, 250 ma. heater supply. Four watts output at 250 volts plate (max.).

1629—Same characteristics as Type 6E5 except for octal base and heater rating of 12.6 volts, 150 ma.

38142 (VT-52)—Similar to Type 45 except for its filament rating of 7.0 volts, 1.18 amperes.

5BP1—Well known 5" cathode ray tube with the usual green trace. Makes a good scope with 1500 to 2000 volt anode supply.

5BP4—Same as 5BP1 except for the screen which gives a white trace.

VT-25A—This is the same as the regular Type 10 but has a low loss base. This item should be interesting to amateurs.

All tubes are available under the familiar L-265, or on rated orders, through Sylvania distributors.

SYLVANIA ELECTRIC

Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

This transmitter has been in use three times a week for the past two years with no adjustments whatsoever and has maintained consistent communication with stations located in a radius of twenty miles. Signal strength has been reliably good and the quality of speech reported excellent. Just an example of what can be done with a little ingenuity combined with several junk boxes.

Now that FCC has announced the resumption of amateur operation on the 112 to 115.5 mc. band, a transmitter of this type will be necessary for the crowded conditions of the near future.

—30—

Q. T. C.

(*Continued from page* 56)

most of them. It certainly will be a big help in shipping circles when a vessel can safely be brought into port or navigated in bad weather when visibility is low. Under the old system it was often necessary to anchor or proceed under very slow speed during such time. This equipment will eliminate the present uncertainty of navigating in narrow or crowded shipping channels and the dangers of fog and darkness when visibility is poor.

CONGRATULATIONS to the U. S. Coast Guard which, in late July, celebrated its 155th anniversary.

A NEW engineering and research building for the manufacturing division of Press Wireless is being constructed at Long Island City, the company recently announced. . . . PW has plants and operations at Hicksville, Baldwin, Little Neck, Long Island, and Chicago. PW did a nice job in communications during the war and expects postwar business to be good.

LAST SPRING General MacArthur paid a tribute to the merchant seamen of the United States which I am sure will be of interest to all of you. This note possibly did not come to your attention. It reads, "With us they have shared the heaviest fire. . . . On these islands I have ordered them off their ships and into foxholes when their ships became untenable targets of attack. At our side they have suffered bloodshed and death. They have contributed tremendously to our success. I hold no branch in higher esteem than the merchant marine service." Like most of the General's statements, it is short, to the point, and shows appreciation for a job well done. Ran across many of the gang who had not seen that item and thought it worth while repeating for those of you who missed it. . . . What became of A. Vandenbergh? Has anyone seen L. Bye around? Some of the gang seem to stay away for long periods of time every now and then . . . or maybe "no shore leave," or longer trips than usual.....73

THROUGH THE N. U. EQUIPMENT PLAN SERVICE DEALERS RECEIVED 60,000 PIECES OF FINE TEST EQUIPMENT

Authorized RADIO-VIDEO ELECTRONIC Service

Since 1930, National Union has been the only radio tube and parts manufacturer whose entire merchandising program has been designed 100% to support the "*service* side of radio row" exclusively!

You know how the N. U. Equipment Plan brought 60,000 pieces of the finest test equipment to radio service dealers—free! You know how N. U. national and cooperative advertising, promotions, literature, displays and other business-builders helped dealers and jobbers prosper.

AFTER THE WAR . . . MORE THAN BEFORE!

Count on National Union for even more help . . . a wider selection of tubes and parts, even better equipment deals, powerful new merchandising plans, more technical service information . . . to make business prosperous for all "on the service side of radio row"!

NATIONAL UNION
RADIO AND ELECTRON TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

4 CHANNEL MIXER for Your Amplifier

By DAVID A. KING

THERE are many amplifiers in use today, both of professional and home constructed types, that have been designed with a single input terminal. These amplifiers are entirely adequate for any purpose where it is desired to amplify sound from only one source at a time. For those who desire to make more elaborate sound pick-ups for such purposes as moving picture sound-tracks and other home recording ventures, the electronic mixing panel described herein will prove of real value.

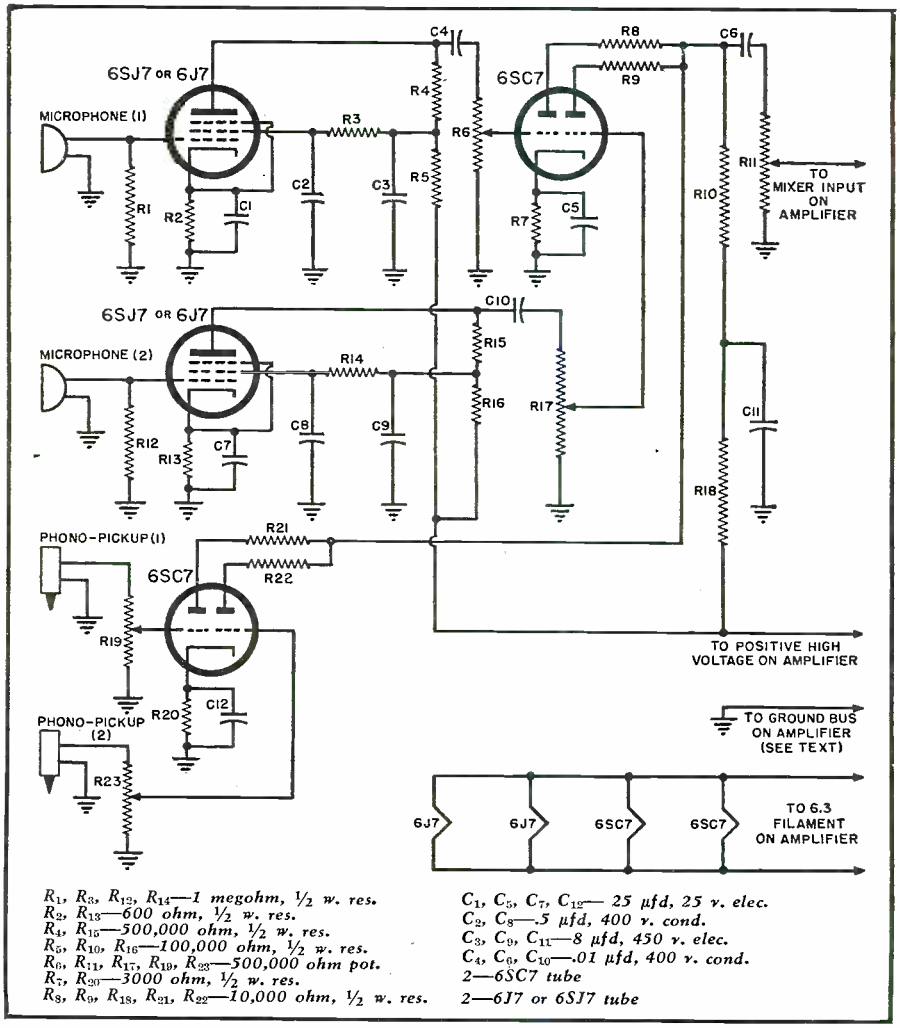
In designing this mixer it was proposed to develop a unit which, while retaining all or most of the advantages enjoyed by expensive professional equipment, still used standard receiver parts. Many of these parts, as in the case of the amplifier, can well be salvaged from discarded radio receivers.

Many volume controls designed for use in home radio sets are somewhat noisy when used ahead of a high-gain instrument where even minute variations in voltage are amplified to the point where they will produce annoying volumes of sound in the loudspeaker.

This fault has been eliminated in the present design by removing the volume controls from the low-level input to the grid circuit of the mixer tube. This means the addition of one extra tube for each low-level channel but, in the opinion of the writer, this extra tube is more than justified by the quieter operation gained through its use.

Through the use of standard electronic mixer tubes, the use of ex-

Schematic diagram of four-tube mixer. Each input has its individual volume control.



R_1, R_3, R_{12}, R_{14}—1 megohm, ½ w. res.
R_2, R_{13}—600 ohm, ½ w. res.
R_4, R_{15}—500,000 ohm, ½ w. res.
R_5, R_{10}, R_{16}—100,000 ohm, ½ w. res.
R_6, R_{11}, R_{17}, R_{19}, R_{23}—500,000 ohm pot.
R_7, R_{20}—3000 ohm, ½ w. res.
R_8, R_9, R_{18}, R_{21}, R_{22}—10,000 ohm, ½ w. res.

C_1, C_5, C_7, C_{12}— 25 μfd, 25 v. elec.
C_2, C_8—.5 μfd, 400 v. cond.
C_3, C_9, C_{11}—8 μfd, 450 v. elec.
C_4, C_6, C_{10}—.01 μfd, 400 v. cond.
2—6SC7 tube
2—6J7 or 6SJ7 tube

CONFIDENTIALLY,

WE'RE JUST A BUNCH OF HAMS AT HEART!

Frankly, the magic of Radio is still a lot of fun to us! We here at GATES—every one of us, right up to the top man—put the enthusiastic imagination of the youngest amateur into our products.

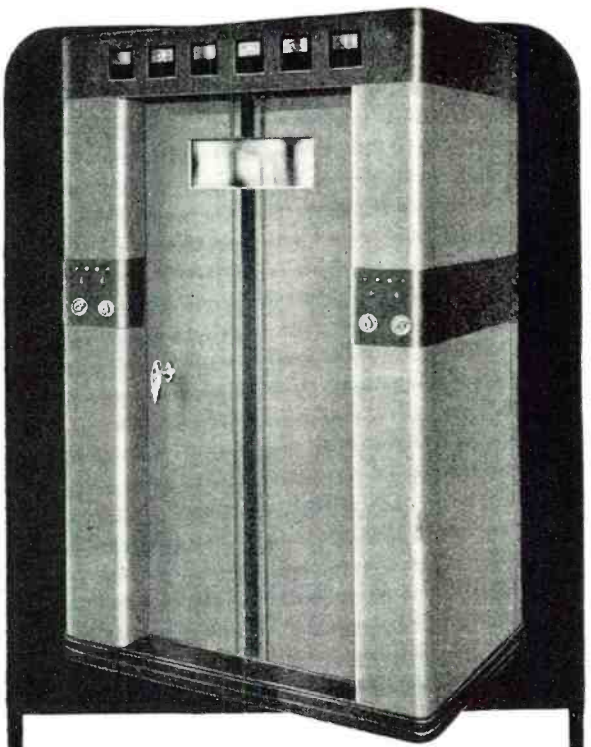
That enthusiasm, supported by a background of continuous experience since 1922—and backed up by engineering ability and real precision workmanship—is what gives GATES Products their dependable quality.

For good Transmitting Equipment—reasonably priced—for your needs today, tomorrow, or whenever—call on GATES! The GATES RADIO CO., Quincy, Ill., U.S.A.

Write for Details About the GATES Priority System for Prompt Post-War Delivery

GATES RADIO CO.

QUINCY, ILLINOIS



GATES ONE KILOWATT BROADCAST TRANSMITTER

This GATES Transmitter embodies the latest in engineering developments—modernized and streamlined to bring efficiency *plus* good looks to the Post-War Broadcasting Station.

All parts are conveniently, accessibly located for simple operation; and the pressure-type cabinet assures dustless, cool performance. A Transmitter of extremely high fidelity.

Detailed Bulletin on the New GATES 1 KW Transmitter Will Soon Be Available

PROGRESS REPORT

GATES is now in full production on civilian equipment and can make prompt delivery on many popular items.

EXCLUSIVE MANUFACTURERS OF RADIO TRANSMITTING EQUIPMENT SINCE 1922

pensive pads has been eliminated and a mixer has been provided where each channel can be set to its own level without inter-acting with any of the other channels.

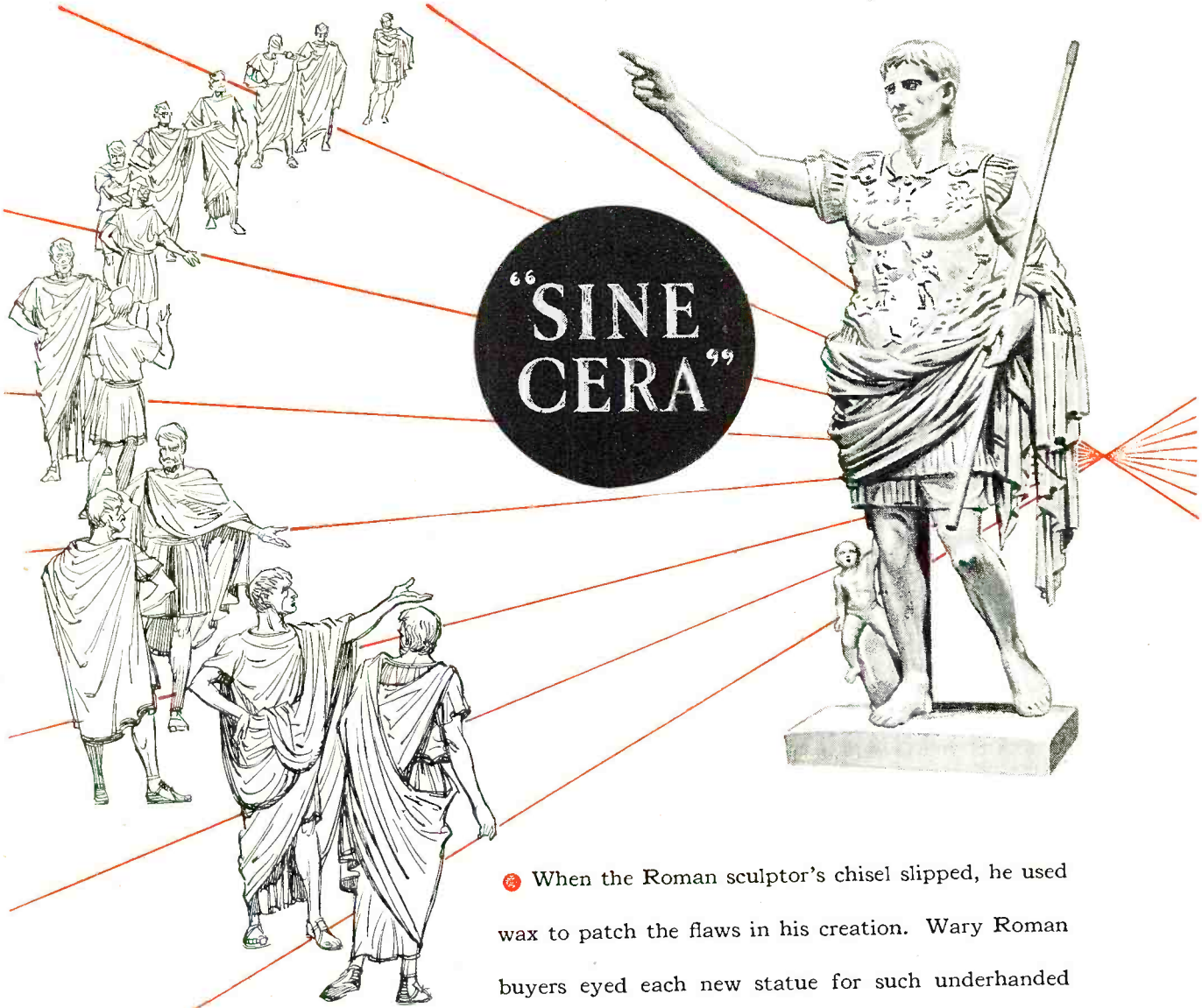
The tube line-up shown is perfectly satisfactory with the circuit constants shown. The reader is referred to any standard hand-book of resistance-coupled amplifier design for constants for tubes other than those shown. The only exception to this is the variation shown in the schematic where it is noted that 6J7 tubes may be substituted for the 6SJ7 tubes used by the writer. Since these tubes differ only in a few minor respects insofar as audio frequency applications are concerned, the same circuit constants may be used with either tube. One added precaution to be used with the 6J7 tube, though, is to be sure to use a shielded lead to the grid-cap and to use one of the little cap shields over the grid-cap. In the case of a "G" tube, of either type, it will be found that a close-fitting metal shield will give a huge reduction in noise pick-up.

In planning your mixer panel lay-out remember that the usual construction rules prevail; keep all leads as short as possible and parts well spaced to prevent intercoupling. All circuits are so routed as to prevent coupling from output to input through any path whatsoever. To this end, the output of the mixer panel should be well separated physically and the associated wiring so routed as to prevent capacitance or inductive coupling between these circuits. It will be noted that de-coupling nets have been introduced into the plate-circuit of each tube. These nets were found to be absolutely indispensable in the prevention of motor-boating and other forms of instability.

As indicated in the schematic, a ground bus interconnected with that on the amplifier will be found to reduce hum and other forms of disturbances to a minimum. Carry this ground bus on mounting lugs which are carefully insulated from the chassis and do not connect this bus to the mixer chassis at any point. Bond the mixer chassis to the amplifier chassis to prevent the formation of static charges between these units. It may be found that a good connection to earth ground will reduce noise level and it will certainly prevent any chance of shock due to any stray voltage between chassis and ground.

In wiring this unit, bear in mind that the low-level input circuits (those marked "mic. 1 and mic. 2" on the schematic) are carrying voltages which are amplified some 7000 to 10,000 times before they are reproduced in the loud-speaker. For that reason, noise voltages which would ordinarily be negligible assume proportions comparable to program level. This latter is true since the output of high-quality microphones is so minute as to be comparable in value to the noise voltage in a carelessly laid-out circuit.

This is mentioned, not as an attempt



When the Roman sculptor's chisel slipped, he used wax to patch the flaws in his creation. Wary Roman buyers eyed each new statue for such underhanded camouflage. Perfect statues prompted an enthusiastic verdict, "sine cera" . . . without wax . . . sincere!

Sincerity produces perfection in the Detrola radio receivers, automatic record changers and other electronic instruments expressly created for the world's foremost merchants and their customers.

DIVISION OF INTERNATIONAL DETROLA CORPORATION DETROIT 9, MICHIGAN

to scare the reader, but to save him from the rather disappointing experience of finding that his mixer is a source of noise rather than a means of amplifying the speech and music it is designed to handle.

These voltages can be reduced to the point where they can be neglected by a few simple precautions. First, keep all low-level signal leads as short as possible and run them entirely in shielded wire. This applies to the grid leads of the low-level or microphone input tubes. Bond these shields carefully to the ground bus, but insulate them carefully where they pass through the chassis. Second, use some type of shielded input jack. An ordinary single circuit radio jack will do if it isn't too large physically. If a large jack is unavoidable, enclose it in its own shield to avoid pick-up. A still better input jack for the "mikes" is the regular amphenol button-contact jack. This latter may be hard to obtain, however. Third, never try to use ordinary wire to connect a high-quality microphone to any amplifier. Use regular microphone cable which is carefully shielded. Even when using cable of this type, carefully avoid cable runs longer than those recommended by the manufacturer of your microphone. This is usually about 50 feet for most makes of high-impedance instruments.

If longer cable runs are necessary, obtain a microphone with a line transformer in its case and provide a line-to-grid transformer for each microphone channel. This latter, if carefully shielded, will provide somewhat better over-all response for the microphone placed at some distance from the mixer.

One more excellent precaution, which will pay off in reduced hum level, is to make sure that all wires carrying raw a.c. (such as filament leads) are carried through the circuit as twisted pairs and pushed as far into a corner of the chassis as possible.

It will be remembered that the filament circuit of the amplifier was grounded on one side to avoid hum pick-up. It would be an excellent idea to ground the mixer filament lead, as well. However, an obvious precaution would be to make sure that the *same* lead is grounded in both amplifier and mixer to avoid any chance of a short circuit.

The panel lay-out is left up to the reader's taste with these few notes. First, if obtainable, select a panel of some metallic material such as iron or aluminum. This may, of course, be finished to suit. Second, lay out the channel controls in logical sequence across the top of the panel and place the master control below them or, if preferred, place the master control near the top of the panel and line the other controls up along the bottom. This is for the sake of avoiding confusion in operation. If practicable, make all microphone and phono connections to the back of the mixer cabinet and keep the low-level tubes as far away from the panel as the size of the chassis permits. This latter is not of too much importance, however, provided shielding has been carried out as suggested.

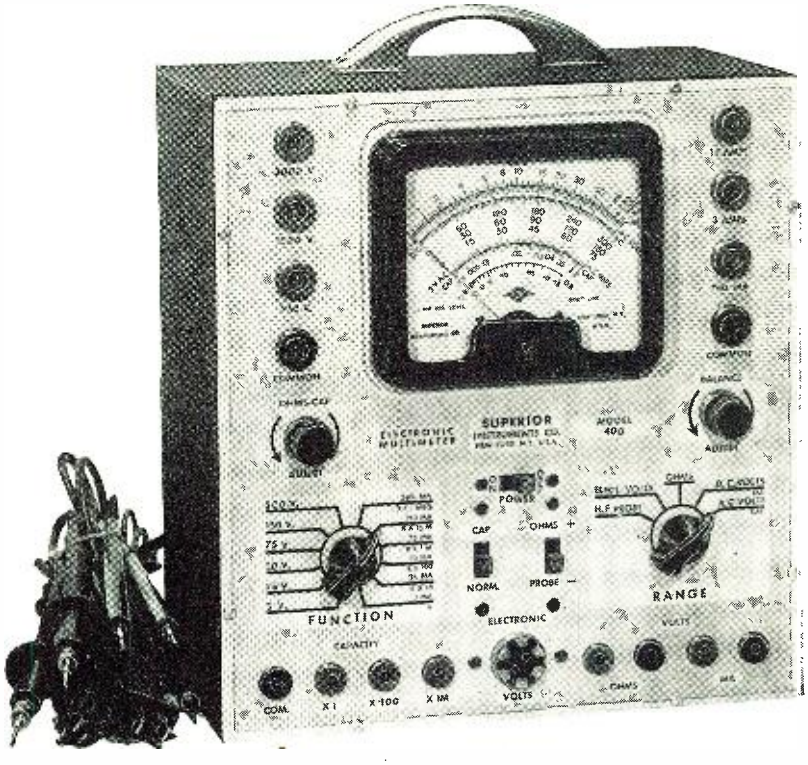
The wiring complete, connect the mixer to the power amplifier as indicated in the schematic. Before placing tubes in the sockets, check voltages on the tube sockets with a good voltmeter if one is available. Failing this, at least check the filament terminals with a neon bulb to be sure that plate and heater leads haven't been crossed. This could cause considerable damage to the amplifier's power pack even though a tube were not burned out.

Now place the tubes in position. Place a finger on the input circuit of one of the low-level inputs and *slowly* advance the corresponding mixer control. The result should be a loud humming sound in the loudspeaker. Now turn this mixer control to zero and try the other low-level channel

Eight elements for test equipment are soldered at one time, in a few seconds, by this new, ingenious electronic power heating set-up in the Camden plant, RCA Victor Division, Radio Corporation of America. Elements are assembled with a pre-formed ring of solder in position at juncture to be sealed, then secured in a fixture. Operator lowers them through holes in work surface, into alternating magnetic field of an induction coil, then applies high-frequency power to coil by pressing a button. Induced currents generate heat in the elements and flow solder uniformly and almost instantly. A 15-kilowatt electronic power generator supplies the power.

The New Model 400

ELECTRONIC MULTI-METER



A COMBINATION
VACUUM-TUBE
VOLTMETER
AND
VOLT-OHM
MILLIAMMETER
PLUS
CAPACITY
INDUCTANCE
REACTANCE
AND
DECIBEL
Measurements

Specifications:

D.C. ELECTRONIC VOLTS:
(At 11 Megohms input resistance)
0 to 3/15/30/75/150/300/750/1500/3000 Volts.

D.C. VOLTS:
(At 1,000 Ohms Per Volt)
0 to 3/15/30/75/150/300/750/1500/3000 Volts.

