RADIO NEWS

APRIL
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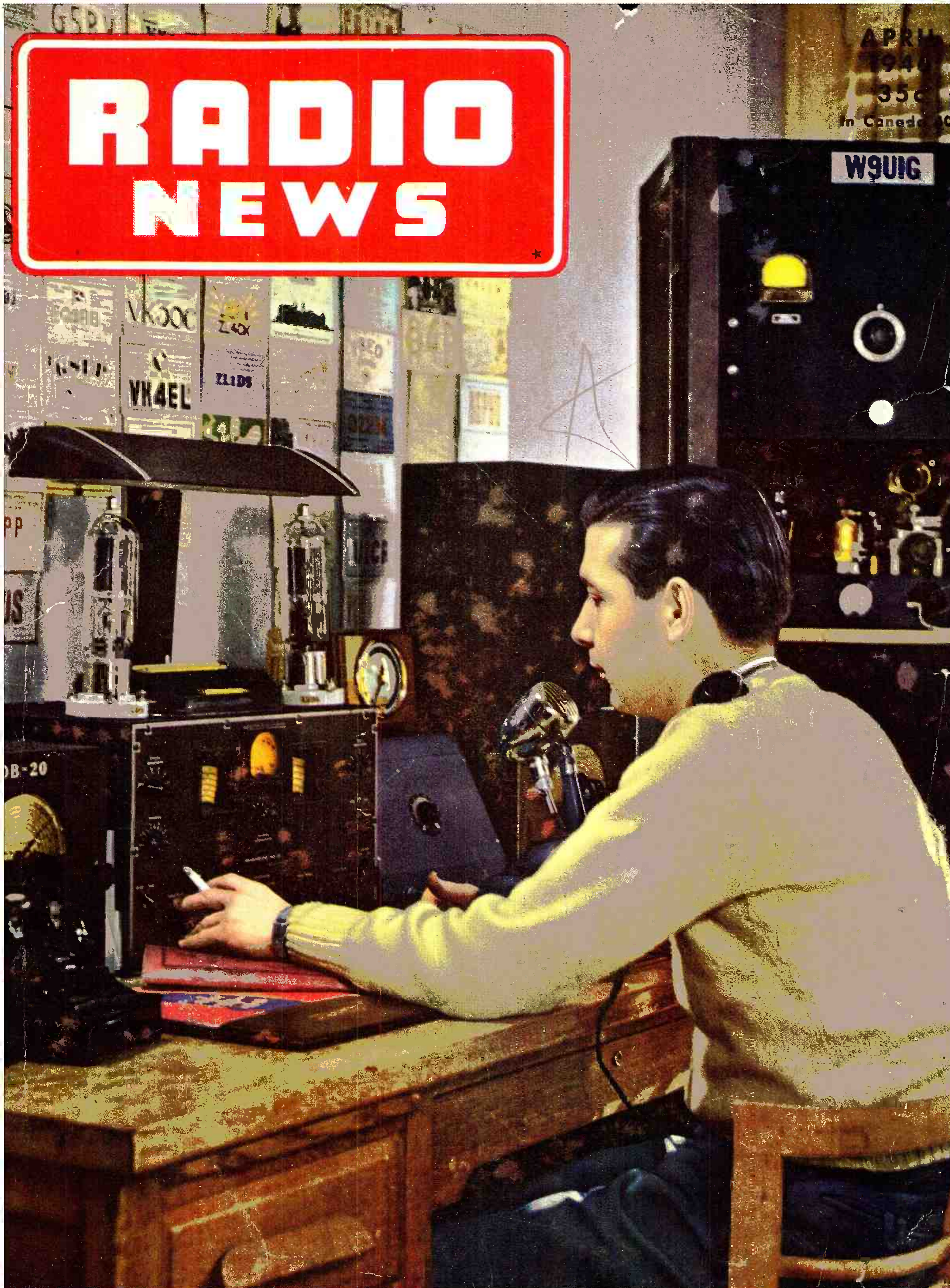
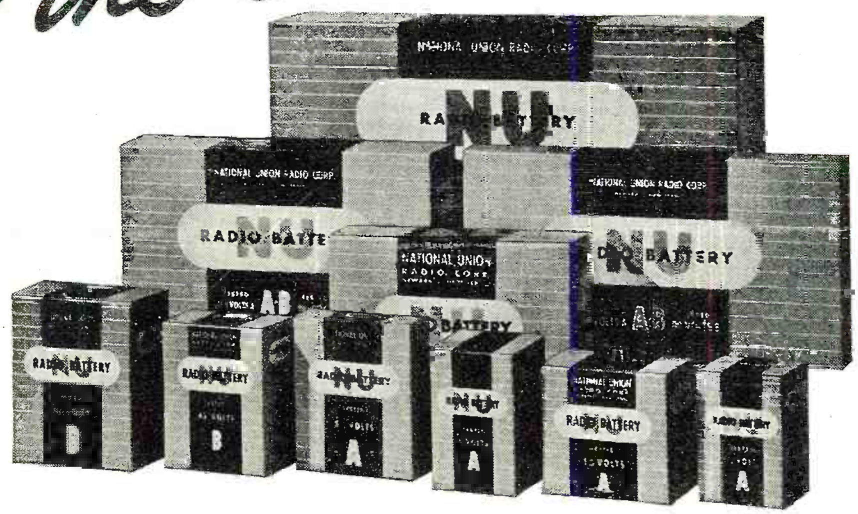


N. U. BATTERIES *by the Carload!*



Get Immediate Deliveries of All Types for Standard Radio and Other Replacements

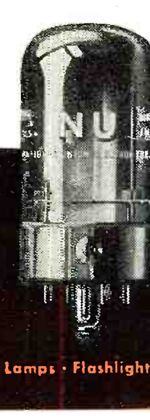
Now you can bring many thousands of good, serviceable battery-powered radio sets *back to life*. Portables—Farm Radios—"carry-about" sets! Here are the batteries you need to bring in this flood of profitable service and parts business. Order now and *tell* your customers to come on the run for the batteries they need.

In batteries as in other products, N. U. quality helps you build for the future. The patented construction of N. U. Batteries permits more active materials—more service hours per dollar. Every N. U. Battery is engineered to the highest initial equipment standards and is designed for universal replacement.

PLACE YOUR BATTERY ORDER TODAY—with YOUR N. U. DISTRIBUTOR

Renew with N. U. . . . the quality line that brings repeat sales at full profit to radio service men!

NATIONAL UNION RADIO CORPORATION, Newark 2, New Jersey



NATIONAL UNION RADIO TUBES AND PARTS

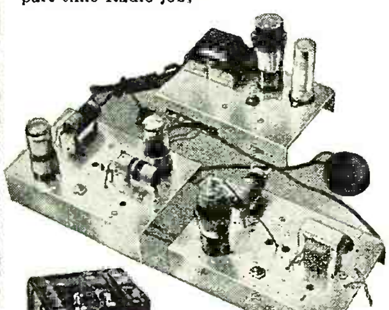
Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

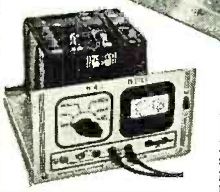
J. E. SMITH
PRESIDENT
National Radio Institute
32nd Year of Training Men for Success in Radio

I WILL TRAIN YOU TO START
A SPARE TIME OR FULL TIME
RADIO SERVICE BUSINESS WITHOUT CAPITAL

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!

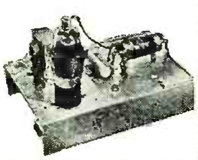




You build MEASURING INSTRUMENT above early in Course, useful for Radio work to pick up EXTRA spare time money. It is a vacuum tube multimeter, measures A.C., D.C., R.F. volts, D.C. currents, resistance, receiver output.

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. 6DR, 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.

"Previous to enrolling for your Radio training I made $12 per week in a hardware store. Now I operate my own repair shop, and often clear $35 to $45 a week." — FREDERICK BELL, 76 Golf Ave., St. Johns, Newfoundland.

"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
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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.)

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- ☐ Government Civilian Radio
- ☐ Aviation Radio
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- ☐ Army, Navy Radio Jobs
- ☐ Operating Police Radio Stations
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(If you have not decided which branch you prefer—mail coupon for facts to help you decide.)

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Address..

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

☐ If you are a war veteran, check here.

APRIL, 1946

RADIO NEWS

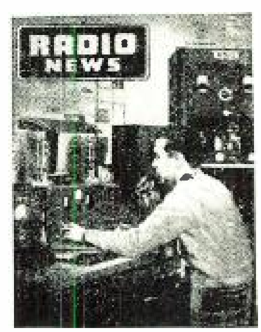
REG. U S PAT OFF

VOLUME 35, NUMBER 4

AMATEUR

SERVICE

GENERAL



Cover Photo
By ARTHUR HAUG

Bill Shaw, W9UIG, among the first hams back on the air, operates with 500 watts phone using a 3 element beam antenna. His receiver is a Hammarlund HQ120X. Other equipment includes a Meissner Signal Shifter and an RME DB20 pre-selector.

185 N. Wabash Ave., Chicago 1, Ill.

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hallicrafters *new Model* S-40

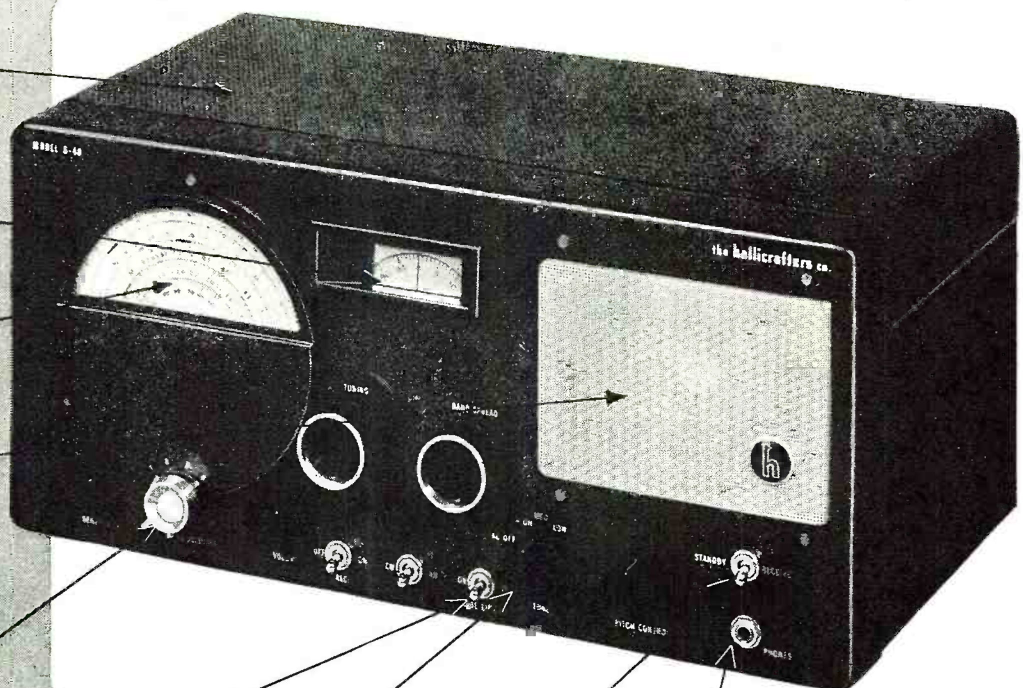
New beauty and perfect ventilation in the perforated steel top

Separate electrical bandspread with inertia flywheel tuning.

Tuning range from 540 kc to 42 Mc continuous in four bands

Self-contained, shock mounted, permanent magnet dynamic speaker

All controls logically grouped for easiest operation. Normal position for broadcast reception marked in red, making possible general use by whole family.



Automatic noise limiter

3-position tone control

Standby receive switch

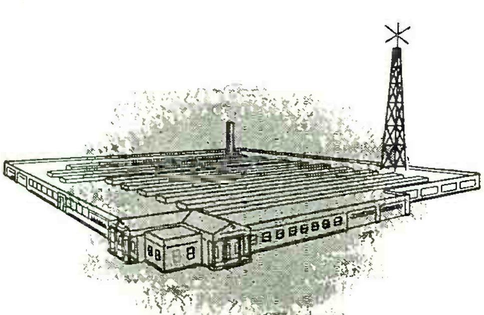
Phone jack

New design, new utility in a great new communications receiver . . .

(APPROXIMATELY)

$79.50

Here is Hallicrafters new Model S-40. With this great communications receiver, handsomely designed, expertly engineered, Hallicrafters points the way to exciting new developments in amateur radio. Read those specifications . . . it's tailor-made for hams. Look at the sheer beauty of the S-40 . . . nothing like it to be seen in the communications field. Listen to the amazing performance . . . excels anything in its price class. See your local distributor about when you can get an S-40.



INSIDE STUFF: Beneath the sleek exterior of the S-40 is a beautifully engineered chassis. One stage of tuned radio frequency amplification, the S-40 uses a type 6SA7 tube as converter mixer for best signal to noise ratio. RF coils are of the permeability adjusted "micro-set" type identical with those used in the most expensive Hallicrafters receivers. The high frequency oscillator is temperature compensated for maximum stability.

From every angle the S-40 is an ideal receiver for all high frequency applications.

hallicrafters RADIO

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Sole Hallicrafters Representatives in Canada: Rogers Majestic Limited, Toronto - Montreal

For the RECORD

BY THE EDITOR

"METAMORPHOSIS" is defined by Webster as "a striking alteration in appearance, character, or circumstances."

We gather from reading our daily mail, visits, and phone calls that the word is particularly applicable at this time to thousands of our readers. The alteration manifests itself in garb, outlook and environment. In those who have shed uniforms, the alteration in appearance is obvious, but there are also those who have shed overalls to don the guise of independent business men.

The change in outlook is sometimes clear, often elusive. There are those who, having been exposed to the virus of radio while in service, desire to continue a close association with this fascinating phenomenon; some as experimenters, others as "hams," many as technicians and business men.

From the war plants come thousands who now look forward to establishing or re-establishing themselves as servicemen. More thousands who stuck to their service trade during the war have an eye to expansion as merchants selling the products they have so well sustained these long years.

Thus, as the cauldron of war is emptied, we find eager men everywhere spreading over the land in pursuit of a peaceful life involving some type of radio activity. The flood tide of these men is beating against industry, seeking an opening. We sympathize with their impatience and hope their persistence and courage will carry them through until our peacetime radio industry unfolds.

Mr. Laurence K. Marshall, president of *Raytheon Manufacturing Company* and *Belmont Radio Corporation,* well described the tempo of the industry when he said, "Tomorrow will never arrive in the electronics industry; new developments, ideas, inventions, models, are relentlessly pursued if for no other reason than scientific curiosity."

This eternal greatness of radio, in all its forms, is naturally more obvious to us as we sit at the crossroads of the multitudes of radio interests represented by our readers.

We are fully aware of the metamorphosis of the men with radio engraved in their thought patterns. We, too, are undergoing the alteration in our editorial make up. In RADIO NEWS, as the months go past, every radio man will find much to stimulate, and add to his fund of knowledge, whether he is a service technician, ham, experimenter or builder.

We are as relentless in our search for vital information to publish for the benefit of peacetime radio men, as we were in our efforts to satisfy the needs of wartime readers. We took a deep breath as the war terminated and consigned to oblivion thousands of dollars worth of manuscripts, photographs, and diagrams dealing with wartime radio and electronics.

We know that thousands of you who conversed on the radio communications of war, when lives were hanging in the balance, will be sitting in your own "shack" burning the midnight filaments to search for fellow "hams" who might have shared a similar martian experience. You'll be buying rigs, building and rebuilding them, eternally striving for transmission and reception perfection. We're going to publish material which should help you.

We're aware of the fact that thousands of you who will earn your living as radio technicians will need every bit of information you can lay your eyes on to keep abreast of radio circuit developments, trends, and technical methods. We are on the alert for the best writers we can find to tell you the facts.

NOW we have proof that there are no limitations to radio! Radar has now taken us out of this world, plunged us into the infinite, challenged the universe with spears of radio impulses that have prodded the moon and returned to open new floodgates of human mental activity. No longer can the defeatists tell us that mankind has passed its last frontier and that we must settle down to the uninspiring prospect of making the most of our little world, frustrated in the belief that the eternal stimulant of adventure into unknown, uncharted areas is a thing of the past.

Even as radio has been a vital factor in shrinking our own world, so does radio now break our fetters and carry us to worlds beyond. What space ship would dare venture into the outer regions without radio?

Now, as we alternately hope and shudder at the prospects of the use of atomic power for good or evil, we find our minds lifted by the hopes of explorations into space which will relieve the pressures of too close associations with men on our own planet.

It's radio we can thank for the opening of these infinite vistas. It will be radio which will make possible the jaunts of twentieth century Vikings into outer space.

Small wonder that we who earn our living in radio, or know the thrill of radio as a hobby are proud of our association with this super-science.

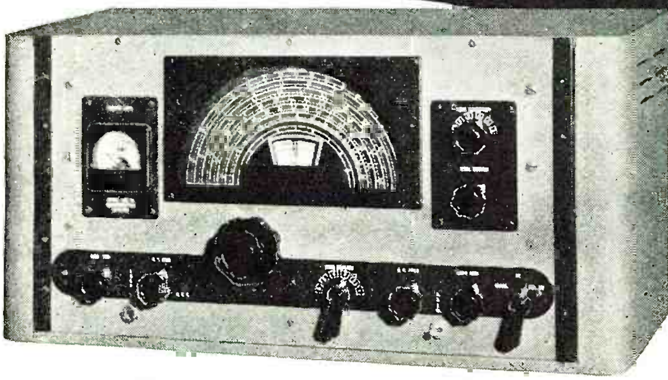
..............................O. R.

For Earliest Delivery... **ORDER YOUR NEW**

COMMUNICATIONS RECEIVER

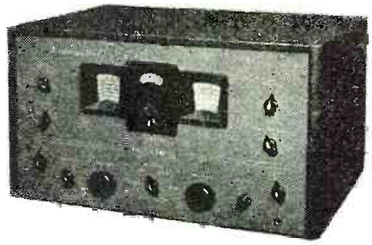
Now from **ALLIED**

AVAILABLE ON
Time Payments
TRADE-INS ACCEPTED



RME 45

The *new* RME 45 Receiver delivers peak reception on *all* frequencies—500 to 33,000 Kc. Full vision calibrated dial using one control for two-speed tuning. Five Amateur bands with ample band spread. DB calibrated signal level meter. 5 step variable crystal filter. Automatic Noise Suppression. Stable, variable pitch beat oscillator. Streamline cabinet with matching speaker. Net, with Speaker... **$186**



HAMMARLUND HQ-129X

Designed to meet the most critical demands of professional operators. Full range .54 to 31 Mc., accurately calibrated. 4 calibrated Ham bands and one arbitrary scale. Variable selectivity crystal filter. Low drift beat oscillator for code and locating stations. Antenna compensator. Voltage regulation. Compensated oscillator to reduce drift during warm-up. Automatic noise limiter. Earphone jack. 3 i.f. amplifier stages. 2 audio stages. For phone or CW. Net.......**$129**

Speaker, net.......**$10.50**

HALLICRAFTERS S-40

Sensational new Hallicrafters receiver! Offers many advanced design and performance features at a popular price. Simple to operate. Frequency range 550 Kc. to 44 Mc. in 4 bands. Wide vision main tuning dial accurately calibrated. Separate electrical bandspread dial, inertia flywheel tuning. Beat frequency oscillator. A.V.C. switch. CW/a.m. switch. Standby/receive switch. Automatic noise limiter. Separate RF and AF gain controls. Three position tone control. "Micro-set" permeability adjusted coils in RF section. Internal dynamic speaker. Net.......**$79.50**

Model SM-40 External "S" Meter....... **$15.00**

NATIONAL NC-2-40C

One of National's top receivers. 490 Kc. to 30 Mc. range in 6 tuning bands. Definite, accurate calibration for all bands. Actual single dial control. Stable high frequency circuits. Frequency drift reduction to a negligible value by temperature compensation. Automatic voltage stabilization. Wide range adjustable series-valve-noise limiter. Flexible crystal filter. Phonograph or high level microphone pick-up jack. Special r.f. coupling circuits maintain full sensitivity. Net.......**$225**

Speaker in matching cabinet, net.......**$15.00**

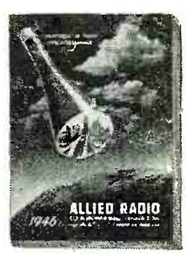
Other Communications Receivers

Hallicrafters SX-25......$94.50	Hallicrafters SX-28A....$223.00
National HRO..........197.70	Hallicrafters S-36A....415.00
RME DB-20 Preselector.. 59.30	Hammarlund 400X........318.00
RME VHF-152 Converter 59.30	Hammarlund 400SX......318.00

Net, F.O.B. Chicago (All prices subject to change)

Free... **SEND NOW FOR ALLIED'S**

NEW 1946 CATALOG



Here's your handiest, most complete 1946 Buying Guide for everything in radio! Includes latest communications receivers, Ham gear, code apparatus, parts, kits, tubes, tools, books, test instruments, public address and other equipment. 10,000 items at your finger tips . . . largest and most complete stocks under one roof. Nationally known makes. Fastest service—from one central source. Experienced staff of licensed radio amateurs to help you.

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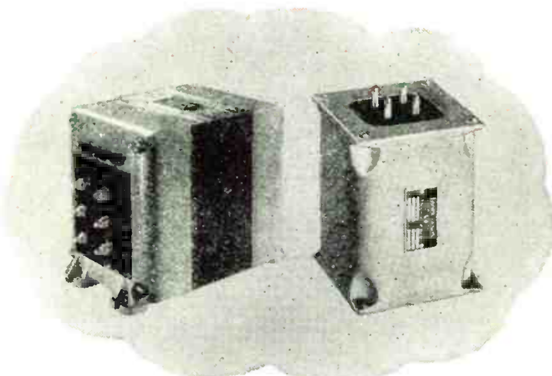
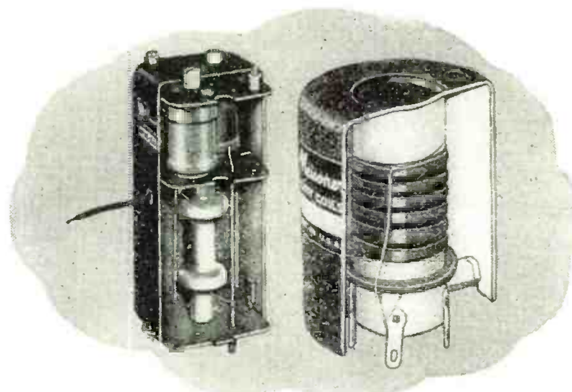


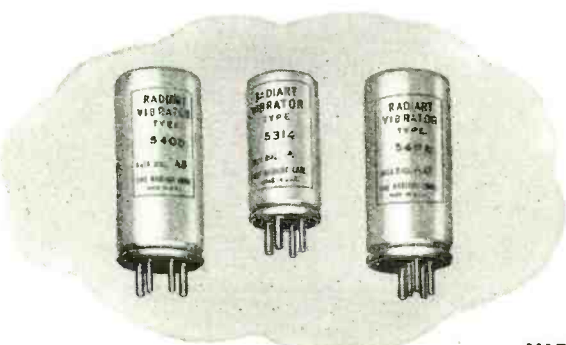
THORDARSON TRANSFORMERS

Over fifty years experience in the manufacture of quality-built transformers for all applications—replacement, communications, sound amplifier, industrial, experimental and amateur. Thordarson also originated Tru-Fidelity Amplifiers.

MEISSNER COMPONENTS

The Meissner reputation, gained and maintained by furnishing high quality components, including antenna, R.F. and oscillator coils; standard and Ferrocart transformers; windings, chokes and accessories. Meissner also makes the finest in service equipments.





RADIART VIBRATORS

Radiart Exact Duplicate Vibrators are individually engineered to meet the physical and electrical requirements of each application. This assures longer life, minimum R.F. interference, low hum level, etc. Radiart also makes rust-proof aerials to fit all cars.

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Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By FRED HAMLIN
Washington Editor, RADIO NEWS

PAUL PORTER'S MOVE from FCC to OPA is viewed unofficially by industrial observers in Washington as a beneficial one to radio. RMA and other Washington authorities are hopeful that some of their price problems will be ironed out under Porter's sympathetic eye and that at least they will be listened to with far more understanding than has been the case. The industry is unanimous that Porter learned quickly and a lot during his FCC chairmanship, and won a wide circle of friends. . . . On the other hand, within higher circles of the government, including the White House, Porter has lined up against the more conservative advisors, and leaders at the Federal level expect that he will go down the line on policies established by former OPA Administrator Chester Bowles who, as the new stabilization director, will, after all, be Porter's government boss.

INDUSTRY FEELING in Washington is otherwise not optimistic when it comes to considering the state of the nation so far as radio is concerned. The promise of big customer demands that led to high optimism on VJ-Day has since been dissipated by labor difficulties, price ceiling problems, and the general confusion prevalent in lining up supplies and production. . . . Skepticism is now being expressed toward the recent FCC forecasts before House appropriations committees concerning the bright future of the radio market. FCC witnesses testified, among other things, that they expected 200,000 walkie-talkie sets to be in operation by next year; that 11,000 stations may be in use by mid-'47 for bus, ambulance, and taxicab services; that railroad radio communications installations will have jumped to 2200 by the same time; ship radios will be up from a 1945 figure of some six thousand to nine thousand by the middle of next year; and radio-equipped aircraft will jump from some two thousand in mid-'45 to more than twenty-six thousand by mid-'47. . . . As for consumption by the general public, the industry is currently compromising the situation by concentrating on table models and other small sets, with the larger sets pushed to the back of the production line until current uncertainties clear up. But whether these will be eliminated in time to go full speed ahead in the last two quarters of the year is now considered a grave question by many observers. . . . Even should full production be realized during the second half of the year, it is also doubted whether it will be sufficient to offset the present delays enough to register favorable profits on the final 1946 balance sheets.

RADIO RECEIVER TRADE SHOWS seem to be a casualty of the current situation. Eager though the industry may be to parade new models, it was decided to forego shows because there isn't sufficient production under way to back up the demonstrators. An optimistic note: Assuming that things do straighten out, manufacturers' representatives in Washington predict confidently that the 1947 show will be a honey. . . . And in spite of everything, the industry continues to expand. Significant is that so far this year, 35 new radio equipment and parts manufacturers have been admitted to membership in the Radio Manufacturers Association, one of the largest groups to become members at one time. This brings the RMA total to a new record of 307 members.

ANOTHER OPTIMISTIC note has been sounded on the outlook in the ham field. Belief is that the number of hams will grow by leaps and bounds as soon as sufficient equipment is available. Chief reason for the optimism is the widespread interest in radio among GI's, thousands of whom have indicated that they want to become hams as soon as they shuck off their uniforms. . . . Alert to the potential in this field, RMA has organized an amateur radio activities section among 35 radio equipment manufacturers. Chairman of the section is W. J. Halligan, president of *The Hallicrafters Co.*, Chicago. Frank Holmstrom, vice-president and treasurer of *Hugh H. Eby, Inc.*, Philadelphia, is vice-chairman, and other members include William A. Ready, president of the *National Company, Inc.*, Malden, Mass.; R. P. Almy, manager of distributor sales for *Sylvania Electric Products, Inc.*, Emporium, Pa.; George Grammer, technical director of the *American Radio Relay League;* Walter Jablon, sales manager of the *Hammarlund Manufacturing Company, Inc.*, New York, and Robert Adams, production manager of the *Aireon*

BLUEPRINT

YOUR MOVES WITH ALLIANCE MOTORS

THE MODEL RR Intermittent duty is enclosed reversible control motor-split phase resistor type, 60 cycles, 24 or 117 volts, with or without gear reduction.

THE MODEL MS is shaded pole induction type for any A.C. voltage from 24 to 250 and frequency of 40, 50 or 60 cycles. Starting torques from one-half ounce inch at 10 watts input, to two ounce inches at 36 watt input.

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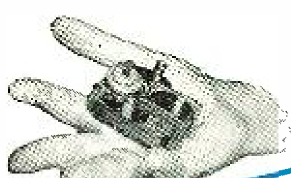
Radio, electronic and electric controls, time, temperature, pressure and humidity controls, coin operated phonographs, drink and merchandise dispensers, fans, valves and blowers, door openers, signals, motion displays, movie projectors and scores of industrial applications.

MINIATURE MOTORS THAT MAKE 'EM MOVE!



Besides the *millions* of Alliance phono-motors built for the radio industry, Alliance is making the POWR-PAKT line of miniature motors rated from less than 1-300th h.p. on up to 1-20th h.p.

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WHEN YOU DESIGN—KEEP alliance MOTORS IN MIND

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Manufacturing Corp., Kansas City, Kan. . . . First targets of the RMA group will be to standardize equipment parts and to support legislation beneficial to radio amateurs.

BOTH CBS AND ZENITH have announced their intention of constructing color television transmitters in Chicago within the very near future.

According to reports from the company, the *Zenith Radio Corporation* will manufacture color television receivers exclusively, thus backing up the *CBS* contention that the future of television lies in the transmission of full color pictures.

Construction of the *Zenith* station is expected to be completed within 90 days.

THE RADAR-TO-THE-MOON EXPERIMENT conducted successfully by the Signal Corps early this year surprised the men working on it when it got such big headlines, because bouncing a beam off of another planet wasn't what they were primarily interested in. Main objective of the test, according to Maj. Gen. Harry C. Ingles, chief signal officer, was to demonstrate that radio waves in the very high frequency band could completely penetrate the ionosphere, or celestial void, as well as break through whatever jacket of atmosphere may shield the moon. . . . We're happy to report that the first radar wave sent out returned not at all travel-worn from its trip of nearly a half million miles, and others also sent on the trip came back equally fresh. . . . The radar set used in the experiment was a war baby, designed primarily for long-range detection of hostile aircraft. It's called the SCR-271. It was modified when it made its successful reach for the moon. A standard SCR-271 sends out a pulse with a peak power of 100 kilowatts. Each pulse lasts from 10 to 30 microseconds, and the pulses are transmitted at a rate of 344 or 621 per second, depending on how the set is adjusted. Because of the great distance to the moon, the set was modified to build up greater energy. The antenna was also altered to obtain the best possible beam projection for the long-distance shot and to employ a specially adjusted oscilloscope whose baseline would represent about 300,000 miles instead of 150 miles.