A.C. VOLTS:
(At 1,000 Ohms Per Volt)
0 to 3/15/30/75/150/300/750/1500/3000 Volts.

D.C. CURRENT:
0 to 3/15/30/75/150/300/750 Ma.—0 to 3/15 Amperes

RESISTANCE:
0 to 1,000/10,000/100,000 Ohms—
0 to 1/10/1,000 Megohms

CAPACITY: (In Mfd.)
.0005—.2 .05—20 .5—200

REACTANCE:
10 to 5M (Ohms) 100—50M (Ohms)
.01—5 (Megohms)

INDUCTANCE: (In Henries)
.035—14 .35—140 35—14,000

DECIBELS:
—10 to + 18 +10 to +38 +30 to +58

The Model 400 comes housed in a rugged crackle-finish steel cabinet complete with batteries, two sets of test leads, one set of V.T.V.M. probes and instructions. Size 5½"x9½"x10". Net..... $52.50

SUPERIOR INSTRUMENTS COMPANY
DEPT. R. N., 227 FULTON STREET, NEW YORK 7, NEW YORK

the same way. Now feed in sound from either a microphone or some other source of equal level and check the amplifier and mixer for quality. If instruments are at hand, an audio oscillator may be used to drive the amplifier and mixer and the over-all frequency response determined for each channel in turn.

In operation, connect each input channel of the mixer to an appropriate sound source, *i.e.*, one or two microphones for spoken commentary and sound-effects and two phono pickups for "canned" sound-effects or musical backgrounds (or both!). If possible arrange to have the microphones placed in rooms away from that used for the mixer panel. This latter is to provide an opportunity to use a loudspeaker to "monitor" the mixing results and adjust each separate channel to its proper level. Failing this, a pair of headphones may be connected into the circuit.

Nothing, in the writer's opinion, can give any person any greater satisfaction than to achieve fine results with apparatus built by his own hands. If those results are a well-planned soundtrack for a home movie film or a well-recorded sound-drama, a person has an artistic achievement as well as a scientific one to "point to with pride". —30—

Transmitter Checking

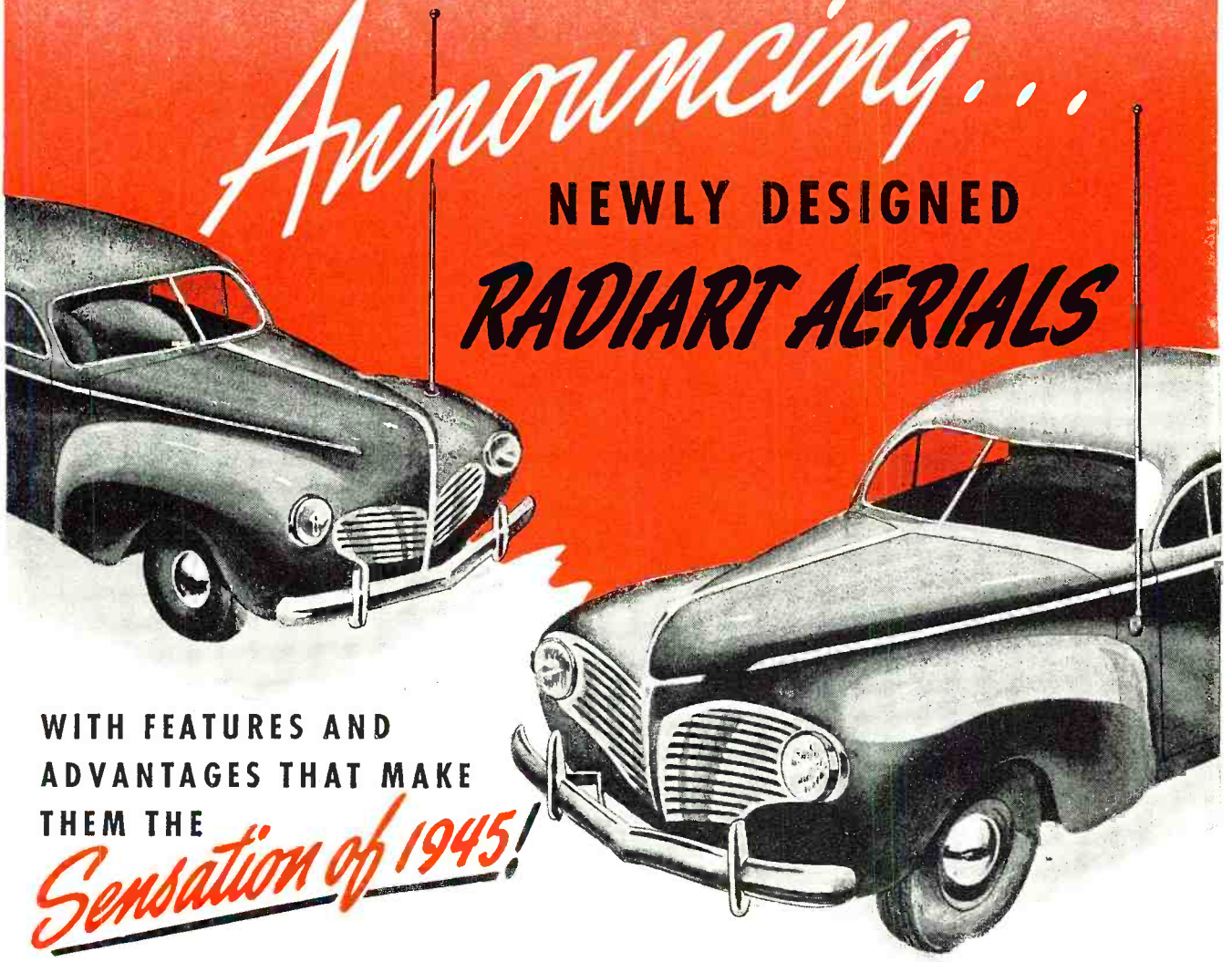
(*Continued from page* 34)

velope pattern, as stated above, are much simpler than those of the trapezoidal pattern. The method consists of feeding some of the output of the modulated amplifier to the vertical axis. This is done with a coil of one or more turns of wire fed to the input terminals by means of a twisted pair. On high frequencies (100 kc. and above) direct connection should be made to the vertical deflector plates of the scope. This measure is necessary because the amplifier contained in the instrument is not capable of handling high frequencies.

The sweep circuit is synchronized with the audio oscillator that is fed to the input of the speech amplifier equipment. To do this, feed the audio output from the oscillator to the synchronization terminals through a .01 μfd. condenser. The height of the pattern is varied by changing the number of turns of the coil or its distance from the output tank. The load, antenna, or antenna tuner is left connected to observe performance under actual working conditions. With the sweep circuit properly synchronized and at a multiple of the audio oscillator frequency, an image appears with several sine waves. By increasing the audio oscillator output, the percentage of modulation is correspondingly increased. By this method, all types of modulation may be observed including plate, grid, screen, and suppressor modulation. Fig. 1 shows the necessary hookup.

Announcing...

NEWLY DESIGNED RADIART AERIALS



WITH FEATURES AND ADVANTAGES THAT MAKE THEM THE *Sensation of 1945!*

This new RADIART Line is complete — 3 and 4 Section Models — to fit all cars — all angles — cowl, fender and under hood types — with waterproofed leads of new design featuring lowest capacity — high efficiency construction — with combination pin and bayonet fittings.

All models are made with only highest quality Admiralty brass tubing and stainless steel top section — thereby providing the maximum in elastic load limit consistent with the utmost in strength and rigidity.

Newly designed method of mounting provides simplest form of one man installation — Mounting is completely waterproofed and impossible to short to the body.

And including those well known RADIART Features of the "Static" muffler magic ring and the permanent all-metal anti-rattler.

★ Check these RADIART advantages and features against all other aerial specifications and you will understand why RADIART AERIALS HAVE ALWAYS BEEN THE STANDARD OF COMPARISON.

Ask your distributor about deliveries of these new models.

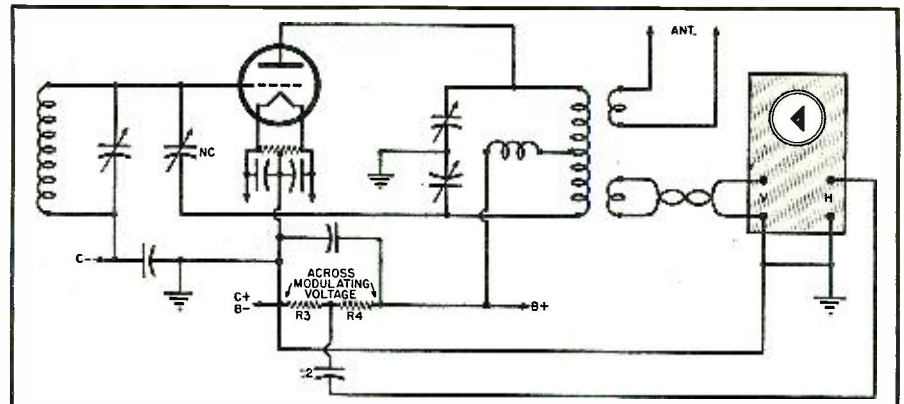
MANUFACTURED BY THE MAKERS OF ***RADIART*** EXACT DUPLICATE VIBRATORS

Radiart Corporation

3571 W. 62nd STREET • CLEVELAND 2, OHIO

Export Division
25 Warren St., New York 7, N.Y.

Canadian Office
455 Craig St., W., Montreal, Canada



Values for R_3 should be determined experimentally. Usual values are as follows:
R_3—25,000 ohm, 1 w. res. (low power)
R_3—10,000 ohm, 1 w. res. (medium power)
R_3—3000 ohm, 1 w. res. (high power)
When direct connection is used, R_3 should be a pot. (.5 meg., .1 meg., 50,000 ohm respectively for low, medium, and high power transmitters). C_2 is placed on variable tap of pot. For low power transmitter, R_4 should be a .5 megohm, 1 w. res. For high power transmitter, several .5 megohm, 1 w. res. are connected in series, one for every 500 v. of d. c. applied to modulated amplifiers.

Fig. 4. Method of obtaining trapezoidal patterns in checking plate modulated transmitter.

If low level modulation is used, the r.f. pickup should be from the final stage as this is the criterion of performance.

If a trapezoidal pattern is to be obtained, the same connections as above are used except for the horizontal axis. Here, some of the audio voltage used to modulate the final amplifier is connected to the horizontal axis. This a.f. voltage must be in the proper phase relationship with the r.f. output in order to obtain the correct pattern.

The requisite voltage is obtained from a voltage divider across the modulating voltage (see Figs. 3 and 4). Connect it to the horizontal amplifier in the 'scope which then makes possible the regulation of the width of the image. Values of the voltage divider are given in the diagram.

Difficulties in Obtaining Patterns

If the proper care is exercised in making connections and instructions are followed carefully, no trouble should be had in obtaining patterns. Otherwise, the operator may believe that the trouble originates in the transmitter itself and search thereof will be made there, while it is due (in most cases) to maladjustment of the oscilloscope. Some of the faults usually encountered and their interpretations are given below.

One of the most common faults that the beginner experiences when the wave-envelope pattern is used is non-sinusoidality. This may be due to the compression of too many waveforms on the screen. The effect can be explained by the fact that the spot diameter of the trace causes the outer edge of the image to appear brighter than the central areas. This is a result of the decreased speed at the edges. It causes the crests to be broader and the troughs of the wave to be narrower. The condition is alleviated if the image occupies a generous portion of the screen and only two or three cycles are observed.

Another fault is leaning of pattern. This results from coupling between the horizontal and vertical circuits of the oscilloscope. It is most common with high-frequency carriers.

Phase shift in the trapezoidal pattern occurs when the horizontal axis is connected to a.f. voltage in the preamplifier instead of the modulating voltage.

In conclusion, as the operator becomes more familiar with the oscilloscope as applied to checking transmitter operation, he will become more expert in interpreting the various patterns encountered.

REFERENCES

Rider, John F.—"The Cathode-Ray Tube at Work." John F. Rider Pub. Co., New York, 1935.

A.R.R.L.—"The Radio Amateur's Handbook," Pub. by American Radio Relay League, 1944.

Jones, etc.—"Radio Handbook," Pub. by Editors and Engineers, Los Angeles, Calif., 1943.

Howard, A., & Eddy, M.—"The Oscilloscope Applied to Radio Servicing," RADIO NEWS, Sept. 1944

-30-

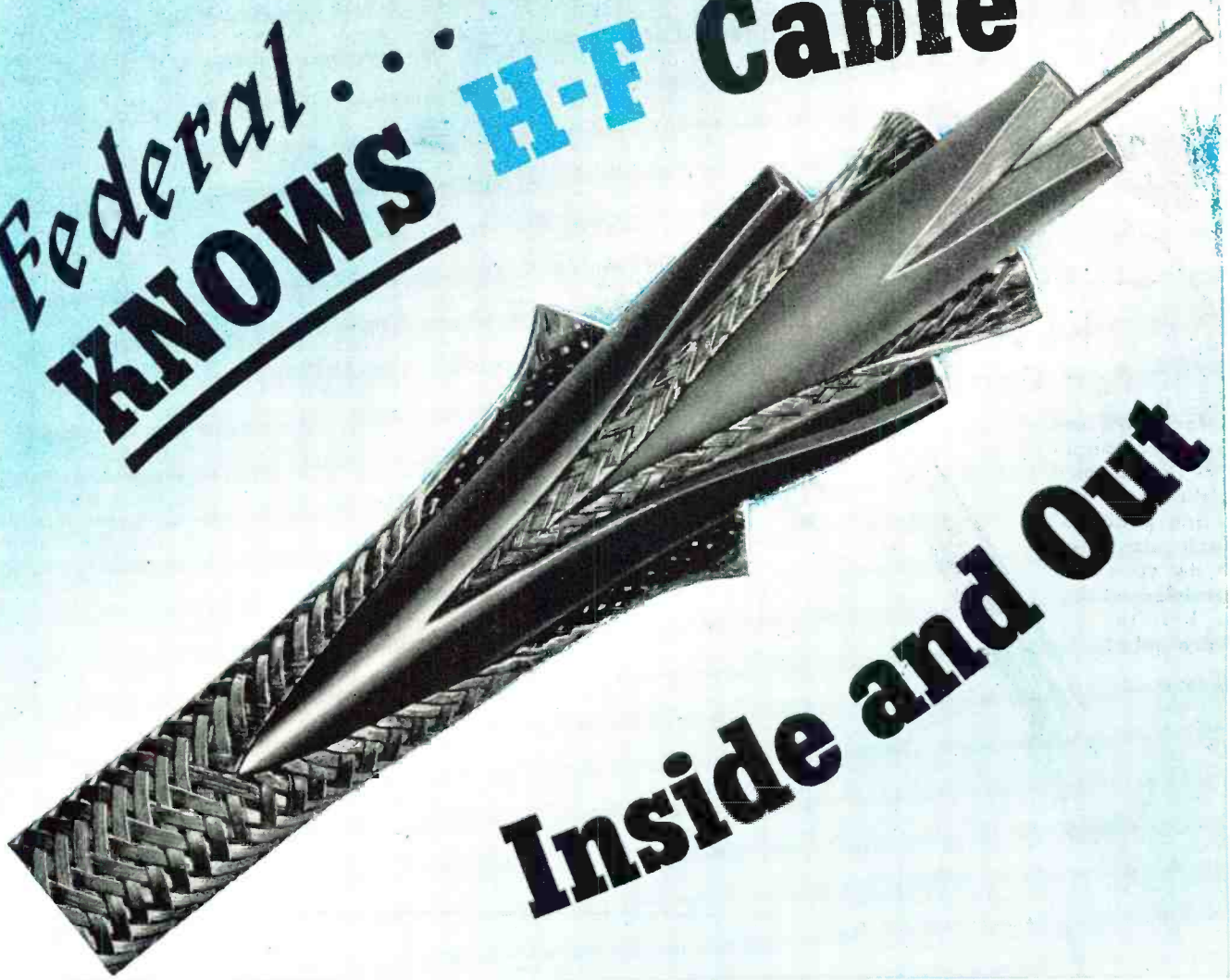
Ultrasonic Communications

(*Continued from page* 49)

mensioned sections of steel rod. In order to determine the resonant frequency, the required over-all length of this steel-quartz-steel "sandwich" may be approximated from the previously mentioned formula, because the velocity of sound in quartz and steel is about the same. This unit has an inherently high impedance requiring a high driving voltage and necessitating the incorporation of a special matching transformer as used with piezoelectric instantaneous record cutting heads. The high voltage appearing across the quartz engenders difficulties in mounting the reproducer.

The dynamic reproducer, illustrated in Figs. 3B and 5, consists essentially of a small permanent magnet loudspeaker with the cone replaced by a resonant brass disc one-quarter inch thick and two inches in diameter, pinned at its center to the central pole piece of the permanent magnet, and

Federal . . . KNOWS H-F Cable Inside and Out



From inner conductor to outer covering : : : Federal really knows high-frequency transmission lines.

And this knowledge was not easily won. As the pioneer in the field Federal not only developed over 80% of all h-f cable types in use today . . . but developed most of the equipment needed to test them.

Attenuation, high-voltage, dielectric and balance testing equipment, velocity of propagation, braid-resistance and electrical length meters : : : were all Federal-*engineered* to fit specific requirements.

That's why it's logical to turn to the acknowledged leader in the field for the finest in h-f cables, specialty-engineered harnesses and cable assemblies.

Where requirements are critical . . . for transmission lines with special characteristics . . . for custom-built and engineered harnesses and cable assemblies . . . take your high-frequency transmission problems to Federal.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

carrying the voice coil. This unit has given excellent service in practice with relatively high output.

Various receivers for receiving the 20 kilocycle sound waves have been employed, all of them requiring some type of microphone, a carrier amplifier, a demodulator, a carrier filter, and an audio system, as in conventional radio receivers. Two different microphones have been successfully used, both being the Rochelle salt crystal type. The first unit is an unmodified commercial crystal microphone (Astatic WR-20) having dual crystals and diaphragms, having good response in the 20 kilocycle region. The second unit, shown in Figs. 3A and 6, employs a stretched foil diaphragm with a small Rochelle salt crystal cemented directly to the inside face. Provision is made, as illustrated, for varying the tension on the diaphragm to permit adjustment for some mode of mechanical resonance at 20 kilocycles. This mechanically "tunable" microphone has considerably higher output on equivalent sound intensities than the standard commercial unit, with the added feature of tending to reject lower, non-resonant frequencies.

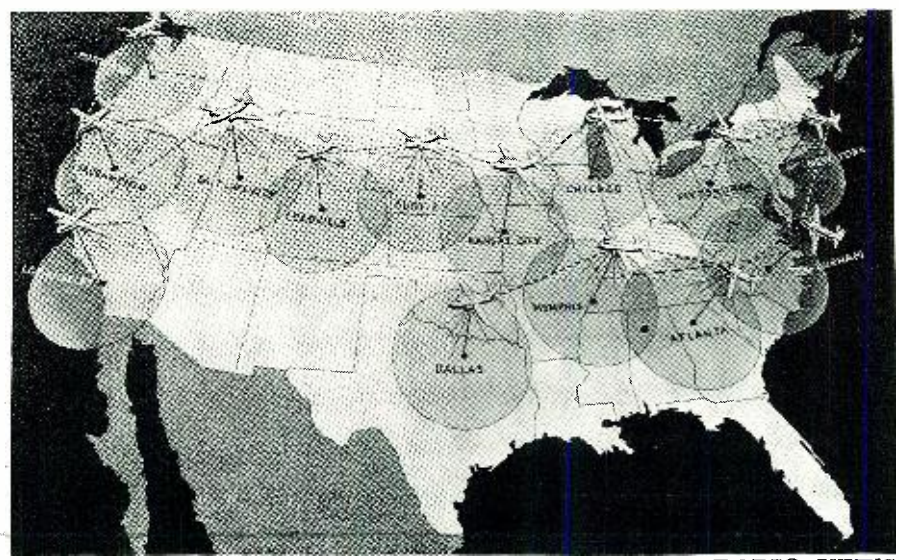
Two types of receivers, one rather unusual in design, have been employed. The first type consists of several stages of tuned audio amplification, followed by a diode detector, carrier filter, and audio amplifier. As an interesting experiment, in an effort to improve sub-harmonic rejection, improve selectivity, and eliminate the necessity for a 20 kilocycle carrier filter, another receiver was designed in which the output from the microphone is successively doubled to 160 kilocycles, amplified with a two-stage 160 kilocycle r.f. amplifier, demodulated, and passed to the conventional audio system. As expected, in this particular arrangement, rather severe audio distortion is caused by the carrier doublers if a high percentage of modulation is used. In subsequent experiments it is proposed to use either push-push doublers or full-wave rectification to elevate the carrier to the higher frequency. With the frequency raised to around 160 kilocycles, standard 175 kilocycle i.f. transformers provide conveniently packaged, high-Q tuned circuits for amplification.

Up to the present time, out-of-door tests with the disclosed equipment have not been made, but experiments which have been performed are of great interest. The 20 kilocycle carrier has been modulated with both tone and phonograph signals and received exceedingly well over distances of some thirty to fifty feet. Modulation does not render the carrier audible to the ear. However, with the unmodulated carrier directed toward the receiver, speaking into the carrier microphone produces audible signals in the receiver audio output system. With the carrier removed, the audible signal disappears.

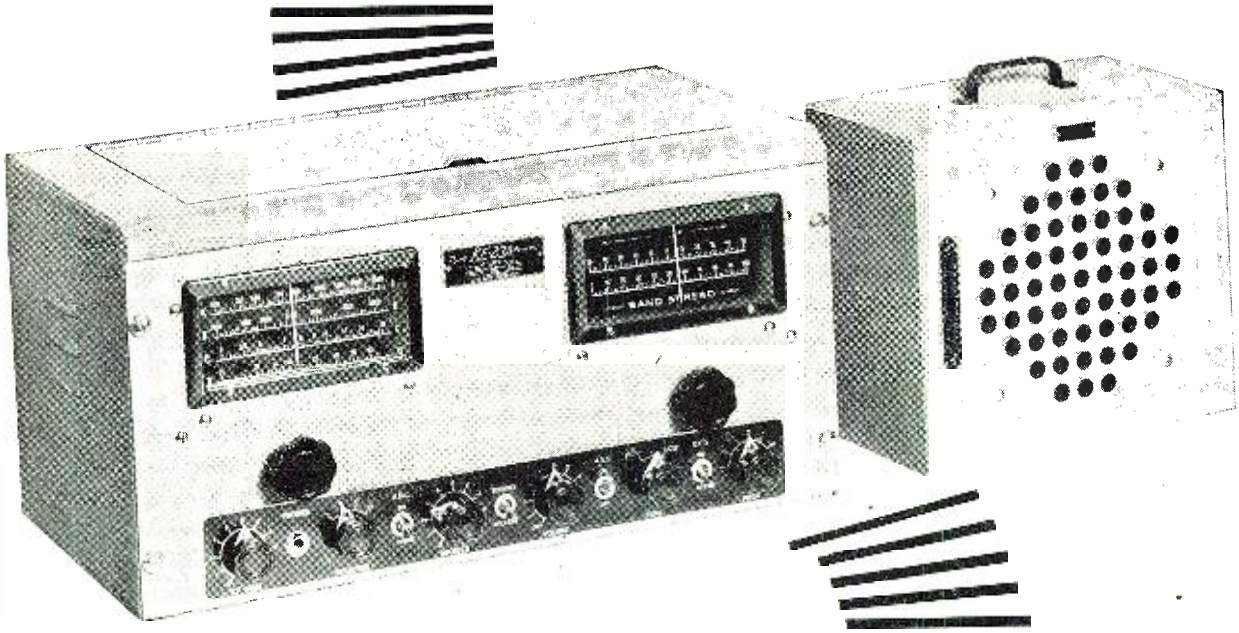
Remarkably pertinent effects may be produced by reflecting a second carrier wave path, in addition to the original path, from reproducer to microphone, as shown in Fig. 7. Fading and phase distortion, such as encountered in standard radio reception, may be produced realistically in the ultrasonic receiver by varying the position of the reflector, the motion of the reflector being somewhat analogous to

---

Transmitters mounted in airplanes flying six miles above the earth hold the key to Stratovision—a new system of nationwide television and FM radio announced August 10th, by the Westinghouse Electric Corporation. Programs for the system, a joint development of Westinghouse and the Glenn L. Martin Company, would be originated in ground studios and "beamed" (solid lines), in much the manner of military radar, to planes for broadcast. Similarly "beamed" plane-to-plane connections (dotted lines) would form a nationwide network. Each plane would receive and broadcast nine simultaneously available programs throughout a 103,000 square-mile area within its 442 mile line-of-sight diameter (shaded circles). Broadcast locations shown would provide coverage for 78 per-cent of the nation's population; 100 per-cent coverage merely would require more airplanes.