SHOTS WERE TAKEN AT THE MOON only just after it rose and just before it set. Reason for this was that the standard SCR-271 employs for its antenna an array consisting of 32 dipoles, 4 and 8 feet wide. The number of these was doubled for the moon experiment, but, because it was capable of being rotated only horizontally, the horizon shots had to be taken. Tests could be conducted for about 15 minutes at moonrise and moonset. . . . Tests are continuing with the present equipment, but with changes in the antenna which will permit it to rotate vertically and thus shoot at the moon throughout its complete orbit above the earth. . . . The set was operated on its standard frequency of 111 megacycles—a wavelength of 300 centimeters. This lies in the very high frequency range. . . . Scientists are most interested, so far as future experiments are concerned, on the change in characteristics of the signals as the moon reaches its zenith, where the radio waves will strike the ionosphere almost at right angles.

HAVING CLIMBED ON AND FALLEN OFF OF the technical sled concerning moon radar half a dozen times at the Signal Corps, we paid a visit to another out-of-this-world set of experts, these in the Army's Ordnance Department. They have designed a machine—the first all-electronic general purpose computer ever developed—that can solve all the mathematical problems of a lifetime in a matter of hours. It's called the ENIAC — Electronic Numerical Integrator and Computer—and was invented by Dr. J. W. Mauchly and J. Presper Eckert, Jr., both of the Moore School of Electrical Engineering at the University of Pennsylvania. . . . Containing some 18,000 vacuum tubes in its mechanism, the new machine occupies a room 30 by 50 feet and weighs 30 tons and costs about $400,000, but in the postwar world can be produced much more cheaply, since research is figured into this price. Thing that intrigued us most about it is that it can add a couple of figures in one-five-thousandths of a second and can do a number of distinct additions simultaneously. It can also multiply and divide. Matter of fact, the only thing that its inventors say it can't do in the mathematical field is think.

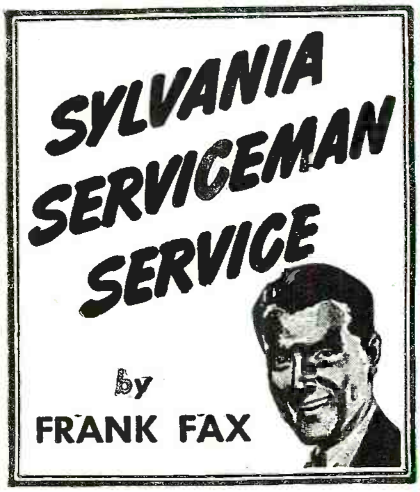
GENERAL ACCEPTANCE of a uniform vacation plan within the parts manufacturing branch of industry is anticipated following preliminary conferences in Washington and elsewhere. Parts manufacturers, of course, have been observing a plant shut-down plan for a number of years, but different plants have closed at different times, leading to delays and confusion. . . . Delays of two and three months have been suffered when the manufacturer of one part closed early in the summer, another in July, and a third in the early fall. The week of July 4th has been tentatively set as time for the shut-down, but no compulsory rules will be laid down.

AN RMA COMMITTEE headed by Ray F. Sparrow, of *P. R. Mallory & Co., Inc.,* Indianapolis, has been appointed to establish a policy on trade marking and customer's marking on radio components. Other members include Harry A. Ehle, of the *International Resistance Company,* Philadelphia, and A. Blumenkrantz, of the *General Instrument Corporation.*

—30—

SYLVANIA NEWS
RADIO SERVICE EDITION

APRIL *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946



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Make sure you have these up-to-the-minute aids to better servicing. They will give you accurate characteristics and base diagrams for all the Sylvania Electric radio receiving tubes. Give your customers the most satisfactory service. Feature the famous Sylvania line of radio tubes. That deal is the best deal for you.

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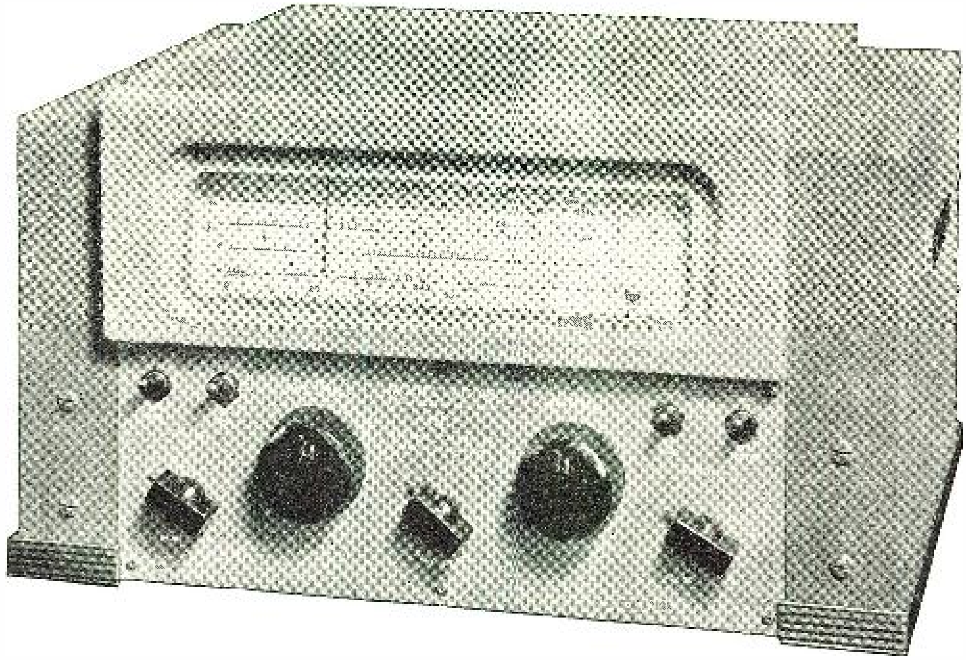

THE NC-46

The new National NC-46 Receiver is a fine performer at a moderate price. Ten tubes in an advanced superheterodyne circuit provide excellent sensitivity throughout the receiver's range from 550 KC to 30 MC. Circuit features include an amplified and delayed AVC, series valve noise limiter with automatic threshold control, CW oscillator and separate RF and AF gain controls. The push-pull output provides 3 watts power, and the AC-DC power supply is self-contained.

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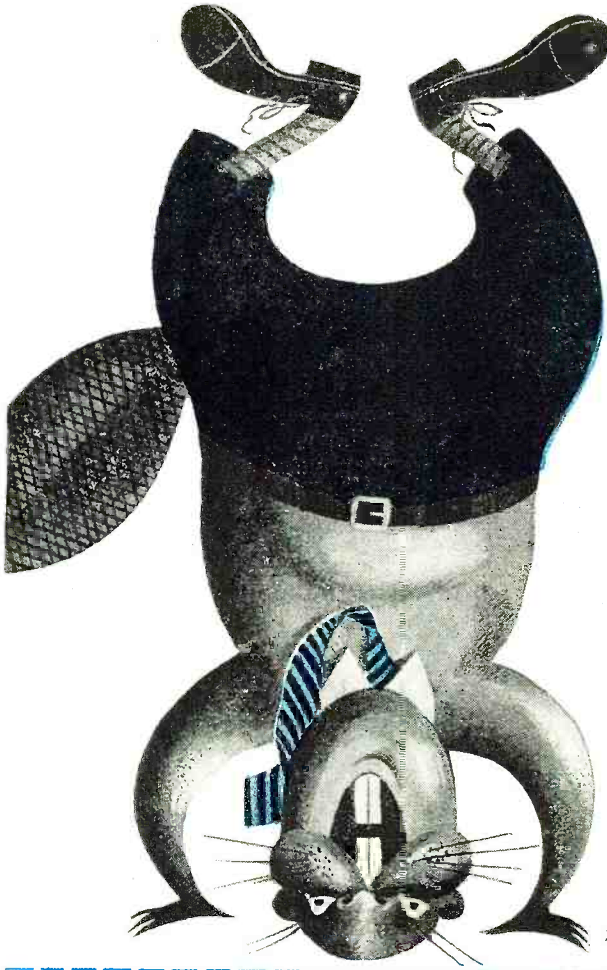

I used to stand on my head...

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"There's not a smart servicer in the business who's losing time on capacitor 'shopping' or 'installation.' They all stock these C-D electrolytics! And why not? Did you ever hear of a bigger name in capacitors than Cornell-Dubilier? 36 years of research and engineering is a long time and a lot of experience. Man, these Beavers have a pedigree . . . they're the stuff you want behind you in a service job."

Well, that fellow sure straightened me out. So I'm passing the good word along. Just to give you an idea of what these dandy Blue Beavers do . . .

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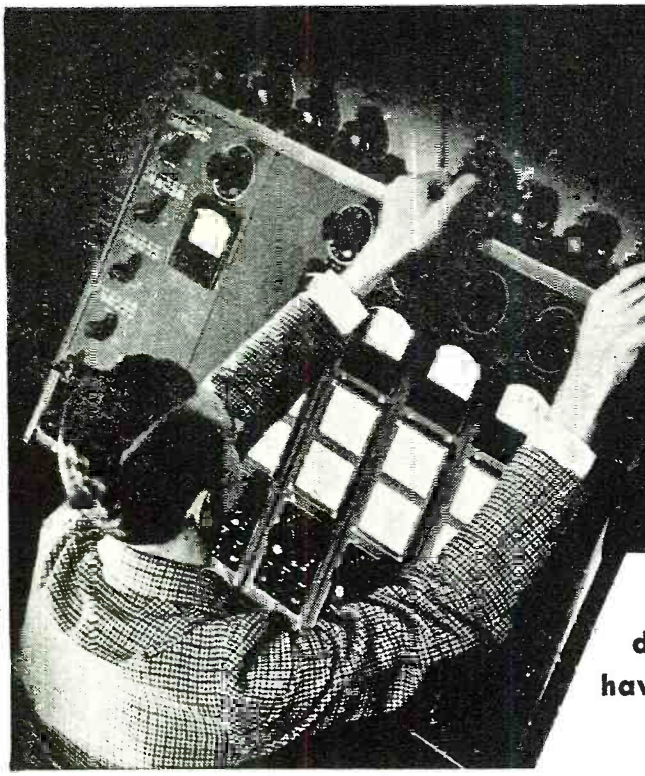

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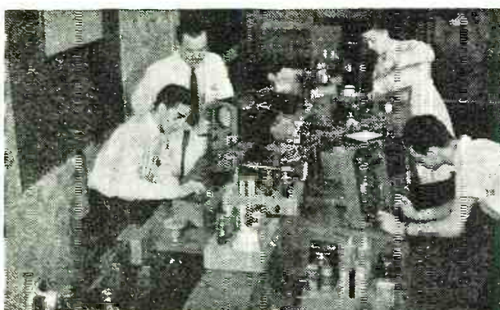

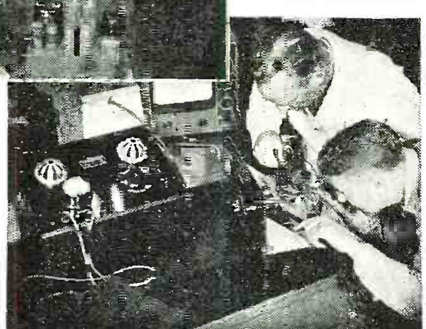

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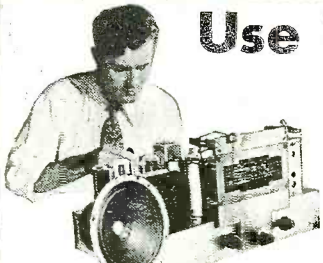

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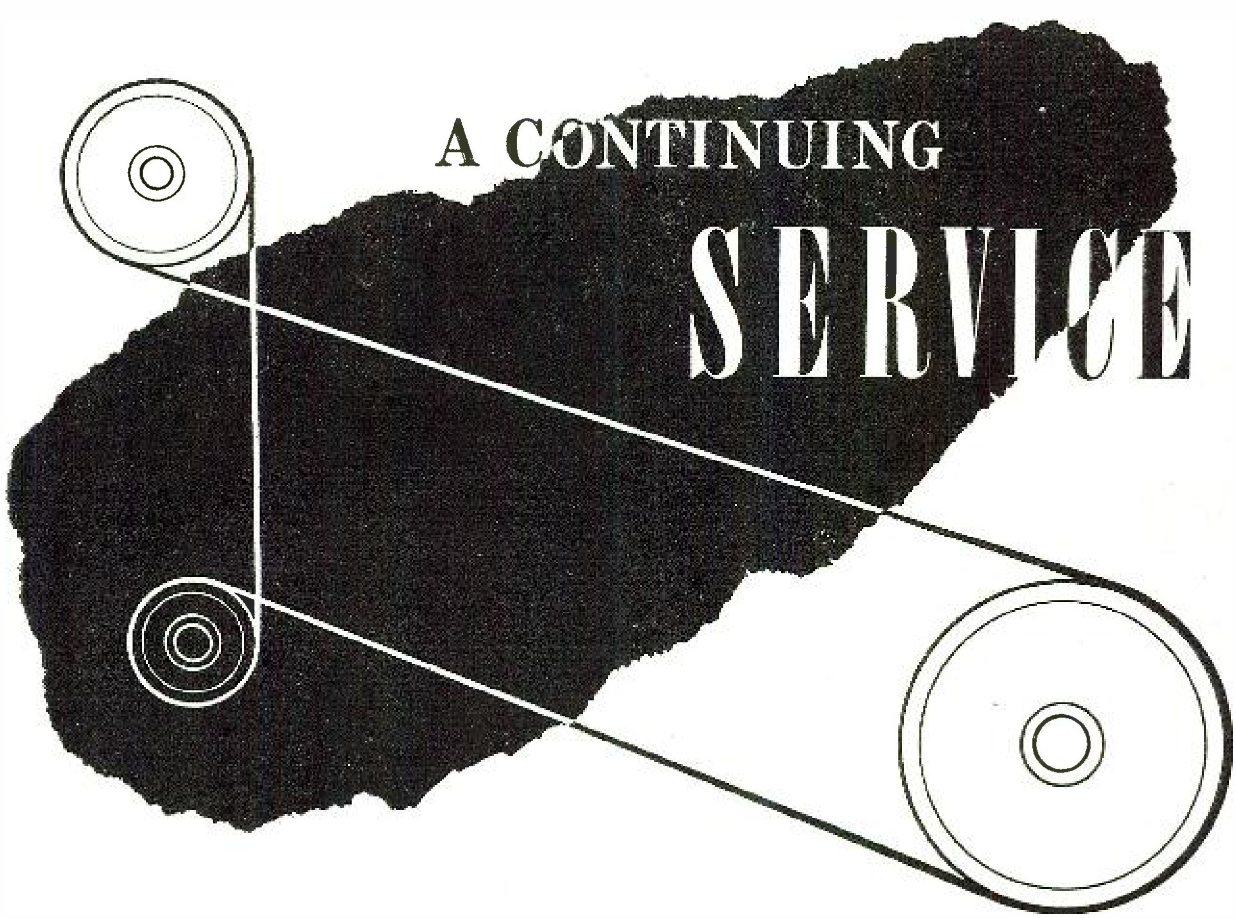

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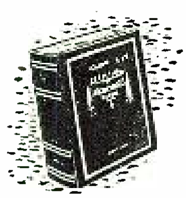

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Application June 28, 1939, Serial No. 281.612
8 Claims. (Cl. 178—44)
This invention pertains to electrical apparatus and circuits of the type known as filters and more especially to such apparatus and circuits of the type referred to as band pass filte
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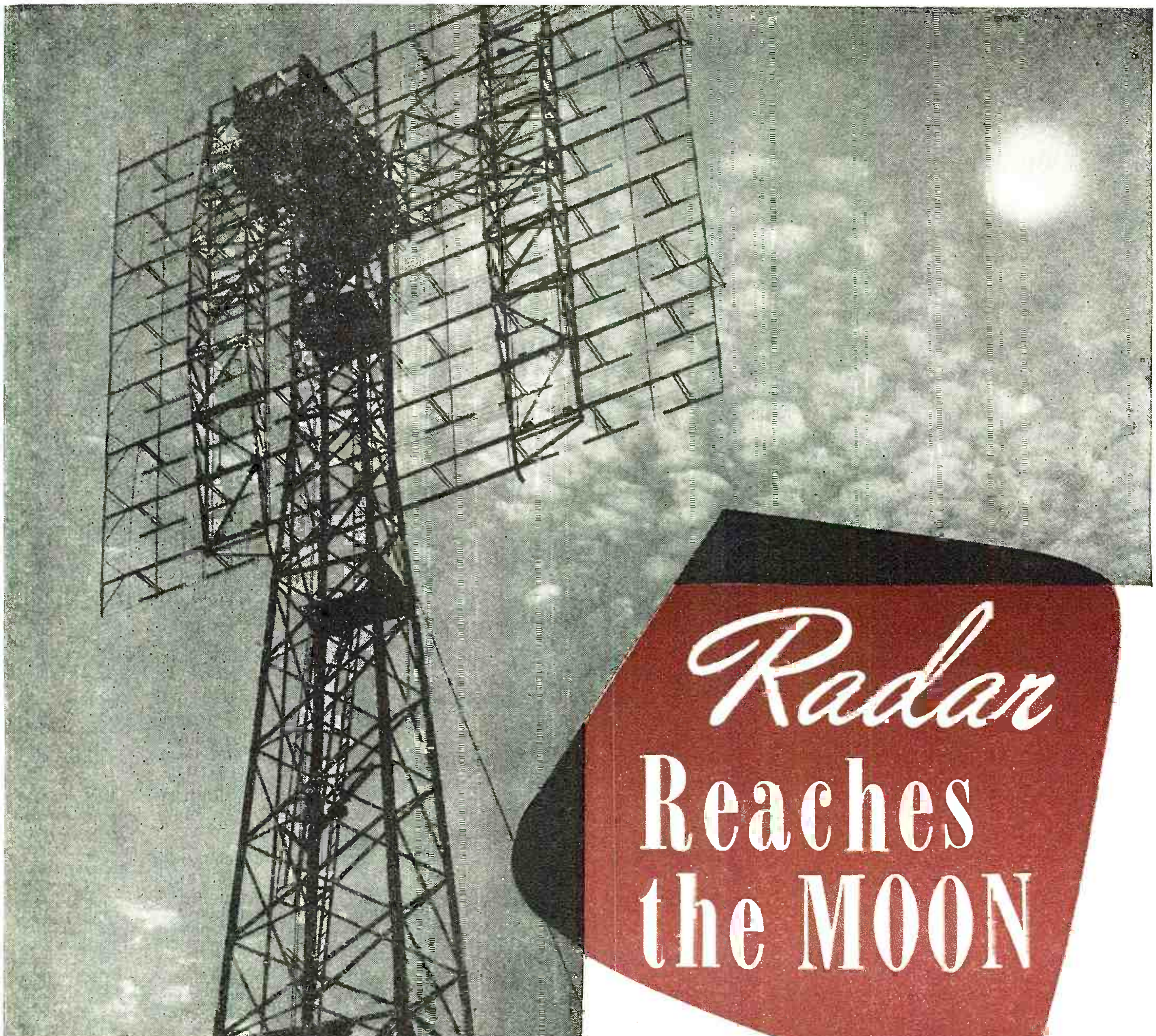


Special radar antenna array of 64 dipoles used for the transmission of pulses and the reception of radar echoes from the moon.

Radar Reaches the MOON

By
TOM GOOTÉE

A new era of scientific exploration begins with development of the first lunar radar.

PULSES of r.f. energy shoot heavenward from the massive radar set—up and out into the darkness of unknown space. It might be like other nights during the five long years of war—when other radar sets swept other skies in search of enemy planes. But this is different.

This is *lunar* radar.

The radar antenna—one of the largest ever constructed—points toward no military target. Its dipoles concentrate the r.f. pulses toward a great ball of whiteness, the moon, just rising above the New Jersey horizon.

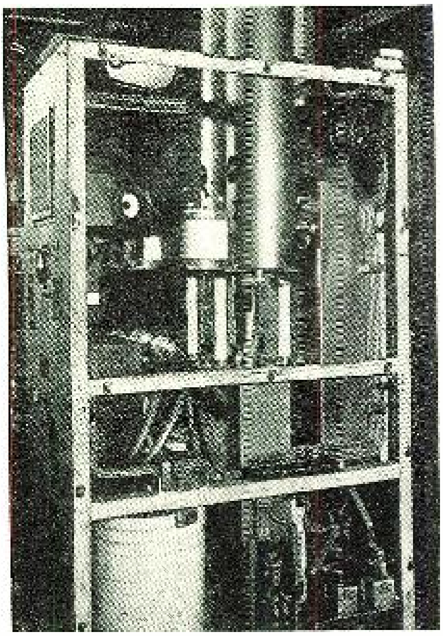
In a tiny shack near the base of the antenna tower, components of the radar set generate the sharp pulses of r.f. energy. The pace is slow, compared to military radar sets. The transmitter functions only once every five seconds. Like the heavy, labored pulsing of a giant heartbeat.

Then, concentrated into a narrow beam by the antenna array, these pulses speed toward the moon at the fantastic speed of light—more than 186,000 miles *per second*—through the ionosphere and on into the unknown void surrounding the earth's atmosphere. The pulses probe where man has never been before, where man has never even dared explore before—with radio waves.

But the men who guide these pulses across distant space have never left their prosaic, tiny shack near Belmar, New Jersey. They wait quietly for results of their inter-planetary effort, they wait for echoes of the radar pulses to return to earth.

Seconds seem like eternities, as the base line crawls across the face of a single 9-inch oscilloscope. Even the scope is geared to cosmic thinking: its calibrated scale is not in miles, but in *hundreds of thousands of miles!*

Suddenly, through the "grass" of noise a wide pip appears along the base line of the scope. And simultaneously, a 180-cycle tone is heard from a speaker on the receiver console. Both last for almost half a sec-



Output stage of the radar transmitter. Two W1-530 tubes (inside large copper shields) supply 50 kilowatts of pulsed power to the antenna. Blowers and filter equipment are in the lower compartment.

ond, then fade out. The time base finishes its sweep, there is a microseconds pause, and the entire procedure is repeated.

An echo pip lasts for almost half a second, and for every radar pulse transmitted: a received pip—appearing at the same place along the base line, indicating a reflecting surface about 238,000 miles distant! An almost stationary image appears on the base line that represents—the moon!

Radar echoes from the moon!

No scientific dream this, no wild tale of phantasy.

Almost every night and day for the past few months, radar engineers and scientists at the Evans Signal Corps Engineering Laboratory in New Jersey have repeated this astounding feat. And the results have been proven beyond a doubt, by leading scientists.

Radar echoes from the moon!

This is the outstanding scientific achievement since the revelation of the atomic bomb. Radar, itself, was a miracle of science—bent to the defensive and offensive requirements of modern warfare: to detect and locate air and surface vessels.

But this *extension* of the use of radar—to measure vast distances that heretofore could only be computed in theory—becomes a singular and major step forward in the field of science.

Planned Strategy

Contact with the moon was no mere accident.

Within a few hours after V-J Day, work was begun on the equipment—under the personal direction of Lt. Col. John H. DeWitt and his four chief associates. Some degree of secrecy was deemed necessary—at least until results were obtained, and proven certain and definite.

The new project was referred to only as the "Diana Project." And the men went to work designing, building, rebuilding, and adapting suitable radar equipment to do the job.

All preparations were completed for a test on January 10th.

On that day the moon rose at 11:48 a.m. At about that time the first radar pulses were transmitted, and the first echoes appeared on the oscilloscope—indicating success.

Accurate timing of *each* pulse and its reflected echo indicated that it took 2.5 seconds for the echo to return.

Since radio waves travel at a fixed rate of speed—about 186,000 miles *per second*—it wasn't difficult to compute the distance from the radar set to the reflecting surface: about 238,000 miles. Col. DeWitt and his radar engineers were convinced they had contacted the moon, because there was nothing else in space at that distance from the earth.

But additional tests were made on following days and nights—each time the moon rose and set.

Said Col. DeWitt, "We knew our months of thinking, planning, calculations, and design were on the right track, but to make doubly positive and sure, as our Army Laboratories must be, we aimed our radar beam at the rising and setting satellite time and time again, so that we knew without question of a doubt that our pulses were striking the moon and echoes were rebounding back to earth."

Finally, a group of distinguished but unidentified scientists visited Belmar and verified all of the findings and conclusions of Col. DeWitt and his group.

Only then, weeks after the initial contact with the moon, did the War Department announce details of the Diana Project. The first earth-to-moon, inter-planetary circuit had been definitely established. All records of long-distance radio transmission had been broken.

And repercussions from the announcement were heard around the world—speculating on both the wartime and peacetime applications of the new long-range radar equipment.

For there are many possible, future applications of such radar equipment—some almost beyond the immediate comprehension of mankind.

A new and far more accurate study of the solar system will be entirely feasible, as soon as adequate and more powerful equipment can be built.

One war possibility is radar-beam control of long-range rockets and jet-propelled missiles. Man has gained *control* of outer space.

But the primary significance of the Signal Corps' achievement is that this is the first time scientists have known with certainty that a very high frequency radio wave sent out from the earth *can actually penetrate the electrically charged ionosphere* which encircles the earth and stratosphere.

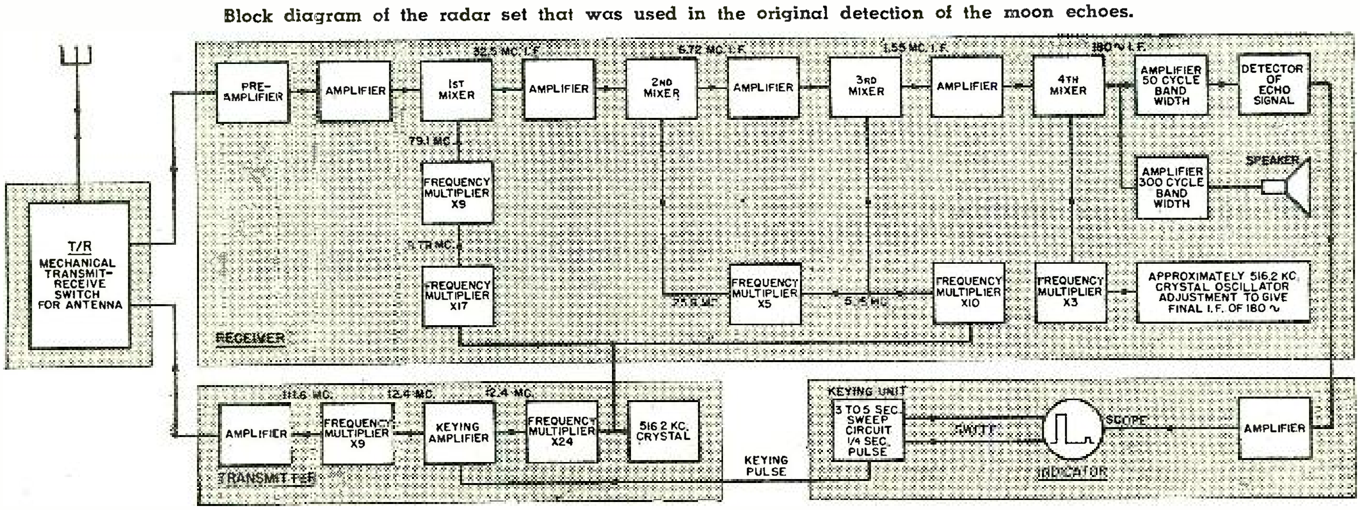
And this proves to be a curious parallel with history.

Link with the Past

More than two decades before contact with the moon was recorded in New Jersey, radio waves were first used for a very similar purpose: to determine the distance to the reflecting surface of the ionosphere.

In 1924, a particular portion of the upper atmosphere, called the Heaviside layer, was believed responsible for the transmission (by reflection) of low-frequency radio signals around the earth. In that year, experiments

Block diagram of the radar set that was used in the original detection of the moon echoes.



were begun in England by Dr. Edward Appleton and M. A. F. Barnett. Using frequency-modulated transmissions of a large broadcasting station, they were able to prove that the received signal varied in intensity with frequency—because it consisted of a direct wave and a reflected component. And a measure of signal intensity caused by a known change in wavelength resulted in a measure of the height of the reflecting layer.

In the same year in the United States, Dr. Gregory Breit and Dr. Merle A. Tuve, of the Carnegie Institute of Washington, used *pulses* of continuous waves for measuring the distance to the reflecting surface of the ionosphere. Their technique consisted of sending skyward a train of very short pulses—a small fraction of a second in length—and measuring the time it took the reflected pulse to return to earth. Fairly low-frequency radio waves were employed. And, after completion of the experiments, pulse ranging soon became the accepted method of ionospheric investigation.

The advent of short-wave radio transmission and the success of these early experiments led scientists in many countries to speculate on the possibility of using such energy to detect the presence of man-made reflectors, such as ships and airplanes. When powerful sources of high-frequency energy, highly sensitive receivers, and refinements in radio technique became available, these possibilities of detection were converted into working devices. Then, with the coming of war, pulse ranging—or radar—was developed under great impetus. And the story of radar's part in winning the war is now well known.

But even before the war, there were a few radio engineers and scientists who saw in the pulse ranging method a means for measuring phenomenal distances: to the moon, other planets, even, perhaps some day, the sun.

One of these men was John H. DeWitt—then chief engineer of station WSM in Nashville. He was also a "ham", and an amateur astronomer. Using his then meager knowledge of pulse ranging, in 1940 he built his own equipment and attempted to contact the moon. His efforts were wholly unsuccessful, but he was undaunted. He looked forward to the day when he might experiment on a really grandiose scale. A year later the country was plunged into war, and DeWitt entered the Armed Forces.

It was not until after the defeat of Japan that his thoughts returned to contacting the moon. Then a Lieutenant Colonel in the Army Signal Corps, he had participated directly in much of the radar development activity of the Army—particularly as Director of the Evans Signal Laboratory near Belmar, New Jersey, with its wartime personnel of over 6000.

Seizing the opportunity, Col. DeWitt immediately started work on equipment suitable for measuring great distances. Four key civilian radar engineers joined his group: E. K. Stodola, Dr. Harold Webb, Herbert Kauffman, and Jacob Mofenson. They had all worked at Evans during the war developing military radar equipment.

First problem facing the group of men was a new philosophy of thought.

They no longer could think of radar ranges in terms of a few hundred miles. The distance to the moon is about 238,567 miles. But this figure varies from day to day, as the moon revolves and moves in an elliptical orbit around the earth. And both the earth and the moon move around the sun.

A staff of mathematicians and physicists spent weeks computing the trend in relationship between the earth and moon, before assembly of the equipment began. It was necessary to determine accurately the speed of the moon relative to the movement of the earth. And this speed varies—with respect to the earth's rotation—from 750 miles faster to 750 miles slower, at Belmar, New Jersey.