UP TO 42 Mc



DOWN TO 500 Kc

No-signal squelch circuit makes this general purpose KAAR RECEIVER IDEAL FOR STANDBY!

The KAAR KE-23A general purpose receiver has a wider than customary range, covering all of the radio communication bands from 500 Kc to 42 Mc. Unsurpassed for most types of emergency, commercial, and amateur operation, it is especially favored as a standby receiver.

A *no-signal squelch circuit*—normally not available in a general purpose receiver—automatically silences the speaker except when a call or message is being received, thus eliminating background noise during standby periods. A threshold control on the panel determines the amount of carrier required to operate the receiver, or cuts out the squelch circuit when desired.

This nine tube receiver has a high degree of stability and its selectivity and sensitivity insure reception under the most difficult conditions.

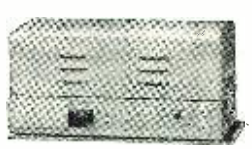
The KE-23A, designed for 117 volt 60 cycle AC operation, is instantly converted to 6 volt DC by plugging in a KAAR 647X power pack at the back. Write today for additional information about this versatile KAAR receiver.

KAAR ENGINEERING CO.
PALO ALTO, CALIFORNIA
Export Agents: FRAZAR & HANSEN
301 Clay Street • San Francisco, California

FM TRANSMITTERS—50 and 100 watt mobile FM transmitters with instant-heating tubes for lower battery drain.

CRYSTALS—Low-drift quartz plates. Fundamental and harmonic types available in various holders.

AM TRANSMITTERS—Mobile, marine, and central station transmitters for medium and high frequencies. Instant heating, quickly serviced.



MICROPHONES—Type 4-C single button carbon. Superb voice quality, high output, moisture proof.

CONDENSERS—Many types of small variable air condensers available for tank circuit and antenna tuning.

the motion of the Heaviside layer. The movement of people within range of the apparatus produces like results and indicates the potential utility of ultrasonics for intrusion or passage detection in air mediums, using the beam-of-sound rather than the beam-of-light principle.

In the near future it is proposed to conduct out-of-door tests in an effort to empirically determine the range of such apparatus.

REFERENCES

1. *Lord Rayleigh, "Theory of Sound."*
2. *Dr. L. Bergmann, "Ultrasonics," P. 195.*
3. *Ibid. (2), P. 194.*

—30—

For the Record

(*Continued from page* 8)

that he thought they were huge machine guns.

These are only a fraction of the many case histories where radar has been used in combating our enemies. Radar, like a tree, has grown from many roots. It has been developed through years of research and experiment. In fact, during all stages of the development of radar, the techniques of the communications art have been drawn upon by the engineers and scientists. In giving due credit to the development of radar we must recognize radar as being a "joint development." Now that we have reached a happy conclusion in our war effort, let us recognize the effective results that may be obtained only by carefully planned and extended team work on the part of nations fighting side by side to attain the common objective. Let us be careful in giving our credit to any one individual and, finally, let us be thankful that both American and foreign scientists rolled up their sleeves and pitched in to develop the potent weapon that is radar.

We are devoting considerable space in this issue to a review of some of the radar equipment used during the war. Space does not permit a complete resume. As time goes on and restrictions are lifted we will bring you later units.

Postwar applications for radar are many. To fly a plane in dense fog or to sail a ship on the high seas without fear has always been the dream of the pilot and navigator. Today it is a reality.

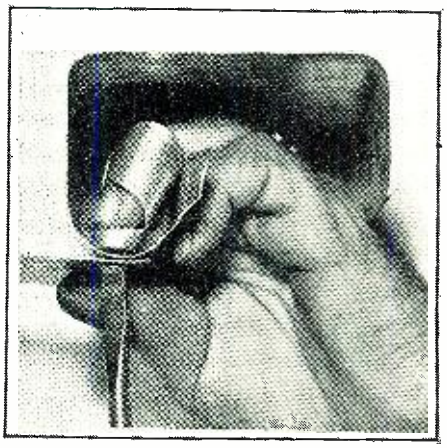
Yes—science moves on. We know now that the electronic tube is playing a vital role in the development of the atomic bomb. Let no one under-estimate the vast use to which electronic tubes will continue to perform in the postwar era . . . . . O.R.

What's New

(*Continued from page* 74)

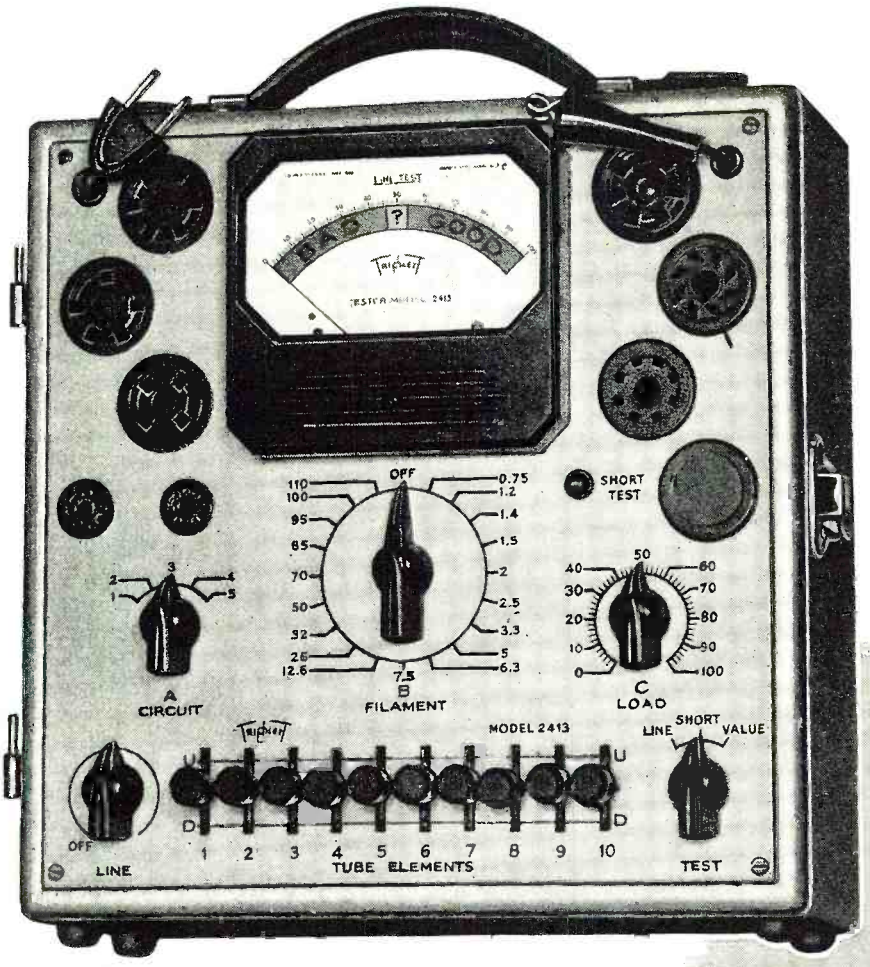
position for assembly or disassembly. Since this tool is always "on hand—at the finger tips", it will be found useful for general mass production operations where the constant use of a wrench, screwdriver, etc., is part of a job detail. It eliminates the repetitive action of laying aside and picking up tools.

The Touch-n-Grip is worn like a



ring without restricting the free motion of the hands or fingers. When not in actual use, it can be turned around the finger and out of the way to leave the hands free for using other tools or work details.

Additional details of this unit will be furnished those requesting them from



MODEL 2413 [T] is another member of the NEW TRIPLETT Square Line

[T]

The New Speed-Chek Tube Tester

MORE FLEXIBLE • FAR FASTER • MORE ACCURATE

Three-position lever switching makes this sensational new model one of the most flexible and speediest of all tube testers. Its multi-purpose test circuit provides for standardized VALUE test; SHORT AND OPEN element test and TRANSCONDUCTANCE comparison test. Large 4" square RED•DOT life-time guaranteed meter.

Simplicity of operation provides for the fastest settings ever developed for practical tube testing. Gives individual control of each tube element.

New SQUARE LINE series metal case 10" x 10" x 5½", striking two-tone hammered baked-on enamel finish. Detachable cover. Tube chart 8" x 9" with the simple settings marked in large easy to read type. Attractively priced. Write for details.

Additional Features

- Authoritative tests for tube value; shorts, open elements, and transconductance (mutual conductance) comparison for matching tubes.
- Flexible lever-switching gives individual control for each tube element; provides for roaming elements, dual cathode structures, multi-purpose tubes, etc.
- Line voltage adjustment control.
- Filament Voltages, 0.75 to 110 volts, through 19 steps.
- Sockets: One only each kind required socket plus one spare.
- Distinctive appearance with 4" meter makes impressive counter tester — also suitable for portable use.

STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

Triplett

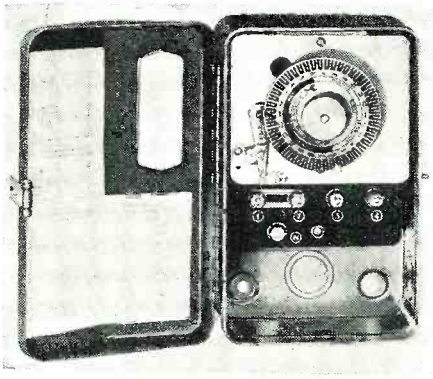
ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

Faso Manufacturing Company, 41-27 Bell Boulevard, Bayside, Long Island.

TELECHRON MOTOR

The *Paragon Electric Company* has announced an improvement in the *Paragon* 300 Series Time Switches. It is the Telechron Motor, an industrial type, self-starting synchronous motor which adds years to the life of the time switch. Complete, self-oiling lubrication by means of a patented capillary oiling system, practically instantaneous self-starting at full rated load, gear reduction fully sealed to exclude dust and dirt, and low power consumption are among the many operating advantages of this motor, according to the manufacturer.

The 300 Series is light in weight,



small and compact in design, and is constructed to give efficient performance. It has switch capacity of 3000 watts per pole with easily mounted-accessible terminals, skip-trip feature, knockouts on both sides, back and bottom, and two bearing plate construction.

These time switches, which may now be purchased without a priority rating, are widely used for controlling signs, commercial lights, attic fans, stokers, oil burners, blowers, pumps, valves, motors, etc.

Further information is available from *Paragon Electric Company,* 37 West Van Buren Street, Chicago 5, Illinois.

MARINE RADIO TELEPHONES

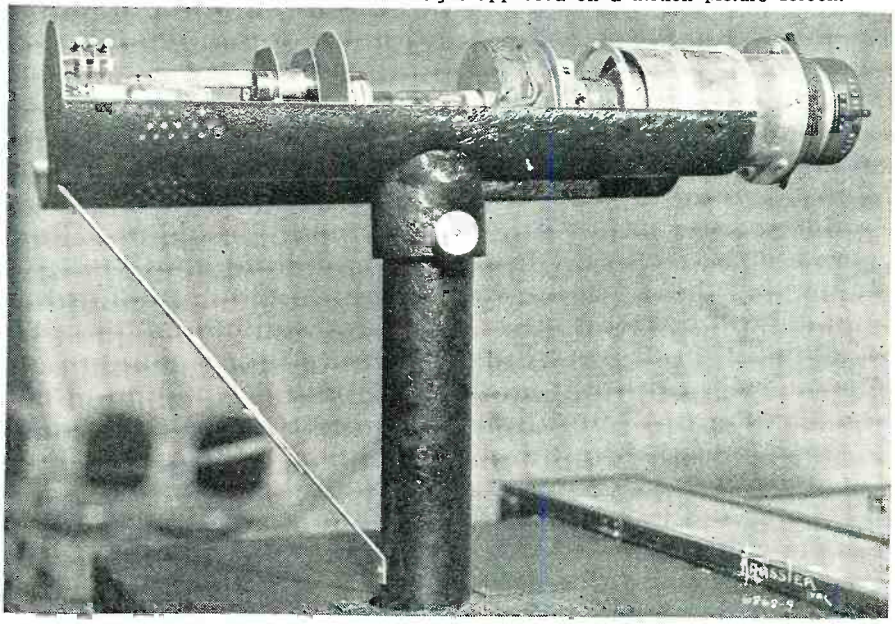
Hudson American Corporation, a subsidiary of *Reeves-Ely Laboratories, Inc.,* has announced four new models of marine radio telephones designed to meet communications requirements in the yachting and coastal harbor services.

The complete line covers ship-to-ship, ship-to-shore, and ship-to-Coast Guard (emergency) marine radio telephones ranging from 5 watts to 75 watts and operating on frequencies between 2100 kc. and 2800 kc.

Exclusive with all four models, which will have identifying trade names, are several unique features. No variable condensers are used in these sets, therefore precluding the danger of inefficient operation due to their use. Completely individual adjustment of each channel is provided to assure greater transmitting and receiving efficiency. The transmitter and receiver have complete crystal control and the new transmitter-output coupling system is designed to give greater efficiency of operation and to minimize both interference with other communications and harmonic radiation.

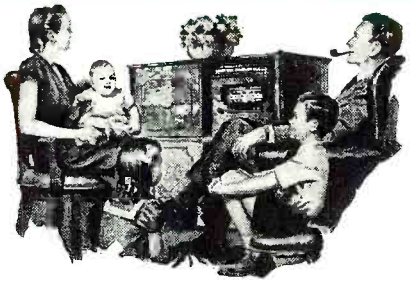
One model is built especially for small craft. A single-channel unit, with a capability of approximately 5 watts of transmitter power output, it can provide two-way communication over a normal distance of approximately 25 to 50 miles under favorable conditions.

Here is the tube that made possible RCA's first practical demonstration of experimental television on the new enlarged screen, approximately three-by-four feet. Before the members of the Society of Motion Picture Engineers, a full hour's program from the NBC television studio was shown in exceptional clarity through this Kinescope projection tube, photographed in profile with the cover laid back to reveal the inside construction. The images appeared on a motion picture screen.



Since there's nothing finer than a Stromberg-Carlson

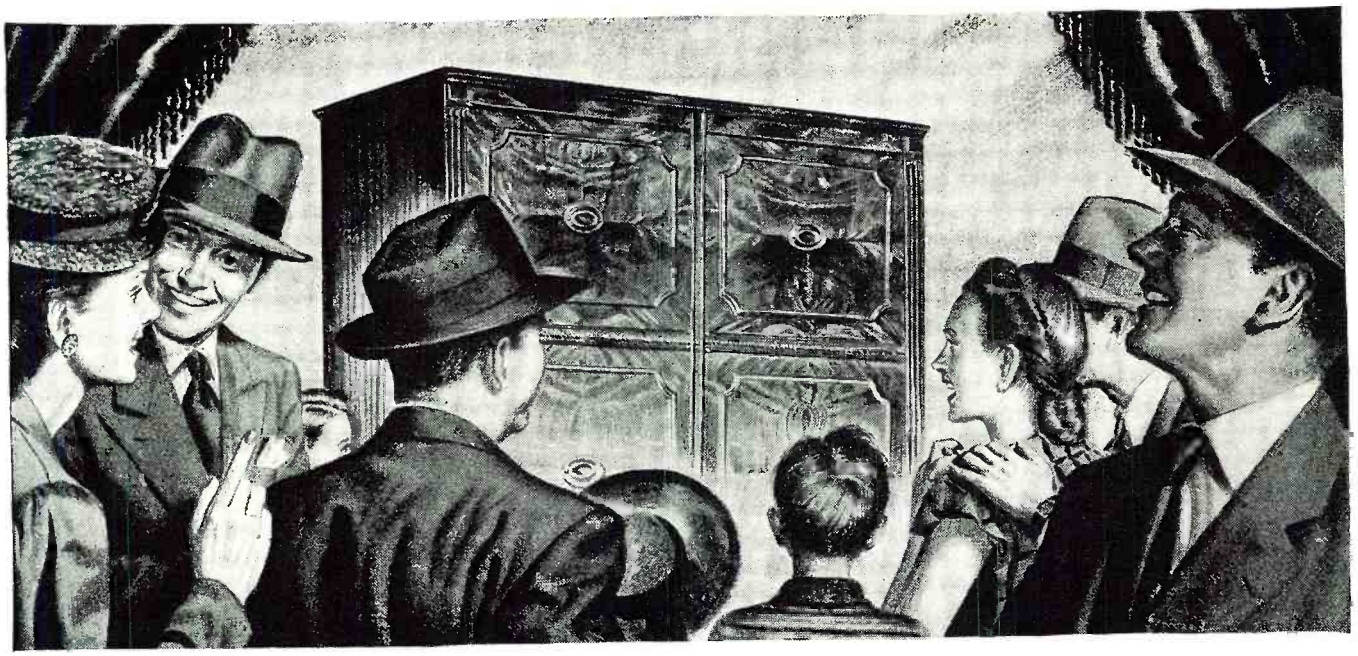
for the Main Radio



in any home

There's nothing finer than a Stromberg-Carlson

for the Main Radio Line in your showroom!



THESE SEVEN WORDS, "There's nothing finer than a Stromberg-Carlson" have aptly summed up Stromberg-Carlson leadership for 51 years. Today, by the millions, America is swiftly swinging to the conviction that the *main* radio in any man's home should be as fine a musical instrument as its owner can possibly buy.

Stromberg-Carlson is the main choice for the *main* radio in whatever price range — whether table model, console, or radio-phonograph combination. And its superiority as a musical instrument is carried to the public through vigorous national advertising with some 475,000,000 impressions in thirteen leading magazines during 1945.

Ask your Stromberg-Carlson distributor for details of the very favorable Franchise Agreement now being offered, or write us directly. For Stromberg-Carlson is:

— the important radio unit
— the radio unit carrying real profit opportunity
— the radio unit with easy-selling public acceptance.

Become an Authorized Dealer now, and organize your postwar business around the Stromberg-Carlson *main radio* — a consistent profit maker whether in an outstanding table model, console, or radio-phonograph combination.

STROMBERG-CARLSON

ROCHESTER 3, NEW YORK

RADIOS . . . RADIO PHONOGRAPHS . . . AND TELEVISION

Another model is nominally rated at 10 watts of transmitter power output, with 5 channels available, and has a communication radius of approximately 75 to 100 miles under favorable conditions. Channels 1 and 2 are set up for ship-to-ship communication. Channel 3 allows for emergency communication with the Coast Guard. Channels 4 and 5 will be made available for any of the ship-to-shore radio telephone channels in the vicinity of the vessel on which the equipment is installed.

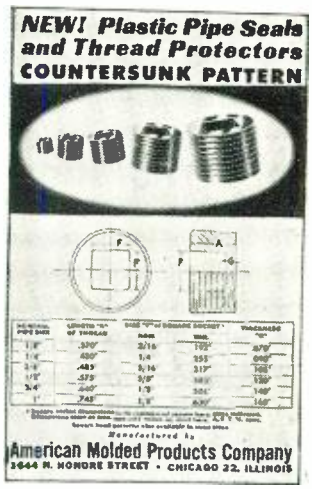
Another model, the Hudson 25-watt, 6-channel marine radio telephone set has a communication radius of approximately 250 to 400 miles under favorable conditions. The 75-watt, 10-channel ship-to-shore radio telephone is designed for ocean-going vessels in the coastal services and offers a normal communication radius of approximately 500 to 1000 miles under favorable conditions.

These four marine radio telephones can be manufactured now for commercial use with the necessary priorities and are the product of *Hudson American Corporation,* New York City.

PLASTIC PIPE SEALS

American Molded Products Company has announced plastic pipe seals and thread protectors in countersunk pattern. Due to the demand for the countersunk type, this addition to the line now gives users a choice, as the squarehead patterns pioneered by this company are still available.

The strength and lightness, as well as the toughness, of plastic make it



suitable for pipe seals and thread protectors. Plastic takes accurate and durable threading, is non-corrosive, dielectric, and most efficiently excludes moisture, oil, dirt, and grit.

The square sockets of this new countersunk pattern are made in dimensions to fit commercial square bars of standard sizes. Dimensions are the same as the maximum size of cold rolled square steel bars given in A.S.T.M. specifications. Sizes available are: ⅛", ¼", ⅜", ½", ¾", and 1".

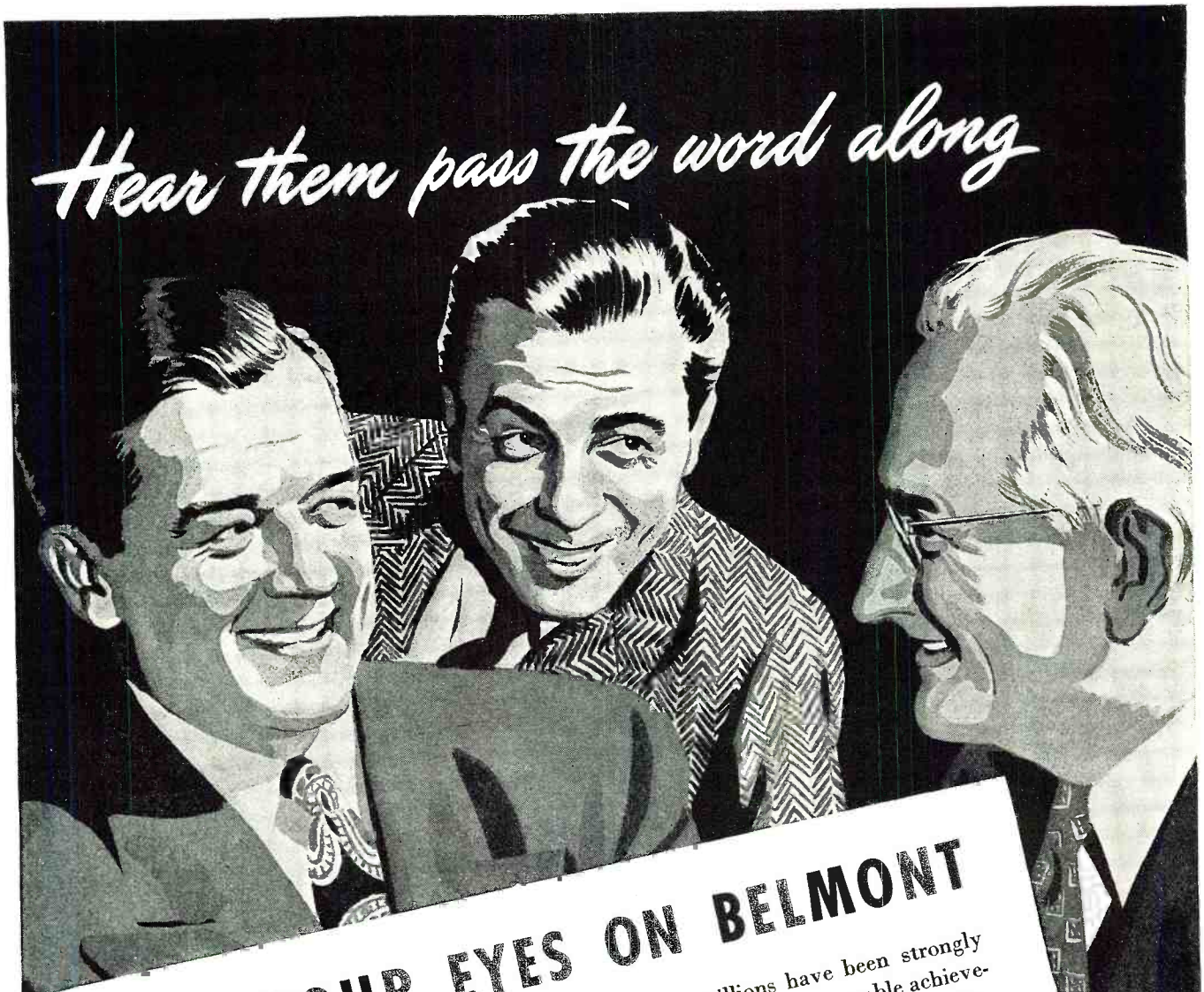
Further information on these new plastic pipe seals and thread protectors may be secured by writing to *American Molded Products Company,* 1644 N. Honore Street, Chicago 22, Illinois.

ISOLATION TYPE VARI-FORMER

A new type W Vari-Former which is double, or isolation, wound for laboratory and industrial use has been introduced by the *Gulow Corporation.*

This unit has a primary wound for

115 volt input and a variable secondary wound for an output of 0-130 volts. Separate terminals are provided for both primary and secondary windings for full flexibility. It is possible to connect these units as auto transformers making several different voltage combinations possible.



KEEP YOUR EYES ON BELMONT

When people talk about the post-war radios and television sets they are planning to buy, you hear more and more of them speak of Belmont.

There are good reasons for this keen and growing interest in Belmont's products of tomorrow.

Millions of future buyers are looking to Belmont with confidence because of the outstanding performance of Belmont-made radios in their own homes.

Additional millions have been strongly impressed by Belmont's notable achievements in the field of wartime electronics. And through a program of consistent national advertising, people everywhere are learning of Belmont's plans to play a dominant part in the post-war radio and television world.

Keep your eyes on Belmont! Belmont Radio Corporation, 5929 West Dickens Avenue, Chicago 39, Illinois.

Belmont Radio

RADAR ★ TELEVISION ★ F.M. ★ ELECTRONICS

Inputs of 115 or 220 volts can be applied and output ranges of 0-65 or 65-130 are obtainable with increments of .3 volts. Likewise output ranges of 0-130 or 115-245 with increments of .6 are possible.

The separate primary and variable secondary windings are wound on the same core which results in close regulation and obviates the necessity of using two transformers to obtain an isolated variable voltage supply. For critical electronic testing and special applications, an electro-static shield has been imposed between the primary and secondary, grounded to the core and brought out to a separate terminal.

This new unit has the same high overload capacity as the type "C" (auto-transformer) Vari-Former. Units with capacities of 500 va. to 2000 va. are available. The 500 va. measures 7" x 9" x 4½" deep, weight 20 lbs. The 2000 va. measures 10" x 10" x 8" deep, weight 50 lbs. Custom designs are also available to meet unusual requirements, both electrical and mechanical.

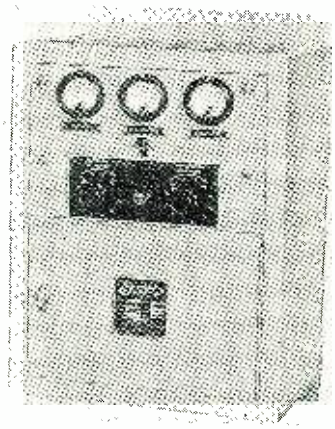
This unit is being manufactured by the *Gulow Corporation,* 26 Waverly Place, New York 3, N. Y.

TELEPHONE BATTERY CHARGERS

The manufacture of fully automatic telephone battery chargers for operation over a wide range of power line voltages and load requirements is announced by *Federal Telephone and Radio Corporation,* associate of *International Telephone and Telegraph Corporation.*

These regulated and filtered chargers are designed to maintain telephone batteries in a fully charged condition, ready for any emergency. They are ideally suited for use in manual central offices, in automatic exchanges, and in both private and rural, manual or automatic branch exchanges.

The battery chargers utilize the



Federal Selenium Rectifier in operation from single-phase, 60 cycle power lines of 110, 130, 200, 220, and 250 volts, selected units providing direct current outputs ranging from 2.4 to 16 amperes for from 12 to 60 cells.

Battery potentials are automatically maintained within selected limits by a voltage control relay circuit which varies the charge between high and trickle rates, both of which are adjustable. The unit is designed to operate without automatic regulation if necessary, permitting the rate of charge to be adjusted manually when desired.

The d.c. output circuit is filtered to prevent the introduction of noise on telephone lines, the a.c. ripple component being guaranteed not to exceed 40 millivolts at full load. An alarm circuit is provided to indicate failure of charger or battery circuits, both of which are equipped with fuse protection and overload switches. A voltmeter on the front panel indicates battery voltage.

Further information may be obtained from *Federal Telephone and Radio Corporation,* 67 Broad Street, New York 4, N. Y.

DYNAMIC MICROPHONE

The prewar KD dynamic microphone for recording, industrial call, and public address systems, manufactured by *Universal Microphone Company,* Inglewood, California, has been reissued.

Various changes have been made technically and in the casing styling to bring the instrument up to the moment. Frequency response is 50-7500 cycles-per-second; output level 63 db. below one volt per bar; and impedance 40,000 ohms. The KD is finished in deep bronze plating, includes a 10 ft. rubber covered cable, uses spring steel cable strain relief at the housing, and uses standard coupling ⅝th inch 27 thread.

The KD weighs under 2 lbs. for shipping. It is 3¼ inches in diameter with a depth of 2⅜ inches. It will be marketed through the 16 factory representatives, the Canadian and export divisions, and the usual jobbing channels.

ALLOY SPRAYER

The exclusive manufacturing and selling right to the Forrester Alloy Sprayer and parts, formerly sold as the Alloy Sprayer, has been acquired by *Stewart Tool Manufacturing Company.*

The Forrester Alloy Sprayer is an electrically heated portable gun for spraying low temperature alloy metals. The complete unit consists of the gun with trigger handle, electric cord, 10 ft. air hose, air filter, pressure gauge, and pressure regulator. It is light weight, easy to handle and a complete unit which can be plugged into any 110 volt circuit and attached to an airline. It heats quickly and metal melts in approximately 2 to 10 minutes, depending on the alloy used.

The spraying is done by pressing the trigger on the pistol grip handle. The spray can be regulated to suit each type of work being done by a thumb controlled valve which is located above the pistol grip handle. The Forrester Alloy Sprayer can be adjusted so it will spray low temperature alloy metals from 100 to 600 degrees F. by simply adjusting the thermo switch to the desired temperature.

"Ceilings" are saving you money

*64 months after war started

It's a far longer and more expensive war than the last one—but this time the cost of living hasn't been allowed to get out of hand. If you're ever tempted to grumble at price-and-wage controls, look at these charts—and DON'T. They're one reason to bless ceiling prices...and to check 'em whenever you shop. (They're posted for your protection!)

Rationing gives all a fair share

The Millionbucks get no more points than the poorest folks in town. Necessities are rationed to see that each gets his share. And rationing also keeps prices down: without it the fellow with the biggest wad of dough would have a terrific edge. Share and play square ... pay points for everything you buy. (And shun black markets like the enemy they are!)

—and the money you DON'T SPEND helps hold living costs down

The plain bread-and-butter fact is this: there's about $1.50 in people's pockets for every dollar's worth of goods in the stores.

Splurge—buy anything you don't actually need—and you put the heat on everything to rise all along the line.

Save—deny yourself something you want but can get along without—and you help yourself a little today and a lot tomorrow.

Squeeze that budget. Squeeze a little more money into your savings account. Squeeze a little more into insurance. Squeeze yourself into buying another War Bond today...and every month from now on in.

Wise enough to harness your money for your own safety?

ONLY YOU CAN DO IT.

ZIFF-DAVIS PUBLISHING COMPANY

A United States War Message prepared by the War Advertising Council, approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

The proper pressure for spraying is controlled by the pressure regulator and pressure gauge. This should be between 30 and 60 lbs. for average work. If a permanent coating is desired the heavier spray at higher pressure will be used. If for reproduction, or temporary protection, a thin coating which can be easily removed will require a lower pressure.

Suggested uses of the Forrester Alloy Sprayer in the electrical and radio fields includes tinning carbon brushes, spraying ceramics for radio, spraying iron-selenium plates for rectifiers and metal spraying glass surfaces and porcelains.

Complete details and price list will be furnished upon request to *Stewart Tool Manufacturing Company,* 5742 Lakewood Avenue, Detroit 13, Michigan.

—30—

International Short-Wave

(*Continued from page* 94)

CNR, 16.666, Rabat, French Morocco, is scheduled 7:8:45 a.m. TGNA, 7.170, Guatemala, has good signals, 8-10:15 p.m. Swedish sources report EQC, 9.680, Teheran, Iran, is scheduled 1-3:30 p.m., and report EPB, 15.120 (not 15.100), is scheduled 3:45-5 a.m. Radio Luxembourg, 7.265, reported 12 midnight-3 a.m. Frequencies of Lusaka, Northern Rhodesia, are 3.915, 4.900, 7.220. OAX4X, 9.510, OAX4Q, 6.010, Lima, Peru, are heard in parallel, 7 p.m.-12:30 a.m. JCTA, 7.190, Cairo, is scheduled 11:30 p.m.-1:30 a.m., 3 a.m.-4 p.m. with news at 3:30, 6:30 a.m., 12:30 and 3 pm. JCKW, 7.220, Cairo, same schedule, but news at 12:30, 7, 11 a.m., 1, 3 p.m. FXE, 8.110, Beirut, Lebanon, scheduled 5:25-5:30 and 11-11:45 a.m. to the Forces, news at 5:25, 11 a.m. (URDXC.)

Okinawa on 10.630 has been heard evenings, good signals, when calling KU5Q, Guam, with dispatches at 8-8:10 p.m. EWT. HEI2, 6.345, Bern, Switzerland, heard from about 5:30 p.m. for a short time. "The British Forces' Program from New Delhi" (India) is heard at good volume until closing at 12:30 p.m. on 9.680. Although VLW6, Perth, operates on same frequency, the Australian is usually drowned by the Indian station. At 12:45 p.m. this Delhi station opens with programs in Hindustani. (Gillett, Australia.)

SPW, 13.635, Warsaw, Poland, is on the air irregularly in early evenings, heard closing at 7:30 p.m. Only foreign language, presumably Polish, is used. Does not seem to have regular schedule, sometimes signing off at 8 p.m. HE15, 11.715, Bern, Switzerland, heard from 2:30-4 p.m. with programs in French, German, and Italian. (Suffolk, Australia.)

OLR4A, 11.840, Prague, Czechoslovakia, heard at 4:34 p.m. in English; signs at 5:05 p.m. CXA10, 11.900, Montevideo, Uruguay, heard with good signal, 7:50-10:13 p.m. JANS, 18-.135, Batavia, Java, recently heard very weak at 10 p.m. WVLC, 7-.795, Manila, Philippines, heard at 12:-23 a.m. WHX, Ketchikan, Alaska, 9.920, heard at 9:35 p.m. (inverted speech). "Polskie Radio," 6.115, Lublin, Poland, heard at 9:20 p.m.

SDB2, 10.780, Stockholm, Sweden, heard at 3:45 p.m. in Swedish. TAP, 9.465, Ankara, Turkey, heard most days in English, 4:27-4:45 p.m. A Spanish station on 9.860 (EAQ?), Madrid, was heard recently at 6:30 p.m. in Spanish. SBT, 15.155 (or 15.160), Stockholm, Sweden, heard in Swedish at 7:30 a.m. VUD3, 15.290, Delhi, India, heard in native language at 8 a.m.; signs at 8:10 a.m. KRHO, 6.120, Honolulu, Hawaii, heard mornings in Japanese and English, news in English at 8 a.m. Algiers on 11.765, relaying "Voice of America" programs was heard to sign-off recently at 7:47 a.m. ZFY, 6.000, Georgetown, British Guiana, heard with a religious program at 8:30 a.m. Sundays. Tananarive, Madagascar, 12.135, heard 8:40 in French, either left air or faded out at 9:40 a.m. (Bromley, Ontario.)

"Radio Dakar," 11.715, Dakar, French West Africa, was recently heard signing on at 3:15 with "Ici Dakar," followed by news in French; believe regular schedule is 8:15-8:45 a.m.

HCJB, 15.100 (or 15.115), heard with good signal, 6-10 a.m. Has excellent signals mornings and evenings on 12.455 and 9.958; English news at 6 p.m. (Gonder, W.Va., Freund, Texas.)

PRL8, 11.72, Rio de Janeiro, Brazil, has excellent signals evenings to 11 p.m. JLT2, 9.645, Tokyo, heard 5:30-8:15 a.m. XEWW, 9.500, Mexico City, pounds in, 9 a.m-1 a.m. next day. JLG2, 9.505, Tokyo, heard mornings, very poor. (Freund, Texas.)

SBT, 15.155, Stockholm, Sweden, heard with good signal at 11 a.m. Dublin, Eire, heard on 17.840 at 1:45 p.m. with news. The 5:10-5:30 p.m. transmission of "Radio Eirann" on 9.595 is erratic. (Harris, Mass.)

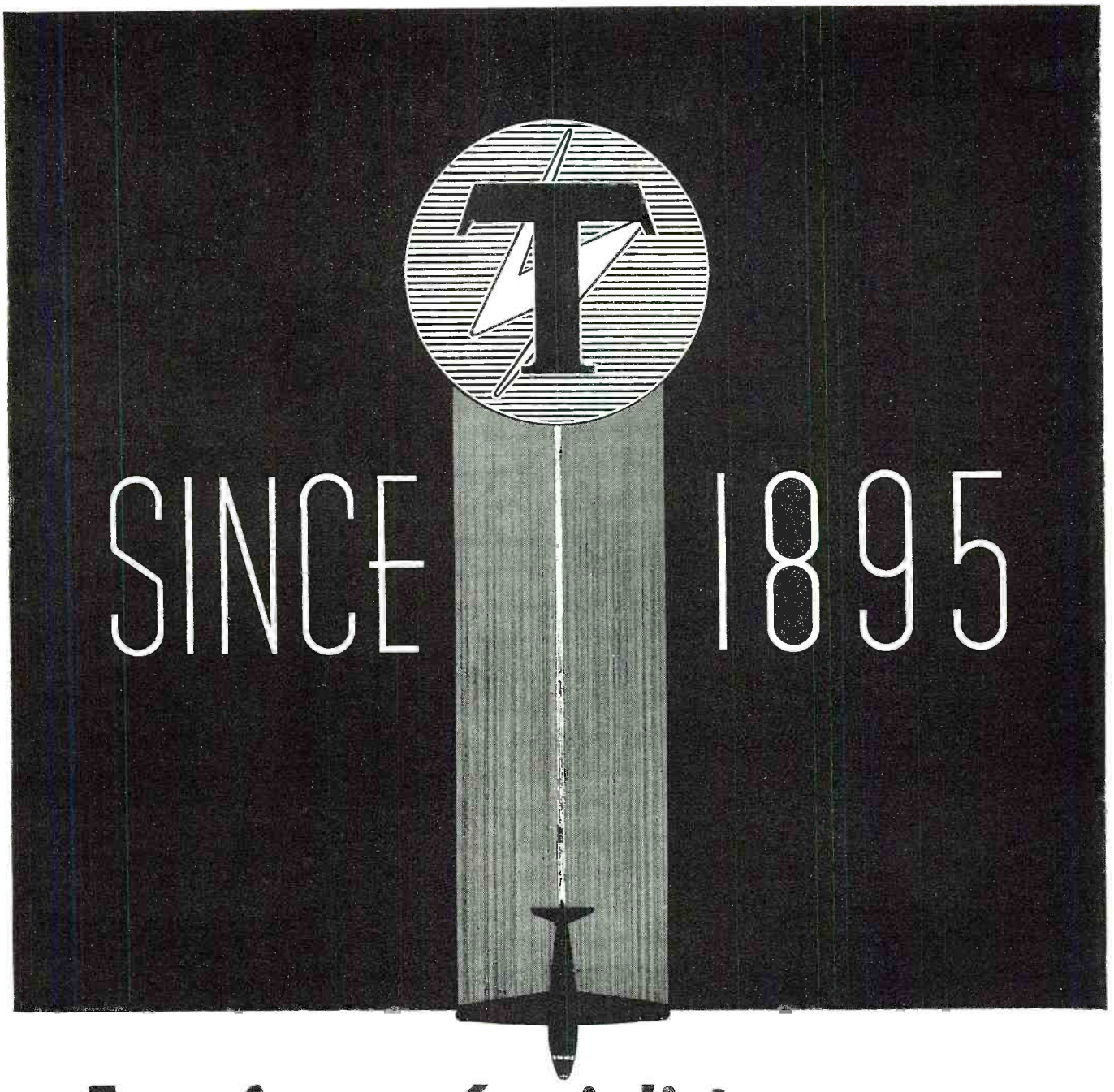
All broadcasting from Holland is on medium or long wavelengths, three stations being in operation — The Hague, Lopik, and Hilversum. These broadcasts are heard in England; except for the English lessons, they are in Dutch, consisting of news, press reviews, messages and answers, and cultural talks. In the event short-wave broadcasts are resumed, frequencies used by Hilversum prior to the war will likely be employed again, but the economic situation in Holland is such that it is difficult to make any prediction as to when this will occur. (Netherlands Information Bureau, Washington.) Many DXers will remember the welcomed, powerful voice of pre-war PHI.

Alma-Ata, U.S.S.R. (Siberia), 8.815, heard in parallel with 9.565 at midnight excellent signal on West Coast. (Harrison, British Columbia.)

CSW6, 11.040, Lisbon, Portugal, musical program at 3:30 p.m., fades. (Kulze, New York.)

HJCT, 6.26, Bogota, Colombia, signs off at 12:15 a.m. (Brewer, Okla.)

—30—



Transformer Specialists . . .

Thordarson's tradition of quality provides the underlying reason for its past half-century of progressive leadership in the specialized manufacture of dependable transformers, components and other electronic devices. This same tradition, upheld through every phase of *Thordarson* design, engineering and manufacturing is your guarantee of the finest transformers for requirements of Tomorrow . . . and years to come. With confidence . . . gained by this ability to produce quality merchandise and coupled with novel sales policies . . . *Thordarson* looks forward to supplying the expanding demands of the radio and electronic industries.

500 WEST HURON ST., CHICAGO, ILL.

ORIGINATORS OF TRUE-FIDELITY AMPLIFIERS

THORDARSON

ELECTRIC MANUFACTURING DIVISION

MAGUIRE INDUSTRIES, INCORPORATED

New Type Signal Tracer

(*Continued from page 31*)

tivity is 1.8 volts full scale from 250 c.p.s. to well past the aural range of 10,000 c.p.s. Below 250 cycles, the sensitivity of the voltmeter is reduced because of the high-pass filter, the sensitivity at 120 cycles being 2.2 volts full scale and dropping to 5.4 volts at 60 cycles. The sensitivity at 40 cycles is even less and although it doesn't appear on the graph, the voltage required for full-scale deflection at this frequency is in the vicinity of 15 volts.

Sensitivity of the probe at the radio frequencies is shown in Fig. 2. It should be noted that the frequency response is flat to 10 mc. Above this point, resonance takes place in the tube and associated parts tending to increase the sensitivity at 15 mc. The sensitivity then takes a decided drop past 20 mc. At 40 mc., the probe requires 1.3 volts to obtain one scale deflection on the meter. Although the probe is essentially flat to 10 mc., the loading on the circuit increases as the frequency is increased. The useful range is to approximately 10 mc. Above 10 mc., loading is excessive due to the material used in the probe.

The remainder of the instrument consists of the battery box, meter, and balancing control. A 45 volt battery is used to supply plate voltage for the 1T4, with a 1½ volt cell taking care of the filament voltage. One of the characteristics of this type of v.t.v.m. is the large idling current. This is caused by the lack of grid bias. When a signal is applied to the

NEW INDUSTRY ON PACIFIC COAST

THE hottest word in the Pacific Coast war effort not long ago was tropicalization. This is the term used for the bitter campaign against fungus, the invisible round-the-clock foe in the battle of the South Pacific. Out of this condition comes a new industry for the Pacific Coast.

Fungi have caused standard signal corps equipment to break down in six hours after it reaches jungle theaters. Arcing, crosstalk, and flashovers, as the result of fungi, have played hob with Army, Navy, and Marine communications at critical stages of our land and sea operations.

There are 5000 different kinds of fungi in the tropics and the vegetable growth, which luxuriates in the heat and moisture of fox-holes, attacks transmitters, receivers, amplifiers and remote control, power supply, and test instruments. Once unpackaged, instruments are seldom dry again in the South Pacific.

Fibre, laminated plastics, cotton, linen paper, and celluloid derivatives, wood, leather, wax, and even glass and metal provide veritable green-houses for the growth of fungus.

"Due to the extreme weather and combat conditions of this war, moisture and fungus growth are shortening the life of signal corps equipment at a startling rate, even to the point of completely destroying its usefulness," says Major General W. H. Harrison, Chief of the Army Procurement and Distribution services.

Signal corps radio experts who can sharp-shoot the ether with an accuracy that has cost the Japs plenty have themselves been disarmed and rendered impotent by fungus.

Now, in the shadow of the California Institute of Technology, tropicalization of all U. S. Signal Corps equipment en route to the South Pacific is going on at a whirlwind pace. Signal corps officers say that this treatment increases the life of some equipment as much as 240 times.

"Lacquers and varnishes containing fungicidal ingredients are the answer," declares Bert Barron of the engineering staff of the Signal Corps job. "From the handy-talkie and so called 'breakie-backie' (which weighs more than 100 pounds) to the self-contained 50-watt radio stations which are landed quickly in the wake of all island invasions, every vulnerable part of the equipment is treated.

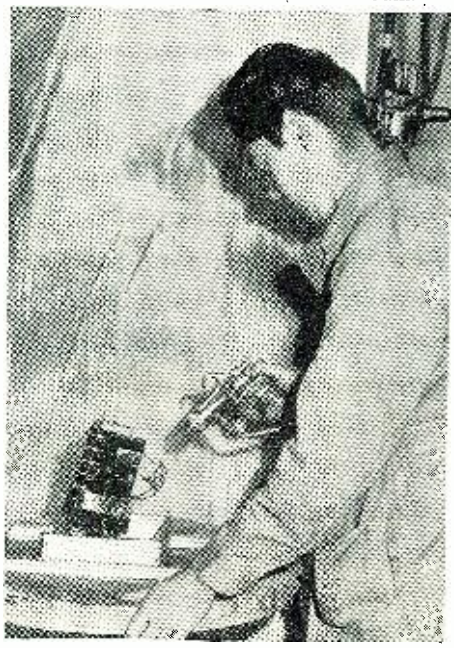
"If contact portions of the equipment cannot be treated because of the danger of insulation, these parts are masked.