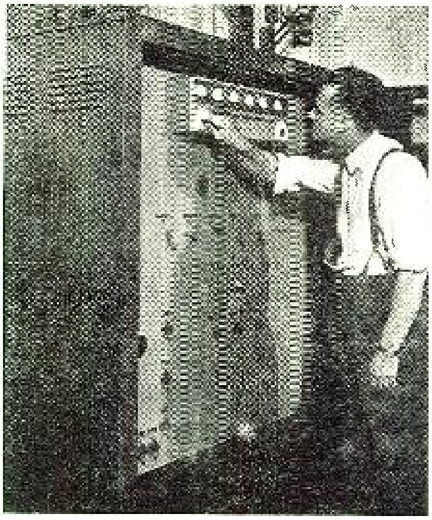
Variations in speed and positions of the earth and its satellite must be taken into consideration *each time* the moon is contacted. Because the net effect of two variables of movement causes a Doppler effect—a shift in the frequency of radio waves. Often this shift is greater than the receiver bandwidth. Thus the relative speeds of earth and moon must be calculated each day with the radar receiver tuned and adjusted to take advantage of the Doppler effect.

Only in this way can a positive check be made on the direct range measurements of the oscilloscope. These calculations are the most reliable verification that the moon is actually being contacted.

General Characteristics

Equipment used on the Diana Project comprised extensive adaptations to the standard wartime long-range radar known as the type SCR-271—originally designed in 1937 and used widely during the war.

Principal components are; transmitter, receiver, antenna system, and indicator. The timer or keyer is part of the indicator unit.



Herbert Kauffman, radio engineer who worked on the "Diana" project, adjusts one of the many stages of frequency multiplication.

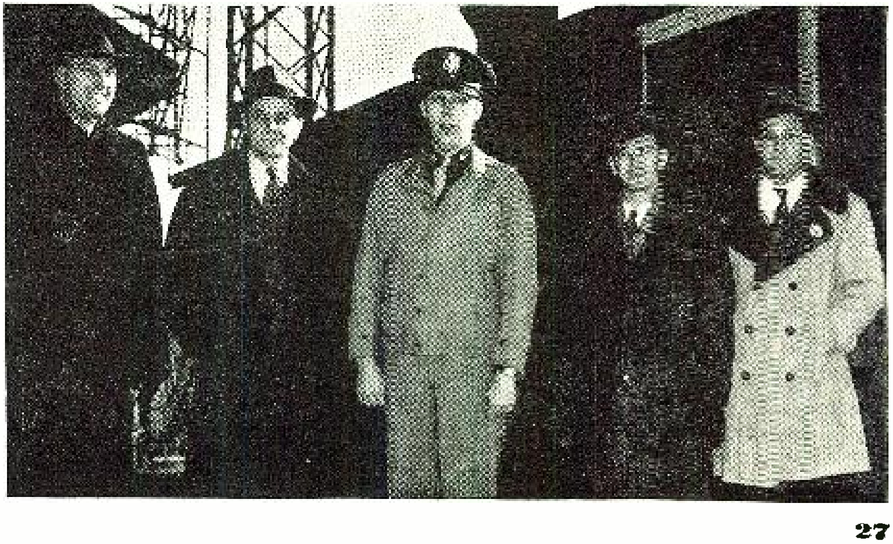
The radar transmitter sends out bursts of radio energy, known as pulses. During intervals between pulses the transmitter is turned off, but the radar receiver functions—and picks up any echo reflections which may be received from distant objects or surfaces. These echoes are amplified and then displayed on the time base of a calibrated oscilloscope. The elapsed time between the transmission of a pulse and the reception of its echo is a measure of the distance from the radar set to the reflecting surface—because radio energy travels through space at the speed of light: about 186,000 miles per second.

Because of the distance and nature of the target, this radar set had to have a number of special features.

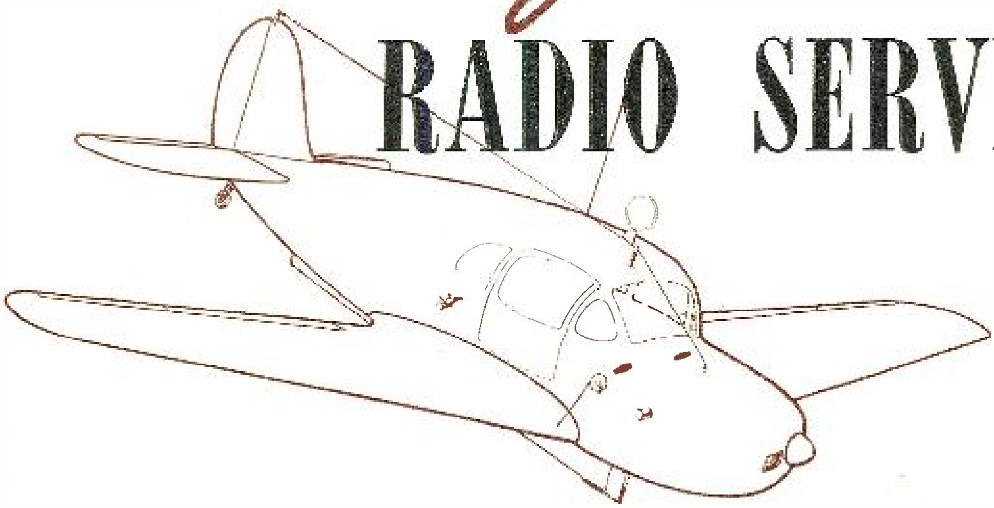
A very slow pulse rate was necessary—since the radio signal must travel a round trip distance of more than 477,714 miles. Time must be allowed for an echo to be received, be-

(*Continued on page* 84)

The five Signal Corps scientists responsible for contacting the moon by radar. (Left to right) Jacob Mofenson, Dr. Harold Webb, Lt. Col. J. H. DeWitt, E. King Stodola, and Herbert Kauffman.



The Aircraft RADIO SERVICEMAN



By
TONY WAYNE*

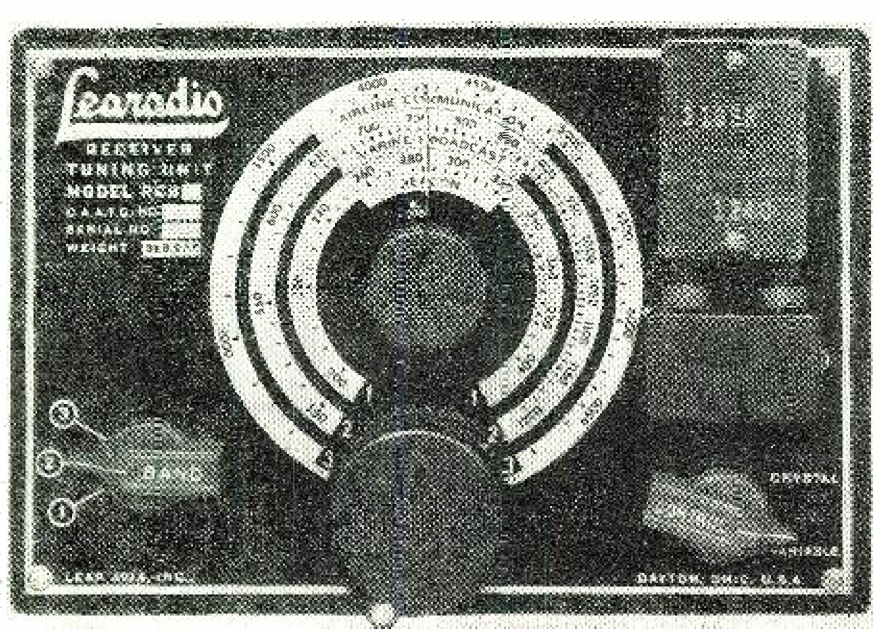
IRRESPECTIVE of the modern trends of present day inventions, use of radio in light private planes doesn't seem to be popular. True, the war had a lot to do with it, but the war is over now. The principal reason for its unpopularity was, and is, installation and maintenance problems. Unlike the car radio, aircraft radio presents many problems, such as interference, bonding, electrolysis, and vibration.

While most everyone drives a car today, and is familiar with its mechanics, this is not true of the airplane. True, most pilots are familiar with their planes, and possess a certain amount of the mechanical aptitude necessary; yet, relatively few servicemen know enough about aircraft to install this equipment properly. The experienced aircraft radio mechanics who were available prior to war, were absorbed by the airlines. Then too, the little aircraft radio business then existent was not sufficient to entice radio mechanics.

This condition has been rectified largely during the past four years, as thousands of men have been trained in Armed Forces' radio schools.

The radio serviceman has always been a resourceful individual. When home sets were not coming into the shop fast enough, and competition was not only keen but rough, with radio shops in every block, in attics, basements, and bedrooms, the serviceman was repairing toasters, irons, heaters, vacuum cleaners, and washing machines. With the advent of new radios, owners of old "blooper" or "orphan" sets, and recognized brands which have been holding out with a wire and a prayer, will be reluctant to have them repaired now.

Fig. 1. Panel view of the Learadio receiver tuning unit, Model RCBB.



It scarcely seems the intelligent thing to do for servicemen to return to toasters and washing machines; rather, they should put their vast knowledge to work specializing in such fields as electronic equipment, television installation, small boat radio and aircraft radio maintenance and installation.

There are a number of public airports for light planes springing up all over the country, and all of them are taking into consideration the varieties of services the private flyer will demand; and are building with the idea in mind of allocating various concessions necessary. Aircraft radio servicemen—this should be your cue—get your bid in now. These airports will furnish you the necessary space, either on a reasonable percentage or rental basis.

All signs are definitely pointing toward an almost unbelievably rapid growth of the use of aircraft radio. Light plane purchasers can look forward to buying planes completely radio equipped. This is not mere crystal gazing, as many large light plane and radio manufacturers have made public this intention.

The subject, in general, should become of interest to the radio serviceman. To meet possible demands for information concerning general description, installation, and maintenance of aircraft radio equipment, and some new and unusual accompanying problems, this article is written. Its purpose is to make available such pertinent information as will provide a general outline of aircraft radio; its parallelisms to the radio serviceman's present activities, showing that the slight departure from those activities will not be too radical.

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With the increasing demand for civilian operated planes, competent technicians will be needed for the installation and maintenance of aircraft radio equipment.

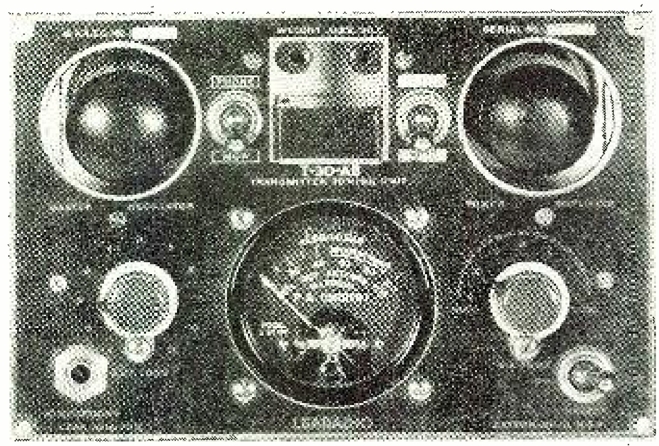


Fig. 2. Transmitter tuning unit, Learadio Model T-30-AB.

This article discusses the problems of aircraft radio, strictly from an elementary viewpoint, with sufficient detail given to enable the radio serviceman to answer questions intelligently. It is also intended that he will gain sufficient information from the detail herein so that he will be able to install and service aircraft radio.

There are a number of factors met in servicing aircraft radio not common to average radio servicing. Mounting and installation alone are of great importance; and when servicing is done on the more complicated units, such as the automatic direction finder, automatic pilot, etc., need of experience and knowledge is greatly enhanced. Need for radio mechanics qualified to service aircraft radio will undoubtedly become greater in the near future, and the importance of sound and dependable training cannot be minimized. Aircraft pilot's dependence upon his radio equipment is too important to leave to the wiles of an untrained serviceman.

Before actually installing radio equipment, it is imperative that you understand the construction of light planes.

For this purpose, we will use illustrations of one of the most popular light planes—the *Piper Cub.* These illustrations will give the necessary information concerning not only the *Piper Cub*, but many similar models as built by other manufacturers.

Fig. 5 shows a cutaway view, clearly indicating the various parts of the airplane, together with their correct names. Recognition of these parts will enable you to talk "pilot's language" about any light plane.

Fig. 3 shows the control system of the light plane.

As a model for our aircraft radio discussion, we will use the model T-30, RCBB two-way aircraft radio equipment as manufactured by *Lear, Incorporated.* Front view of the receiver is shown in Fig. 1.

To require a minimum of instrument panel control space, and to allow better weight distribution, this receiver has been divided electrically and mechanically into two units. The tuning control unit incorporates r.f. amplifier, detector, and oscillator; while Model G-3-AB unit contains dynamotor power supply, i.f. amplifier, second detector, a.f. amplifier, and range filter. In the case of the transmitter-receiver power supply, Model G-30-AB, the modulator unit of the T-30 transmitter is also built on this chassis; and it is only necessary to add the i.f. section of the transmitter and the necessary cables to have the T-30, RCBB two-way combination.

A front view of the model T-30-AB transmitter tuning unit is shown in Fig. 2.

The RCBB is a three band receiver covering the 200 to 400 kc. beacon band; the 500 to 1200 kc. broadcast band; and the 2800 to 6700 kc. aircraft communications band.

Prior to the actual installation of any aircraft radio equipment, make a "bench" test of its operation. This will serve as a basis for trouble shooting the installation, should it not operate upon completion.

Actual placement of the tuning control unit and the power supply in an aircraft installation is dictated by several considerations.

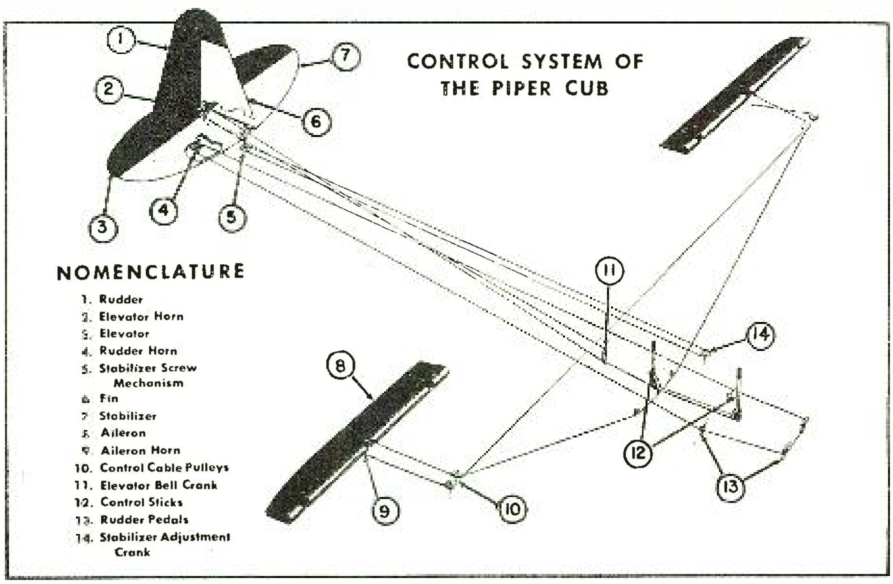
Whether the receiver tuning and control section is mounted in the instrument panel, overhead or elsewhere within arm's reach, must be determined by the user of the equipment and may be limited by space available in the instrument panel, vision, movement of controls or other considerations. The wide variety of individual demands and limitations imposed by previously installed equipment makes it difficult to recommend standard installations in aircraft already in use.

Center of Gravity

While an aircraft radio mechanic can scarcely be expected to be responsible for the weight and balance of the aircraft in which he is installing or servicing radio equipment, he should be concerned when his installation or the possible addition of radio equipment will affect the center-of-gravity consideration (Fig. 6A).

Every particular airplane is designed to do a certain job and fly

Fig. 3. Conventional control equipment employed in a Piper Cub Plane.



EQUIPMENT TROUBLE SHOOTING CHART

EQUIPMENT SYMPTOM	POSSIBLE CAUSE
Entire Unit Dead	Power switch not on—No connection to power source—Supply voltage absent or low—Fuses blown—Broken wire—Defective rectifier—Short on voltage supply—Defective component.
Broad Tuning	Battery voltage low—Improper alignment—Weak tube—Open grid circuit.
Operation Below Normal	Remote control circuit open—Local or external interference—Poor connection to antenna (broken or shorted)—Transmitter defective—Receiver defective—Modulator defective.
Low Transmitter Power Output	Defective transmitter oscillator tube—Defective modulator tube—Low plate voltage—Low filament voltage—Loose or corroded connections which may result in high resistance joints.
Discrepancy of more than 15% in Meter Readings	Trouble in that circuit.
Contact Noise (Intermittent)	Poor bonding or parts not bonded—Loose light bulbs—Loose fuses—Loose fuse elements—Loose plugs.
Electrical Leakage Noise	Windshield wipers — Generator — Lights — Cigarette lighter, and other electrical accessories.
Dead Spots	Oscillator not working—Shorted tuning condenser—Switching arrangement defective—Bad oscillator tube.
Fuse Blows	Defective rectifier—High voltage grounded—Defective line switch.
Equipment Smokes	Resistor defective (incorrect size or wattage)—Shorted tube—Shorted condenser—Defective insulation—Circuit overloaded.
Distortion	Incorrect bias—Oscillator tube weak—Push-pull tubes not matched—Bias resistor filter condenser open—Defective microphone or headset—Excessive high voltage or filament voltage—Tube in wrong socket—Weak tubes—Receiver not tuned to resonance—Volume control advanced too much.
Inability to Tune	Defect purely mechanical and easily located by visual inspection.
High Input Current and Low Output Voltage	Shorted dynamotor armature—Defective dynamotor bearings.

within stipulated load limits. The top limit is figured with a factor of safety sufficient to allow for stresses and strains of all ordinary operations. Attempting to fly an overloaded airplane will definitely decrease its range, increase its stalling speed, and require a longer runway to take off and land. Should an overloaded airplane run into rough weather or experience any other unforeseen trouble, the margin of safety due to high gross weight will be reduced to such an extent that the pilot may not pull through.

Balance will affect an airplane's performance more than overload. An airplane slightly out of balance will not only change the spin and stall characteristics of the airplane, but will render it uncontrollable, and if a pilot encountered trouble in the air, he could not recover.—Fig. 6B.

The center-of-gravity (CG) for a loaded airplane should be that point at which it would balance itself were it suspended, as shown in Fig. 6A.

Vibration

Shock and vibration are of relatively great amplitude and of three-dimensional character. The impact experienced when an airplane "bumps" in for a landing on rough terrain, is often of considerable magnitude and may cause serious damage to radio equipment if adequate cushioning of shocks is not afforded.

Also, it is important that radio equipment, in aircraft, be properly protected from the weather, as well as from such trouble makers as corrosion, commonly known as electrolysis. Two dissimilar metal bodies making contact with each other in salt air causes an electrolytic action to set in. This not only corrodes the parts, but results in a difference of potential, which causes noise in the radio.

When installed in an instrument panel and when using rubber mounted brackets, sufficient clearance must be allowed in the size of the hole cut in the panel to prevent the receiver from vibrating and rubbing the instrument panel. Mount the receiver from the front of the panel. Mount the power unit wherever space is available—baggage compartment, cabin floor, or on a special mounting in the rear of the fuselage. Because the power unit need not be accessible for operation, it may be installed forward or aft in the fuselage to bring the center-of-gravity to a desired point.

The various switches and controls may be installed wherever convenient and each cable to them should be securely taped and laced into place. *Danger!* Be certain that in lacing any electrical or mechanical cables they are not fastened to any of the aircraft controls. Double check all controls upon completion of the installation to be sure that they are free!

Don't fasten the unshielded *antenna lead* parallel to any metal parts of the aircraft, such as the fuselage tubing, for a greater distance than necessary. The capacity between the antenna lead and such metal surfaces reduces signal strength. The antenna lead-in should not be shielded, except where transmission lines or coaxial cables are originally supplied.

Don't run the antenna lead near any of the ship's ignition, or electrical wiring. This includes the primary of the ignition system to the ignition switch even though these leads themselves are shielded.

Don't route the *battery lead* near the aircraft's *magnetic compass.* Check this by switching on the receiver and noting its effect on the magnetic compass.

CAA and FCC Rules

A mechanic installing radio equipment in aircraft need not be a certified CAA mechanic. However, his work must be examined by one, to be sure it does not provide a hazard in plane operation. This is the only requirement in the Civil Air Regulations on this subject.

According to the CAA, ". . . Anyone using an aircraft radio transmitter, whether in checking frequencies or contacting the tower, according to FCC rules, must have at least a Class 3 operator's license."

The FCC has no specific requirements for radio mechanics performing work on aircraft radio equipment. However, personnel making adjustments to non-governmental radio transmitting equipment which involves the radiation of energy, should hold a radio operator's license of the second class or higher, either radiotelephone or telegraph.

Now, the $64 question is—if it only takes a restricted phone ticket (3rd class phone), to operate the equipment in a plane, why make the poor mechanic take that "engineering course"—2nd class phone or telegraph exam?

Precipitation Static

Aircraft radio servicemen should be cognizant of that type of static which is so common to aircraft radio—Precipitation Static—new pilots experiencing the brilliant fiery display on their prop tips, on the windshield, or along the wing and tail surfaces (as shown in Fig. 7), and have experienced the difficulties of the accompanying static, will expect the serviceman to do something about it. Actually, there is very little you can do, except give the customer an explanation of precipitation static, and then install a loop antenna, instructing the customer in its use.

It has been discovered that certain types of aircraft antennas are definite sources of precipitation static, since the antenna is directly exposed to extremely high electric fields.

These high fields cause corona discharge, which introduces electrical pulses directly into the radio receiver, shock exciting it, resulting in noisy precipitation static, Fig. 4.

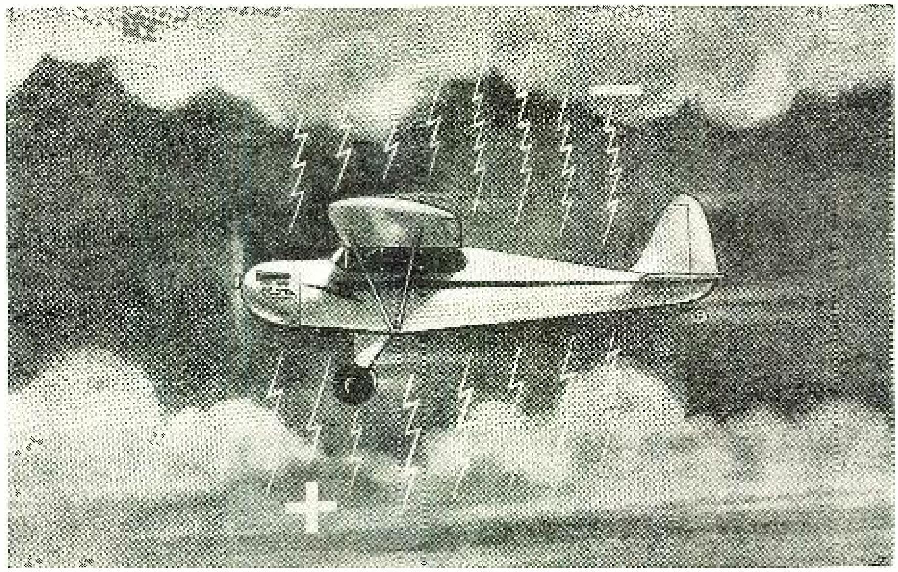


Fig. 4. Cloud layers that are electrically charged cause corona discharge. This charge introduces severe electrical pulses in the radio receiver.

Some of the present day static dischargers are not successful in eliminating this interference at the antenna. More desirable methods are to use an insulating plastic covering on the antenna wire or to use a bare wire of a very large diameter. All metallic connections to the antenna and lead-in should be covered with an insulating dielectric material, preferably plastic. However, even these methods are not effective, since it is possible on first encounter with an electrical field of sufficient intensity, the insulation will be punctured and you will be right back where you started.

It has been common practice for quite a few pilots to reel out their trailing antenna, grounding it to some metal part of their airplane, in an effort to provide a discharge path for the charge. This is a waste of energy since the discharge noise is worse than that which the pilot is endeavoring to eliminate, and is especially dangerous in storm areas, as the trailing wire will function as a lightning rod, inviting lightning to strike and ruin the radio equipment.

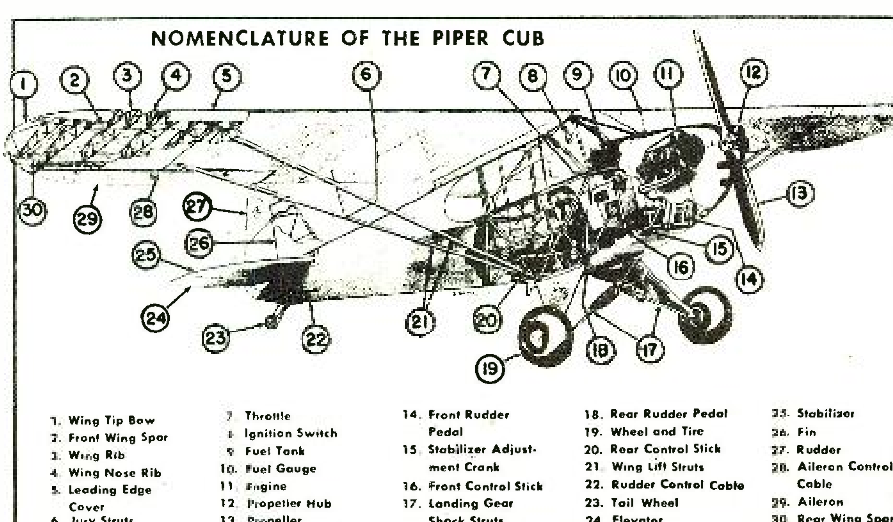
Bonding

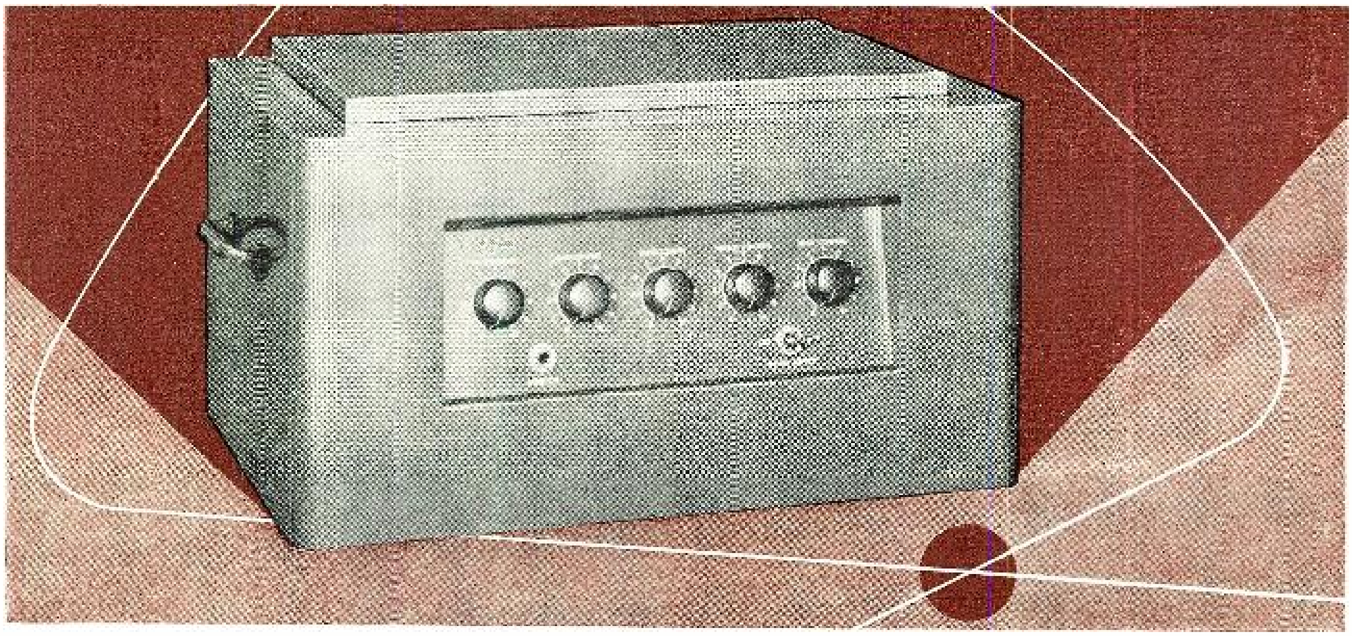
One of the primary requisites for noise-free reception is proper grounding or so-called bonding of individual units of an installation. Each unit should have an individual grounding strap securely fastened to the nearest metal part of the aircraft structure. When this structure is steel tubing, the plated copper braiding can be soldered directly to the tubing after paint is cleaned away. This operation requires a heavy-duty soldering iron and the connection should be cleaned off and re-painted or shellacked to prevent corrosion or rust.

Non-metal fuselage aircraft present a special problem in this respect, and the aircraft manufacturer should be consulted for the right method of bonding, if the usual method of bond-

(*Continued on page* 111)

Fig. 5. Cutaway view indicating the various parts of a Piper Cub plane.





Front panel view shows simplicity of design. Controls from left to right are: microphone gain, microphone gain, phonograph gain, treble and bass controls.

High-Fidelity ALL PURPOSE AMPLIFIER

By ROY T. ROGERS
Chief Engineer
and MILTON PUTMAN
Clark Radio Equip. Corp.

This 30 watt, commercially constructed amplifier is designed for public address work and high fidelity sound reproduction

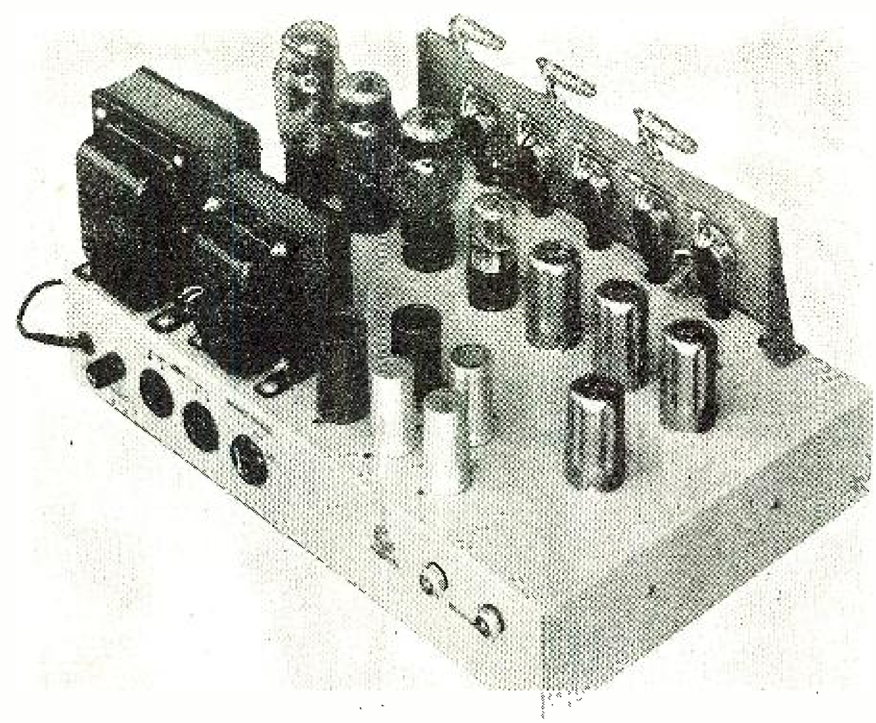
THE amplifier to be described in this article was designed primarily to bridge the gap between equipment normally associated with public address work and that which is primarily designed for application in the broadcast field. With a view towards the ever increasing appreciation of the public in respect to sound reproduction, it is felt that certain improvements were warranted over the conventional equipment used for public address or sound reinforcement work.

Some of the more important considerations are; reduction of hum, improvement of linearity of frequency response, improvement of balance between upper and lower frequency limit, provision for greater flexibility and independent control of bass and treble frequencies in ranges which afford the most pleasing balance, and reduction of distortion and particularly improvement of the low frequency waveform within the useful range. No attempt was made to extend the frequency response beyond 10,000 cycles in view of the specified field of application. However, consideration was given to the importance of choosing a low frequency limit which provided the most satisfactory balance. The amplifier, in the range between 50 and 10,000 cycles, was designed to give the least distorted output. The equalizer circuit which is incorporated provided a tremendous amount of variation at the lower and upper frequency limits of 50 and 10,000 cycles as described in more detail later on. Subjective tests were conducted to determine the characteristic slope of the pre-emphasis curve at the low and high frequency ends which gave the most pleasing results. This proved of considerable interest and it is concluded that a slope starting at approximately 500 cycles and increasing at the rate of 8 or 9 db. per octave down to 50 cycles provided the most satisfactory bass compensation when a very large amount of boost is used.

Various systems of equalization of audio amplifiers have been used. Among the most frequently used circuits are those which incorporate tuned circuits or at least inductances. These tuned circuits or conventional types of filters required, in some applications, rather large inductances which are frequently bulky or undesirable from the standpoint of hum pickup. A further disadvantage of employing the tuned circuit type of equalizer is that it introduces harmonic distortion particularly in highly selective circuits.

One of the objects of the design of this particular equalizer circuit was to provide a system which had none of the inherent limitations of any of the forenamed types, in order that a maximum flexibility of control over predetermined bands of frequencies be accomplished; that the amplification through the equalizer be sufficient that even at the frequencies passed at the least amplitude, the gain is still a useful amount; and that the system introduces a minimum of distortion throughout the wide variation in compensation.

The equalizer circuit consists essentially of three separate channels; namely, low frequency, middle frequency and high frequency. The middle frequency network is a single "T" network in the input circuit of the high frequency section of the dual triode. A high pass circuit with a turn-over frequency of 500 cycles is in the plate circuit of this section of the tube. This is a fixed network designed to give linear response between 500 and 1500 cycles with the response falling off approximately 12 db. at 50 cycles and 15 db. at 10,000 cycles. The circuit was designed so that the equalizer tube provides a gain of approximately 6 db. between 500 and 1500 cycles. The middle frequency network is independent of the high and low frequency circuits; therefore, the gain through the middle network is not affected by the position of the bass or treble control. The high frequency circuit consists of a high pass network from the input source which also provides isolation. From the arm of the high frequency control an isolating resistance feeds the grid of the high frequency section of the triode. The relationship between the value of this isolating resistance and that in the middle frequency network is such as to prevent interaction between these two circuits. The feedback voltage is taken from the plate of the high frequency triode and fed back to the grid through the control in such a manner that as the amount of signal which passes through the high frequency channel is increased, the percentage of feedback is also increased, counteracting excessive phase shift and providing pre-emphasis of high frequencies as much as 20 db. at 10,000 cycles with very little increase in distortion. The low frequency circuit which consists of the other section of the dual triode is fed through an isolating resistance to the control. The feedback circuit for this section of the tube consists of a bridged "T" network which is very selective. As the amount of signal which reaches the grid of this section of the tube is increased, the feedback is also increased and the operation is the same as outlined above. The plate circuits of the high frequency and low frequency sections of the equalizer are coupled together through suitable isolating networks to prevent interaction and to give the desired response. The series resistance and capacitance in the plate circuit of the low frequency section is a network designed to reduce the response below fifty cycles. From the characteristic curves it can be seen that a variation of approximately 30 db. is possible at 50 and 10,000 cycles. The gain of the amplifier between 500 and 1500 cycles remains substantially constant with a variation of only ± 1½ db. throughout the complete variation of the high and low frequency controls. Without careful adjustment and from calibration curves given on production models, it is possible to set the amplifier in a flat position which will give response within ± 1 db., 50 to 10,000 cycles.



Top view of chassis shows most advantageous placement of component parts.

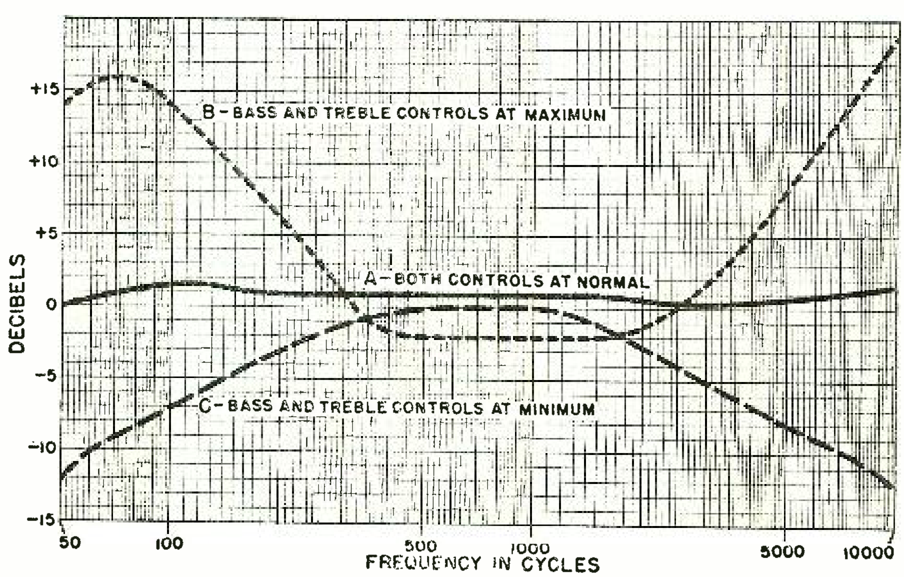
The advantages of this setting to any predetermined range are readily apparent to the reader. For many applications it is desirable to be able to have certain frequencies emphasized or attenuated and the use of the individual curves are ideal for this purpose.

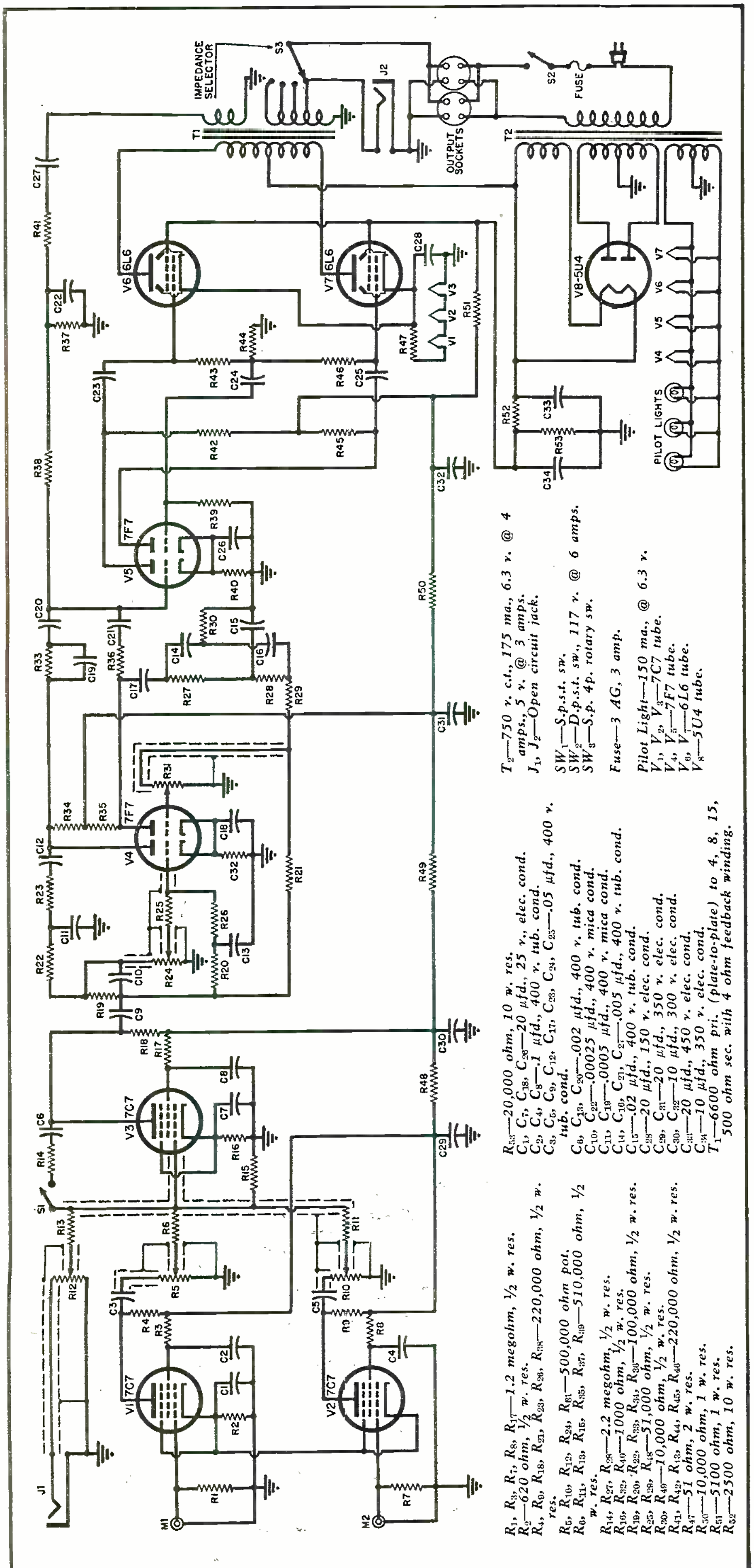
Some of the applications where this feature is desirable are; sound effects, recording, band passing or rejection, or similar problems.

As mentioned previously, the characteristic slope was determined after consideration of all the factors involved, both from a technical standpoint and from the practical standpoint. In view of the characteristics which were chosen, it can readily be seen that the circuit lends itself particularly well to the type of work that involves wide ranges of equalization, such as recording. One problem which is encountered in the practical application of this type of circuit, however less serious than in the aforementioned equalizers which used iron core inductances, is the elimination of hum. This problem may be minimized by the proper choice of low frequency pre-emphasis slope and the frequency at which maximum pre-emphasis occurs.

The microphone and mixer stages of the amplifier use d.c. on the filaments supplied from the bias circuit of the output stage. This results in a hum reduction of 12 to 15 db. in the microphone stage and approximately

Frequency response curve. Selective boost or attenuation of both high and low ends of the audible spectrum can be obtained without affecting the middle frequencies.





R_1, R_3, R_7, R_8, R_{17}—1.2 megohm, ½ w. res.
R_2—620 ohm, ½ w. res.
R_4, R_9, R_{18}, R_{21}, R_{23}, R_{26}, R_{38}—220,000 ohm, ½ w. res.
R_5, R_{10}, R_{12}, R_{24}, R_{31}—500,000 ohm pot.
R_6, R_{11}, R_{13}, R_{15}, R_{35}, R_{37}, R_{39}—510,000 ohm, ½ w. res.
R_{14}, R_{27}, R_{28}—2.2 megohm, ½ w. res.
R_{16}, R_{32}, R_{40}—1000 ohm, ½ w. res.
R_{19}, R_{20}, R_{22}, R_{33}, R_{34}, R_{36}—100,000 ohm, ½ w. res.
R_{25}, R_{29}, R_{48}—51,000 ohm, ½ w. res.
R_{30}, R_{49}—10,000 ohm, ½ w. res.
R_{41}, R_{42}, R_{43}, R_{44}, R_{45}, R_{46}—220,000 ohm, ½ w. res.
R_{47}—51 ohm, 2 w. res.
R_{50}—10,000 ohm, 1 w. res.
R_{51}—5100 ohm, 1 w. res.
R_{52}—2500 ohm, 10 w. res.
R_{53}—20,000 ohm, 10 w. res.
C_1, C_7, C_{18}, C_{26}—20 μfd., 25 v., elec. cond.
C_2, C_4, C_8—.1 μfd., 400 v. tub. cond.
C_3, C_5, C_9, C_{12}, C_{17}, C_{23}, C_{24}, C_{25}—.05 μfd., 400 v. tub. cond.
C_6, C_{13}, C_{20}—.002 μfd., 400 v. tub. cond.
C_{10}, C_{22}—.00025 μfd., 400 v. mica cond.
C_{11}, C_{19}—.0005 μfd., 400 v. mica cond.
C_{14}, C_{16}, C_{21}, C_{27}—.005 μfd., 400 v. tub. cond.
C_{15}—.02 μfd., 400 v. tub. cond.
C_{28}—20 μfd., 150 v. elec. cond.
C_{29}, C_{31}—20 μfd., 350 v. elec. cond.
C_{30}, C_{32}—10 μfd., 300 v. elec. cond.
C_{33}—20 μfd., 450 v. elec. cond.
C_{34}—10 μfd., 350 v. elec. cond.
T_1—6600 ohm pri. (plate-to-plate) to 4, 8, 15, 500 ohm sec. with 4 ohm feedback winding.
T_2—750 v. c.t., 175 ma., 6.3 v. @ 4 amps., 5 v. @ 3 amps.
J_1, J_2—Open circuit jack.

SW_1—S.p.s.t. sw.
SW_2—D.p.s.t. sw., 117 v. @ 6 amps.
SW_3—S.p. 4p. rotary sw.

Fuse—3 AG, 3 amp.

Pilot Light—150 ma., @ 6.3 v.
V_1, V_2, V_3—7C7 tube.
V_4, V_5—7F7 tube.
V_6, V_7—6L6 tube.
V_8—5U4 tube.

Schematic diagram of the eight-tube a.c. operated amplifier. Employing push-pull 6L6's, a maximum of 30 watts is obtained at less than four per-cent harmonic distortion.

←

4 db. in the mixer stage. The isolation resistors between the output of the microphone stage and the phonograph input prevent interaction from mixing and the total variation is less than 2 db. for any setting of the microphone or phonograph controls. The output from either the microphone stages or the mixer stage is flat going into the equalizer and variation shown in the characteristic curves is accomplished entirely in the equalizer stage. The feedback circuit in the plate of the mixer stage is switched in and out to provide a gain variation and a substantial reduction in tube noise when the amplifier is being used in applications which called for a still lower noise level. The output of the equalizer is connected to the phase inverter stage which is the self-balancing type. The over-all voltage feedback is taken from a separate feedback winding on the output transformer and fed back to the input grid of the phase inverter.

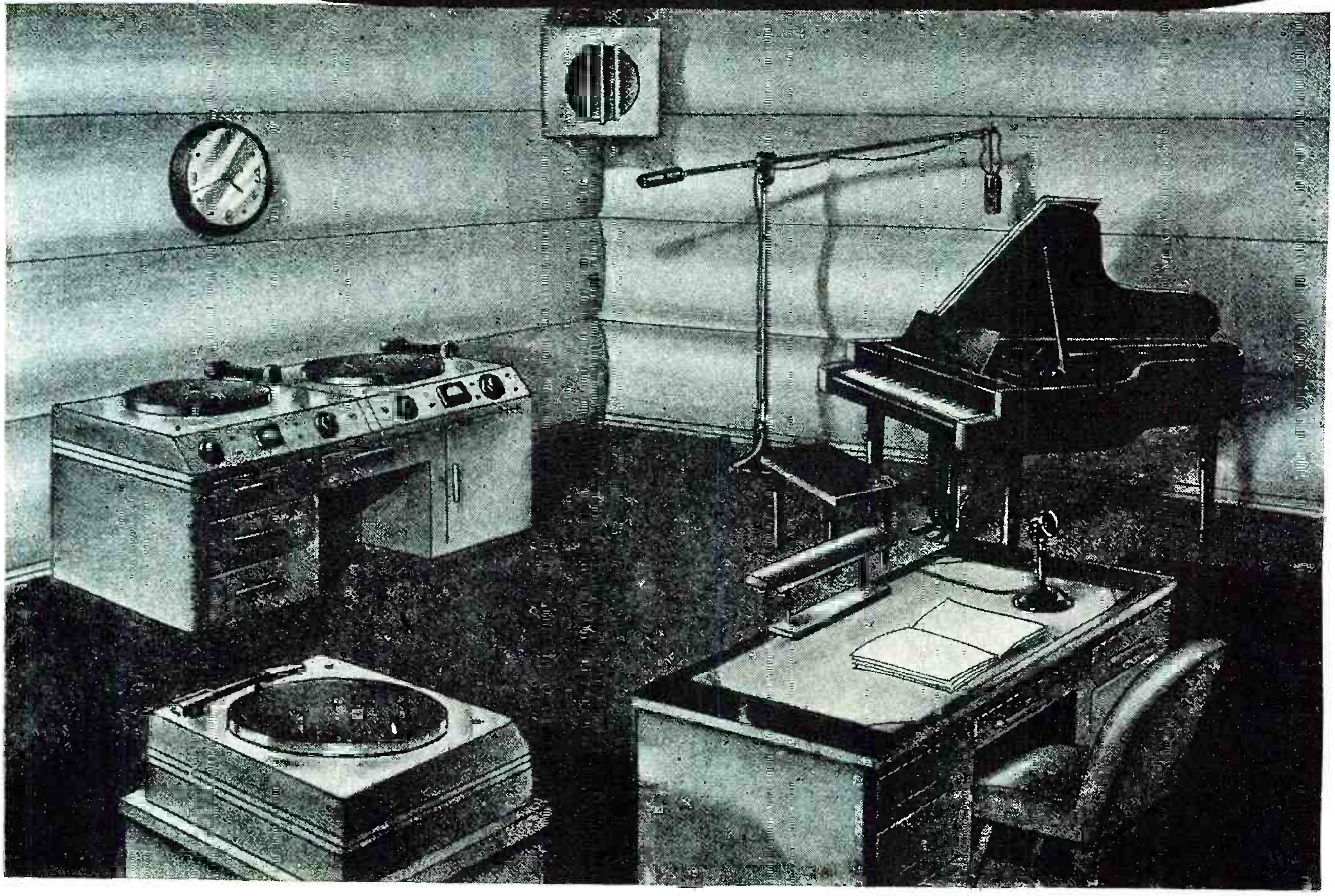
Of many types of inverse feedback tried, this method proved by far the most satisfactory. By its inclusion, any distortion which is present immediately following the tone control circuits is effectively eliminated or considerably reduced. This is readily apparent in a listening test.

In making final test analysis of the amplifier's gain, measurements were made at an input impedance of 25,000 ohms and converted to gain based on 100,000 ohm input which is probably the most standard figure for high impedance input measurements in the field. However, the gain of many amplifiers is given in figures representing gain at an input impedance as high as two megohms. The noise level on production run amplifiers is normally around 55 db. below full output with the bass control full on. If a lower noise level is desired in a particular application, such as a monitor for phonograph playback, the feedback switch may be closed on the mixer stage and the noise level will be approximately 65 db. below full output. It is perhaps worthwhile to mention that to enjoy the full flexibility of the equalizer any device which is used as an input source should be equalized independently to a flat characteristic. It is not intended that the amplifier cannot be used to complement for the deficiencies of any other device, but rather that the increased flexibility for various compensation characteristics may be more greatly appreciated if the input source has a flat characteristic.

With an output power of 30 watts with less than four per-cent distortion, this amplifier will serve for a wide range of applications. Housed in an attractive metalized bronze gray cabinet, with the control panel indirectly illuminated, it will harmonize with almost any surroundings.

—30—

Serviceman's RECORDING STUDIO



The recording studio incorporates all latest acoustical considerations. It features two separate microphone channels, dual recording units, and playback turntable and pickup.

By RUSSELL PAIGE

Radio serviceman Kenneth Doyle of Massena, New York, finds recording studio pays dividends.

KENNETH DOYLE returned from the wars determined to set up his own radio service establishment, but like many another returning warrior he discovered that he had, to put it mildly, a group of competitors—servicemen with an established clientele. Doyle, after a survey of existing radio service centers, decided that to be successful his service unit must offer a new service commodity to the community. With that thought in mind he has established a "Community Recording Center." As a companion service he has a portable recorder which journeys with him on all service calls.

Doyle's design of a recording studio in his own serviceshop is typically modern in all respects. The studio contains a dual recording turntable console equipped for 33 or 78 r.p.m. operation. A piano is, of course, standard equipment with a boom mike adjacent and overhead. A desk equipped with a desk mike is provided for solely speech recordings. A playback unit completes the equipment. The playback speaker is mounted in an upper corner of the recording studio. Wires connecting mike and turntables as well as all other wires are run underneath the floor to eliminate pickup.

When the record-making client appears on the Doyle premises, he or she is ushered into the studio by Doyle or an assistant. Two high school seniors have charge of the record studio—both trained musicians themselves. The client is shown the correct distance to stand or sit from the mike and the assistant is on the spot at all times while the record is being made. In the event that for reasons of privacy the customer prefers to "cut his own" he is instructed in the not-so-complex art of record-preparation. The customer is advised to start the record needle playing from the center of the disc outward rather than from the outside towards dead center. Provided with an accurate timepiece, wall mounted directly in front of them, the customers are able to time their musical or speech making activities to coincide with the playing limits of the disc.

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A Precision FREQUENCY STANDARD

By Merl Saxon

Amateur version of the popular BC-211 frequency meter. Though surplus parts are used, high accuracy is obtained.

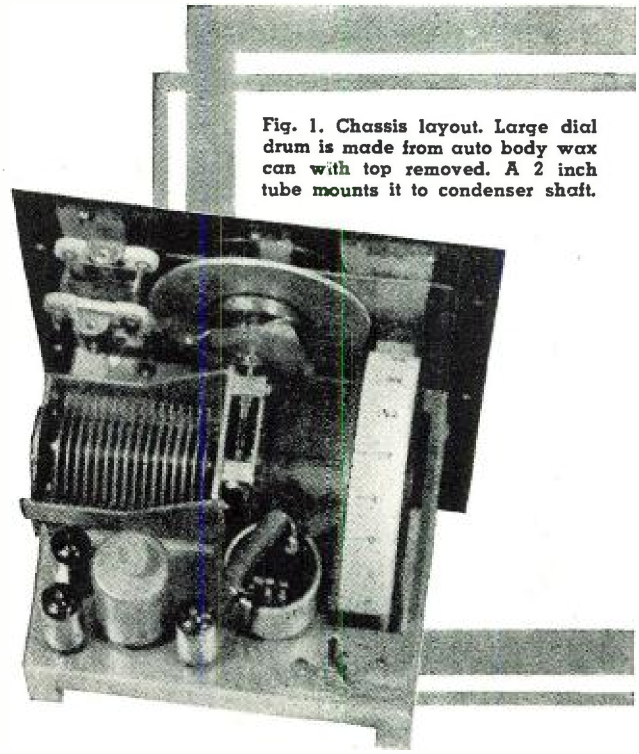
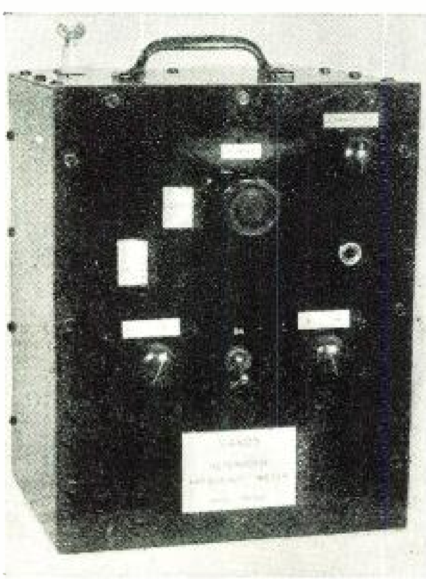


Fig. 1. Chassis layout. Large dial drum is made from auto body wax can with top removed. A 2 inch tube mounts it to condenser shaft.

FOR the past four years the construction of a piece of electronic gear in the home workshop was undertaken only by the most ambitious experimenter. At a time when 100% production of electronic parts went to military uses it became a huge task to assemble all necessary components to go into a project. But necessity can sire most any invention—thus this novel heterodyne frequency meter came into being.

Several months' association with the Army's BC-211 and BC-221 frequency meters left the author with a savory desire for one of them. These Army units were heterodyne type frequency meters employing a well designed variable frequency oscillator, a detector and an audio amplifier, feeding headphones. Of that oscillator much can be written, but a brief survey of its qualities will suffice. It has a superbly designed worm gear driven condenser with precious metal plated condenser plates to prevent corrosion from affecting its capacity. Even the metal used in the condenser was selected for minimum temperature coefficient of expansion. It is attached to a dial accurately readable to five places or digits and having 50,000 dial divisions, counting vernier scale. Fundamental range of the instrument is 125 to 250 kilocycles on the low range which figures slightly more than 25 cycles per main division or about 3 cycles for each vernier division. For such accuracy the dial was maintained in calibration by use of a 1000 kc. crystal oscillator and with initial adjustment to station WWV furnishes accurate check points throughout the dial range. A small corrector capacitor in multiple with the main tuning condenser provides calibration adjustment. Lastly, these BC-211's were powered by No. 6 dry cells and 22½ volt "C" batteries and required a 10 to 15-minute warmup period.

Fig. 2. Front panel view. The standoff insulator (left rear) is antenna post.



But where can one find the components to make a similar meter? Amateur radio operators are likely not to find even the time to build it in their mad scramble to get that old dust covered 40-meter transmitter to operate on 10 meters. Military aircraft radio has in recent months afforded a supply of parts rather unique in shape and design but quite adaptable to our use. The meter here described was built around a certain tuning condenser extracted from one unit of an SCR-274-N Command Transmitter. The condenser, driven by a well designed worm gear, usually is removed from the command set when it is converted over to crystal control for civilian use. Most any airport that harbors a former military aircraft whose radio has been remodeled for private use will have a "heap" of removed radio parts lying around. The author found one firm selling the worm gear condensers used in his meter for fifty cents apiece. Several other aircraft parts are used and are identifiable in the photographs.

Self-contained battery operation with 50 milliampere miniature tubes were first of all settled upon for basic design so that long warm-up waiting periods might be avoided. This becomes feasible with a relatively small operating range of room temperature. Next, an oscillator tube had to be selected. A counterpart of the 1A7 could not be found in miniature so a second best was chosen in the 1R5. In isolating the oscillatory circuit from output plate, a 1A7 can offer two grounded grids (with respect to r.f.) while the 1R5 has one. Nevertheless to favor our selection is the fact that it is a stronger oscillator than the 1A7—a distinct advantage when using high order harmonics. The same type tube is used for a detector while the audio amplifier tube selection is a matter of preference.

First glance at the schematic diagram (Fig. 4) leaves one with the impression that the meter might be simple to construct. Behind the three battery powered tubes, one tuned circuit and a relative scarcity of parts lies more than the eye can see. In fact, making of the instrument boiled down to more mechanical than electrical problems. A constant vigil had to be maintained in the assembly and se-

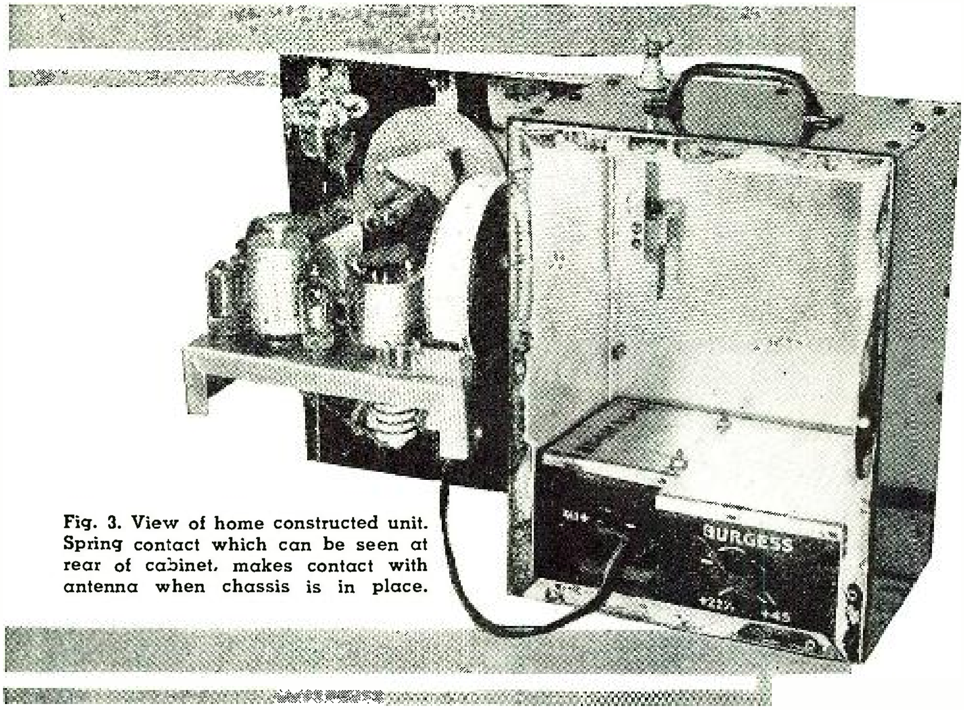


Fig. 3. View of home constructed unit. Spring contact which can be seen at rear of cabinet, makes contact with antenna when chassis is in place.

lection of parts so that no one weak point would jeopardize the accuracy of the very heart of the meter—the tuning condenser and its dial. Rigid wiring was used in the tuned circuit. All other circuits are served with a laced cable.