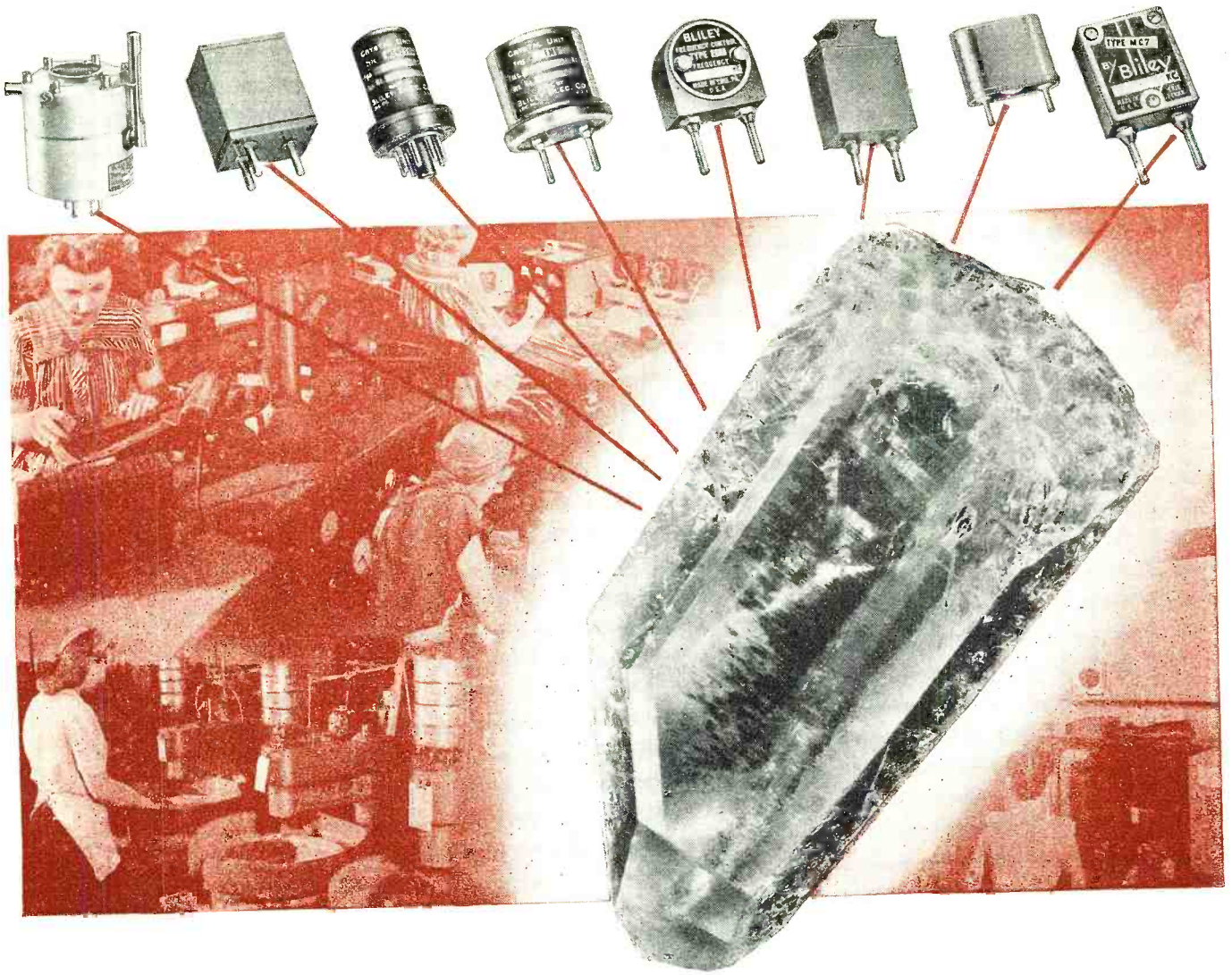
"Cables, coils, electric inductors, transformers, phenolic parts, terminal boards, switches, and hook-up wires are among the parts treated. These are baked for six hours in a pre-heated oven at a temperature of 140 degrees Fahrenheit before spraying. Equipment is then reassembled and tested before final packaging."

Communications Equipment Corporation has built a dehydrating and spraying plant on their grounds in East Colorado Street. With the expansion of postwar trade in the South Pacific it is believed by company officials that tropicalization will constitute a permanent and specialized Pacific Coast industry.

—30—

Photo shows tropicalization process in coating equipment at the Communications Equipment Corp., Pasadena, Calif.





You name the application . . .

BLILEY has the crystals

Post VJ Day production of Bliley acid etched* crystals for FM receivers, Aircraft and Marine radios, Railroad communications equipment and many other applications is proceeding with the same skill and efficiency that marked our wartime operations.

Substantial quantities of these crystals are in the hands of foresighted manufacturers who planned in advance with Bliley engineers for frequency stabilization in their postwar models.

Now, more than ever before, you need the versatile experience of Bliley engineers and craftsmen gained through more than 15 years of quartz crystal engineering exclusively. Whether your requirements are one crystal or a million, you can be sure of top quality—top design—and top performance—in Bliley crystals.

Another star has been added. Our 5th citation for outstanding achievement in producing materials essential to the war effort.

Bliley CRYSTALS

\+ + +

**Acid etching quartz crystals to frequency is a patented Bliley process.*

Radio Engineers—
write for temporary
Bulletin RN-26

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

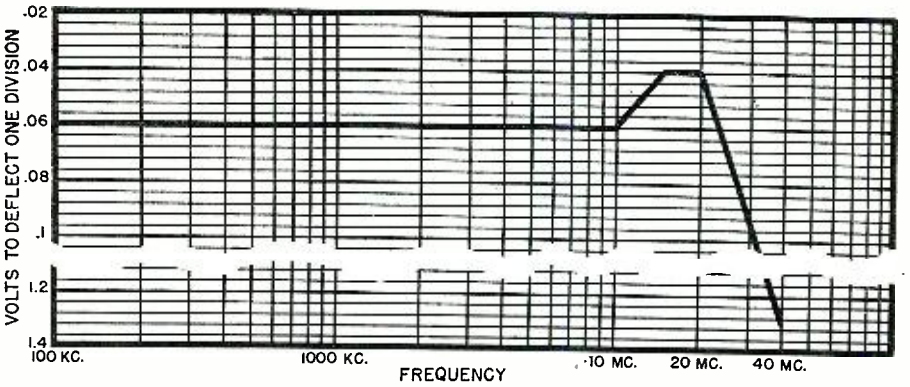


Fig. 2. Curve shows the sensitivity of the probe at radio frequency.

grid, rectification takes place and the grid current flowing through the grid resistor biases the tube, causing the plate current to drop. Ordinarily, this would cause the meter to read backwards. In this unit, however, the meter is connected backwards—the plus terminal being connected to the plate and the minus terminal connected to "B+". A bucking voltage is applied across the meter so that the meter reads zero with no signal applied. When a signal is applied, the meter reads up scale in the conventional manner.

As an example of how this signal tracer could be used to locate trouble in a receiver, the following illustration is given. A typical a.c.-d.c. receiver with a loop antenna and the following tubes, 12SA7, 12SK7, 12SQ7, 50L6, 35Z5, has intermittent operation and a very distorted signal.

With the receiver set to receive a station, take readings at the control grid and plate of each tube, starting with the 12SA7 control grid and working toward the 50L6 plate. As the probe is moved from grid to plate of each stage, the reading of the v.t.v.m. should increase. Failure of the meter to increase indicates a defective stage. The above, of course, can only be done while the receiver is in the inoperative condition. If when we touch the control grid pin of the 12SK7, we get a reading of 20 on the meter and the plate shows no signal, the trouble is obviously due to a defective 12SK7 stage.

This can be caused by a defective tube, open i.f. transformer, or open cathode resistor. The exact cause can be found with a tube-tester, or any standard volt-ohm-milliammeter.

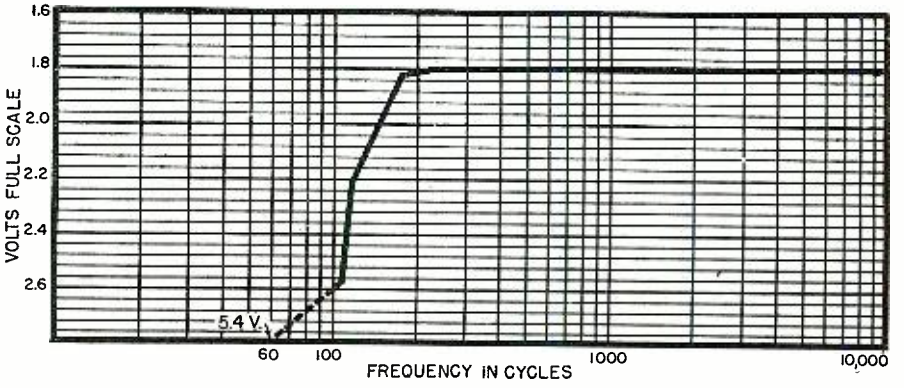
The distortion can then be detected the same way. When using the v.t.v.m. to detect audio, the needle will fluctuate with the modulation. A steady deflection indicates hum. If it is desired to listen to the distortion, phones are plugged into the jacks provided, and the meter disconnected by means of a switch on the panel. The probe can then be touched to the grid and plate of each tube until the received signal is distortionless. If when connected to the grid of the 50L6, no distortion is noticed and, when connected to the plate, it shows considerable distortion, the trouble is then in the 50L6 and its associated circuits. The cathode can be shorted to one side of the filament, or a high resistance leak can occur between the grid and the cathode or filament. Distortion or hum throughout the receiver can be caused by a defective 35Z5, the filter condenser, or a.c. that is in the power supply.

Although only two instances are shown above, the signal tracer can be used for various other purposes. The oscillator for example can be checked for oscillation by simply holding the probe near the coil or tuning condenser. If oscillation ceases when the condenser is rotated, the plates of the variable condenser may be shorted or the tube may be defective.

Thus, it becomes readily apparent that "bugs" may be found quickly and under innumerable conditions with the simple expediency of a model CA-11 signal tracer.

—30—

Fig. 3. The voltage required for full-scale deflection of the v.t.v.m.



FARNSWORTH

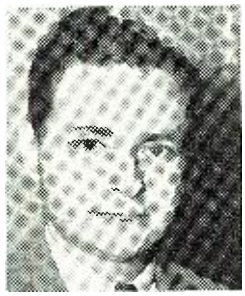
EXTENDS COMMUNICATION ACTIVITIES

BY ACQUIRING

THE HALSTEAD

TRAFFIC COMMUNICATIONS CORPORATION

WILLIAM S. HALSTEAD, president of the Halstead Company, joins the Farnsworth organization as consultant on radio communications equipment and traffic control, as well as on other phases of Farnsworth's broad electronic developments.



JOHN A. CURTIS, vice president of the Halstead Company and chairman of its management committee, joins the Farnsworth organization as manager of the mobile communications division.

TO EXTEND its broad communications activities into the rapidly expanding field of mobile railway and highway communications and control, Farnsworth has acquired the assets of the Halstead Traffic Communications Corporation, including its developments, designs and patents. Key personnel, including William S. Halstead, president, and John A. Curtis, vice president, have joined the Farnsworth staff.

The Halstead organization is a recognized pioneer in this relatively new field of radio communications. It has invented, developed and produced field-tested equipment to provide railroads with modern, unfailing radio communications. It gave the world its first successful highway radio service, including the centralized control of busses, trucks and passenger vehicles.

The Halstead technical staff will establish new headquarters at the Fort Wayne Farnsworth laboratories. The organization will be merged and coordinated with more than two hundred Farnsworth research and development engineering personnel—a staff of scientists and technicians recognized as one of the country's leading technical organizations in the development of television; broadcast transmitters and receivers; radio-phonographs, and the most complicated types of radio and radar equipment for the Armed Forces.

Farnsworth resources, plus its seventeen years of electronic pioneering, its extensive engineering staff, and specialized manufacturing facilities, will strongly augment the outstanding position of the Halstead developments in this field.

FARNSWORTH TELEVISION & RADIO CORPORATION

FORT WAYNE 1, INDIANA

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Halstead Mobile Communications and Control Systems for Rail and Highway • the Farnsworth Phonograph-Radio • the Capehart • the Capehart-Panamuse

TUNING FORK MULTIVIBRATOR

By CPL. HAYWARD L. TALLEY
Instructor, Signal Corps Schools

THE control of oscillator frequencies has long been of primary importance in the electronics field. In the case of radio-frequency oscillators the question of frequency control was largely solved with the advent of the quartz crystal oscillator.

The use of quartz crystals is far from practical in the case of audio oscillators however. The thickness of a crystal is inversely proportional to frequency, and the thickness of a crystal for the audio range would therefore exceed all practical limits. The thickness of a 1000 cycle crystal would be between 66 and 112.6 inches depending upon the cut used. Accordingly another system of oscillation control must be used for the audio frequency range.

One such system is the tuning fork multivibrator. The fork long has had a record of faithful service. Today, with its application in oscillator control circuits, its scope of usefulness has been multiplied.

The multivibrator is well known today for its part in radio frequency measurements. When operated as an independent oscillator, the multivibrator may be designed to generate frequencies ranging from as low as one cycle-per-minute to frequencies in excess of 100,000 cycles-per-second.

Uncontrolled, the multivibrator is notoriously unstable. Its frequency is altered abruptly by shifts in operating voltages or circuit values. However, the device has another noteworthy property. It may be stabilized readily, and in the controlled state the stability and frequency accuracy of the multivibrator reach the same order as those properties of the controlling device.

A simple fork-controlled multivibrator is shown in Fig. 1. It is seen to be essentially a two-stage triode resistance-coupled amplifier with the exception that the output is coupled back to the input through the feedback condenser C_2. C_1 is the interstage coupling condenser, C_3 the plate circuit by-pass condenser usually encountered in RC amplifier circuits. T_3 compensates for the phase change encountered in the tuning fork transformer T_1, thus maintaining the conditions for positive feedback. The tubes are identical in type, often the two sections of a twin triode such as the 6N7.

The precision tuning fork is of bimetallic construction giving it a low temperature coefficient of frequency and permitting a large mass for a given frequency. In the best laboratory units where the maximum amount of precision is desired, the fork itself is held at constant tem-

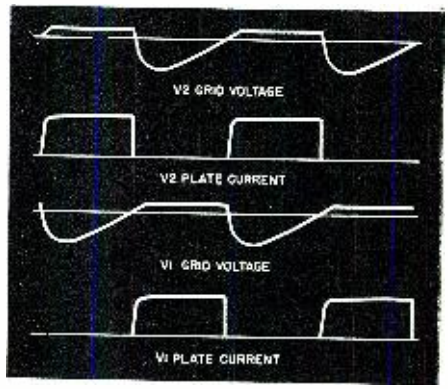
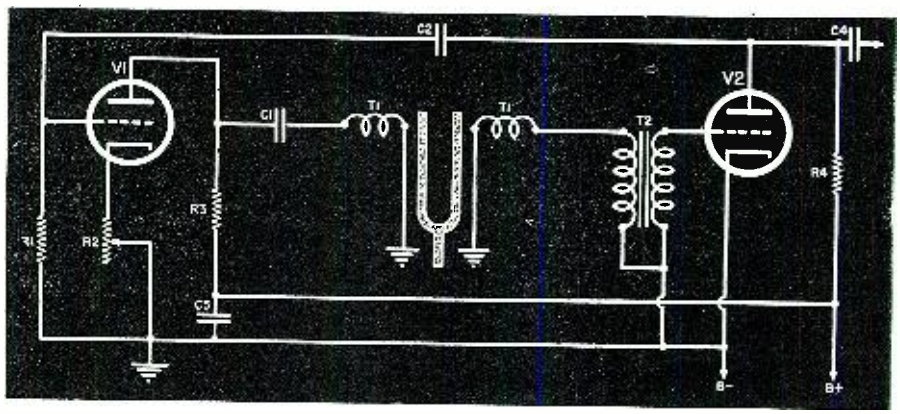
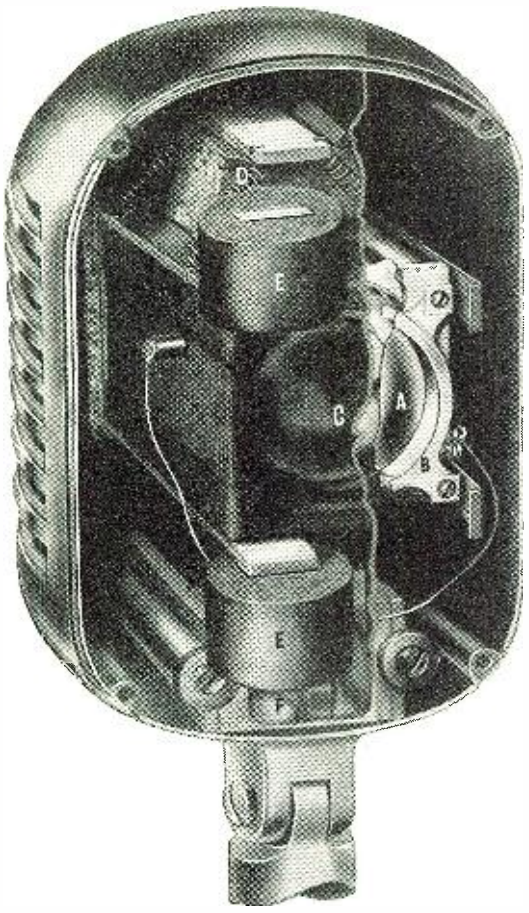


Fig. 2. Oscillograms show wave form at various points of the circuit. The multivibrator, as an independent oscillator, can generate frequencies from one to one hundred thousand cycles-per-sec.

Fig. 1. Diagram of tuning fork controlled multivibrator.



. . . this is the single unit* construction of SHURE Super-Cardioid Dynamic Microphones



(A) Single moving coil diaphragm.

(B) Rugged 4 point moving coil suspension.

(C) First wind and dust screen.

(D) Spring mounted mechanism.

(E) Shock absorbers.

(F) High fidelity transformer.

* Using the "Uniphase" principle, an exclusive patented Shure development, this single unit construction is possible in a unidirectional Microphone. This eliminates the problems of matching two dissimilar units and results in compactness and ruggedness. Because only one unit is employed, all these advantages are available at less cost to you.

SHURE MICROPHONES

List Prices . . . Shure Super-Cardioid Dynamic Microphones

Models "556" Broadcast $75

Models "55" Unidyne . . . . . $47 to $49.50

SHURE BROTHERS

Designers and Manufacturers of Microphones and Acoustic Devices

225 West Huron Street, Chicago 10, Illinois • Cable Address: SHUREMICRO

perature in an oven similar to those employed in quartz crystal stabilization. Such a control may be satisfactory when incorporated in any oscillator not requiring closer original frequency adjustment than about .005 per-cent or smaller frequency drift than approximately .01 per-cent. Such applications include the synchronization of facsimile scanning drums, timepiece and power alternator rating, and certain a.c. bridge measurements.

The operation of the multivibrator may be understood by reference to the oscillograms of Fig. 2. Oscillation begins as a result of a surge of electrons in one of the tubes (say tube V_2) as plate voltage is applied. This causes the plate voltage of tube V_2 to decrease, and likewise the grid of tube V_1. As plate current in tube V_1 decreases the plate becomes more positive. The positive pulse passes through condenser C_1 (Fig. 1), the tuning fork transformer T_1, and transformer T_2 to the grid of tube V_2. In this way the current in tube V_2 increases and that in tube V_1 decreases until tube V_1 cuts off. Tube V_1 cannot remain cut off however for C_2 will slowly discharge through R_1 allowing the grid of tube V_1 to lose its negative potential. As tube V_1 begins to conduct, the grid of tube V_2 becomes more negative so that the initial action is reversed. This is clearly shown in Fig. 2.

The characteristic frequency of the uncontrolled multivibrator is determined primarily by the grid-leak resistance and the grid condenser capacity. This characteristic frequency is duplicated by the natural frequency of the tuning fork.

The fork is set into vibration by the initial pulse from T_1. As long as the amplitude of the driving pulses remains constant the multivibrator is held rigidly to a fixed frequency, due to the switch-like action of the fork as it varies the coupling between the primary and secondary of T_1. A vernier frequency adjustment is provided by a potentiometer in the cathode circuit of tube V_1 which allows a slight variation in the amplitude of the driving pulses. If the amplitude of vibration is sufficiently high this range of control may be extended to allow the fork to be manually set to frequency through a wide temperature change. A more accurate method, however, is to temperature control the fork in the manner described earlier. In this case the amplitude of vibration of the fork may be reduced greatly and the vernier range of control becomes very small. A low amplitude of vibration makes the fork far more accurate.

Design Data

Usually it is desirable to make C_1 equal to C_2 and R_1 equal to the impedance of the secondary of T_2 at the frequency under consideration. In some cases it may become necessary to add a resistor in series with the secondary of T_2 to ground. An approximation of the necessary values

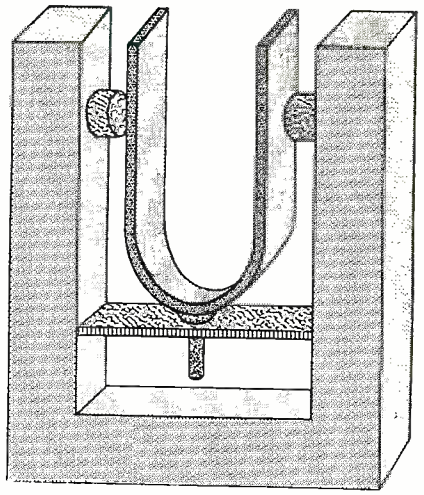


Fig. 3. Tuning fork transformer assembly.

may be obtained by the use of the formula

$$F = \frac{1{,}000{,}000}{R_1 C_2 Z C_1}$$

where

F = frequency in cycles
C = capacitance in microfarads
R = resistance in ohms
Z = total impedance of T_2 secondary and any series resistance used.

Typical operating values for a 1000 cycle frequency are as follows:

C_1 = .01 microfarads
C_2 = .01 microfarads
R_1 = 50,000 ohms
Z = 50,000 ohms

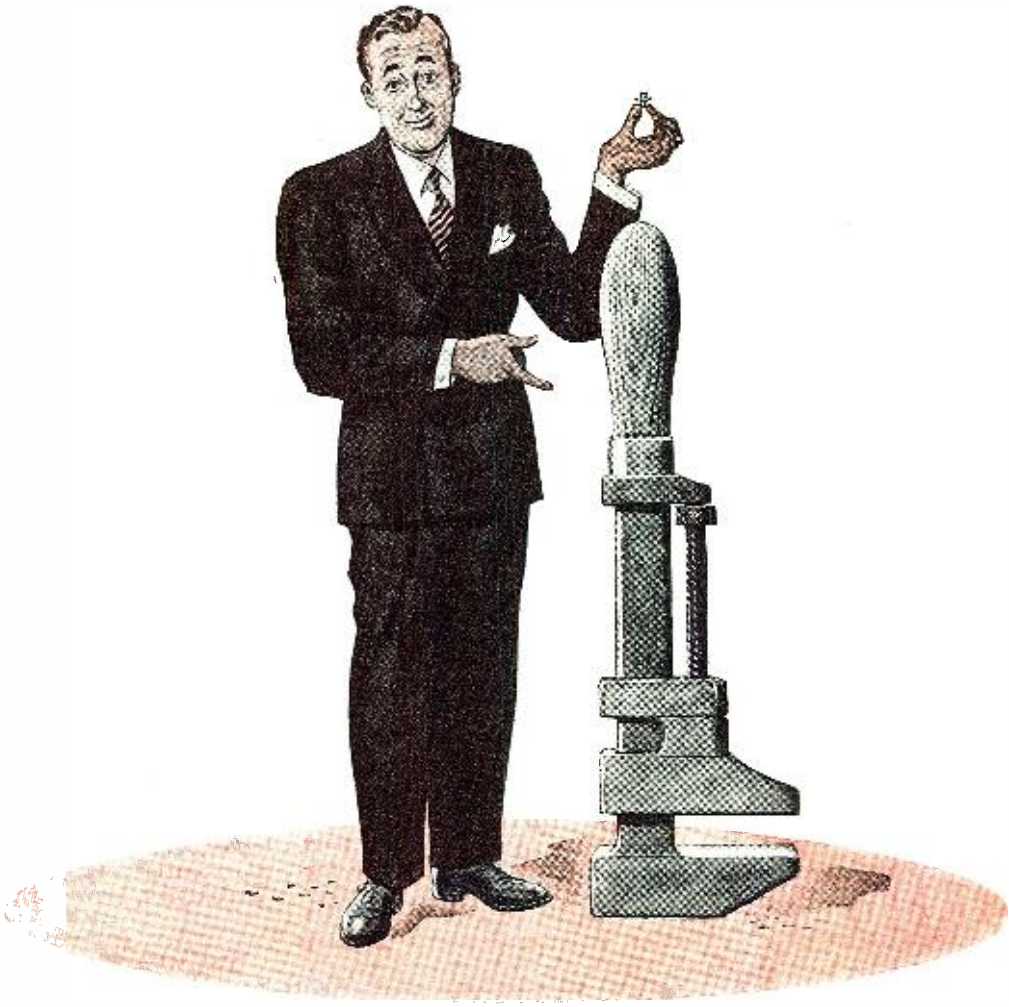
For the most reliable operation, C_1 and C_2 should be first grade mica condensers whenever the capacitance permits. They should be mounted below the instrument chassis away from the heat of tubes and close to their points of connection. As far as practicable the triodes should be matched in characteristics, particularly inter-electrode capacitances. The resistors should be of not less than 2 watt ratings for any of the receiving type triodes operated at less than 250 volts on the plate.