The cabinet was made of .064 inch aircraft aluminum sheet stock. Because small pieces were all that were available, each side had to be a separate piece. But with care taken to bend the stock evenly and accurately in a tin smithy's "brake" and to bolt or rivet the sides together firmly, a substantial metal box can be made. Rigid front panel construction is obtained with ⅛ inch panel aluminum supporting an inverted bathtub shelf. Gusset plates or angle supports from rear of shelf to top of the panel were unnecessary. Batteries shown in Fig. 3 are clamped firmly in bottom of the box with a top plate and two studs.

Our variable oscillator tuning condenser can never approach, in design, the one used in the BC-211, but it did have glass bead insulation and ball bearings, the latter a good point in preventing wear of bearings and, in turn, the disturbing of calibration. The worm also has ball bearings. Mounting this condenser firmly onto the shelf with four No. 6 screws gave sufficient rigidity, but the worm shaft then had to be connected directly to the front panel shaft. Since that arrangement could prove disastrous with any misalignment of the two shafts or any exertion of thrust upon the tuning knob, a large flexible coupling was made to fit just behind the 0—100 "tens" dial in Fig. 1. All this mass hung onto the tuning shaft proved to be an advantage in providing a flywheel effect.

To drive this condenser with a suitable dial presented by far the most important mechanical problem encountered. Initial planning gave consideration to several commercial dials, but a lengthy scrutiny of the tuner resulted in the 4800 division dial (worm gear ratio is 96 to 1). On the worm shaft a 360-degree dial with 100 numbered divisions was mounted. Then, on an extension from the main shaft of the condenser, a 5-inch diameter drum is placed to read 0 to 48 so that one complete revolution of the worm shaft moves the drum one division. The latter is the "hundreds" dial and the former is the "tens" dial. Through the two plexiglass windows (Fig. 2), not exactly aligned horizontally, the four place dial can be read directly in its mathematical order from left to right. Dexterity will yield one-fourth or even one-tenth of a dial division on the 0—100 scale thus making the dial readable to five places.

Asking a broadcast band oscillator to deliver a usable 100th harmonic in the neighborhood of 75 megacycles is just about too much of a request, so two frequency ranges were provided. After initial tests were made with the condenser selected, it was found that a 2 to 1 range in frequency would be impossible. This came about by the inherent high minimum capacity of about 60 μμfd. Maximum was 180 μμfd. If we select a range for this meter of from 1500 kc. to well above 100 mc. and we do not have a 2 to 1 variable frequency tuning range, then it is necessary that the low range begin at slightly below one-half the above selected 1500 kc. in order that harmonics will overlap. The broadcast range has a coverage of 630 to 1040 kc., and its second harmonic is 1260 to 2080 kc. By this arrangement our dead spot is from 1040 to 1260 which is below our 1500 kc. minimum. Third and higher order harmonic ranges overlap and give no further dead spot. Short-wave range is 6750 to 11,000 kc.

After a five place dial is decided upon, there should be some method of reference check to give assurance that the dial will maintain its calibration. Incorporation of a crystal oscillator and a small shunt capacity corrector in the variable oscillator permits, by predetermined check points, an adjustment of the frequency and dial reading to exactly the point of original calibration. A 1000 kc. crystal would be about ideal, but again we compromised with what aircraft parts were available—a 4600 kc. BT-cut crystal. This combination produces nineteen broadcast band check points and eight on the short-wave band, all marked in red pencil in a spiral notebook used to record the calibration. It might be mentioned that a round figure like

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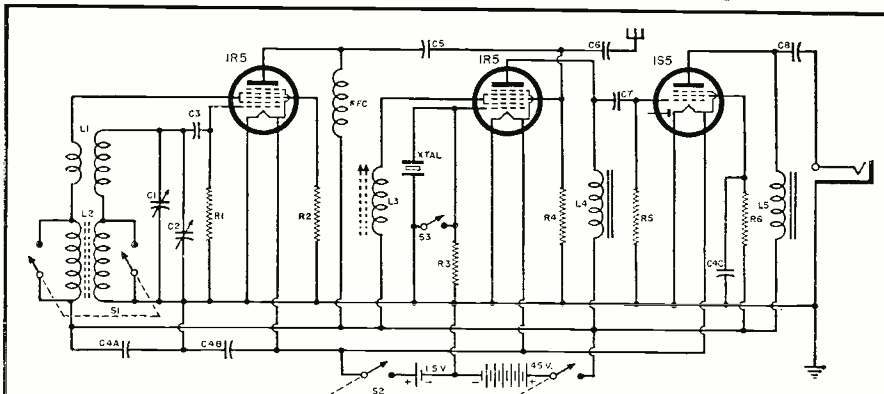
Fig. 4. Schematic diagram of three tube, battery operated frequency standard.

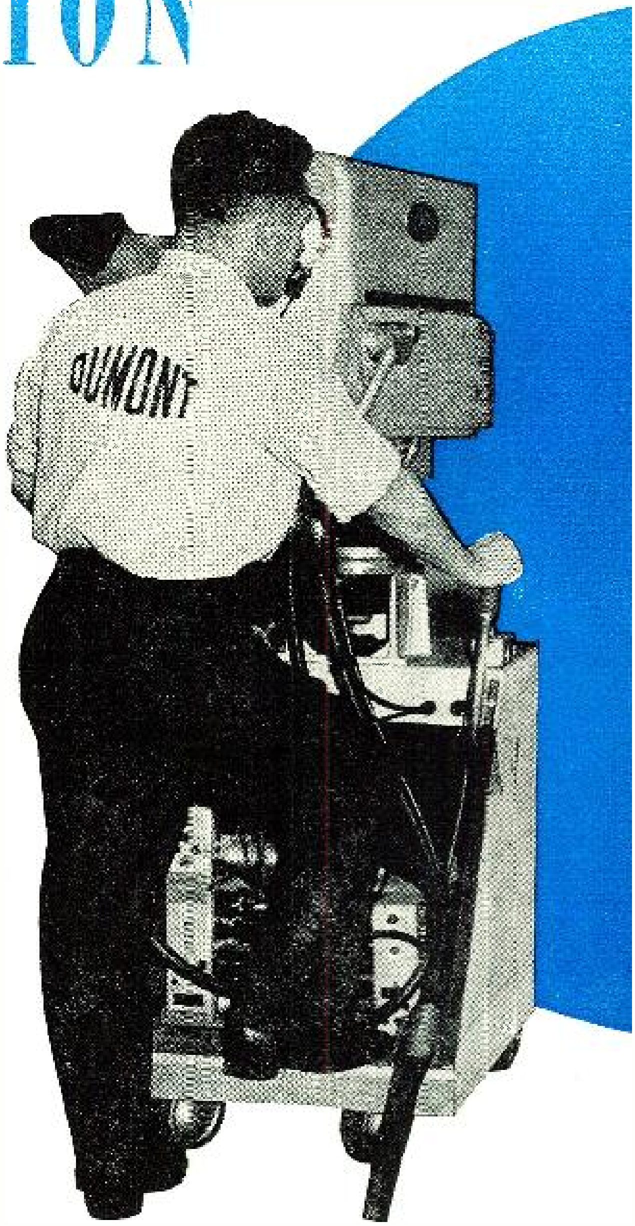


R_1—50,000 ohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—25,000 ohm, ½ w. res.
R_4—200,000 ohm, ½ w. res.
R_5, R_6—1 meg., ½ w. res.
C_1—15 μμfd. variable cond.
C_2—180 μμfd. variable cond. (see text)
C_3—250 μμfd. mica cond.
C_4—Triple .05 μμfd. paper cond.
C_5, C_6—50 μμfd. mica cond.
C_7, C_8—.01 μμfd. paper cond.
L_1, L_2, L_4, L_5—See text
L_3—Resonant to crystal used
RFC—80 mh., r.f. choke
S_1—D.p.s.t. rotary sw.
S_2—D.ps.t. toggle sw.
S_3—S.p.s.t. rotary sw.
Xtal—See text

DIRECT-WIRE TELEVISION

By HERBERT E. TAYLOR, JR.
Dir. of Transmitter Equip. Sales
Allen B. DuMont Laboratories, Inc.

Direct-wire television has an important future as a merchandising medium for department stores. Techniques for programming vary slightly from video broadcast.



Glorianne Lehr demonstrates the Richard Hudnut course before the television cameras of DuMont television station WABD. The camera closed up on the miniatures of the exercising figures, then faded into live demonstration of the various exercises.

PROSPECTS of broadcasting pictures in addition to sound have so captured the public's imagination that many of television's other very important applications have been shunted into the background. Yet these non-broadcast forms of television may well amount to hundreds of thousands, or even millions, of dollars worth of equipment purchased and a tremendous number of jobs for technical and semi-technical workers before many years have passed.

We will examine this phase of television, the types of outlets, equipment involved, nature of its installation, its personnel, operation, maintenance, and potential for expansion. But first, let's take a long, over-all view of the subject.

In an address before the National Retail Dry Goods Association's 1945 national convention, Leonard F. Cramer, Executive Vice President of *Allen B. DuMont Laboratories,* described the functions of direct-wire television as follows:

"For intra-store television, you don't require costly transmitters to send television through the ether to receivers in your trading area, nor do you need worry about a Federal license, elaborate studios, complicated antenna structures, large maintenance, and operational personnel or many of the other obstacles which might deter you from setting up your own complete television station.

"All you need for this simplified television is: (1) a camera or two before which merchandise is displayed and demonstrated, (2) enough studio space to house whatever settings and properties you consider necessary to present your sales and institutional program material effectively, and (3) a number of vastly simplified receivers, located wherever you wish them throughout the building, linked to the cameras in your small tele-merchandising studio by cable. Your personnel problem will be partly solved by utilizing the sales and maintenance force already in the store."

To evidence the effectiveness of this type of installation in communicating information to crowds of people, Mr. Cramer cited the experience of a Jamaica, L. I., experimenter in television who "leaves a receiver on every night in his store window, so that every night, from approximately 8 to 10 o'clock, passersby can witness a television program there.

"Even in the worst weather, late at night, in this comparatively obscure location, there is always a crowd in front of that window. This crowd is gathered from a much thinner traffic than is found at almost any time of the day before department stores. Yet, night in and night out, for months, these groups have been forming and they are about as large now as they were when the television receiver was first installed."

In quick summary, Mr. Cramer pointed out that these systems help even out the flow of customers throughout the stores, put merchan-

dise on sale immediately, train sales personnel through their watching of the programs, afford facilities for demonstrating telesets even when no broadcasts are on the air, and serve as powerful sales implements.

While department stores represent one of the most important of the utilizers of direct-wire television, they are far from the only type of agency which will employ it. Schools may well use this system for teaching many classes throughout the city simultaneously and bringing to students all over town the finest visual instruction material, speakers, inspirational material and, occasionally, special entertainment programs available. Industry can use such a set-up for presenting information simultaneously to all departments, giving employees instruction in safety and new products in a quick, convenient manner or in countless other ways depending on the type of operation involved. In metropolitan areas, all police stations can present pictures of wanted persons and other information that must be distributed instantaneously by direct-wire television without danger of others intercepting the televised images. The full scope of direct-wire television will depend on the scope of the manufacturers' and users' imaginations.

Now, let's examine the equipment used in these operations.

Most conspicuous and basic of the studio equipment is the camera. Two of these are needed in most direct-wire coverages. The camera contains a pick-up tube on which the lens focuses the image to be telecast. This pick-up tube contains a mosaic consisting of thousands of individually insulated photoelectric cells. As the image is focused on the mosaic, each cell converts the light striking it into a tiny electrical charge.

Those cells on which bright light falls store comparatively powerful charges. Those struck by weaker light develop weaker charges.

A beam made up of billions of electrons scans the mosaic from left to right, top to bottom, of the mosaic. The electron beam sweeps over or scans 525 horizontal lines per frame, and at a speed of 30 frames per second. Thus, television exceeds the speed of 24 frames per second used in movie projection.

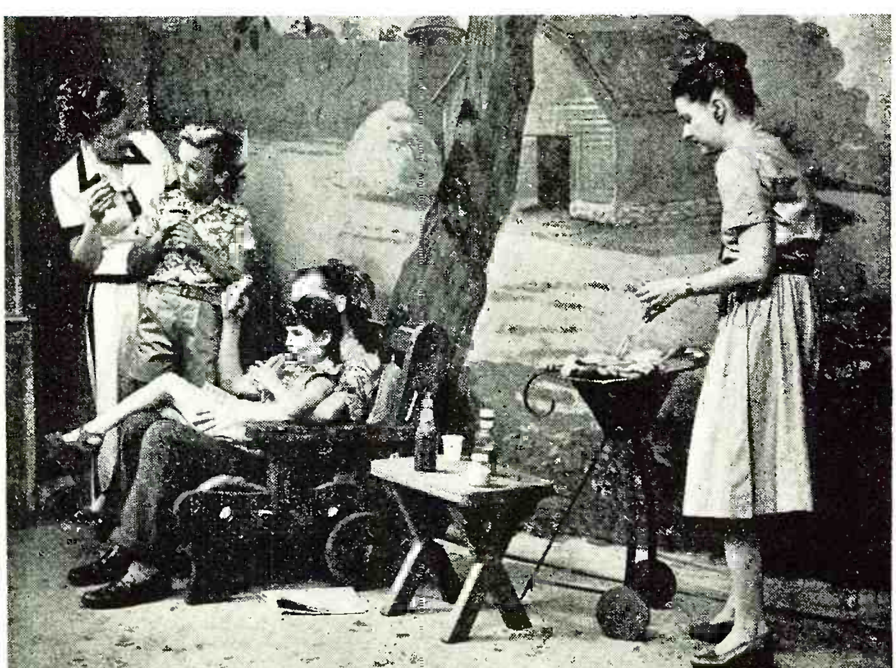
In addition to the lens and pick-up tube, the camera contains a pre-amplifier network. Tubes used in these circuits at this writing are those developed before the war, but all the equipment manufacturers in the country are working now to determine which of the tubes perfected during the war can be used in this work. These circuits are necessary because the impulses picked up from the mosaic are so weak that they would be lost in the coaxial cable running from the camera to the camera controls unless a means is employed to raise the signal level. The five-stage, broad-band, pre-amplifier circuit mounted in the pick-up tube housing raises the value of the charges to approximately six milliwatts.

The horizontal sweep amplifier is also mounted on the camera housing. This permits the transmission of horizontal sweep signals from the synchronizing generator, which controls the scanning action of the beam in the pick-up tube, to be sent to the camera at a low signal level. The vertical sawtooth waveform, used in scanning, is fed directly to the camera and with no additional amplifier at the camera. We will touch on this operation further when the synchronizing generator comes under discussion.

Operating in conjunction with the camera is the electronic viewfinder, as distinguished from the camera-type optical viewfinder used on some television cameras. Through exploration it has been determined that the electronic viewfinder is the most practical, since it permits the operator to see the exact image being picked up by his camera on the five-inch tube of a miniature receiver. He has a picture he can examine at close range for critical focusing and composition. The image is free of extraneous detail, such as outside marginal material, and is viewed right side up. A stereoptic shield gives the operator a sharp view of the image despite studio lighting.

The electronic viewfinder needn't remain attached to the side of the television camera. It can be removed from the side of the camera and used in a comfortable position despite any camera movement that may be necessary, so that the operator doesn't need

An effective application of the department store version of direct-wire television demonstrates "fashions in action." Skits are used to present fashions for various activities and occasions without resorting to the stylized type of fashion showing.



Nash-Kelvinator Corp. sponsored this televised program of the Society of Amateur Chefs. (Left to right) Otto Soglow, John Reed King, and Rube Goldberg demonstrate their cooking techniques before the all-seeing eye of the television camera.

to ride his camera to a variety of levels.

The cameraman has only two simple mechanical controls to handle in addition to his positioning of the camera. One is for camera angle or composition, the other is for bringing the lens into position for sharp focus.

The camera head is mounted on a gyroscopic neck which permits smooth, silent panning and tilting.

These are mounted on two different types of dollies. One is a free-rolling, lightweight push dolly, for standard floor shots. This is the basic, the less expensive, and the most practical of the two types. The other is a boom dolly which permits great elevation of the camera, swooping effects and low dips by the camera for extreme angles.

The camera is electrically connected to the control operator's console by coaxial and other cables to permit the control engineer to hold the reins of the whole operation. The control engineer handles all electrical controls of the camera. The cameraman's operations are all mechanical.

The technical director of the program, or the control engineer, communicates with the camera operator, or operators, through a microphone which transmits the messages to earphones worn by the cameraman.

Some of the electrical controls handled at the control engineer's console are set before the program begins. Among controls adjusted prior to the program period are the horizontal and vertical sweep controls and the keystoning which gives uniform proportions to the frame; meter controls which let the operator switch different power units through a metering device to check the normalcy of their outputs; and beam intensity which determines the electron volume of the scanning beam. While all of this group of controls handled at the console are substantially fixed, they are often varied during the picking up of the program.

The other "active" controls handled by the operator need constant watching and frequent adjustment. One of these is the video gain to set the power level of the picture being fed to the control console. A second active control is of the light "pedestal." The pedestal control is a brightness control which electronically permits adjustment of the general or average brightness of the scene. It also can be used to raise or lower the key of the light for special effects, such as darkening the picture to denote a rising storm, lightening it suddenly to represent lightning, or permitting slow fades or lap dissolves.

The console also houses shading controls which compensate for uneven signal response from various portions of the mosaic. Shading is necessary due to the uneven rain and fall of secondary electrons upon the photosensitized surface of the mosaic, resulting in "dark spot signal" from the mosaic. Correction of these uneven tones is accomplished by inserting various types of d.c. signals to flatten the response at all parts of the signal ranges. Controls are four vertical and four horizontal shading knobs for inserting saw, sine, parabola, and sine phase signals to lop off peaks and valleys of the picked-up image as recorded on the cathode-ray oscillograph.

The output gain, or strengthening the power of the signal being fed to the line amplifier, is the next control handled by the operator. He also handles the vertical and horizontal sweep controls, for the 60 vertical and 15,750 horizontal sweeps a second.

The television system must arrange for the scanning of the picture being picked up to exactly parallel the recreation of that picture on the receiving set. This is accomplished by means of inserting a synchronizing or "trigger" signal which is more powerful than those translated to visual information. As each of these signals reaches the receiver or monitor, it causes the deflection plates to throw the electron beam back to the proper position for creating the next line. The synchronizing generator serves for both horizontal and vertical synchronization. This device has a separate panel on the control console and may even be separated from it.

As the engineer sits at the control console operating the many instruments described, he has before him,

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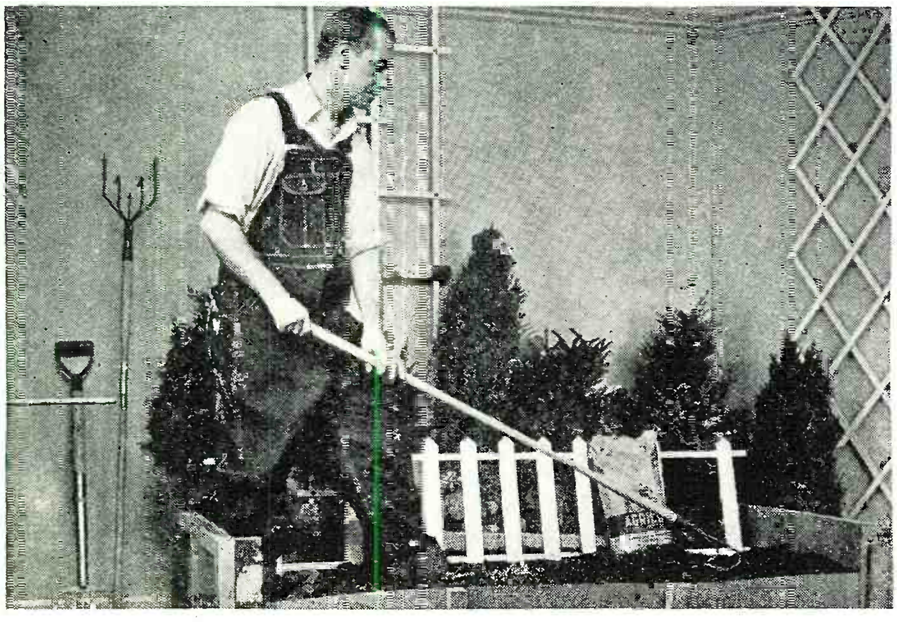
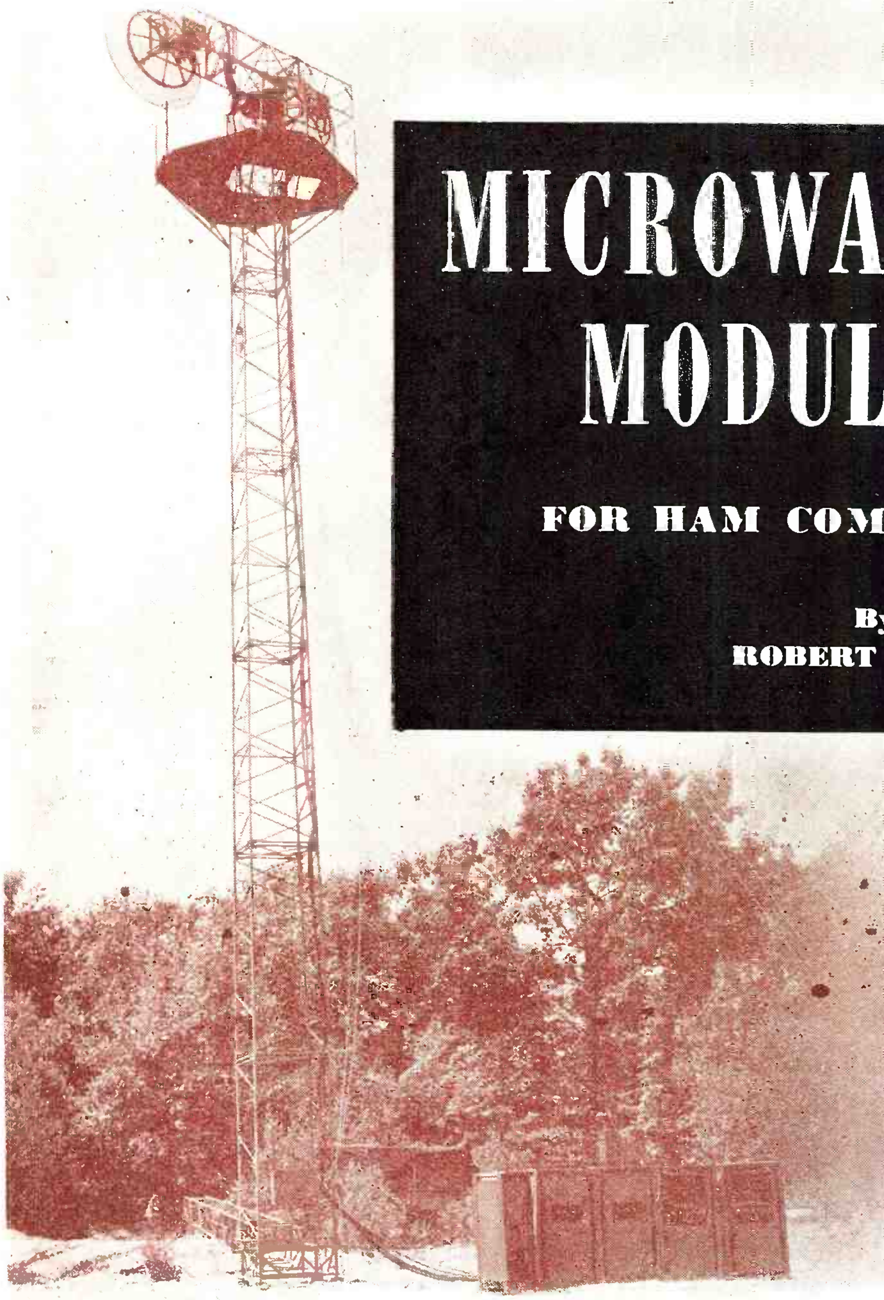
The correct use of various gardening tools is demonstrated graphically in this television program. R. H. Macy Company sponsored this showing over station WABD.





MICROWAVE PULSE MODULATION

FOR HAM COMMUNICATIONS

By
ROBERT ENDALL

A simple analysis of a wartime development which will have widespread ham application in the u.h.f. and s.h.f. bands

Fig. 1. Signal Corps 4500 mc. eight-channel pulse transmission equipment, showing all spare and operating components and antenna, set up for field operation.

IN THE past, radio amateurs have always been in the forefront of technical progress in experimental communication on the higher frequencies, and many of the advances in high-frequency communication are traceable directly to amateur activity. Before the war many hams were spending much of their time on the 56- and 112-mc. bands and experimenting with higher frequencies. Wartime progress has so greatly extended the radio frequency spectrum that communication frequencies are now regularly assigned and may be expected to carry useful traffic up to 30,000 mc. Many radio amateurs, especially those who have for the past five years been active in wartime u.h.f. and microwave research, will now want to go on the air at carrier frequencies well up in the microwave region.

The cost of ultra-high frequency equipment, the expense of tubes for generating microwave power, and the difficulty of modulating at u.h.f., have up to now been a handicap to widespread amateur experimentation on these frequencies. The intensive military program of development and production of high frequency equipment has done much to eliminate these difficulties. The application of mass production techniques has greatly decreased the expense of equipment. The development of disc-seal tubes, magnetrons and klystrons, has greatly simplified the problem of generating microwaves. Now the new technique of pulse-time modulation, which has recently been removed from the secret list by military authorities, introduces a considerable simplification in the problem of modulating microwave transmissions.

A pulse-time-modulated carrier consists of signals of the simplest type—short pulses of r.f. having constant shape and amplitude with variable timing. Because of bandwidth considerations, this type of modulation has its maximum usefulness at microwave frequencies. Although developed primarily for commercial multiplex telephone transmission, pulse-time modulation has distinct advantages which suit it particularly well to amateur communications:

1. Since the carrier is modulated

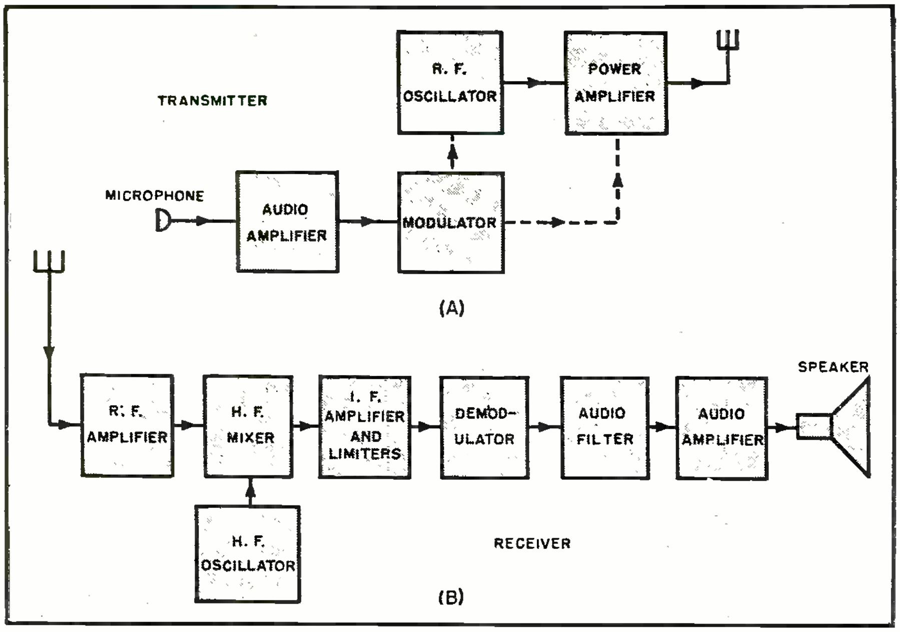


Fig. 2. Block diagrams of conventional type of transmitter and receiver that may be used for any type of modulation. (A) transmitter. (B) receiver.

only by being switched on or off to create the pulses, the circuit can be of an extreme simplicity of design not possible with other systems.

2. By making full use of the much wider bands per channel which are not only available, but definitely preferable, at the higher frequencies, this system makes it possible to reduce considerably the influence of parasites of artificial origin and to increase considerably signal-to-noise ratio.

3. Higher peak power and much higher frequencies are attainable than would otherwise be possible because of limitations due to heating of the transmitter tubes.

Thus, at the same time that it effects economy in transmission and simplifies and improves the efficiency of reception, pulse-time modulation provides also a greater degree of static reduction in communication.

In addition, the multiplex properties of pulse-time modulation open up still another application for amateur communication in helping to overcome line-of-sight difficulties to some extent. The transmitted pulses are of very short duration and separated by comparatively large spaces, therefore more than one telephone channel may be transmitted on the same carrier provided that the pulses are suitably displaced with respect to one another. It is quite conceivable that by making use of this factor, amateurs may cooperate in setting up long nets and relay systems by means of which each operator will be conducting his own conversation and acting as a relay point for as many as eight or ten other conversations taking place over distances far beyond the limitations of ordinary line-of-sight communication.

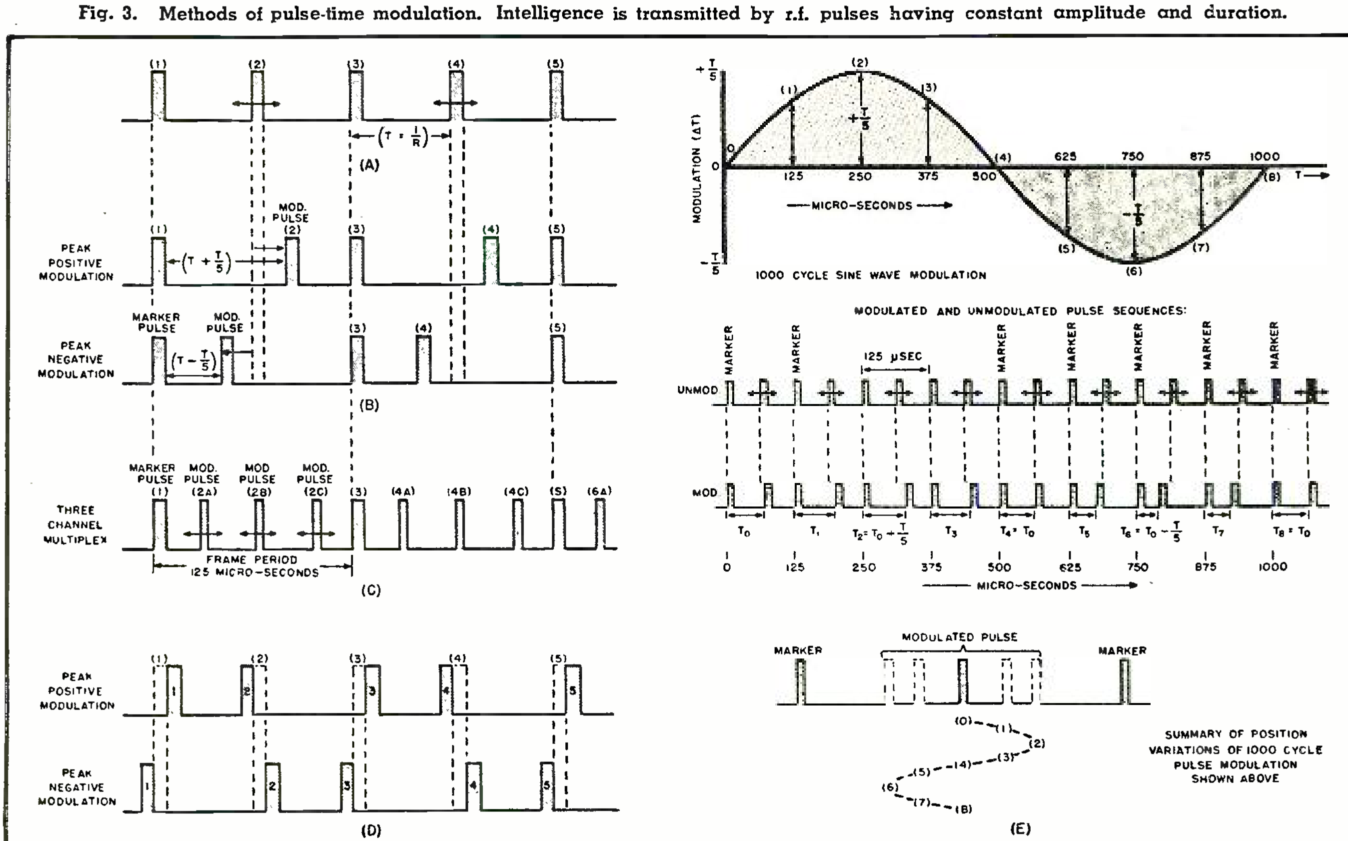
Theory of Pulse-time Modulation

The basic theory of pulse-time modulation is extremely simple. It consists of transmitting intelligence by pulses of r.f. having constant amplitude and duration, the instantaneous amplitude of the voice being translated into variation of time intervals between successive pulses. The rate of this variation corresponds to the instantaneous frequency of the signal. The pulses themselves are of very short duration, separated by comparatively large spaces.

The spacing between the successive pulses can be varied in a number of different ways. Two of these possible methods of position-variation which have been used in practice are of interest to amateurs, and will be described.

The unmodulated carrier, consisting

Fig. 3. Methods of pulse-time modulation. Intelligence is transmitted by r.f. pulses having constant amplitude and duration.



of a series of pulses having a constant repetition rate, is shown in (A) of Fig. 3. The individual pulses may be designated by numbers 1, 2, 3, 4, 5, etc., and the pulse repetition rate R per second. Then the time interval between successive pulses is $T = 1/R$ seconds. When modulation is applied, the timing between the pulses is varied by an amount proportional to the modulating voltage, and at a rate corresponding to the frequency of the modulating signal.

In the first type of time modulation, one set of pulses is kept fixed in its time position and serves as a reference set for the time modulation of the other pulses. For instance, in Fig. 3A and 3B it can be seen that the odd-numbered pulses 1, 3, 5, etc., always remain in the same position under one another, while the position of the even-numbered pulses 2, 4, 6, etc., varies. The fixed pulses are the reference (or marker) pulses, and the others are modulated in position with reference to them. Fig. 3B illustrates the pulse position relationships for a single-channel system having a peak modulation of $T/5$. As shown in the upper part of the diagram, the distance between the modulated pulse and the marker is increased for positive modulation; the lower figure in diagram B shows the corresponding decrease in distance between modulated and marker pulse for peak negative modulation.

The process of modulation may be better understood by reference to Fig. 3E, which shows the pulse-position relationships when the single-channel system is modulated by one complete cycle of a 1000-cycle sine wave. During the positive half-cycle the pulse spacing is increased, as shown, by amounts varying from zero to $T/5$ according to the modulating voltage; while during the negative half-cycle of modulating voltage the spacing is decreased by amounts varying from zero to $T/5$. A comparison between pulse positions for the modulated and unmodulated condition can be seen in the middle diagram of Fig. 3E, which shows the pulse sequence through a complete position-modulated cycle. The position variations of the modulated pulse for the 1000-cycle modulation are shown in summarized form in the lower figure, which shows the various positions of the pulse at different times in the modulation cycle. A system of the type shown, having a frame period of 125 microseconds (i.e., repetition frequency of 8000 cycles), is capable of transmitting a telephone channel of 3000 cycles.

(This system may be used for multiplex transmission in the manner shown in Fig. 3C. In this case the same marker pulses and the same frame period are used as in the single-channel system just described, but for each marker pulse there are now three modulated pulses each capable of carrying its own independent modulation. Thus, when the B pulses are modulated, the distance between the B pulses and the marker is varied within its limits regardless of the instantaneous position of the A and C pulses. Likewise the positions of the A and of the C pulses are varied regardless of the other channels. In the system illustrated, the A pulses constitute channel I, the B pulses channel II, and the C pulses channel III. When multiplex transmission is used, the marker pulse is made wider than the others, as illustrated, in order to distinguish it from the channel pulses.)

The second type of pulse-time modulation does not make use of a fixed series of pulses. Instead, the pulses are divided into pairs, and the timing between the two pulses of each set varied in accordance with the modulating voltage. Thus, pulses 1 and 2 would be one pair, 3 and 4 another, 5 and 6, etc. For the condition of peak positive modulation as shown in the upper part of Fig. 3D, these pairs are moved closer together while the pairs of pulses 2 and 3, 4 and 5, 6 and 7, etc., are moved farther apart by an equal amount. For the condition of peak negative modulation as shown in the lower part of the diagram, the situation is exactly reversed. Pulses 1 and 2, 3 and 4, etc., are moved farther apart while 2 and 3, 4 and 5, etc., are brought closer together. There is no change in the average pulse rate.

In pulse-time modulation systems the exact shape, duration or amplitude of the pulse has no fundamental importance, although it does affect the signal-to-noise ratio of the system. As in the case of a frequency-modulated system, the amplitudes are made uniform in the receiver by an amplitude-limiting circuit, thus making possible a considerable reduction in noise on the sole condition that the maximum potential due to noise is lower by a certain amount than the maximum amplitude of the received pulses. (In fact, even if the noise amplitude is greater than the signal pulse amplitude, there is still the possibility of time modulating during part of the pulse interval only, and of eliminating the majority of the interference by blocking the receiver except during the extremely short interval when the pulses are actually transmitted.)

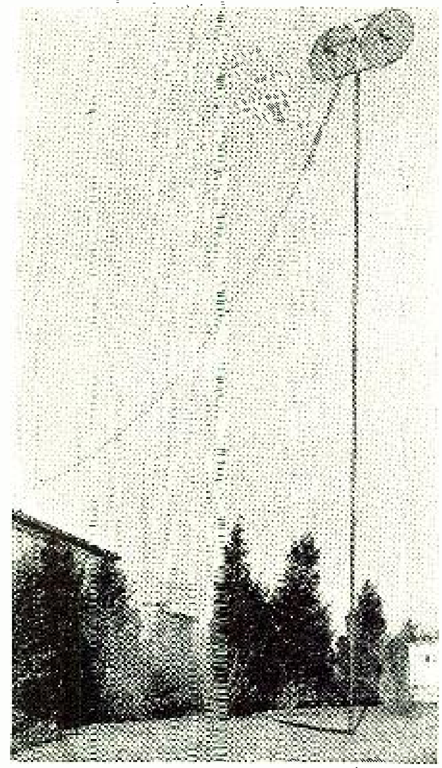
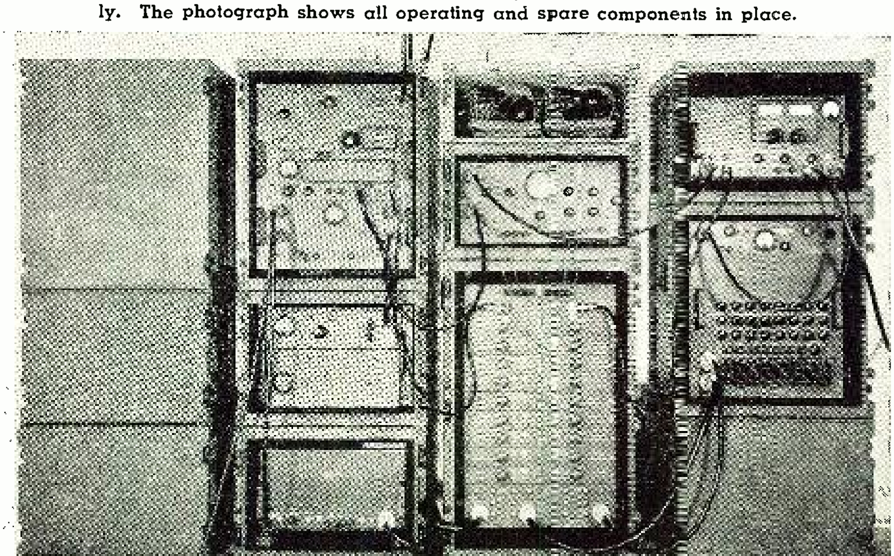


Fig. 4. Antenna system used in conjunction with equipment illustrated in Fig. 5.

Any noise small enough in amplitude to be eliminated by the limiters will nevertheless generate an audible noise at the output of the demodulator, because it also has the effect of advancing or retarding the time position of the leading edge of the desired pulse. This effect is decreased as the steepness of the wave front of the transmitted pulse is increased.

Fig. 5. Signal Corps 1400 mc. pulse-time modulation equipment for transmitting and receiving eight independent telephone channels simultaneously. The photograph shows all operating and spare components in place.



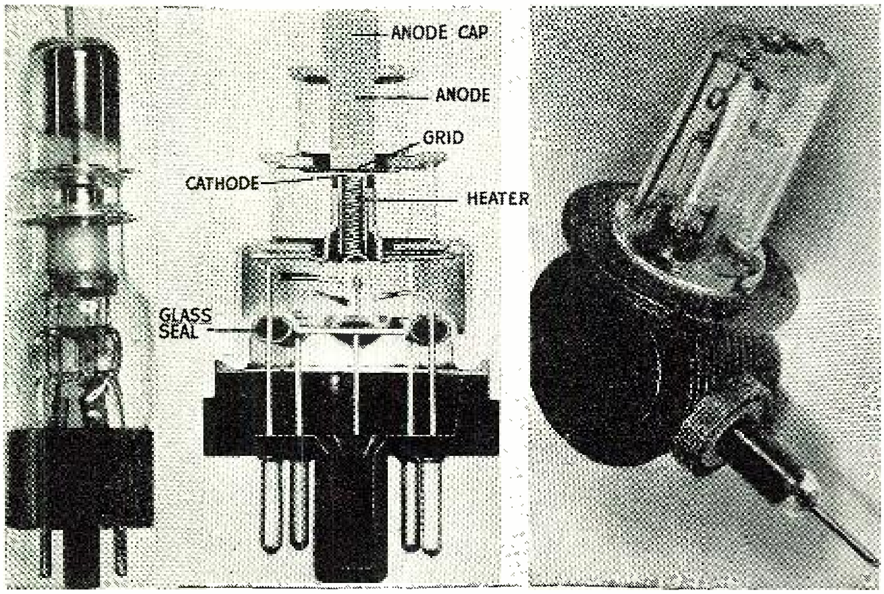


Fig. 6. Tubes for generating receiver beat oscillations and microwave power. (Left) Klystron. (Center) Disc-seal (lighthouse) tube. (Right) Magnetron.

Since both the required band-width and the signal-to-noise ratio are determined by the steepness of rise of the transmitted pulse, it is thus possible to strike the best compromise between band-width, noise, and receiver-oscillator stability to make most effective use of the high-frequency bands.

Pulse-time-modulation Circuits

A number of the circuits which have been developed for time-modulated pulse transmission and reception are of interest to radio amateurs from the viewpoint of experimental communication on the microwave frequencies. Some of these circuits can be used with very little modification, while others can easily be adapted to make them reasonably inexpensive and suitable for ham use. A brief consideration of the existing circuits will serve to illustrate how amateurs can use them for experimental microwave communication, and how they may go about designing their own circuits for high-frequency pulse communication.

The principles of pulse-modulation transmitters and receivers can best be understood by considering them from the viewpoint of the basic principles of radio transmitter and receiver design. Fig. 2 shows block diagrams giving the essential details of the most general types of transmitter and receiver. These block diagrams apply to all three types of modulation now in general use — amplitude modulation, frequency modulation, and pulse-time modulation.

For any type of modulation, the transmitter consists essentially of the following sections: (a) an audio amplifier, (b) the modulator, (c) a high-frequency oscillator for generating the carrier, (d) a radio-frequency power amplifier. The receiver can be divided into the following sections: (a) a radio-frequency amplifier, (b) a high-frequency local oscillator and converter, (c) an intermediate-frequency amplifier and a series of limiters, (d) a converter or demodulator to restore the audio characteristics of the original signal, (e) audio filters and an audio amplifier to bring the signal to the desired level. In u.h.f. receivers, the r.f. amplifier (a) is generally omitted and the signal from the antenna fed directly to the high-frequency mixer.

The circuits for the three types of modulation differ from one another primarily in the modulating and demodulating circuits, and in the manner in which the modulation is applied to the output stage of the transmitter. In an AM transmitter, the modulation is generally applied to the power amplifier or to an intermediate power amplifier. In an FM transmitter, the modulation is applied before the power amplifier to the r.f. oscillator, whose frequency is caused to vary by an amount proportional to the instantaneous audio amplitude. A pulse-time modulated transmitter uses no power amplifier, the oscillator supplying the carrier power directly to the antenna. The modulator in this system serves the function of converting the audio amplitude into time-modulated pulses, which are applied to either the grid or plate circuit of the power oscillator so that the carrier is generated in short position-modulated pulses.

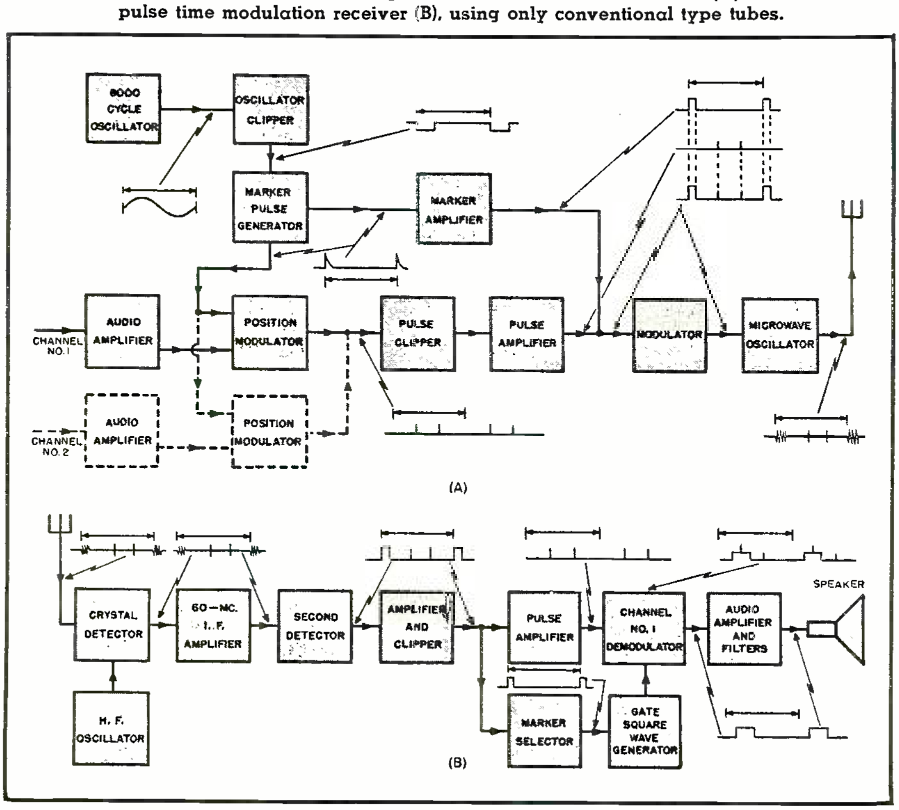
The essential difference between AM receivers and receivers for FM and pulse-time modulation is in the use of limiters. The AM receiver is a linear system as regards both the audio signal and the noise input, whereas the use of limiters in FM and pulse-time modulation receivers makes possible a considerable reduction in the noise output. Pulse-time modulation possesses the further advantage that oscillator tuning and stability are much less critical than in FM reception.

Modulation and demodulation, which is where pulse-time communication differs basically from AM and FM, may be accomplished by many different methods:

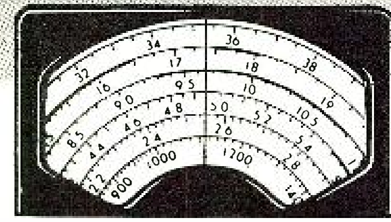
(a) One pulse-time system of the first type—i.e., using a fixed series

(*Continued on page* 88)

Fig. 7. Block diagram of a pulse-time modulation transmitter (A) and pulse time modulation receiver (B), using only conventional type tubes.



International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

SO many letters have been received from readers for information regarding *active* radio clubs that we have compiled the following data on those known to your Short-wave Editor:

Australia—Australian DX Radio Club, headquarters address is not known; South Australia Division can be addressed in care of Station 5KA, 43 Franklin Street, Adelaide, South Australia. There are several other active clubs in Australia about which I expect data soon.

Great Britain—British Short Wave League, address not known; gets out a monthly leaflet.

New Zealand—New Zealand DX Club, Harold J. Barr, Headquarters Secretary, 10 Koraha St., Remuera, Auckland, S.E. 2, New Zealand; house organ is "The N.A. DX-TRA," published monthly at 5 Dublin St., Invercargill, New Zealand; Merv Branks, Editor; Art Cushen, Short-wave Editor; Keith Robinson, Associate BCB Editor; Branch Notes Editor, Max Rattray; Competitions Editor, Des Lynn; Circulation Manager and Printer, Bill Milne.

N.Z. Radio Hobbies Club, 11 Manner St., Wellington, C.1., New Zealand; club formed in 1930 with sole object of fostering radio as a hobby. Started by the Electric Lamp House, Ltd., and has its mutual advantages to the club members and to the Company; "Radiogram" is the club's monthly paper. Membership fee is $1.50 per year. Members are known as "Rahobs." Claims "over 6,000 members, the largest radio club in Australasia."

New Zealand DX Relay Association, Editor "Tune-In," 20 Marion St., Wellington, C. 2., New Zealand.

Sweden—Sveriges Radioklubb (Radio Club of Sweden), Stockholm 5, Sweden; house organ is "Kortvags-Lyssnaren," Stockholm 29, Sweden, H. G. Appelgren, Editor; DX Editor is Arne Skoog, Grundlaggarvagen 16, Abrahamsberg, Stockholm, Sweden.

United States—National Radio Club, 325 Shirley Avenue, Buffalo 15, New York; Ray Edge, Editor; strictly BCB.

Newark News Radio Club, Market St., Newark, New Jersey; Irving Potts, President; BCB and SW.

Universal Radio DX Club, Chas. Norton, Pres., 7507 Holly St., Oakland 3, California; Bill Howe, Short-wave Editor, Apt. 301, 1614 Abingdon Drive, Alexandria, Virginia; Alexander F. Maley, BCB Editor, 46 Ft. Putnam St., Highland Falls, New York; Ralph Kastner, Amateur Editor, P.O. Box 134, New Braunfels, Texas; Dr. John William Kirk, BCB Contest Manager, 415½ Main St., Point Pleasant, West Virginia. Established 1933. Issues "Universalite" bulletin, semi-monthly during the DX season, 19 issues per year.

Victory Radio Club, Ligonier Ave., Latrobe, Pennsylvania; Art Hankins, Editor; BCB and SW.

(If anyone can furnish information on additional active radio clubs anywhere in the world, I would be glad to have it.)

* * *

EGYPTIAN DATA

Through the Royal Egyptian Embassy in Washington, D. C., I have received the following information from Cairo about short-wave service from Egypt:

"The Egyptian Government is hiring from the Marconi Company a radio transmitting apparatus, 10 kw., frequency 7.867 (38.13 m.), for two hours daily for broadcasting National Programs in Arabic language between 1:50-3:50 p.m. and to 7 p.m. on special occasions and holidays; also, once a week for broadcasting Friday's prayer and Koran recitation for one hour at 7 a.m. on 10 kw. apparatus with a frequency of 10.055 (29.83.).

"The Government will install a transmitting apparatus on short-wave of 25-50 kilowatts." (Proposed wavelength or date when this transmitter will be put in operation was not given.)

A copy of "Cairo Calling," the Journal of Egyptian State Broadcasting, was enclosed, giving program schedule of Radio Cairo on 7.190 (41.70 m.) for Middle East (except Cairo Area which is served by a BCB transmitter) as 1:30 a.m.-4 p.m. EST. "Cairo Calling" is the official organ of Egyptian State Broadcasting, Radio House, Cairo; Editor is E. Howitt.

* * *

RADIO CLUB DE PERNAMBUCO S/A

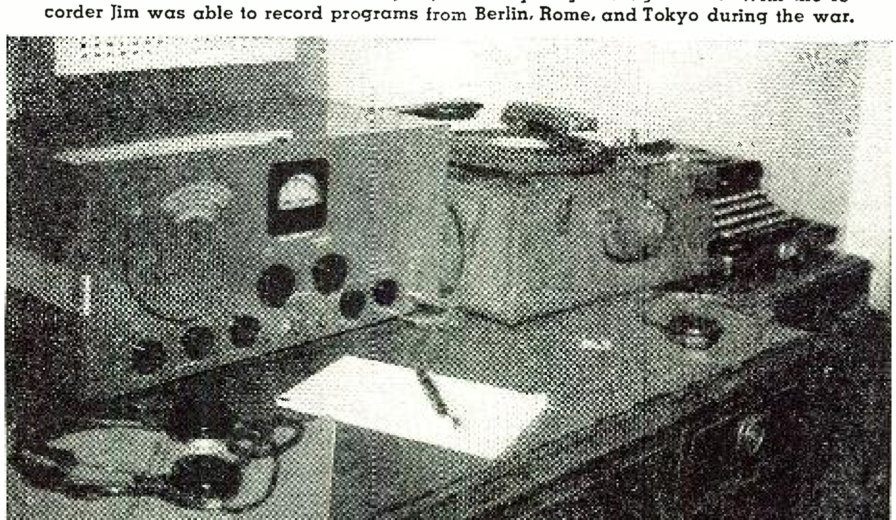
From Recife, Brazil, comes information about PRA-8, Recife, Pernambuco, Brazil, of the Radio Club de Pernambuco S/A:

PRA-8 operates on 6.015 (49.87 m.) on SW and on 720 kcs. (416 m.) on BCB, all days, 8 a.m. to 11 p.m. (6 a.m.-9 p.m. EST), in the Portuguese language. While there are no programs in English, the Director-Presidente of the Radio Club de Pernambuco S/A, who sent along this data, suggests that listeners in the United States and Canada might well listen to the studio programs between 6-9 p.m.

Location and address, Avenida Cruz

(*Continued on page* 70)

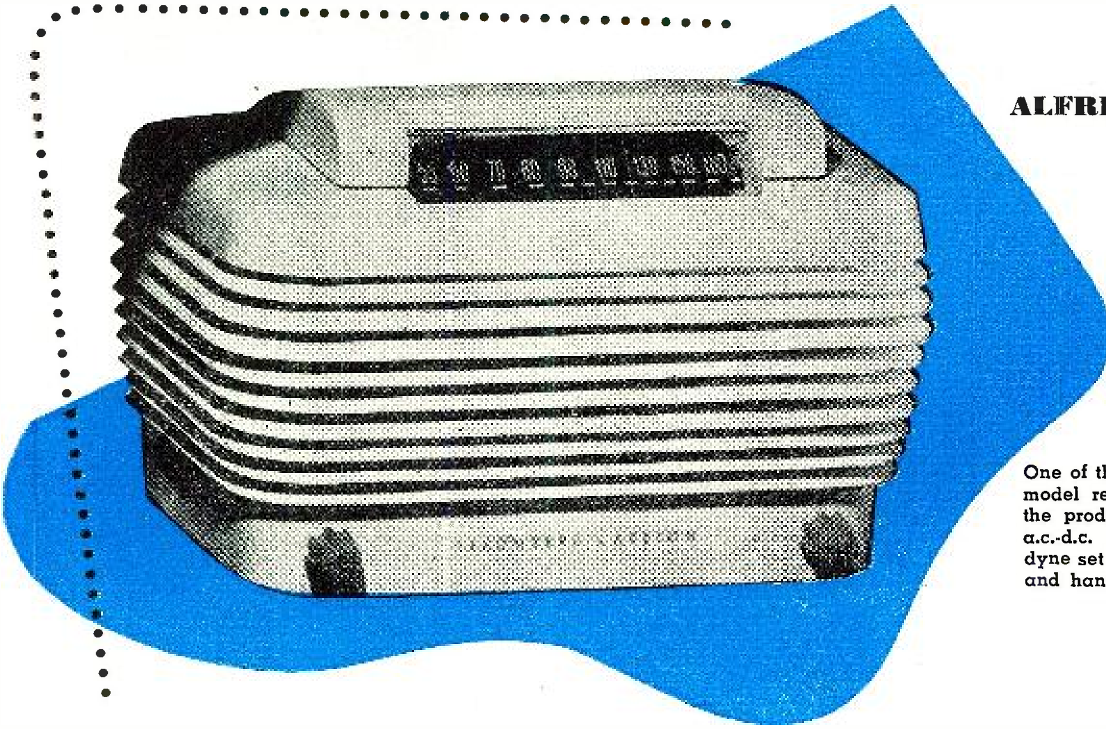
This neat corner is the SWL Post of Jim Johnson, young Chicago DXer. With the recorder Jim was able to record programs from Berlin, Rome, and Tokyo during the war.



Unless otherwise indicated, all time referred to herein is Eastern Standard Time. (EST).

Practical RADIO COURSE

By
ALFRED A. GHIRARDI



One of the many new 1946 table model receivers that will be off the production line shortly. This a.c.-d.c. operated superheterodyne set features a combined dial and hand-hold at top of cabinet.

Part 43. Analysis of automatic frequency control, as employed for adjusting oscillator frequency of superheterodyne receivers to its correct value.

AN ENTIRELY different approach[1] to solution of the problem of providing correct oscillator frequency in the superheterodyne lies in the use of automatic frequency control (abbreviated AFC). A more correct name would be "automatic tuning correction control."

AFC provides a means by which the oscillator frequency is automatically adjusted or "pulled in" to the correct value required to make the i.f. carrier frequency exactly equal to that for which the i.f. amplifier is designed—all this, *after* the receiver tuning circuits have first been approximately tuned to the desired signal. Consequently, AFC operates in such a manner as to keep the oscillator frequency dead accurate at the required value for the signal being received. If the receiver ever happens to be so tuned (either manually, automatically, or due to oscillator frequency "drift") that the oscillator frequency is, say, 4 kc. too low or too high for proper reception of the signal being received, then the AFC comes into operation and automatically increases or decreases (whichever is required) the oscillator frequency by the required 4 kc. so that the frequency of the intermediate carrier produced in the mixer or converter tube and passed on to the i.f. amplifier will lie exactly at the center of the pass-band of the sharply-tuned i.f. amplifier in which most of the amplification of the receiver is produced.

The control action that AFC exerts on the frequency of the oscillator makes it useful for correcting oscillator frequency drift caused by temperature change or anything else. It is particularly useful (when its cost is not prohibitive) in receivers employing any of the various types[2] of push-button systems. In these, the tuning may not remain quite accurate over extended time periods, and AFC may be used effectively to carry out the final adjustment of the oscillator frequency after the respective tuning capacitances and/or inductances have been selected by the automatic tuning system. Therefore, when AFC is used in such receivers, absolute accuracy of the mechanical and electrical parts and adjustments of the oscillator portion of the push-button controlled tuning system is not required, because (within certain limits) the automatic correction corrects any possible oscillator tuning errors due to such imperfections.

Essential Parts of AFC Systems

The adjustment of the oscillator frequency can be performed in several ways, by means of an *oscillator control stage,* usually employing a tube.

Obviously, however, this control stage must be supplied with some sort of signal which indicates to it whether the oscillator frequency is correct for the particular desired signal being received, and if not, what the amount of the error is and in what direction it lies. The part of the AFC system that performs this service is called the *frequency discriminator,* and usually contains a tube with accompanying circuit network.

The AFC system is composed then of two essential parts:

1. The frequency discriminator.
2. The oscillator frequency control.

The functional block diagram of Fig. 1 shows the various parts of a superhet equipped with AFC, and the relation of the discriminator and the oscillator frequency control to the other parts of the receiver. It will be noticed that the discriminator stage is fed by a branch circuit from the i.f. section of the receiver proper.

The Frequency Discriminator

The function of the frequency discriminator is to develop a d.c. voltage that is proportional to the *extent* that the i.f. carrier (and the oscillator fre-

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[1] See PRACTICAL RADIO COURSE, Part 42, March, 1946, issue of RADIO NEWS.

[2] For an explanation of the various push-button tuning systems, see Part 39, PRACTICAL RADIO COURSE in the December, 1945, issue of RADIO NEWS.

quency) differs from the required value, and whose polarity is dictated by the *direction* of this departure. When the oscillator frequency (and i.f. carrier frequency) is correct, the voltage output from the discriminator should be the same as that existing in the absence of signal. At frequencies above or below the correct frequency, the controlling voltage should be appropriately above or below the mean voltage. Normally, the discriminator is placed in the i.f. circuits of the receiver after the last i.f. amplifier tube, and comprises a specialized form of selective circuit combined with two differentially-connected diodes, the complete circuit giving the characteristic "S" type frequency-response curve illustrated in Fig. 2.