The fork and transformer assembly (see Fig. 3) is composed of a tuning fork of an alloy having a suitable temperature coefficient of frequency as previously described, a non-magnetic framework, preferably of cast aluminum, and a clamp of the same material for holding the tuning fork fast within the frame. A coil is fastened to each side of the upper portion of the frame; together these coils compose T_1.

Obviously, care must be taken to assure that sufficient clearance is allowed between the fork and these transformer coils to eliminate any possibility of the coils impeding the movement of the tines of the fork as the fork is driven by an impulse of reasonable amplitude. It is often desirable to mount the entire assembly within a can covered with a blanket of rock wool or other insulating material to reduce the effect of radical changes in temperature.

—30—

No e he Sad Resemblance?



THE LITTLE GADGET is a metal insert —for *your* plastic part, perhaps. It's likewise the monkey wrench in the works of many a molding and delivery schedule. But not to us and *our* customers!

We produce inserts right in our plant. And we cut out snarls in shipping—misunderstandings about materials, methods, dimensions or tolerances—and difficulties in meshing insert and molding schedules. In fact, that resemblance we mentioned doesn't even exist here at Kurz-Kasch.

This is another evidence of our policy of shouldering *complete* responsibility for your plastics molding job —and that goes for every step from design to delivery. We offer, too, one of the largest, best-equipped custom molding plants in the country—plus one of the oldest and most respected records in the industry for furnishing plastic parts to American industry.

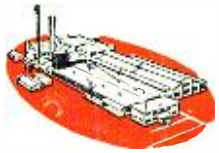
Our front door is open, and we're interested in what business we can fit in. If you have an interest in plastic parts molded by compression or transfer, let's talk it over.

"A Businessman's Guide to the Molding of Plastics"

Send for your free copy of this illustrated brochure. Just write to Dept. 7 on your letterhead and we'll send it with our compliments.

THE WAR BONDS YOU KEEP ARE THE BONDS THAT COUNT

Kurz-Kasch



For over 28 years Planners and Molders in Plastics

Kurz-Kasch, Inc. 1429 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

In view of the present paper shortage, a limited number of copies of the booklets described herein are printed. Manufacturers will endeavor to comply with all requests; however, if your copy is not received after proper request has been made, it most likely will indicate that the supply is exhausted.

GROUND RESISTANCE

A bulletin covering several models of the *Associated Research, Inc.,* line of ground resistance test equipment has been released for distribution.

Details of ground resistance testing procedures are included along with data on earth conditions, specifications, and prices of the Vibroground line of instruments.

A copy of this bulletin, Catalogue 104, will be sent to those requesting it from *Associated Research, Inc.,* 221V S. Green Street, Chicago 7, Illinois.

FM TRANSMITTERS

Federal Telephone and Radio Corporation has announced that their line of FM transmitters covering the new 88 to 106 mc. band are available.

Details of this line of transmitters, which include 1 kw., 3 kw., 10 kw., and 50 kw. units, are contained in the booklet which the company now has available for distribution to engineers and station managers in the FM field.

A copy of the bulletin will be forwarded upon request to *Federal Telephone and Radio Corporation,* 200 Mt. Pleasant Avenue, Newark 1, New York.

CONDENSED CATALOGUE

A description of the most frequently demanded rotary power equipment has been condensed into a four-page bulletin, issued by *Carter Motor Company,* which is now available for distribution.

Included in the bulletin are various genemotors, magmotors, and other rotary equipment, along with complete information and pictures. A number of the newly developed units of the line have been added to the listing.

A copy of Bulletin No. 445 will be sent to engineers and radio amateurs who make their request to the company on letterheads. Requests may be made to *Carter Motor Company,* 1608 Milwaukee Avenue, Chicago, Illinois. Copies are also available from radio parts distributors.

INSTRUMENT BOOKLET

The Triplett Electrical Instrument Company has issued a four-page booklet covering their recently announced line of hermetically sealed instruments.

Included in the booklet are engineering details of the 1½", 2½", and 3½" meters which are adapted for flush mounting on instrument panels. The line of instruments includes a.c. voltmeters, ammeters, and milliammeters; r.f. ammeters and milliammeters; and d.c. voltmeters, ammemeters, milliammeters, and microammeters.

A copy of the booklet will be furnished to those requesting it from *The Triplett Electrical Instrument Company,* Bluffton, Ohio.

TUBE CHART

A tube interchangeability chart, for the convenience of engineers and purchasers of electronic tubes, is now being offered by *Amperex Electronic Corporation.*

Approximately 300 transmitting tube type numbers and their equivalent designation in Amperex tubes are included in the chart. The listing is printed on an 8½ x 11½ inch card which is punched for convenient wall mounting.

One of these cards will be forwarded upon request to *Amperex Electronic Corporation,* 25 Washington Street, Brooklyn 1, New York.

SPEAKER DATA

The *Altec Lansing Corporation* has recently released a 12-page brochure covering their line of two-way, multicellular speakers.

In addition to describing various models of the multi-cellular speaker, the booklet includes response curves and other pertinent data of value to the engineer and the serviceman. According to the company, this new line of speakers provides a frequency coverage of from 40 to 15,000 cycles plus.

A copy of this brochure will be forwarded to those requesting it from *Altec Lansing Corporation,* 1210 Taft Building, Hollywood 28, California.

PARTS CATALOGUE

A complete listing of radio cements, chemicals, hardware, cabinet repair kits, repair parts, tools, and other service accessories are included in a new catalogue now being offered by *General Cement Manufacturing Company* of Rockford.

This catalogue, No. 146, will be forwarded upon request to the company at 919 Taylor Avenue, Rockford, Illinois, or may be secured from any *General Cement* jobber.

COMMERCIAL VIDEO

The *General Electric Company* has recently released a 16-page publica-

A. G. HOFFMAN
PRESIDENT

E. F. HOFFMAN
VICE-PRESIDENT

MIDWEST RADIO CORPORATION

CELEBRATES ITS

25th Anniversary Year

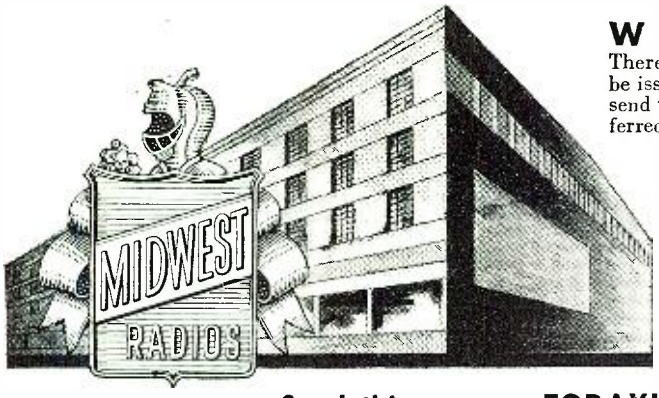
The year 1945 completes a quarter-century of pioneering, of progress, of achievement,of leadership in the field of radio for the Midwest Radio Corporation. Very few radio manufacturers can match the unbroken record of continuous manufacture and of faithful adherence to high quality standards which MIDWEST RADIO has established and maintained during the past twenty-five years.

Since its establishment in 1920, Midwest Radio Corporation has figured prominently in the pioneering of many outstanding radio developments. Among them: Single dial, 3-gang condenser battery sets . . . all electric radios . . . superheterodyne . . . screen grid . . . amplified and resonant AVC . . . dual speakers . . . 2400 meters band . . . shielded switching . . . noise-reducing antenna system . . . push button tuning . . . ceramic porcelain insulation . . . reinforced capacitors . . . pre-balanced coil assembly . . . acoustisonic louvres . . . 9-Band dial . . . and others too many to mention.

Today—although still engaged exclusively in the production of electronic and radio instruments for our Armed forces—Midwest is planning new and finer radios for the post-war period.

PLAN TO BUY YOUR POSTWAR RADIO DIRECT FROM THE MIDWEST FACTORY

That's how thousands of Midwest Radio owners, for 25 years, have enjoyed the finest in radio . . . and at SAVINGS UP TO 50%. Midwest's Factory-to-You plan of distribution has been amazingly popular because it enables you to buy better radios for less, and because the Midwest organization is directly responsible to you.



WRITE FOR CATALOG NOW!

There is already a heavy advance demand for the Midwest Radio Catalog to be issued after Victory. To be sure that you will receive one of the first copies, send the coupon below requesting that your name be placed on the preferred list. The print order will be limited, so act now!

Mr. A. G. Hoffman, President
Midwest Radio Corporation
Dept. 11-AA, 909 Broadway
Cincinnati 2, Ohio

Gentlemen: Please place my name on your list to receive the first post-war catalog of MIDWEST RADIOS.

Name.....

Address.....

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

Send this coupon TODAY!

MIDWEST RADIO CORPORATION

DEPT. 11-AA . . . 909 BROADWAY . . . CINCINNATI 2, OHIO

tion entitled "Intra-Tel Systems" which describes, in detail, a television system for use by department stores.

Complete information on installation costs, yearly operating budget, and other data for a typical system is included. The booklet is illustrated by charts, drawings, and scenes from recent merchandising presentations over station WRGB in Schenectady.

Copies of the brochure may be secured free of charge from the Electronics Department, *General Electric Company,* Schenectady 5, New York. Please specify brochure EBT-28-A when making your request.

HEADER DATA

For the information of engineers and designers, *Electrical Industries, Inc.,* has issued a new booklet covering data and specifications on E-I multiple headers and sealed leads.

Various items of essential information and dimensions are included to facilitate the selection of proper headers and leads for the job.

A copy of this data sheet will be forwarded upon request to *Electrical Industries, Inc.,* 42 Summer Avenue, Newark 5, New Jersey.

INDUSTRIAL BROCHURES

A series of brochures which list various types of industrial equipment are being offered by *Walker-Jimieson, Inc.,* of Chicago.

These brochures are designed to acquaint industrialists with various types of equipment available for production, inspection, and research applications. Among the titles available are booklets on voltage supply equipment, lighting equipment, shop tools and equipment, sound equipment, electrical maintenance equipment, and test and inspection equipment.

The brochures will be sent free of charge to engineers and purchasing agents who write on company letterhead to *Walker-Jimieson, Inc.,* 311 S. Western Avenue, Chicago 12, Illinois.

MECK PRESS BOOK

The *John Meck Industries* of Plymouth, Indiana, has announced that they are mailing a completely prepared press book to all of their jobbers.

This book has been prepared to enable local jobbers to provide publicity stories for the local newspapers and other publications, as well as material and suggestions on short talks for business groups and a radio script. The booklet also contains suggestions for tying-in the first local showing of new merchandising with new stories.

The booklet also contains a list of photographs which will be sent to the jobber on request and completely prepared stories for the press.

MOLDING MANUAL

A new eight-page manual covering various applications of molded plastics, including electronics, has been issued by *Mack Molding Company, Inc.,* 180 Main Street, Wayne, New Jersey.

According to the manual, the company is prepared to mold plastics to include any property or combination of properties.

A copy of this publication will be forwarded upon request to the company.

AMPLIFIERS

The *Eastern Amplifier Corporation* has announced that a new postwar catalogue covering the company's complete line of amplifiers will be available for distribution in the near future.

All requests to receive this catalogue should be addressed to *Eastern Amplifier Corporation,* Bruckner Blvd. and 140th Street, New York 54, New York.

LAYMAN'S ELECTRONICS

A specially prepared booklet, "The Amazing Electron", is now available for distribution to educators, consumer organizations, farm groups, labor unions, and the general public, according to the announcement made by *Electronic Corporation of America.*

This booklet is profusely illustrated with cartoons and is written in a simple non-technical manner which provides basic information on electronics for the layman. A brief description of the development of various pieces of electrical equipment is included.

Copies of this booklet can be obtained from *Electronic Corporation of America,* 45 West 18th Street, New York 11, New York, free of charge to individuals, and in quantities of 20 or more, for a five-cent handling charge.

INDUSTRIAL TUBES

The *General Electric Company's* tube division has announced the compilation of a new 412-page technical manual covering electronic tubes for industrial applications. The book is designed for engineers, designers, and other tube users as a guide in selection of tubes for industrial applications.

The manual is profusely illustrated with photographs, outline drawings, and performance curves. Tabbed dividers facilitate the locating of tube data, and the looseleaf binding permits the addition of new data sheets as they are released.

The manual is available at a cost of $2.00 per copy and new data sheet service is $1.00. Orders for the manual should be addressed to Electronics Department, 267-122, *General Electric Company,* Schenectady, New York.

HIGH FREQUENCY FM

In a booklet prepared for the public, the *Hallicrafters Company* of Chicago has outlined some of the advantages which may be expected from the shift to higher frequencies for FM.

The booklet, which was written by Cyrus T. Read, director of sales engineering for the company, is entitled "The New FM Frequencies and What They Offer to You". The distribution of this booklet will be made to the public through *Hallicrafters'* distributors and representatives.

—30—

Microphones Engineered by Electro-Voice

Answer Everyday Sound Problems

Maximum Intelligibility Under Extreme Noise

Hand-Held, close-talking single button carbon *DIFFERENTIAL microphone for all speech transmission in any noisy, windy, wet or extremely hot or cold locations. Cancels out background noise. Articulation is at least 97% under quiet conditions, and 88% under a 115 db noise field.

Model 205-S. List Price.....$25

Patent No. 2,350,010

Higher Articulation with Less Fatigue

Moving coil, hand-held Dynamic microphone for high fidelity speech transmission. Uniform response, free from peaks, in the useful frequencies gives higher articulation, provides more usable power level, and is less fatiguing to the listener. For outdoor or indoor use.

Model 600-D. Dynamic. List. $27.50
Model 210-S. Carbon. List. . $17.50

Poly-Directional with Adjustable Polar Pattern

The versatile high fidelity Cardak is readily adjustable to reduce any combination of reflected sound. Cuts reverberation or random noise pick-up . . . minimizes acoustic feedback. For broadcasting, recording, public address, communications.

Model 725—Cardak I. List....$55
Model 730—Cardak II. List....$75

General-Purpose Dynamic for Voice and Music

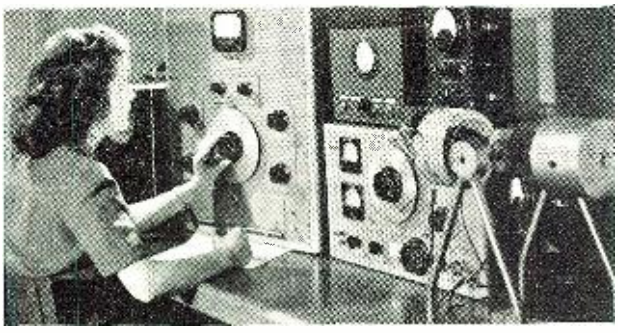
Widely used because of its dependable all-around performance. Excellent frequency response for both indoor and outdoor speech and music pick-up. Rugged, small size, light weight. High output. Suitable for public address, dispatching, paging, recording and remote broadcast.

Model 630-C. List Price.....$30

Velocity High Fidelity Bi-Directional Sound Pick-Up

Wide, flat frequency response, bi-directional polar pattern, high fidelity characteristics, wide-angle front pick-up, and pick-up range make it ideal for solo, orchestra, or chorus, for single speaker or groups. For indoor P.A., broadcasting, recording.

Model V-1-C. List Price.....$30
Model V-2. List Price.....$37.50
Model V-3. List Price.....$50



Corner of E-V "Lab"

One of our Quality-Control units used in testing close-talking microphones. Harmonic distortion, frequency response, positional response (for carbons) level, etc., are carefully analyzed. Calibration is effected by Bell Laboratory standards and our own reciprocity checks.

SEND FOR COMPLETE CATALOG

Gives valuable data on Electro-Voice Microphones for communications, public address, broadcasting and recording. Includes helpful Reference Level Conversion Chart.

Authorized Distributors Everywhere

No finer choice than **Electro-Voice MICROPHONES**

GUARANTEE

The E-V models shown here are guaranteed forever against defects in workmanship and material.

ELECTRO-VOICE, INC., 1239 South Bend Ave., South Bend 24, Indiana ★ *Export Division:* 13 East 40th St., New York 16, N. Y., U. S. A.—Cables: Arlab

LETTERS

FROM OUR READERS

IDENTIFICATION

"I WISH to compliment Mr. Thomas H. Bell of North Attleboro, Mass., for his letter to you on practical suggestions for manufacturers of radios who make a Chinese puzzle of their sets for underpaid servicemen to unscramble.

"The suggestion of listing the model number so it can be referred to is great and I hope they stop making upside down jammed-in pancake receivers. Let's all get behind this and run a series of protests each month so the radio manufacturers will take note and really build a set they can be proud of from a serviceman's standpoint also."

S. J. Rust
South Bend, Indiana

* * *

"YOUR editorial in the August issue of RADIO NEWS about Westbrook Pegler was very timely. In my opinion he is a screwball of the highest order.

"Many men have tried to slander the radio industry before and I think it's about time we did something about it. . . ."

Carl C. Seidler
Brooklyn, N. Y.

* * *

HAZARD!!

From one of our most prominent authors comes the following notice which appears in a St. Paul hotel:

WARNING!!

ELECTRIC CURRENT

Please use care with
electric appliances.

The current varies
from a.c. to d.c.
without warning.

For information call
Extension 55.

The Management

"We found the attached in our room in this hotel. I consider this the last word in hazards.

"Scares me! Tho't you (et al) would be amused."

John D. Goodell
St. Paul, Minn.

* * *

"I HAVE just received my August issue of RADIO NEWS and happened to turn to an article on page 28 entitled, 'QRM—A Threat to Amateur Radio', written by T/Sgt. George Mobus, W9UAO.

"This not only is an interesting article, but the pictures drawn are also quite an item of surprise as this is my station W9CVU. I am enclosing a picture of my station for your comparison. . . ."

"I am quite proud of the record of this station for 40 watts. On 75 meter phone I have worked all districts in the U. S., Hawaii, Mexico, Alaska, Puerto Rico, and have a three-hour confirmation of my phone on 75 meters from New Zealand. On 20 and 10 I have worked all over the world. I use a 20 meter and 10 meter 8 JK antenna and a full wave antenna for 75 meters. I have been on the air since 1913 and all transmissions have been from one address, 1949 1st Ave.,

East. Was Official Observer for the ARRL before the war. Have 30 w.p.m. code proficiency award from ARRL.

"The transmitter is a Collins 32G and the receiver is a National 101X."

Chas. W. Boegel, Jr.
Cedar Rapids, Iowa

Congratulations W9CVU! We selected this photograph as an outstanding looking ham station for our artist to use in making his illustrations.

* * *

"THE many letters published by you regarding the licensing of radio servicemen have been most interesting, but they seem to present mainly the radio servicemen's side of the question.

"As a customer who never intends to be a serviceman, I see no necessity of a licensing system, nor any advantages therein for others than the organizers. Many charlatans and incompetents are found in all of the trades and professions, both licensed and unlicensed, and a license is no guarantee of their exclusion.

"The theory of licensing sounds well, but unfortunately the licensing systems do not seem to keep pace with technical advances. Consequently, the soon-obsolete entrance requirements allow the licensing of sub-caliber personnel, those already licensed tend to rest on their laurels instead of keeping up to date on the latest developments, and both the industry and its customers suffer.

"In the selection of a man to service my own radios, I avoid two classes: those professing to service all makes, and those with a cluttered-up shop

full of junk, I shall continue to select the man who has specialized on my brand of radio and who has sufficient modern equipment for the servicing of it. And, after the war, additional preference will be given to the radio man who has been trained in one of the Army or Navy schools, as I have learned from observation that he has been trained in repairing to a high standard of quality rather than down to a price.

"It does not appear that the returning graduates of our service schools need worry any about being able to pass the stiffest license examinations that can be cooked up. However, our American plan of free enterprise and competition is not based on the payment of a fee or tribute to a system or organization in order to earn an honest living.

"Let's keep it that way."

Major Ed. M. Hoskinson
Chicago, Illinois

* * *

"I HAVE been a fan of RADIO NEWS for a good number of years.

"Prior to my army career, I had also been a serviceman in the radio field. I went through the depression days working in that field. While in the service of Uncle Sam of around three years or so, I have become acquainted with other prewar servicemen, also in the service, and my comments are on practically the same thought as the others I have had the honor to meet.

"I have been following the articles in the news—pro and con. My supposition is that servicemen who have not been in the armed services in this war era do not relish competition. Also, some of the ones who are howling so loud, as I imagine it, have been doing a very lucrative business while others are in the armed services for their good.

"While here in the U. S. I had been in three camps, all of which are very near large cities. During my army career in those three camps, I had, at times, contacted the service shops and had become fairly acquainted with each of them personally, and to their efficiency and also their service charges. All but one was waxing fat on the public in regards to the actual troubles with each radio serviced. I realize that is a broad statement, but true. I also realize a number of the ones who howl fairly loud do not relish competition, which is natural.

"I believe what I am about to say would stop some of the servicemen who are making most of the noise in regards to discharged veterans getting into the field.

"Since FM and AM and television are practically a reality and will enter the serviceman's shop in the near future, if not sooner, why not have a universal examination covered by all the states in the U. S. A. covering theory on FM and AM and some on theory on television as we will have them coming into our shops soon. Also, some questions on oscilloscopes (theory) as that is in conjunction with

television. Then, I do believe, some of the old timers or new timers who are doing some of the most howling will howl because they also have to pass the examinations as they have been servicing a number of years. This article should shut a lot of the howlers up. Personally, I'm for just such an examination. How about the howlers. Why not make the examination a tough one.