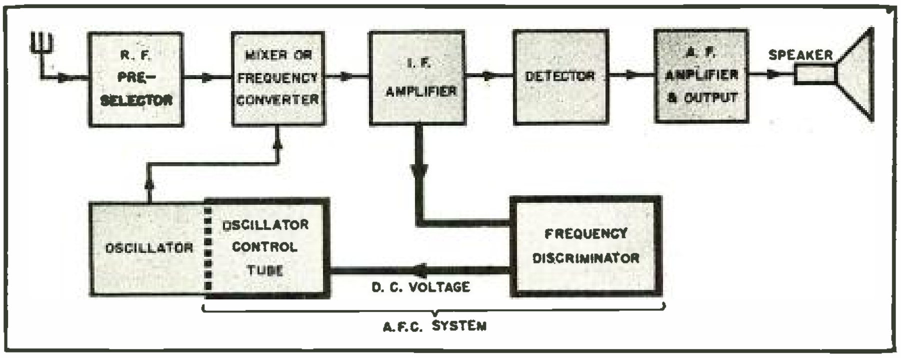


Fig. 1. Block diagram of a superheterodyne receiver provided with AFC. Notice that part of the i.f. is fed to the discriminator. This actuates the oscillator frequency control circuit, pulling the oscillator frequency to the value required for the frequency of the particular signal that the receiver has been tuned to receive.

The Detuned-Circuit Type of Frequency Discriminator

Two well-known frequency discriminator circuits (and slight modifications of them) have been developed for deriving the d.c. control voltage. That illustrated in Fig. 3 is called the Round-Travis circuit, after its inventors. It makes use of a primary circuit L_3C_3 tuned to the i.f. and coupled symmetrically to two *tuned* input circuits, one of which (L_1C_1) is tuned to a frequency *above* (at least 1%) the i.f. peak of the receiver (to which L_3C_3 is tuned), and the other of which (L_2C_2) is tuned to a frequency *below* the i.f. peak by the same amount. In the illustration shown, the i.f. peak is 455 kc., and these two input circuits are tuned to 460 and 450 kc., respectively. Consequently they both are *detuned* an equal amount from the correct i.f. peak of the receiver. Each tuned input circuit is connected to a diode, forming a complete rectifying system by itself. Equal resistors R_1 and R_2 are connected across the diode outputs. The diode direct currents flowing through these resistors are in opposite directions, so the voltage drops across them are of such polarity as to buck each other.

Whenever the oscillator frequency is correct, the i.f. carrier will have the correct frequency value of 455 kc. Under this condition, tuned circuits L_1C_1 and L_2C_2 will be equally detuned from the i.f. carrier, so equal i.f. voltages will be set up in them and will be applied to the two diodes. The diode currents flowing through R_1 and R_2 will be equal, and, bucking each other, the net voltage across the complete diode output circuit will be zero. This means that point *A* will be at the same potential as ground. Consequently, no d.c. control voltage will be fed to the grid of the oscillator control tube which follows, so the oscillator frequency will not be influenced.

If the oscillator frequency drifts from the correct value for any reason whatsoever, the i.f. carrier frequency will change correspondingly, so one of the tuned input circuits will be less mistuned to the i.f. carrier and the i.f. voltage appearing across it will increase. The other will be correspondingly more mistuned to the i.f. carrier, so the i.f. voltage appearing across it will *decrease*. As a result, the two diode currents become unequal, and the voltage across one output resistor becomes greater than that across the other. Accordingly, the potential of point *A* becomes either positive, or negative, with respect to ground by an amount equal to the difference between these two voltages. Since *A* is connected to the grid of the oscillator control tube this varies the control-grid bias potential of this tube. Just how this variation of its grid potential is translated into the required control of the oscillator frequency will be explained later when the various types of oscillator frequency control circuits are explained.

Variations and slight misadjustments, developing in the course of time, of the fixed resonant frequencies to which the two input circuits L_1C_1 and L_2C_2 are adjusted must be allowed for. The further apart the two circuits are tuned, the less will such changes affect the AFC. For this reason, these two resonant frequencies should be made *not less* than ±1% off the intermediate frequency for which the receiver is designed.

The Round-Travis discriminator circuit has not found wide application in commercial receivers because other circuits which produce essentially the same results and possess certain distinctive advantages are available. However, the operation of this circuit

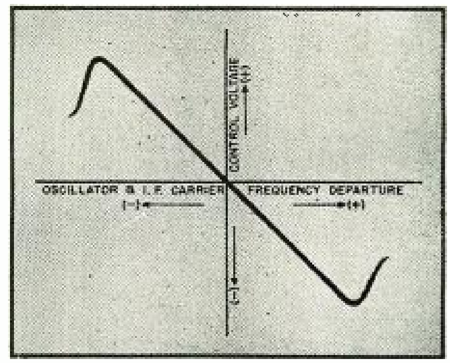


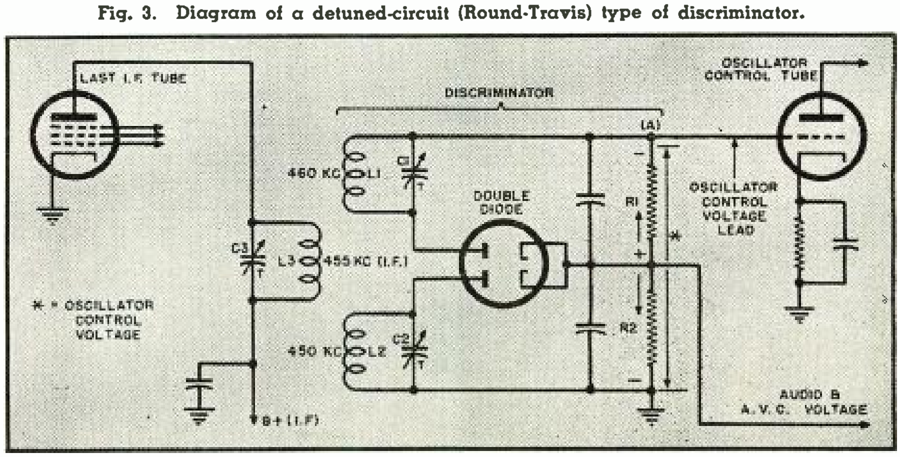
Fig. 2. Typical "S" shaped response curve of the discriminator. The curve represents the combined voltages across R_1 and R_2 (Figs. 3 and 4) for various values of oscillator and i.f. carrier frequency departure from correct values.

is of technical interest because the more complicated discriminator circuits embody the same fundamental principles.

The Foster-Seeley Discriminator

The second discriminator circuit, one that has been used in the majority of AM receivers employing AFC, is illustrated in basic form in Fig. 4. It is called the Foster-Seeley circuit, after its inventors. It will be observed that the two diodes are fed by an input circuit containing an i.f. transformer consisting of a primary, L_3, loosely coupled to a center-tapped secondary, (L_1L_2). Both the primary and second-

Fig. 3. Diagram of a detuned-circuit (Round-Travis) type of discriminator.



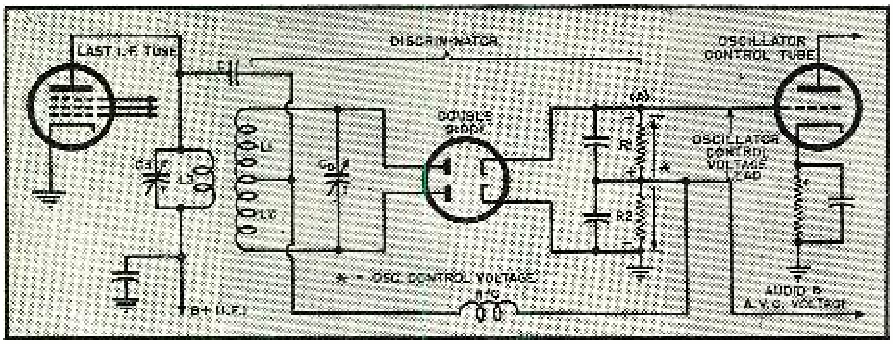


Fig. 4. Diagram of the often used Foster-Seeley discriminator circuit.

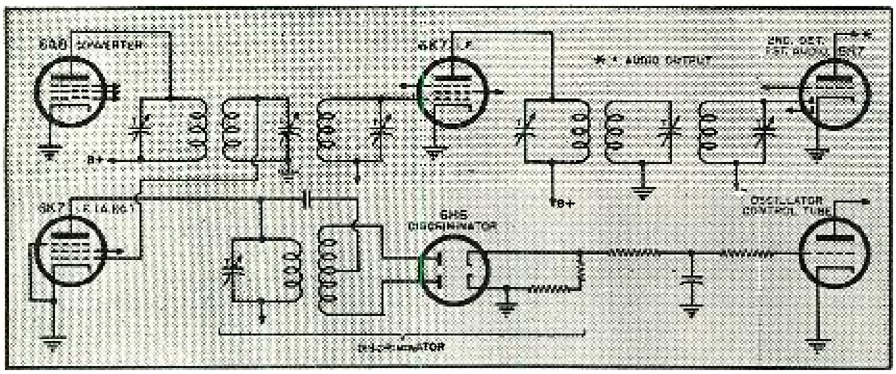


Fig. 5. AFC circuit employed in the Crosley Model 1316 receiver. Note that a separate i.f. channel is used which feeds directly to the 6H6 discriminator.

ary are accurately fixed-tuned to the i.f. employed in the receiver. The secondary feeds the double-diode discriminator tube. This is usually a special double diode having two separate cathodes—such as the 6H6 type. The resistance network in the output circuit of the diodes is very similar to that employed in the Round-Travis type of discriminator illustrated in Fig. 3, and the rectified output (osc.-control) voltage is the difference of the rectified outputs of the individual diodes.

The operation of the Foster-Seeley discriminator is based on the phase difference that exists between the primary and secondary in coupled tuned circuits. As the actions taking place in it are rather complex, space limitations prevent a detailed discussion of them here. The brief explanation which follows will suffice for our purpose.

If an i.f. carrier of the resonant frequency flows through the primary of the two loosely-coupled circuits which are tuned to the same frequency, the voltage developed across the secondary, L_1L_2, differs 90° in phase from the voltage across the primary, L_3. The potentials acting on the plates of the diodes are then of equal magnitude. However, if the frequency of the i.f. carrier deviates slightly from the resonance frequency, the phase difference between the induced secondary voltage and the primary voltage becomes greater or less than 90°, with the result that the r.f. voltage applied to one diode plate becomes *larger* and the voltage to the other plate becomes *smaller*. The result is a rectified differential output voltage developed across the load resistance R_1R_2 (as explained previously for the Round-Travis discriminator), making point *A* negative with respect to ground if the incoming intermediate carrier frequency is too high, and positive if it is too low (or vice versa). As before, point *A* is connected to the control-grid of the oscillator control tube, so whatever *net* voltage is developed across R_1R_2 varies the control-grid bias potential of this tube. The control voltage developed varies almost linearly over a considerable range of intermediate carrier frequency deviation from the correct value. If the frequency of the intermediate carrier happens to be dead correct, no control voltage is produced across R_1R_2, and the oscillator frequency is not influenced.

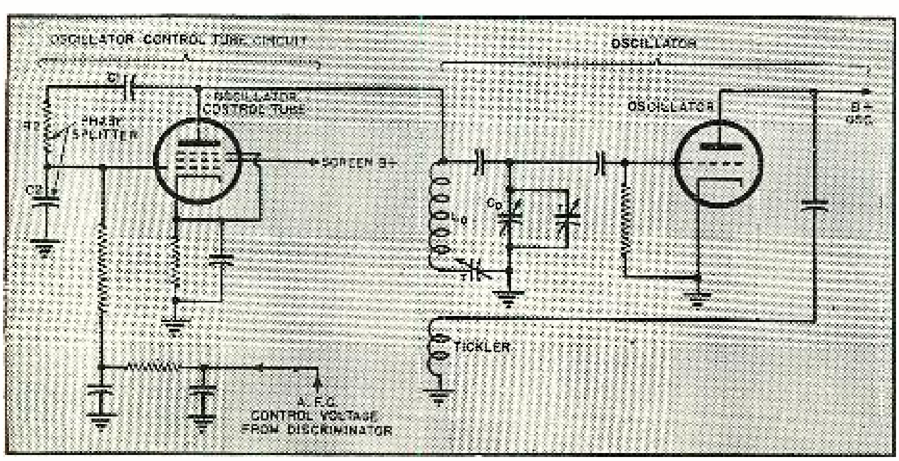
The Foster-Seeley discriminator circuit is easier to align than is the Round-Travis discriminator since all the circuits are adjusted to resonate to the exact intermediate frequency. The discriminator secondary does not aid signal amplification, and is in a condition of absorptive resonance. Also, it does not contribute to the overall selectivity of the i.f. circuit of the receiver, so one extra tuned circuit is usually needed to regain the same order of selectivity as compared with a similar receiver not employing AFC.

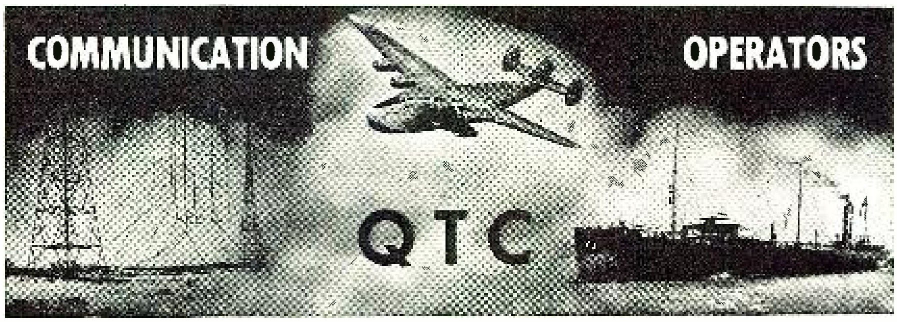
When the AFC channel is to be made broad without causing corresponding reduction in the regular i.f. channel selectivity of the receiver, the arrangement shown in Fig. 5 may be used, splitting to two separate channels for i.f. amplification and discrimination. Here, the regular i.f. channel does not feed the AFC circuit directly. Instead, the grid of another 6K7 tube, arranged as an i.f. amplifier tube, is fed from an extra secondary winding on the first i.f. transformer of the regular i.f. channel, the output of this 6K7 stage feeding directly into a conventional Foster-Seeley type discriminator employing a 6H6 double-diode tube.

As indicated in the circuit diagrams, the discriminator circuits of Figs. 3 and 4 can be made to provide the audio and also AVC voltage, as well as the AFC control potential. However, the detector output represents a somewhat distorted reproduction of the modulated wave because of the asymmetric action of the discriminator with respect to the two side bands. Accordingly, when high fidelity is important, it is customary to employ a separate diode detector, as shown in the arrangement of Fig. 5, for developing the audio output. If the separate-channel arrangement of Fig. 5 is not employed, the detector tube may be fed by an extra secondary provided in the discriminator input transformer.

(*Continued on page* 102)

Fig. 6. Basic oscillator control tube circuit applied to a simple plate-tickler type oscillator. C_2 and R_2 form the phase-splitter circuit, and blocking capacitor, C_1, keeps the d.c. voltage from the grid of the control tube.





By CARL COLEMAN

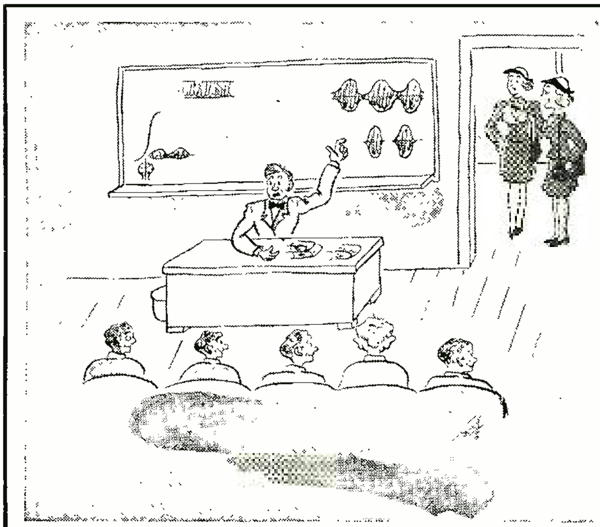
THE U. S. Maritime Commission reported recently that 604 American merchant vessels of 1000 tons or more were lost through direct enemy action and that 139 more were sunk as a result of wartime marine hazards. . . . American President Lines reported that trans-Pacific service will be resumed within the next few months. Four large passenger liners will provide 2000 passenger accommodations and will operate on a sailing schedule of every fourteen days from San Francisco and Los Angeles. American South African Lines have recently launched their "African Star," first of a fleet of six new fast freighters of the modified C-3 type of 12,555 dwt. with accommodations for twelve passengers. The six new ships will provide passenger and cargo service between here and Cape Town, Port Elizabeth, East London, Durban and other points. The vessel now being fitted out will be placed in service early in April, it is expected. The Grace Line is also reported to have a total of nine, either built or building, of the modified C-2 class combination passenger-cargo vessels. Moore-McCormack Lines are reported to be under way with plans for two large passenger vessels and four smaller units of the cargo-passenger type for use in its Scandinavian services. With all this new construction is it any wonder that the Libertys are being tied up at the 'lay-up' points along all coasts having served their purpose and being too slow for postwar cargo carrying.

SECRETARY of the Navy Forrestal, in his annual report to the President, said the active postwar fleet will include 3,627 aircraft, thirteen big carriers, the same number of escort carriers, but only four battleships, twenty-eight cruisers, one-hundred and thirty-five destroyers, thirty-six destroyer escorts and ninety submarines. Forrestal reported that the Atlantic Fleet under Admiral Jonas H. Ingram will be about one half the size of the Pacific Fleet under Admiral Raymond A. Spruance. Others of the Navy's warships will be divided between a "ready reserve" and a "laid up reserve." The peacetime personnel is to be composed of a force of 58,000 officers and 500,000 men.

ELTON JONES and Russel Werner are both recent additions to the shore staff of W. C. Simon's Tropical Radio Service Corp. in New York. . . . E. F. Dondajewski running regularly out of New York in the West Indies trade. . . . F. Bishop in recently aboard "Belle of the West." . . . The Santa Marta sailed with Pat O'Keefe, a real old timer as chief. . . . Maurice Reller is Pat's new 2nd. . . . Donald Gilmore making short runs to the islands and return during the past few trips. . . . James Sherman was in recently aboard his Liberty. . . . J. Victor Stout is now chief aboard the Freeport Seam, after having spent several months on a troop carrier and reports the new craft a big improvement over the older type vessels. . . . Alexander Pierce in recently aboard his Liberty for a short stay. . . . Nice letter from W. R. Gates down in the Gulf with the following: "The Mississippi Shipping Company have three new super-duper passenger ships to be delivered by the Ingalls Shipbuilding Co., for delivery early this spring and will be placed in the New Orleans-Houston-South American runs and are equipped with Radar, and Sparks will be called on to keep it in operation along with the D.F. Telephone and Telegraph Transmitters, Fathometer etc." . . . "Scotty" Gould again back at the old stand pounding brass for the Detroit Police after a year's assignment on the Geo. W. Woodward. . . . Ernie Baccarri on a 'Great White Fleet' banana run. . . . Rumor has it that the ever popular old timer, Madison Monroe has been elected prexy of Port Arthur College. Stanley 'Dusty' Rhoads expects to leave WNU to ship out soon. . . . We also understand that United Fruit Company is having two new ships designed for passenger service which will maintain that outfit's peacetime demands for some of the finest ships afloat. UFCO's new cargo ships of which some are already in service are really something to talk about with their yacht-like appearance and comfortable quarters. . . . Bill Lamson about to start out in marine or aviation radio after three years in the AAF as a flight radio operator. . . . John McCurdy, five years in the Army, is out now looking for a job in civilian radio.

FRANCIS CULLEN in recently with his craft after another "ferry" run down among the islands. . . . Rufus Lea took out the Rolling Hitch. . . . John Scott was in New York for some time recently while his Liberty was overhauling. . . . John Largent assigned to a Victory in the Matson Line. . . . John Faiola, W. Connors and S. Allen aboard a Liberty. . . . Charles Morell expecting to get into marine radio operating shortly.

With all the talk and some action being taken in postwar cargo and passenger tonnage under construction for a modern U. S. merchant fleet it must be kept in mind that to make this a success it will be first of all necessary to get the customers, both passengers and those shipping freight, to 'Ship American'—commercial freight and passenger traffic from this country during peace times is usually high, the average American wants to travel and see how the other half lives, but in the past a large portion of this business of both types has gone to foreign shipping companies. . . . Both U. S. steamship and plane outfits must get this business if this country's shipping interests are to prosper, such will of course also help American workers by employing American crew members. One big factor in this respect compared to the prewar set up is the fact that now the United States has the world's finest planes and ships, both for cargo and passenger traffic on a world-wide operating basis. After the last war the major portion of the American traveling public patronized foreign steamship lines, to the detriment of U. S. lines and ships; this was due in great part to the better ships (*Cont. on page* 107)



"And now, gentlemen, we shall commence the study of a most interesting subject—waveforms."

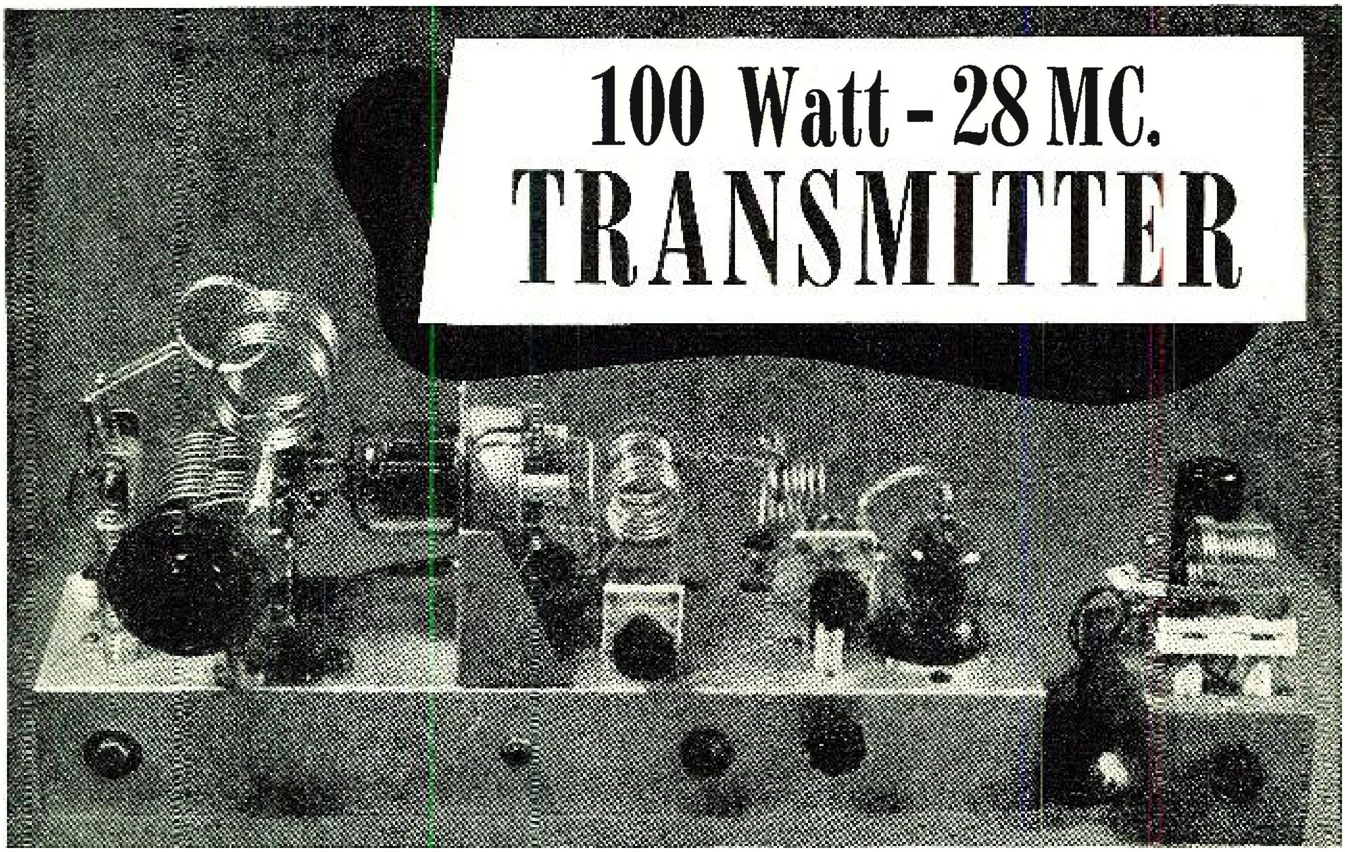


Fig. 1. Although home built and without a panel, mechanical rigidity and electrical efficiency compare favorably with commercial units.

By NICHOLAS LEFOR, W2BIQ

Employing war-born 829B tubes, this rig is ideal for amateur use on recently reopened 28 mc. phone band.

PRIOR to December 7, 1941, a date sooner to be forgotten than remembered, amateurs were content to utilize the common type of triodes, pentodes, and tetrodes, available at that time. The uncommon type of beam tubes, including the 829, were tubes designed more for laboratory use than general use.

The war effort has brought forth the 829, the 829A, and subsequently the 829B, which suits general amateur application more than at first is apparent. Examining the operating characteristics of the 829B, one finds that this tube will supply a fairly decent output with good efficiency at the amateur frequencies. This output is supplied at a minimum of expense since the drive requirements are extremely low, driving power being only 0.9 watts for maximum efficiency at 200 mc. Other considerations are freedom from neutralization, minimum power requirements, and its universal application as described herein, amplifying its use as doubler or quadrupler.

Since the 28 mc. phone band had just been returned to the amateur, it was decided that a rig utilizing the 829B in its wider application would be used. Its application, as described, will undoubtedly suggest numerous applications of this tube. It was decided to put the 829B to work as push-push doubler driving an 829B amplifier.

The crystal oscillator unit is shown in Fig 1 at the right. The crystal unit is a plate grid oscillator, which functions equally well as a fundamental crystal oscillator utilizing a 20 meter crystal, or doubling in its plate circuit with a 40 meter crystal.

Operated in the manner as shown, the crystal oscillator will deliver approximately the same power with either a 20 meter or 40 meter crystal. Power output from this unit is more than sufficient to excite the 829B as a doubler or quadrupler. Consulting the schematic of the crystal oscillator will show that this circuit is quite common and requires no great detail, (Fig. 3).

The main r.f. unit containing the 829B push-push doubler or quadrupler and the 10 meter final is mounted on a 2½" x 4" x 18" aluminum chassis. The push-push doubler is mounted on the right of the chassis with its input circuit beneath the chassis. The grid of this tube is resonated on the fundamental of the driver. In this case the grid is resonated on 20 meters. The plate circuit of this doubler is tuned to 10 meters. Power output on this frequency is more than sufficient to drive the 829B amplifier. The push-push doubler output, as shown, is sufficient to drive a ½ kw. c.w. final to full output. As will be noted, all stages utilize link coupling. The advantages of link coupling from stage to stage are readily apparent to all amateurs, in ease of adjustment of drive, minimum reaction on preceding stages, and servicing requirements being at a minimum.

The socket used for the 829B final is one of the type which has the bypass condensers built in as an integral part of the socket. While this is necessary in equipment built to operate above 60 mc., a standard socket may be used in this rig with no ill effects.

The 10 meter final occupies the greater portion of the left hand side of the chassis. A special bracket was constructed, as shown in the photograph, to support the 829B final. This construction lends itself admirably to short leads. While this tube normally requires no neutralization, various physical layouts of this final may find a slight amount of r.f. getting through to the final tank circuit. Such was the case in this layout. Neutralization is accomplished by the short leads of No. 14 wire, shown alongside the plate elements of the 829B final. These leads are installed on the top of each plate element and cut ½" at a time until all r.f. ceases to be present in the final r.f. tank circuit. Neutralization is, of course, effected with the plate voltage removed from the final stage.

The antenna is coupled to the final by the link, as shown, on the extreme left hand side of the chassis.

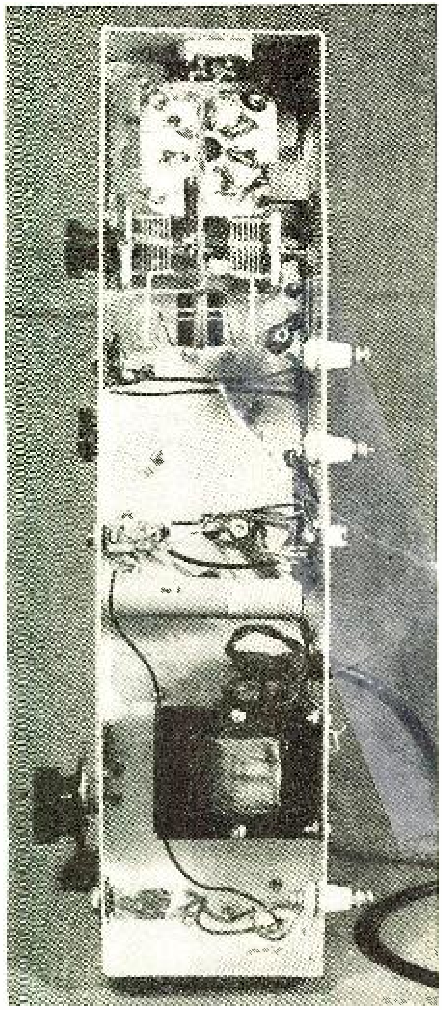
All circuit constants were designed to have optimum efficiencies on the recently opened 28 mc. phone band.

Examining Fig. 2 the 20 meter grid push-push coil is shown mounted directly on its grid tuning condenser. This coil may be a 40 meter coil with the plate circuit quadrupling to 10 meters. The filament transformer, as shown, operates all filaments. This is possible due to the complete isolation afforded by proper bypassing of filaments and cathode operation of the tubes in this r.f. lineup. Resistor values were carefully chosen as to optimum performance and should be strictly adhered to.

In Fig. 3, as shown, both crystal stage and push-push doubler are operated from the same power supply. Corresponding terminals, as indicated, are connected together. As will be noted, the number of resistors and condensers have been kept to a minimum. Metering is accomplished in the respective cathode circuits of the 829B tubes.

The 829B, being a tube of high power sensitivity, will, unless its plate and screen are operated at its correct values, give indication of double resonance and other effects. If operated at high values other than those recommended by the tube manufacturer the tube will indicate creeping plate, grid, and screen currents, and unless controlled, will

Fig. 2. Main r.f. assembly. This unit is built on a separate chassis from that of the crystal oscillator section. →



eventually ruin the tube. An overexcited grid on the 829B will cause the grid to emit electrons and subsequently burn the grid of the tube and also ruin the tube. This all may be overcome by operating the tube well within its rating.

The dividends of operating this tube within its rating will be well worth the effort by continued performance of this remarkable tube.