Sgt. H. Bronwell
El Paso, Texas

* * *

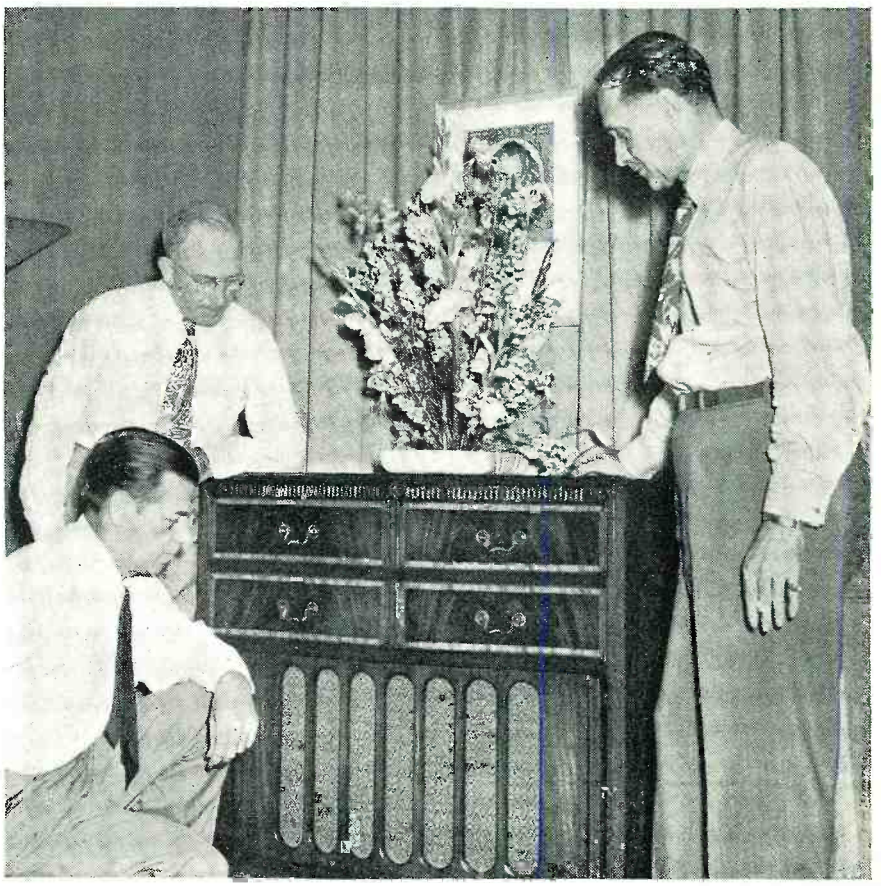
"I AM duly in receipt of your July issue which altogether is a very interesting number but am still at a loss to see why something cannot be done to put Radio and Electronics on a materially physical basis. It would surely simplify the whole subject and greatly facilitate developments.

"It requires a radical change in our concepts of matter and motion but could anything be more absurd than the accepted atomic theory. Matter is not a force measurable by weight, matter is an indestructible volumetric substance which of itself develops no weight. The atoms and elements are volumetrically proportionate and are not in any remote way gravimetrically proportionate. It is the size, shape and condition of motion of the atoms which determines the physical character of the elements.

"It is assumed that the force of gravity is a magnetic force and in spite of every evidence to the contrary, it is again assumed that all matter is equally magnetic and that equal weights of the elements are equal quantities of matter, hence the atomic weights. The weights of the atoms are entirely dependent on the intensity of the electronic force impressed on them and nothing could be more variable. Sixteen pounds of oxygen combined with 2 pounds of hydrogen do not make 18 pounds of water. There is perhaps no compound which has the same weight as the combined weights of its component atoms. Weight is a force produced by the vibratory motion of the electronic atmosphere and has two main variables viz., the intensity of the vibratory force of the electronic atmosphere and the atomic size, shape, and intensity of the vibratory motion of the matter weighed both of which are continually changing.

"But what has all this got to do

Men who developed the "Meissner" electronic radio phonograph listen to a symphony record at the first official showing of the instrument held recently at their sales' headquarters in Chicago. Left to right: E. J. Stanmyre, chief engineer; James T. Watson, vice-president in charge of plant; and G. J. Rockey, vice-president in charge of sales. The Meissner Manufacturing Company, along with the Thordarson Electric Manufacturing Company of Chicago, recently became a part of Maguire Industries, Inc., New York. This organization was created in the years since 1939 by Russell Maguire, from a forgotten arms manufacturing company and the production of $130,000,000 of the famous "Tommy guns" for the United Nations. Its present products include radio and electronic equipment, powder metallurgy items, oil, and a mixture for asphalt paving.



with Radio and Electronics? It has everything to do with the subject if we would deal with it in a material physical way.

"Atomic Matter is an indestructible volumetric substance which of itself develops no weight but is built up from matter in a primary state of subdivision being in what we may call electricity. This electronic matter still consists of pieces of matter of many sizes and shapes and different sized atoms are built up of different kinds of electrons under different conditions.

"The density of the universal electronic atmosphere is very great. Under some conditions it is perhaps denser than any of the elements, atomically, but when perfectly fluid it is not perceived by us except through the forces which it develops such as light, radio, electric currents, etc. These are transitory vibratory motions which are super-imposed on the static vibrating medium of transmission. The fluidity and vibratory intensity of the electronic atmosphere is indicated by the velocity of light, etc.

"Due to the extreme fluidity and very high frequency of the electronic atmosphere, its energized condition is not perceived by us as temperature but as voltage, but it is readily convertible into temperature by atomic resistance as in a lamp filament. It is not compressible in the ordinary mechanical way, but it can be compressed by induction as in an electric generator and it can be expanded by eduction through an electric motor. This applies only to certain kinds of electric currents. There must be as many kinds of electric currents as there are different kinds of light or different kinds of sound or other vibratory systems.

"The primary motion of the particles of matter is rotative motion, a secondary motion is orbital motion. These in combination develop a helical motion and this is what we call rotatively vibratory motion. There is no such thing as positive and negative electricity except in the positive and negative rotation of the systems. Pieces of iron in a magnetic field of force do not attract or repel each other. They are pushed or pulled around by the helical forces of the electronic atmosphere.

"From the foregoing, it should be evident that all the phenomena in connection with electronics is purely mechanical, based on matter and motion. The universe is a very dense ocean of electronic matter energized beyond anything we can conceive of as temperature. The earth and the other bodies we see floating around are waste dumps of the de-energized electronic matter, their motions being controlled by the atmosphere in which they float. The basic energy of the universe resides in the electronic ocean or just where we should expect to find it, with its vibratory velocity of about 186,000 miles-per-second."

John Roger, N.Y.

—30—

Video Amplifiers

(*Continued from page* 62)

tal frequency and a series of harmonics. Now, if phase distortion is present, the higher harmonic components may lead or lag the fundamental and lower harmonics, which rounds off or distorts the pulse, causing delay in triggering or instability. Fortunately, if a linear frequency response is maintained stage by stage, the phase distortion or non-linear time delay is not serious; however, in systems in which there is lumped frequency compensation, there can be serious phase distortion which must be corrected by a phase network or some form of phase compensation in each stage.

In a parallel resistor-capacitor combination, a prescribed length of time is required for the voltage to build up across the combination after the plate current variation has passed through it. The actual delay time is proportional to the decreasing reactance-resistance ratio. When the reactance decreases, with an increase in frequency, to a value approaching the value of the resistance, the delay time or lagging angle increases. If the resistance is very small in comparison to the reactance of the distributed capacity (Fig. 7) over the middle range of frequencies, there is no appreciable lag, plate current variations and output voltage e_o being essentially in phase. However, at the high frequencies, where the reactance of the distributed capacity approaches the value of the resistor, the time delay is constant for all frequencies (equal angles of lag); there is no phase distortion. This example is comparable to the usual 180-degree phase shift in a vacuum tube. However, if some frequencies, in this case the high frequencies, are delayed with respect to other frequencies as far as phase angle is concerned, it means that they are also delayed with respect to each other as far as time is concerned. Thus, it will take a higher frequency longer to build up across the combination than a lower frequency, producing phase distortion.

Likewise, the interstage coupling capacitor introduces phase distortion because it causes the lower frequencies, as they appear across the grid resistor, to lead the middle range frequencies. At frequencies where the reactance of the coupling capacitor is negligible in comparison with the grid resistance, the grid voltage is essentially in phase (no phase lag) with the signal current flowing through the series coupling-capacitor and grid-resistor combination. However, at low frequencies where the reactance of the coupling capacitor has increased to a value approaching the value of the grid resistor, the signal current begins to lead the voltage e_{in} applied to the series combination. Since the voltage across the grid resistor is in phase with this current, it effectively leads similar voltages of the middle range of frequencies, which also appear across the grid resistor and which, supposedly, are to reach peak amplitude at the same instant.

Next month's installment treats the video amplifier in detail, demonstrating how it fits into the over-all theory of operation. It explains, among other things, signal polarity, necessity for direct coupling, d.c. reinsertion, contrast control, picture-tube bias, etc. In preparation for this article, the reader should review installments 2, 3, and 4, to refresh and reinforce his knowledge of the general over-all operation of the television system.

(*To be continued*)

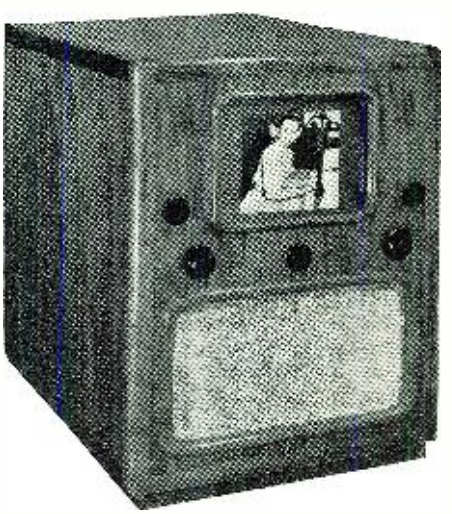
Spot Radio News

(*Continued from page* 16)

Personals

Arie Vernes has been appointed executive vice president and general manager of *Philips Export Corporation.* He will also continue his post as Secretary of the organization. . . . **William E. Snodgrass,** formerly executive v. p. of the *Dictograph Products Company* has joined *Western Electric* as general manager of the hearing aid division. . . . **Haraden Pratt** has been elected Chairman of the Radio Technical Planning Board, succeeding **Dr. W. R. G. Baker.** Mr. Pratt is vice president and chief engineer of *American Cable and Radio Corporation,* an *I. T. & T.* subsidiary. . . . In preparation for a postwar expansion of the phonograph record business, *RCA Victor* has announced the return of **Eli Oberstein,** to the Popular Artists Relations and Repertoire post he left in 1939. . . . **Lloyd L. Spencer,** vice president in charge

One of the first to announce a television receiver out of the luxury class, the Viewtone Co of New York City, recently demonstrated its new set which they claim is designed for low cost mass production. The set retailing for about $100 is a small table-model. It uses a 7-inch viewing tube which affords sharp, clear-cut images and surprisingly comfortable viewing with a minimum of eye-strain.



of sales for *Stromberg-Carlson* has announced the appointment of **Colby H. Knapp** as supply sales manager for the telephone division. . . . **Crosley Corporation's** peace-time products will be handled in Cuba by **Gustavo Madrazo**, president of the *Independent Electric Company of Cuba*, according to the announcement made by **John W. Delind, Jr.**, director of exports for the company. . . . **Paul A. Ryan**, founder and first editor of the *Crosley* house organ *News and Views*, has been named first vice president of the American Association of Industrial Editors, Inc. . . . *Reeves-Ely Laboratories, Inc.*, has announced several organizational changes including the appointment of **E. L. Wayman, Jr.**, as General Administrative Head, **P. E. Bowen** as Sales Manager for the *Hudson American Corporation*, **F. F. Sylvester** as Technical Director in charge of research and engineering for both the parent organization and affiliated companies. . . . **Harold C. Vance** has been appointed Manager of the Direct Sales Department for the *RCA Tube Division*. . . . **Herbert H. Kronen** has been named Vice President and General Manager of *RCA Victor's* Brazilian subsidiary with headquarters in Rio de Janeiro.

-30-

Radar Terms

(*Continued from page* 45)

Indicator—Any of several types of cathode ray oscilloscopes.

Indicator gate—See Gate.

Isolating circuit—A stage which passes signals in only one direction through a circuit.

Klystron—A velocity modulated tube used to produce low-power u.h.f. oscillations.

Lighthouse tube—A high-frequency triode of special design used to produce u.h.f. oscillations of medium power.

Limiter—A circuit which limits, clips, or removes either (or both) the positive or negative extremities of a wave form.

Listening period—The time during which a radar transmitter is quiescent or not radiating energy.

Magnetron—A high-frequency magnetic-field diode of special design used to produce u.h.f. oscillations of very high power.

Main pulse—See Transmitter pulse.

Master oscillator—A source of timing oscillations which control or affect all other radar circuits.

Microsecond—One millionth of a second.

Modulator—A circuit which directly controls or triggers the radar transmitter.

Multivibrator—A relaxation oscillator which oscillates of its own accord (a free-running multivibrator), or which oscillates only when triggered by an external voltage.

Overdriven amplifier—Amplifier circuit in which the combination of cut-off limiting and saturation limiting of a sine wave produce a rectangular voltage wave.

Peaking circuit—A differentiator circuit used to sharpen a wave form.

Peak power—The maximum output power of an r.f. pulse at the transmitter.

Presentation—The form in which radar echoes appear visually on an oscilloscope.

Pulse—A sudden change of voltage (or current) of brief duration.

Pulse duration—The time duration of a pulse.
Pulse generator—See Electronic timer.
Pulse rate—See Pulse recurrence frequency.
Pulse recurrence frequency or p.r.f.—The timing rate of radar pulses, originating in the electronic timer.
Pulse recurrence time—The reciprocal of pulse recurrence frequency.
Pulse width—See pulse duration.
Quiescent period—See Listening period.
R.F. oscillator—Output stage of the radar transmitter in which u.h.f. oscillations are generated.
Range—The direct-line distance between a radar set and a target.
Receiver—The component of a radar set which receives, detects, and amplifies echoes reflected from targets.
Receiver gate—See Gate.
Recurrence rate—See Pulse recurrence frequency.
Reflector—A metallic object or surface behind a radiating dipole to reinforce radiation in a desired direction.
Reflex Klystron—See Klystron.
Repetition rate—See Pulse recurrence frequency.
Ring oscillator—Any number of pairs of high-frequency triodes operated as an r.f. oscillator in a tuned-grid tuned-plate circuit.
Rotary spark gap—A pulse-protruding device in which circularly arranged electrodes are rotated past a fixed electrode producing periodic high-voltage arc discharges.
Saturation limiting—Limiting action of an amplifier when operated beyond the point where grid current flows.
Scanning—The direction of pulsed r.f. energy over or across a given region or area.
Sea return—That part of the r.f. pulse reflected by water surrounding a sea-borne radar set.
Spark gap—An arrangement of two fixed electrodes between which a high-voltage arc discharge takes place.
Squaring amplifier—See Overdriven amplifier.
Squegging oscillator—An extreme form of grid blocking in an r.f. tuned-grid tuned-plate circuit.
Synchronism—The relationship between two or more periodic or recurrent wave forms, when the phase difference between them is zero.
Synchronizer—See Electronic timer.
T-R switch—A device which switches a radar antenna between the radar transmitter and receiver, preventing transmitted energy from reaching and damaging the receiver.
Tail—Attenuated decay of an r.f. pulse.
Target—Any object which produces a radar echo.
Time base—The trace produced on the screen of a cathode ray tube by horizontal deflection of the electron beam.
Time constant—An indication of the speed with which a circuit can be charged or discharged.
Timer—See Electronic timer.
Transmitter pulse—Burst of r.f. energy radiated by the radar transmitter. The pulse appears as a strong signal at the left end of the oscilloscope time base.
Unidirectional—In one direction only.
Video amplifier—A circuit amplifying a very wide range of frequencies which includes and exceeds the audio range.
Wave guide—A hollow pipe or tube, having a circular or rectangular cross-section, used to transmit r.f. energy.

—30—

of the electrons, the voltage of the reflector, or the resonant frequency of the cavity. Thus, any one of these interrelated variables can be used to tune and adjust the Klystron for operation at any desired local-oscillator frequency.

I.F. Amplification

The large amount of gain required in a radar receiver is obtained by considerable amplification of the intermediate frequency, thus requiring a large number of i.f. amplifier stages.

The intermediate frequency may be quite high, while some radar receivers function with a considerably lower i.f. signal. An important factor governing the choice of intermediate frequency is the bandwidth of the circuits.

The width of the frequency channel passed by the i.f. amplifier is determined by the spectrum range of the returning echo signal. Since reception of the signal is of the double-sideband variety, this region allows for sufficient uniform amplification of all video frequencies.

The frequency bandwidth must be fairly wide to pass all of the component frequencies contained in the received r.f. signal. To fix the bandwidth within acceptable limits, "damping" resistors could be used in the i.f. circuits.

The sensitivity as well as the selectivity of the entire set will suffer if the bandwidth of the i.f. amplifier is too wide. Losses in the i.f. amplifier stages can be made almost negligible by using very close coupling between the primary and secondary windings of i.f. transformers.

In order to vary this coupling, the physical location of the primary winding can be changed with respect to the secondary winding. This coupling adjustment is particularly critical in the first stage of i.f. amplification.

The first i.f. stage should be operated with the lowest possible noise level, in an effort to obtain as high a signal-to-noise ratio as possible.

Following stages of i.f. amplification may be primarily straight i.f. amplifiers, operating under similar but not so exacting conditions as the first stages. All i.f. stages are double-tuned.

Since gain values as high as 100 db. can be expected from the combined stages of i.f. amplification, tendencies toward regeneration must be carefully controlled by filters and proper shielding.

Lead shielding and filters can also prevent the receiver from being oversensitive to strong external r.f. and a.f. fields.

Although the radar receiver is protected by the T-R switch (Fig. 1) from transmitter power surges, a small signal is permitted to "leak through" the receiver in order to register as a

strong pulse—or "transmitter" pulse—at the beginning of the time base of the indicator oscilloscope. This r.f. signal *directly* from the radar transmitter may have a blocking effect each time the pulse passes through the receiver. To counteract this possibility, a *gate pulse* could be applied to the second i.f. amplifier stage.

The gate pulse consists of a rectangular voltage wave controlled by the electronic timer. The wave would be applied to one or more of the i.f. stages and could either bias the tube(s) to cut-off, or completely remove the plate voltage *during the time the transmitter is pulsing.* This, in effect, is a protective device to prevent the i.f. stages from overloading due to the extremely powerful input pulses from the transmitter.

After the desired degree of amplification has been obtained by the i.f. stages of the radar receiver, the signal is detected—probably by means of a conventional diode—and the rectified output is then applied to the video stages of amplification.

Video Amplification

An energizing voltage of from 50 to 200 volts peak with a bandwidth of about three megacycles is required by most cathode-ray tube circuits. It is the purpose of the video stages of amplification to supply this wide range of frequencies at the desired voltage amplitudes.

Video-frequency amplifiers are usually resistance-coupled with a characteristically almost-flat gain response over the entire range of frequency operation, about three megacycles.

Video-frequency amplifiers have been developed which supply from 30 db. to 50 db. of gain *per stage* with bandwidths as great as two megacycles. Use of the same circuits for bandwidths of about three megacycles, lowers the amount of stage gain to about 25-35 db.

Some means of limiting the amplitude of the video output may be provided, to prevent defocusing of the cathode-ray tube due to strong signals. The output signal from the video amplifier is usually a negative-going pulse, applied to the grid of the cathode-ray tube. A positive-going pulse would be applied to the cathode of the indicator tube.

The type of cathode ray oscilloscope used by the radar set would not normally influence the nature of the output from the video amplifier stage or stages.

Superregenerative Receiver

Another type of receiver offering radar possibilities is the superregenerative receiver (Fig. 3).

A superregenerative oscillator forms the basis of this type of receiver. Superregeneration takes place when oscillations are started and stopped at an r.f. rate which is low in comparison with the frequency of the generated voltage. This is accomplished by means of a quench oscillator.

The incoming r.f. signal from the antenna is applied to the grid of the superregenerative stage. Since the tube is operated in a highly regenerative state, there will be very high amplification of the signal *during periods of oscillation.*

Because of the limiting action of the circuit, the video output doesn't depend on the strength of the input r.f. signal.

Although the sensitivity of a superregenerative receiver is very high, its lack of stability, and other disadvantages, prevents wide use in radar applications.

(To be continued)

Capacitor Checker

(Continued from page 40)

bridge or good ohmmeter. These setting are inscribed upon the rheostat scales. If arbitrary dial divisions are employed, locate each resistance setting listed in Chart 2 and make a list of the corresponding dial settings rather than ohmic values.

To check the power supply, voltage control potentiometer, and d.c. voltmeter circuit, (1) with S_1 switched off, insert power plug into line receptacle and (2) while holding pushbutton S_2 depressed, close S_1 and advance R_4 slowly, noting readings on voltmeter scale of meter M. If it is desired to compare meter M readings with those of a standard d.c. voltmeter, connect latter between positive X terminal and junction of Ch and R_1. If the milliammeter is of good quality and calibration and if the voltage scale has been drawn carefully and the resistors R_3 and R_4 critically adjusted, the voltage scale of meter M will be found to agree closely with a standard d.c. voltmeter.

If desired, the voltage control potentiometer may be provided with a scale or dial graduated directly in volts. This will obviate taking voltage readings with the meter. However, such a scale is not recommended unreservedly, since its readings will not be true for all load conditions.

If rheostats R_A, R_B, and R_C are calibrated meticulously, no further adjustment or calibration of the instrument will be required.

How to Operate the Instrument

The method of using the capacitor checker is always the same, regardless of the type and characteristics of electrolytic units tested. Only the settings of the controls will differ for various capacitances and working voltages. The routine manipulations may be mastered in a short time by the busy serviceman.

The following procedure must be observed in checking the condition of electrolytic capacitors: (1) With line plug inserted into power outlet and S_1 switched off, connect electrolytic capacitor to terminals *X-X, positive capacitor terminal to positive instrument terminal.* (2) Set rheostats R_A, R_B, and R_C and switch S_M to positions given in Chart 2. (3) Switch on S_1 and advance voltage control potentiometer R_4 slowly from zero voltage, a short distance, noting meter M reading. (4) At this point, check operating voltage simply by depressing pushbutton S_2 and reading voltage scale of meter M. If voltage is not up to rated working value for capacitor under test, release S_2 and advance R_4 slightly higher. Re-check voltage by depressing S_2. As capacitor charges, or as it forms (if it has been shelved for a considerable period), voltage may be observed to fall very slowly. In this case, continue adjustments over period of several minutes until voltage stabilizes at the working value. (5) When voltage is stabilized, release pushbutton

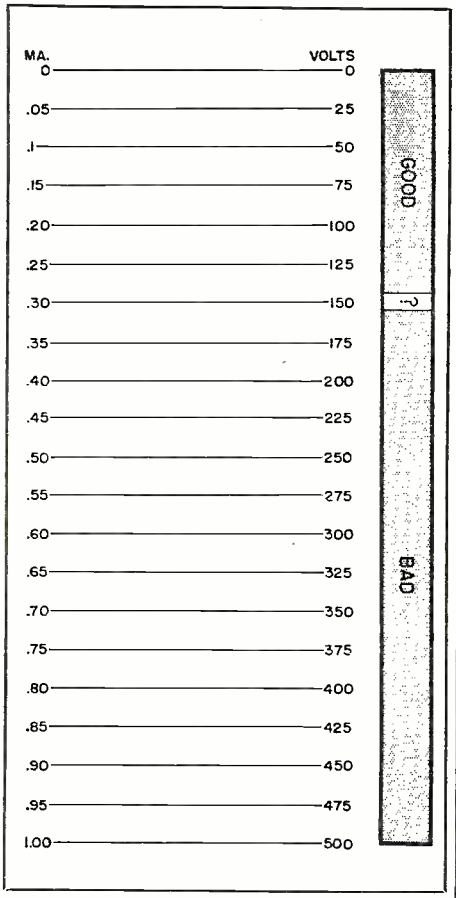


Chart 3. Dial calibrations.

S_2 and read capacitor condition on English portion of meter scale. (6) If meter pointer reaches BAD portion of scale (with S_2 released) before voltage reaches rated working value for capacitor, and does not fall slowly back toward zero, capacitor has excessive leakage and is probably shorted if the pointer climbs to the upper limit of the BAD region. (7) When meter reading (with S_2 released) is at the question mark on the meter scale, capacitor leakage is at the maximum permissible value for the unit being tested.

Always discharge the capacitor after it has been tested, otherwise a severe shock may be received. Keep switch S_1 *off* when an actual test is not being made, and turn it *off* again before disconnecting the capacitor from the instrument. Keep a good pilot lamp in the socket to warn you when the power is on. Never attempt to disconnect the capacitor from the instrument until the pointer of the meter (instrument in the leakage test, not voltage, position) has fallen all the way back to zero, indicating complete discharge of the capacitor. If the pointer seems too slow in falling to zero, the capacitor may be discharged more quickly by short-circuiting its terminals or the *X-X* instrument terminals to which it is connected. For this purpose, use a short length of insulated wire with the two ends bared, but be sure to touch only the insulated portion when discharging the capacitor.

—30—

The Road to Hamdom

(*Continued from page* 55)

miliar with the gear, from suffering possible injury or worse.

In wiring the transmitter it is good practice to have the various parts arranged so that the leads, particularly in the tank sections, are as short as possible. By tank sections we refer to the resonant or tuning circuits of the transmitter which include, usually, a variable condenser and a coil. It is extremely important that the power supply unit and the power leads be kept out of the "inductive field" of these r.f. circuits if the emitted signal of the transmitter is to be free of hum or other modulation. Toward this end, it is also desirable that the wires bringing power to the filaments of the tubes be twisted. This effectively prevents the building up of an a.c. field in the vicinity of the r.f. sections.

Fasten all component parts of your transmitter securely to the breadboard or chassis. While the use of a crystal-controlled oscillator will anchor your signal pretty well to one frequency, you can still be troubled to a great extent with a wobbly signal if any of the parts in the transmitter are subject to vibration or other movement.

The construction of your receiver will probably offer more headaches than any other piece of equipment or part of your station. The quantity of aspirin tablets consumed will be decreased considerably, however, if a few simple rules are observed.

Shielding is important. Therefore, it is advisable that, instead of a breadboard being used, the receiver be built on a metal chassis with a metal panel. It is even more desirable to build it on a metal chassis that will slide into a metal cabinet since this method of construction will give you over-all shielding. As with the transmitter, the receiver parts must be securely fastened down for, in high-frequency reception, stability of the signal is of prime importance.

Unless the circuit of the receiver is of a fairly advanced design and you have been very careful in laying out the parts, it is wiser not to build the power supply on the same chassis and enclosed in the same cabinet with the receiver. The regenerative type receiver is very sensitive to inductive hum and in order to bring in the weaker signals and to bring in any signal with a clear CW note it is necessary that your receiver be absolutely free of such hum.

Your power supplies will be comparatively simple to build. However, as with any of the equipment, careful planning and construction will pay off with trouble-free operation. As stated earlier, two units will be needed. It is possible to use just one but such practice will entail the use of a rather complicated switching arrangement and a system of dividing and dropping the voltage output. Any power supplies that you build at this time will find a place in later and more advanced stages of your work in amateur radio.

The two general types of rectifier tubes in common use with power supplies for low-powered work are high-vacuum and mercury-vapor. Either of these types may be used in the receiver supply but the mercury-vapor is recommended for the transmitter power. The mercury-vapor rectifier tube has the advantage of better voltage regulation over the tubes of a high-vacuum type. This is extremely important if the power supply is to be used with a CW transmitter since the variation in load on the supply when the transmitter is keyed will cause a "chirpy" signal. Even better regulation may be obtained by the use of a "bleeder" resistor across the power output of the supply. The type-83 mercury-vapor tube is ideal for such purpose since one of these tubes can safely handle power sufficient to deliver 600 volts output with plenty of filter and enough current to supply your transmitter input-power requirements with a safe margin. A choke-input filter should be used with these mercury-vapor rectifiers. The filament voltage should be applied before turning on the plate power.

A monitor is nothing more than a very simple regenerative receiver. The

unit, with its required batteries, should be enclosed in a metal container. It can be built small enough to carry around the room since only a small 22½ volt "B" battery and a flash-light cell will furnish enough power for its operation if a low-drain tube is used. A type-30 tube is recommended for this unit.

If your transmitter is of the "self-excited" type, the monitor may be used to adjust the transmitter to any desired frequency. This is done by first using the monitor as a miniature transmitter. The receiver is tuned to the frequency you want to use and the monitor, set near-by, is tuned until the beat-note from it is heard in the receiver. This indicates that the monitor is tuned to the same frequency as the receiver. Now the monitor is used as a receiver. The headset is plugged into the monitor and the transmitter is tuned until the signal is heard. Since the monitor is tuned to the frequency you desire and the transmitter is tuned to the monitor therefore the transmitter is tuned to the right spot. QED!

Due to the fact that space conditions vary so much with each station location, no particular transmitting antenna type will be discussed. Generally speaking, where space permits, a half-wave or full-wave antenna will give maximum results. If the transmitter is to be operated on the lower frequencies of the ham-bands, it is very likely that a full-wave antenna will be found impractical. The antenna should be erected as high as possible and away from obstructions such as buildings and trees. Low-loss insulators (and spacer-bars, in the case of Zepp feeders) should be used. Pyrex, steatite, or glazed porcelain, to mention only a few, are excellent for this purpose. A switch, at your operating position, will enable you to use the one antenna for both transmitter and receiver.

Well, we seem to have given a rather general coverage of the fundamental pieces of equipment for your station. This article is not intended to be technical. Detail can come later. Obviously you cannot build up your station at this time since Uncle Sam has nixed general amateur operating for the duration. The word *priorities* rears its ugly head also. But— now is the time for planning and firing the imagination and *brother*—is my imagination fired! Oh, to dive once again into the QRM on forty. Oh, to hear again the melodious voices of the gang on seventy-five telling me my "mojulation" is perfect.

What does it matter that the Jr. Op, expected momentarily at 9UAO, will need a new pair of booties about the time the OM needs a new plate transformer. Or, does it matter if the XYL hankers for that "perfectly divine" dress just when the boss (?) decides to broaden his scope with a new xtal. Naw! I can always take up woodcarving.

—30—

★ INDUSTRIAL ★ MAN-POWER BUREAU

ELECTRONIC ENGINEERS!

War-Winners Today, Post-War Builders Tomorrow!

Leaders in NATIONAL UNION RADIO CORPORATION'S staff of engineers, scientists and technicians have brought us far out in front in the electronic industry. We have a research laboratory and two manufacturing plants in Newark, N. J., and a manufacturing plant near Philadelphia, Pa. We invite you to consider your opportunities with us for professional advancement, stimulating, friendly associations, and a future with promise.

NATIONAL UNION NEEDS:

SENIOR TUBE ENGINEERS: These men MUST have actual experience with radio tube manufacture. The pay and opportunities are commensurate with your ability.

COMMERCIAL ENGINEERS: Engineers interested in developing electronic tube applications, who may represent us among radio manufacturers upon occasion.

QUALITY CONTROL MEN AND WOMEN: Here you need an interest in the practical application of statistical and/or engineering procedures to many factory processes.

TEST EQUIPMENT ENGINEERS: Men experienced with meters or electronic test equipment to work either as TEST EQUIPMENT DESIGN ENGINEERS or as MEASUREMENT LABORATORY ENGINEERS.

JUNIOR ENGINEERS—MEN AND WOMEN: Do you have a college degree in Physics, Electrical Engineering, Chemical Engineering, Mechanical Engineering, Mathematics or Chemistry? This company offers an opportunity for young, ambitious graduates to assume responsibilities and to exercise initiative.

WOMEN!

We have a number of fine young women engineers with us now. We need more. If you have a degree in Electrical Engineering, Chemical Engineering, Mechanical Engineering, Physics, Chemistry or Mathematics and are seeking career opportunities, investigate.

If you have thorough training in your field, as evidenced by job experience in radio or allied industries, or by a college degree—if you have ambition, initiative and resourcefulness—if you have the ability to inspire your co-workers, then . . .

Phone or Write

DR. L. GRANT HECTOR

Director of Engineering

NATIONAL UNION RADIO CORPORATION

Plane St. at Raymond Blvd. **Newark 2, New Jersey**

WMC RULES OBSERVED

Give generously to

YOUR COMMUNITY WAR FUND

Representing the NATIONAL WAR FUND

OPENINGS FOR

RADIO ENGINEERS

ELECTRICAL ENGINEERS

MECHANICAL ENGINEERS

In the development and production of all types of radio receiving and low-power transmitting tubes. Excellent post-war opportunities with an established company in a field having unlimited post-war possibilities.

Apply in person or in writing to:

Personnel Manager

RAYTHEON MANUFACTURING CO.

Radio Receiving Tube Div.

55 Chapel St., Newton, Mass.

Technical Writers Wanted!

Engineers and physicists who have had experience in (spare time) writing technical manuscripts on electronic design or applications including radio, television, facsimile, etc.

Reply Box 310, c/o RADIO NEWS

185 N. Wabash Ave., Chicago 1, Ill.

Practical Radio Course

(*Continued from page* 51)

each band switch. Capacitors T_{13} and T_{12} are the broadcast-band preselector and oscillator high-frequency trimmers respectively, which are to be adjusted for proper high-frequency tracking at a preselector frequency of 1500 kc. Capacitor T_{15} is the adjustable unit of the broadcast-band low-frequency padder, and is to be adjusted for proper low-frequency tracking at 600 kc.

S_1 is the first short-wave band position of each band switch. Capacitors T_9 and T_8 are the high-frequency trimmers for this band, and are to be adjusted for correct high-frequency tracking at a preselector frequency of 4.5 mc. Capacitor T_{11} is the low-frequency padder for this band, and is to be adjusted for proper low-frequency tracking at a preselector frequency of 1.8 mc.

S_2 is the higher-frequency short-wave band position of each band switch. Capacitors T_6 and T_5 are the high-frequency trimmers for this band, and are to be adjusted for correct high-frequency tracking at a preselector frequency of 15 mc. No low-frequency adjustable padder is provided for this band—the fixed low-frequency padder 47 sufficing for correct tracking here.

To insure perfect tracking the ganged main oscillator tuning capacitor should be "rocked" while adjusting the low-frequency padders, so that the maximum signal output will be followed.

Interlocking Trimmers

Inspection of the separate-coil multi-band oscillator circuit in Fig. 4 reveals that a separate coil and oscillator high-frequency trimmer is used for each band. The trimmer is connected across the coil for that particular band and utilized only when that coil is in the circuit. Hence, the adjustment of a trimmer on one band is entirely independent of the trimmer adjustments on any other band so it does not matter which band is first adjusted for correct high-frequency tracking.

Many multi-band receivers that use a tapped-coil tuning system instead, employ trimmers that are in the circuit on more than one band. For example, for the broadcast band in the oscillator of the *Stromberg-Carlson* 58 receiver (see Fig. 3), all three trimmers are in series across the full tuning coil. Therefore, the oscillator tracking at the high-frequency end of the bands must be adjusted on the highest-frequency band first, when the lower two portions of the tuning *coil,* and their trimmers, are shorted out by the waveband switch. Then the adjustment is made on the medium-frequency band, and finally the broadcast-band. If the tracking adjustment were made on the broadcast-band first, the subsequent tracking adjustments made on the other two bands would

nullify the settings on the broadcast-band because the trimmer capacitors for the two short-wave bands also have a tuning effect on the full tuning coil when it is used for broadcast-band reception. Similarly, adjustment of trimmer C_{12} affects the tuning of the portion of the coil used for the medium-frequency band, so, unless the highest frequency band is tracked before the medium-frequency band, it will nullify the settings on the latter.

Fixed Tracking Padders

In the oscillators of some multi-band receivers there is only an *adjustable* type series-padding capacitor for the broadcast-band, the series padder for the medium- and short-wave bands being in the form of fixed capacitors (see Fig. 3). In others, all bands but the highest-frequency band are provided with adjustable padders, the latter requiring only a *fixed* padder of the proper capacitance value (see Figs. 1 and 4).

It is interesting to note that if the receiver is designed to have the oscillator operating at a *lower* frequency than the signal, the low-frequency pad or pads are placed in the preselector tuning circuits instead of the oscillator tuning circuits. Using a "low side" oscillator is advantageous in ultra-high frequency receivers, since the oscillator has greater output and stability when operating at a *lower* frequency. Let us see the reason for this. The difference between "low side" (or lower-frequency) oscillator operation and "high side" (or higher-frequency) oscillator operation amounts to twice the intermediate frequency. Therefore, in a standard broadcast-band receiver employing the usual 455 kc. i.f., the frequency advantage gained by low-side oscillator operation would be only $455 \times 2 = 910$ kc. The benefits of such operation would be negligible! The difference in efficiency also would be negligible. On the other hand, in a u.h.f. receiver employing a much higher i.f., say 5 megacycles, the difference of $5 \times 2 = 10$ mc. between the two methods of oscillator operation could result in a considerable improvement in oscillator performance if the "low-side" mode of operation is employed.

The special oscillator-preselector tracking problems encountered in receivers that employ push-button station selection will be explained in the next article of this series.

(To be continued)

Photo Credits

Page	Credit
25, 26 (top, bottom right), 27 (center), 28 (center, bottom left), 29 (top, bottom right), 30	U. S. Navy
26 (center, bottom left and center), 27 (top, bottom), 29 (bottom left)	U. S. Army Air Forces
31	Supreme Instruments Co.
41, 42, 43	G. Haug
58	General Electric Co.
92	Paul Guillumette, Inc. (CNS)
96	U. S. Army Signal Corps
114	RCA Victor Division, RCA
120	Westinghouse Electric Corp.
146	Maguire Industries, Inc.

INDEX OF Advertisers

Oct. 1945

AEROVOX

"Know-How"

Aerovox "Know-How" in action: Chief Engineer Stanley Green (center) with Joseph L. Collins (Electrolytics), Louis Kahn (Assistant Chief Engineer) and Samuel Heyman (Production Manager) working out the capacitance problem of a customer from the application blueprints.

. . . can save you untold time, expense, trouble

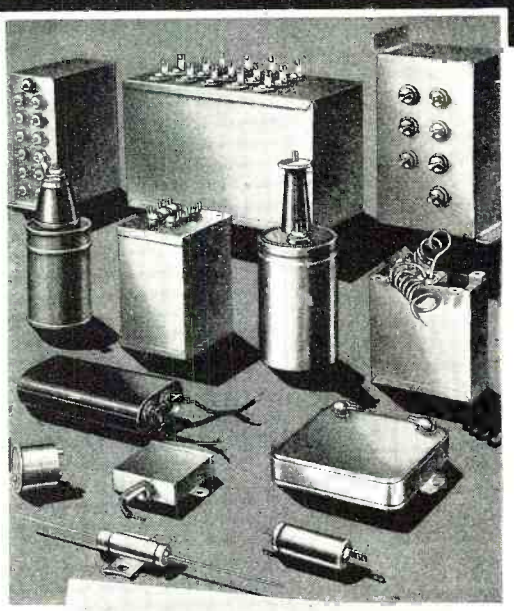
Ingenuity, imagination, versatility, adaptability, coupled with sound engineering practice, add up to Aerovox "Know-How."

Of course Aerovox has an outstanding line of *standard* capacitors—paper, oil, electrolytic, mica and low-loss ultra-high-frequency types. A wide range of requirements are met with such a variety of listings. But Aerovox can also meet most extraordinary needs with *special* types that do not have to be billed at usual special prices. Here's why:

A tremendous variety of cans, terminals, insulators, mountings and production processes at the disposal of Aerovox engineers enables Aerovox to make up special types quickly, readily, inexpensively. So:

Bear in mind Aerovox "Know-How"—and save untold time, expense, trouble.

Try us on that capacitance problem.



Typical "special" capacitors assembled from standard Aerovox parts, indicating the wide variety of cans, terminals, insulators and mountings.

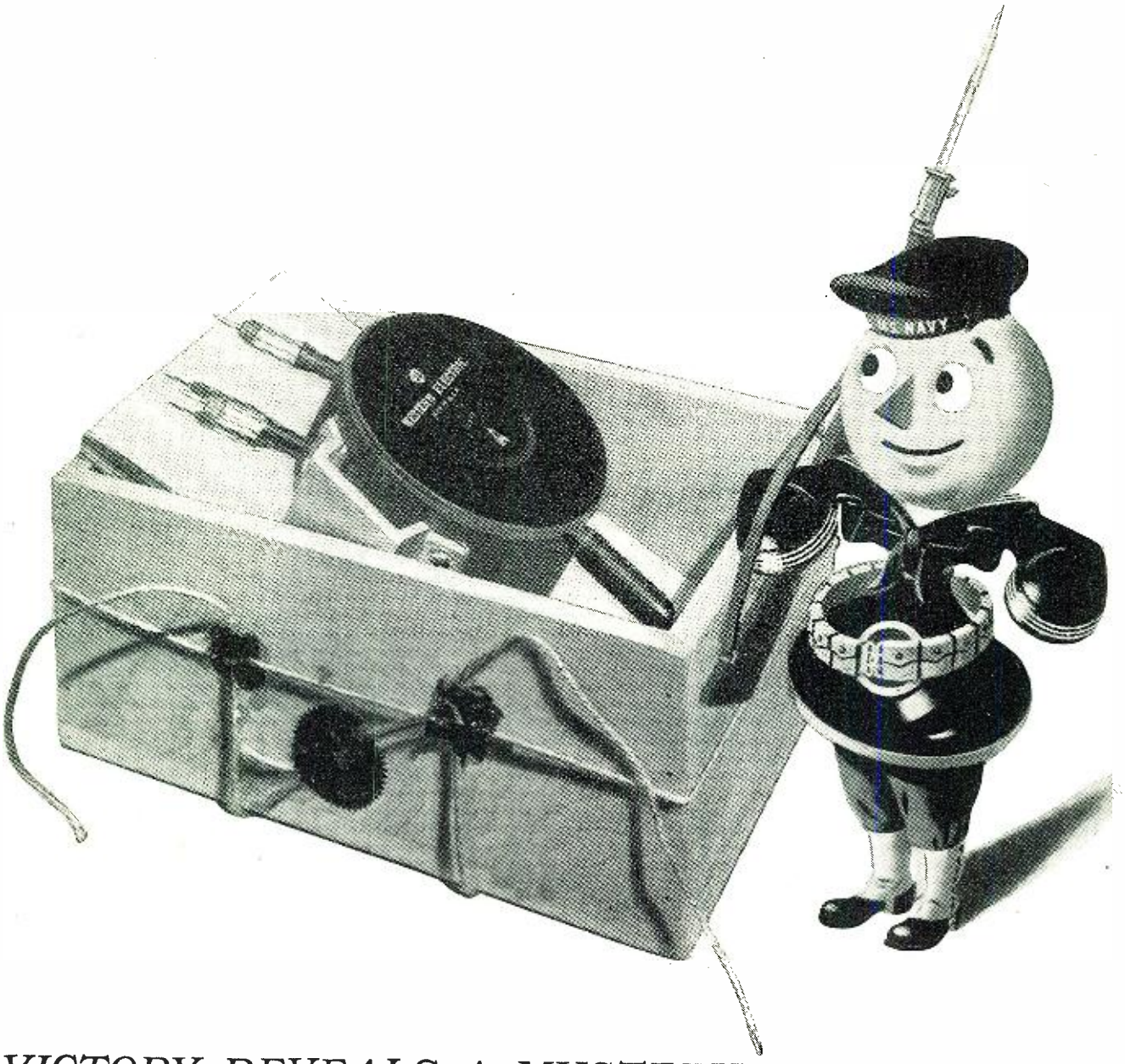
AEROVOX

Capacitors

INDIVIDUALLY TESTED

AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. · SALES OFFICES IN ALL PRINCIPAL CITIES

Export: 13 E. 40 St. New York 16, N. Y. · Cable: 'ARLAB' · In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.



VICTORY REVEALS A MYSTERY

More than two years ago, an engineer of the Laboratories visited *U.S.S. Boise*, returned with a mysterious box which went into the Laboratories' vault. Now, victory opens the box and discloses a special kind of electron tube called a magnetron. It was part of a Radar which furnished data to aim *U.S.S. Boise's* guns during the night action off Savo Island on October 11-12, 1942. Because of the high frequency generated by this magnetron, the Radar was not detected by the enemy and the action was a complete surprise. Six Japanese warships were sent to the bottom of the sea.

This magnetron is a symbol of the Laboratories' enormous war program. Half of it was devoted to Radar, the other half gave birth to radio transmitters and receivers, sonar apparatus for the Navy, loudspeaker systems for ships and beach-heads, fire-control apparatus for anti-aircraft artillery. Coming months will unfold the story of these and many other contributions of the Laboratories to the victory of our arms.

Bell Telephone Laboratories' war work began before the war; until now, it claimed practically all our attention. With victory, we will go back to our regular job—helping to bring you the world's finest telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service.

Printed in U. S. A.

WHY CARRY LARGE VIBRATOR STOCKS?

4 . . . when 4 E-L Vibrators Meet 95% of All Auto Radio Replacement Needs!

Model 1703 serves 738 auto-radios

Model 2089 serves 237 auto-radios

Model 2041 serves 75 auto-radios

Model 2088 serves 72 auto-radios

YES, it's true! You need stock only *four* models of E-L Vibrators to serve the 1,122 auto-radio models comprising 95% of the replacement demand! Result: much smaller inventory, faster turnover, and greater profits for dealers and distributors.

Standardization with Higher Quality – This unique E-L Vibrator standardization plan is the product of exhaustive research into auto-radio requirements . . . and of adapting to those requirements E-L models whose design and exclusive features have been perfected and proved in the toughest military applications.

These E-L Vibrators are of the balanced resonance type, with 8 contacts instead of 4—*twice* as many as other makes. Tests show they provide 33% *longer vibrator life,* with output and starting voltages held virtually constant at all times.

See Your E-L Distributor – Your E-L distributor will fill your orders as soon as possible, considering the fact that his stocks are limited due to military demands.

With your order, you'll receive your copy of the new E-L Auto-Radio Vibrator Replacement Guide. Designed to hang on your wall, it will tell you instantly which E-L Vibrator to use for most auto-radios as far back as 1936. See your E-L distributor!

Electronic
LABORATORIES, INC.
INDIANAPOLIS

E-L Auto Radio VIBRATORS

The RCA 155-C — A Versatile OSCILLOSCOPE

WHEREVER a general-purpose oscilloscope is required, the RCA 155-C is the choice. Designed for simple operation, faithful reproduction, accurate comparisons, and quick results, this oscilloscope is fast becoming standard equipment in laboratories and service shops.

The 155-C is different from other 3" oscilloscopes because it includes a built-in light shield, removable graph screen, direct deflector connection, binding jacks (a combination binding-post and pin jack), a 6-volt AC terminal, and an improved-timing axis oscillator.

Completely portable and attractively cased, this instrument is priced within the reach of owners of small shops and laboratories.

MAIL THE COUPON FOR FURTHER TECHNICAL DETAILS

Test and Measuring Equipment Section
Radio Corporation of America
Camden, N. J.

Please send me information about the RCA 155-C Oscilloscope.

Name .....

Street Address .....

City and State .....

155-BB

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY, LIMITED, Montre