If construction is carefully carried out, no difficulty should be experienced in obtaining optimum performance from this transmitter. No bugs should be encountered if reasonable precautions are observed, and all leads made as short as possible.

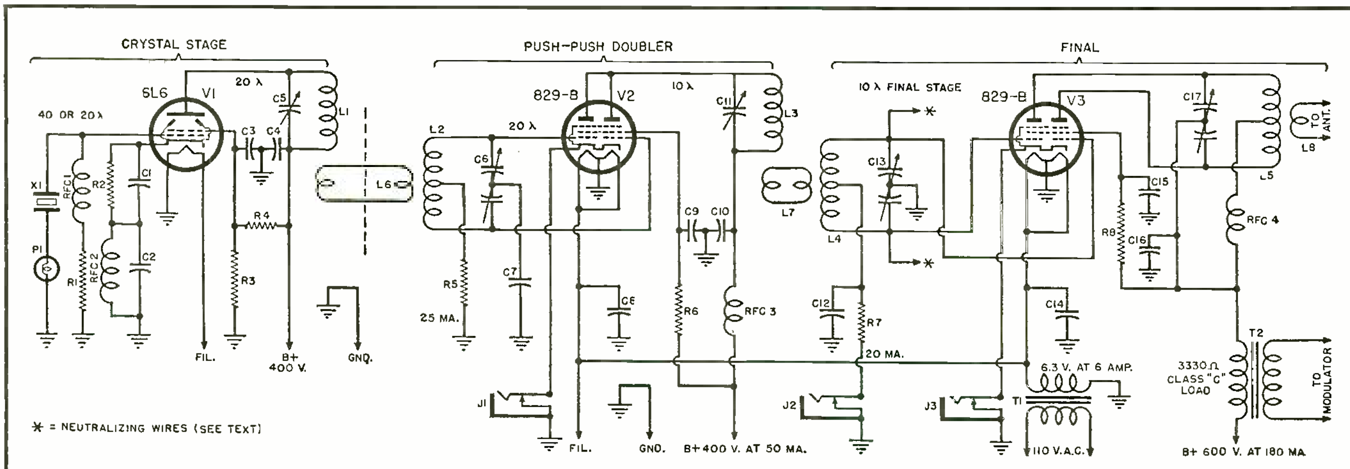
Correct operating conditions of these tubes are shown in the schematic diagram, Fig. 3. The 829B operating as a push-push doubler requires higher drive and subsequently greater wave distortion in its grid and plate circuits. This is of no consequence since it acts as a buffer and driver. About 25 grid mils is required for this tube. The same value is sufficient for the 829B final, operating as a modulated Class "C" stage. Screen voltage should hold to a maximum of 250 volts on both stages.

Any modulator capable of furnishing 50 watts of audio may be used as a modulator. An 815 operating in class "AB_2" with 500 volts on the plate, and a plate-to-plate load of 8000 ohms, will be ideal for this purpose. Such a unit may be easily constructed.

While the physical design of this layout gives a compact 100 watt transmitter, it leaves a wide latitude for amateur design. However, the technical considerations are fundamental and should be considered in applying this tube to amateur applications.

—30—

Fig. 3. Schematic diagram of the crystal oscillator and r.f. section. An 829B is used as a push-push doubler driving an 829B amplifier.



R_1, R_3—15,000 ohm, 1 w. res.
R_2—200 ohm, 5 w. res.
R_4—30,000 ohm, 10 w. res.
R_5—15,000 ohm, 10 w. res.
R_6—10,000 ohm, 10 w. res.
R_7—7500 ohm, 5 w. res.
R_8—15,000 ohm, 20 w. res.

C_1, C_3, C_4, C_7, C_8, C_9, C_{12}, C_{14}—.001 µfd. mica cond.
C_2—.0001 µfd. mica cond.
C_5, C_{11}—50 µµfd. var. cond.

C_6, C_{13}—50 µµfd./sec. var. cond.
C_{10}—.005 µfd. mica cond.
C_{15}, C_{16}—.0005 µfd. mica cond.
C_{17}—35 µµfd./sec. var. cond.

RFC_1, RFC_2, RFC_3—2.5 mh. r.f. choke
RFC_4—30 µh.r.f. choke

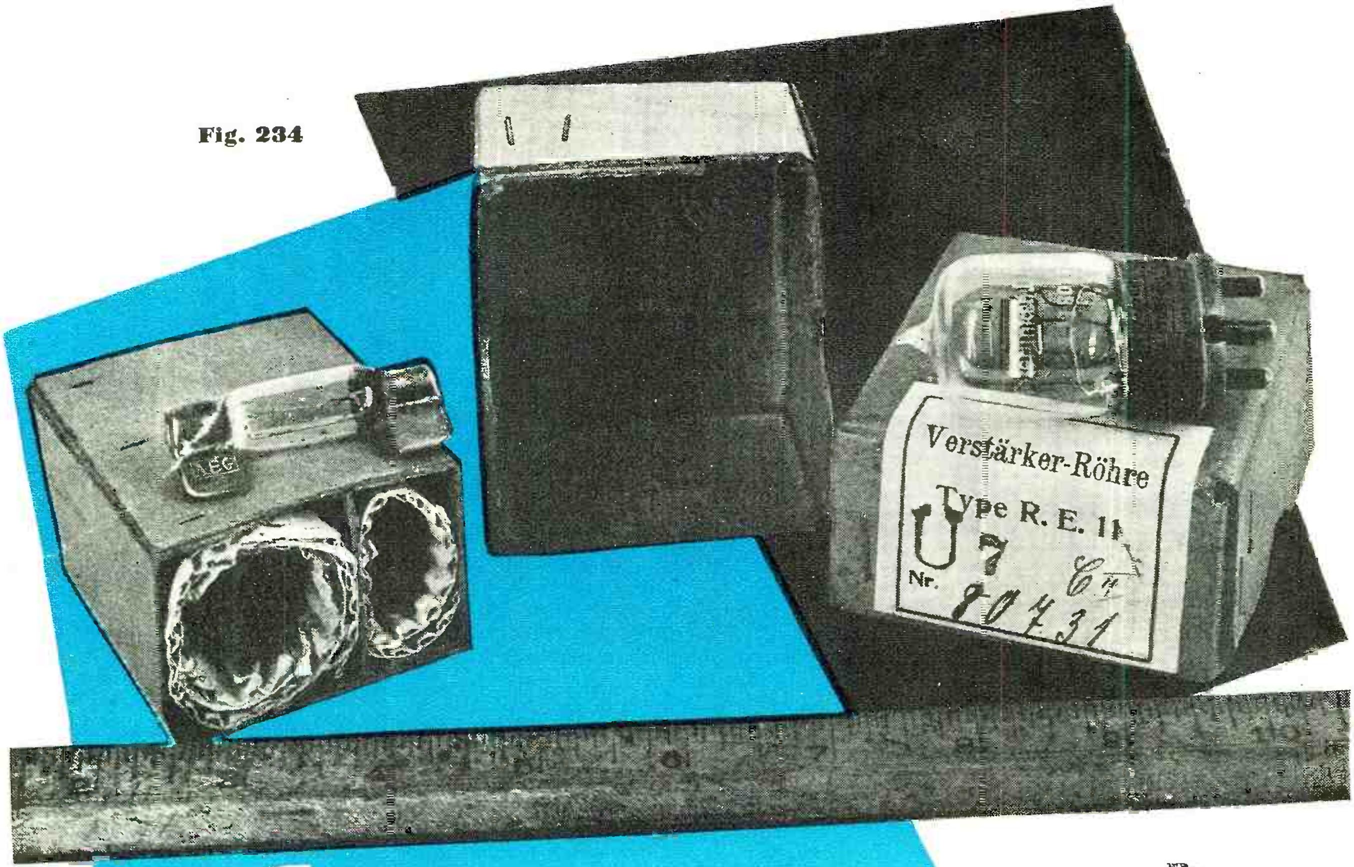
L_1—Exciter coil, National AR16-20E
L_2—16 turns, #20 e, center tapped, close wound, 1" dia. poly. form
L_3—6 turns, #14 tinned, 1¼" dia.

L_4—8 turns, #14, tinned 1¼" dia. c.t.
L_5—8 turns, #12 tinned, 2" dia. c.t.
L_6, L_7—2 turn link, 1¼" dia.
L_8—2 turn link, 1⅝" dia.
J_1, J_2, J_3—Single circuit, closed circuit jack

T_1—Fil. trans.
T_2—Modulation trans.

P_1—150 ma. pilot light
X_1—Crystal

Fig. 234



Saga of the VACUUM TUBE

By
GERALD F. J. TYNE
Research Eng.

Part 22. Concluding article of a historical series which has covered the development of the vacuum tube from its conception to the end of World War I.

NOT long after the EVE173 tube was put into production the system of nomenclature was changed and German receiving tubes were denoted by the prefix RE (= Rohre Empfanger), transmitting tubes by RS (= Rohre Sende), and two new prefixes came into being RG (= Rohre Gleichrichter) for rectifiers and RV (= Rohre Endverstarker) for output tubes.[312]

Probably the first of these tubes to be made in any quantity, 250 per day in 1918,[313] was the RE11, shown in Fig. 234. This tube like most of its predecessors was used with an iron wire ballast resistor in the filament circuit and one of these ballast resistors is also shown in the figure. This tube had a tungsten filament of about the same characteristics as the EVE173 (.55 ampere at 2.8 volts), but operated at an anode voltage of 40 to 70 volts and had an amplification factor of 8 and mutual conductance of 120-150 micromhos, slightly higher than that of the EVE173.[314] It was a general purpose tube.

Another general purpose tube, bearing a closer resemblance to the EVE173, was the RE16 shown in Fig. 244. This was used chiefly as a detector for c.w. work.[315] The extent of its use may be gauged by the fact that in the summer of 1918 *Telefunken* was producing them at the rate of 1000 per day.[313] It had a filament which took 0.5-0.6 ampere at 4.0 volts. The usual anode voltage was 65 and the mutual conductance about 200 micromhos, the internal resistance being about 24,000 ohms. This tube had about the same anode characteristics as the French tube described in the preceding installment although it required less filament power. The normal anode current was about 1 milliampere.

Triode tubes were also made during this period by other German manufacturers, among them *Huth,*[316] *Seddig,*[317] and *Auer.*[318] Some of these tubes are shown in Figs. 238 and 239. It will be observed that the *Huth* tube shown was of plane parallel electrode construction. Earlier *Huth* tubes used a cylindrical element assembly but *Huth* was compelled to change to the plane electrodes because of patent difficulties. The earlier *Huth* tubes bore RE numbers similar to those of *Telefunken,* but those with plane electrode systems were designated by LE numbers.[319]

It is during this period also that we find considerable research effort being expended in Germany on the multiple electrode tube. It was early realized by Dr. Walter Schottky[320] of the *Siemens & Halske Company* that there were limits to the amplification which could be attained by the use of a triode

Fig. 235

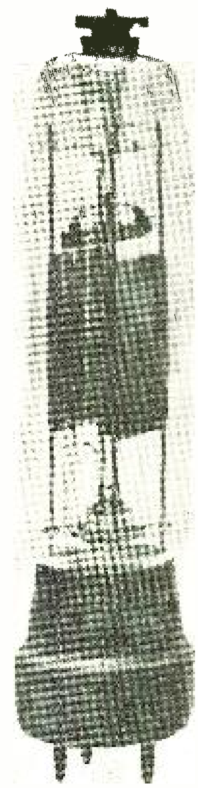


Fig. 236

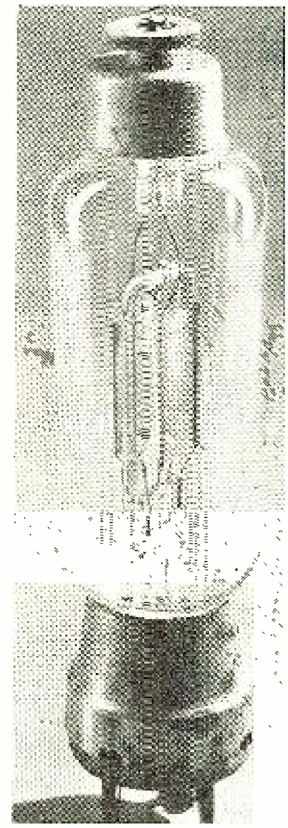


Fig. 237

and he set out to devise a tube which would be capable of high amplification with the low anode potentials available in Army field equipment.

Accordingly he investigated the possibility of modifying the high vacuum triode by the insertion of additional electrodes. He patented the space charge principle in 1915[321] and the "protective network" type in 1916.[322] His first patent on a multiple electrode tube was German patent D.R.P. 300617, issued June 1, 1916, and covered a tube designated by Schottky as a "protective network" (Schutznetz) type. Another patent, D.R.P. 300192 issued June 21, 1916, covered another double grid arrangement. Patent D.R.P. 300191 for a tube having a space charge grid in which both grids were characterized by being composed of strips of sheet metal placed with edges toward the cathode was issued on January 24, 1917.

The first production of the multiple electrode Schottky tubes were tetrodes of the protective network type, known as the SSI, SSII, and SSIII. While the protective network was a grid inserted between the control grid and the anode these tubes differed from the modern "screen-grid" type in that no attempt was made to use the additional grid to minimize the electrostatic capacitance between the anode and the control grid. This difference is relatively unimportant for low-frequency work, but is of great importance in high-frequency applications. As Schottky himself pointed out, his tubes were not suitable for use at high frequencies.[323]

The early model and later quantity-production type of the SS tubes are shown in Fig. 241. Fig. 241 (left) shows the earliest construction of this type. The electrode assembly was cylindrical, the grids were of the "squirrel cage" type, and a double press was used. The electrodes were slotted so that it was possible to insert the filament assembly into the electrode assembly after fabricating the two separately. Fig. 241 (right) shows a single-ended production type tube with glass "star" as the support of the electrode system.

The SSI was first manufactured in 1917. It had a filament which operated with 0.4 ampere at 2.4 volts. The anode potential was 35 volts and the potential of the protective network was 15 volts. When so operated it gave an amplification of about 50 and had a mutual conductance of 250 micromhos.

The SSII, also known as the RE97,[324] was a lower powered, lower gain tube, operating with a filament current of 0.24 ampere at 1.9 to 2.2 volts, and with 10.5 volts on both the anode and the protective network. It had an amplification factor of 30 and mutual conductance of 30 micromhos.

The SSIII, also known as the RE114, drew a filament current of 0.55 ampere at 3.2 volts and operated with 120 volts on the anode and 45 volts on the protective network. It had an amplification factor of about 100 and a mutual conductance of 250 micromhos. The internal resistance was about 250,000 ohms.

Tubes of the space-charge grid type were also manufactured during this period. Typical examples of the smaller ones are the *Telefunken* RE20 and RE26, shown in Fig. 242. Both these tubes had tungsten filaments operating at 0.5 ampere at 2.8 and 4.0 volts respectively. They operated at 12 to 18 volts on the anode and space charge grid, had an amplification factor of about 8 and mutual conductance of about 350. Since they had 5 prong bases they required special sockets.

Larger tubes of the space-charge grid type were also developed and Fig. 243 shows the development series of one such tube. Figs. 243(A) and 243(B) show the early models. The grids are of wire netting. The space charge grid is small in diameter while the control grid is very close to the anode. Fig. 243(C) shows a production type tube of the vintage of 1919, still with the double press, Fig. 243(D) illustrates the final construction which was put into production about 1920.

Combination space charge and protective network tubes with three grids were also developed and some of these are shown in Fig. 245. The tube at the left is an experimental type with three grids using a double press and slotted electrodes. That at the right is a production type similar to the SS series.

In parallel with the work on receiving tubes *Telefunken* and the other German concerns had also been carrying on the development of transmitting tubes. The first of these to be made in quantities was the RS1, shown

Fig. 238

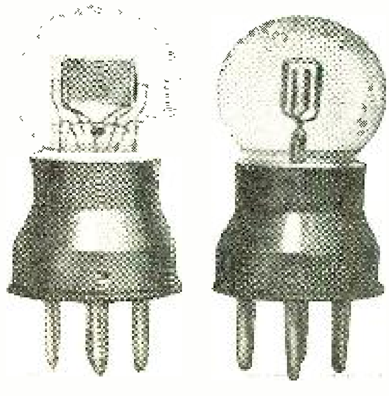
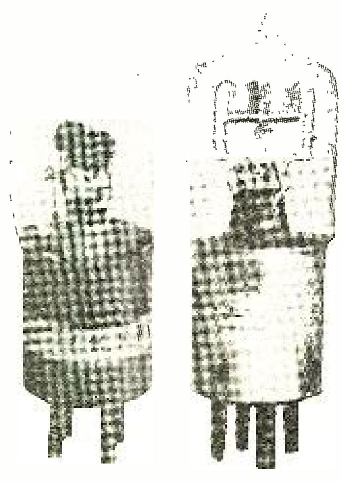


Fig. 239



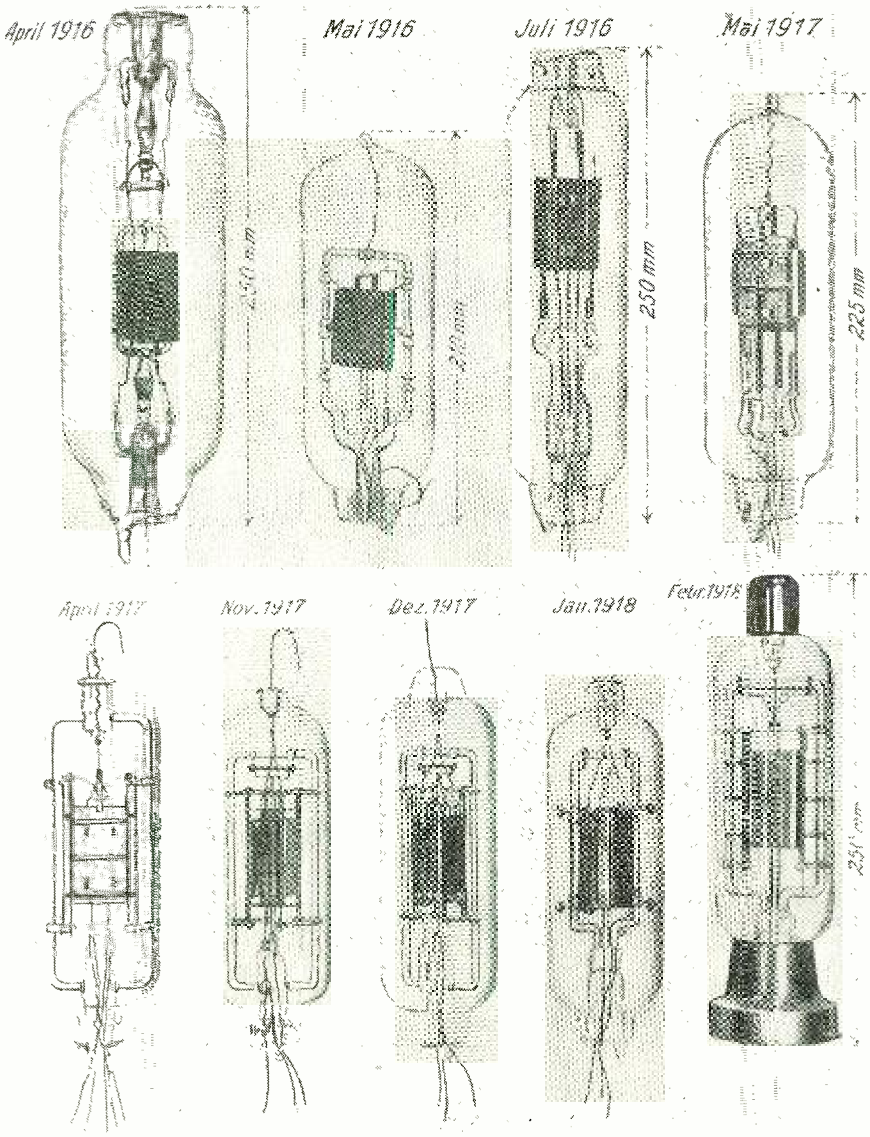


Fig. 240

in Fig. 235. It gave about three watts output when operated with 400 volts on the anode, in the apparatus in which it was first used, an Army trench transmitter. It was capable of operation at higher anode voltages, and at 600 to 800 volts would put out 10 to 20 watts.[325] The RS2 and RS3 were of no particular importance. The RS4 was a higher powered tube giving 50 to 75 watts output at 1000 to 2000 volts on the anode, and had a filament which took 3 amperes at 9 volts. The RS5, shown in Fig. 236, was an RS4 with improved characteristics. It took a filament current of 3 amperes at about 8 volts. The successor to the RS4 was the RS17, the evolution of which is shown graphically in Fig. 240.

All these transmitting tubes were characterized by the excellent glass work shown in their internal construction. This construction was common to all of the small transmitter tubes of early German manufacture, and is again exemplified in the TKD ST-12 shown in Fig. 237.[326] This tube again shows the effect of metal shortages. The interior portion of the base, in which the connecting pins are mounted, is of wood and the shell is of iron, with a poor nickel plate.

This series of articles has been presented to trace the development which took place up to the end of World War I along a particular branch of the network of roads which led to the modern radio tube. It has attempted to trace the evolution from studies of the interactions between heat and electricity as pursued by the early philosophers and by the physicists who followed them. These limitations have been adopted in an attempt to report the work done in the years where there is a dearth of readily available published material.

In any field of human activity books and periodicals are published by and for those interested. Such was the case in the early days of radio, with which the vacuum tube is so inextricably bound up. Much of the widespread interest in radio in the United States may be traced to the band of eager enthusiasts who made up the amateur fraternity in the days before World War I. The ham of those days spent his spare, and often not-so-spare, cash, burned his midnight electricity, and experimented unceasingly to fathom the mysteries of transmission and reception. Much progress came from interchange of ideas and experiences with others of like inclination. But unlike the situation existing today the facilities for such interchange were very limited. Books and periodicals dealing with such matters were few

(*Continued on page* 132)

Fig. 241

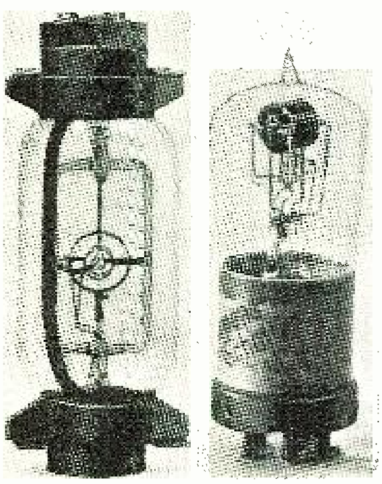


Fig. 242

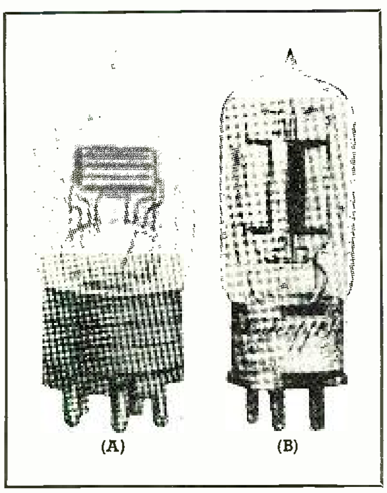
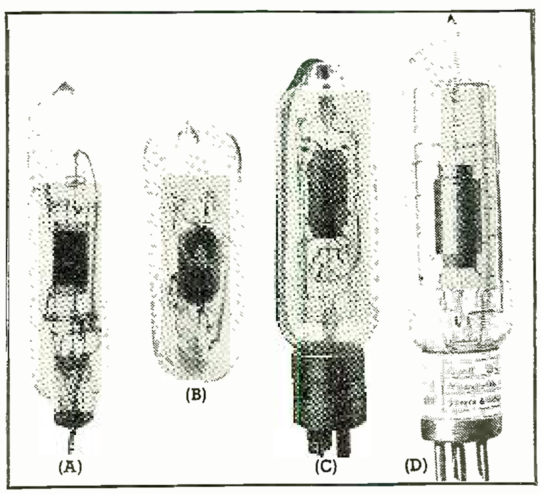


Fig. 243



Class "C"
GRID BIAS MODULATION

By W. W. SMITH, W6BCX

Part 1. The design and operation of some brand new circuit innovations of Class "C" grid bias modulation.

CLASS "C" grid modulation is one of the many significant developments in the communications field that can be credited to the traditional curiosity and "let's try it" spirit of the radio amateur. Back in the days when the literature described grid bias modulation as a highly inefficient method which required class "A" operation of the modulated stage and careful adjustment in order to keep distortion at an acceptable level, a number of amateurs independently decided to see for themselves. Perhaps in some cases they tried it because they hadn't read the literature and didn't know any better, but in most cases they tried it simply because they were not convinced.

Many a ham, with a hefty tube percolating on c.w and a hankering to try phone, was reluctant to invest in the still bigger tube required for Heising (plate) modulation. Just who was the first amateur to try class "C" grid modulation, with some idea of what he was doing and why and how to go about it, has not been established. When the writer began wondering about its possibilities back in 1931 he discovered that Harwood, W6DJZ; McCullough, W6CHE; Sharp, W6DMY, and one or two other sixes whose identity has been forgotten were giving or already had given it a fling, and with considerable success. Undoubtedly there were others in other parts of the country.

At first, some of the considerations involved were not fully appreciated by many of those who were using the system, but results in most cases were nevertheless good. At first there was some argument as to whether or not the system was a true variable efficiency system of the same generic type as the class "B" linear amplifier. Some advanced the theory that it was a variable input system, and that with sine wave 100 per-cent modulation the plate current should kick up 50 percent to provide for the 50 per-cent increase in output power represented by the sidebands. However, before long it was established that class "C" grid modulation is essentially a variable efficiency system, and that the plate current should remain substantially constant with modulation.

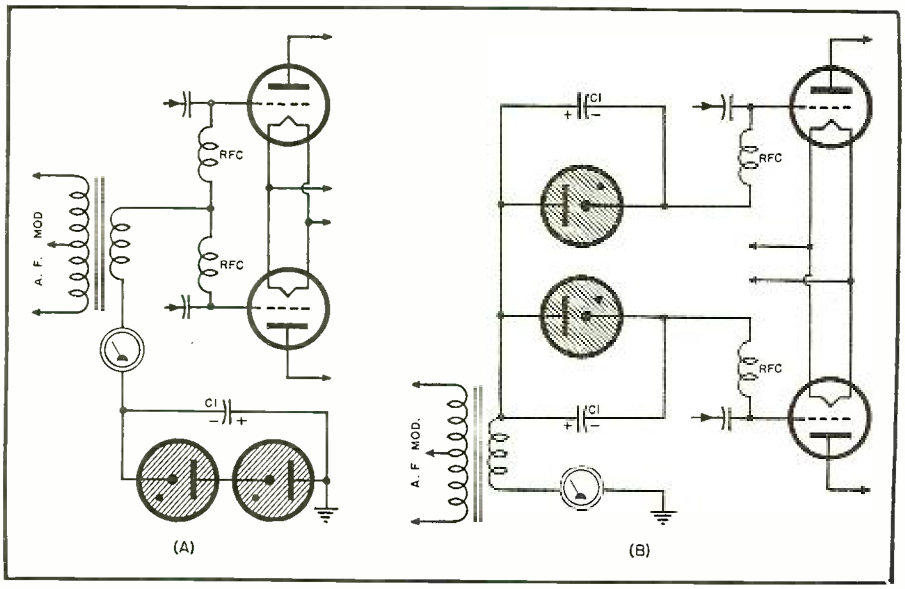
But even after the system had received widespread amateur acceptance, the commercial engineering profession was slow to acknowledge its highly gratifying performance characteristics. As late as 1934 a prominent engineer associated with one of the best known commercial laboratories made a statement to the effect that while the system might be made to give fair efficiency, the distortion would be intolerable. Shortly thereafter, however, the commercial brethren conceded that with proper design and adjustment the distortion was sufficiently low for communications applications. Now, with rectified carrier inverse feedback to reduce the distortion, class "C" grid modulation is even used for broadcast work.

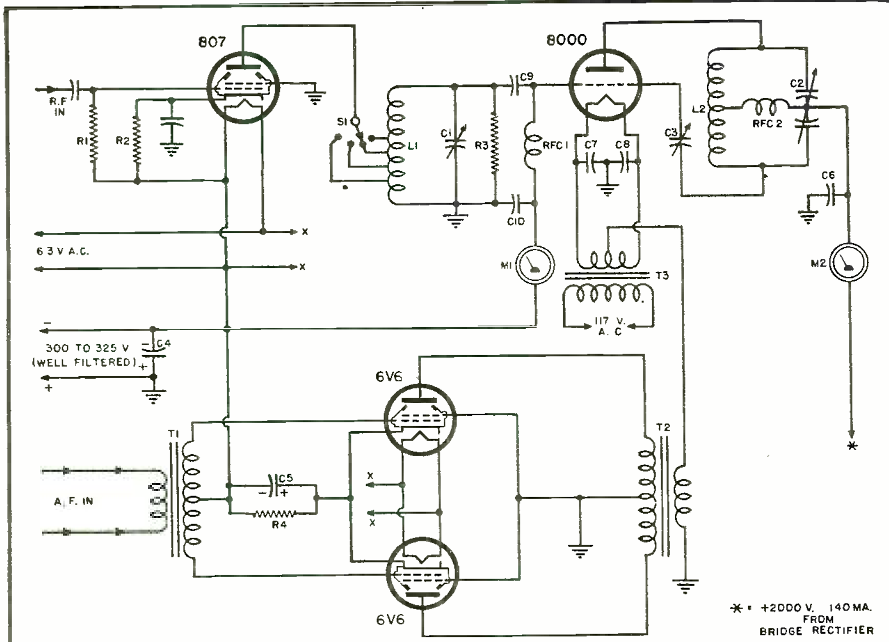
General Theory

For amplitude modulation it is necessary that the r.f. output voltage of a modulated stage vary in accordance with the audio modulating voltage. For distortionless modulation the relationship must be linear.

It is readily apparent that if the bias to a normally operating class "C" stage is progressively increased, the

Fig. 1. Use of V.R. tubes as a source of fixed bias. Circuit (A) may be used where the resting current is at least 5 ma. and the current at 100 per-cent modulation does not exceed 60 ma. When the resting current of a push-pull stage is at least 10 ma. and the maximum not over 120 ma., circuit (B) may be used. Any combination of V.R. tubes in series may be employed to give 75, 105, 150, 180, 210, 255, 300 volts, etc. The condenser C_1 may be an 8 microfarad electrolytic.





C_1—Suitable for bands covered, 500 v. spacing, providing high C Tank
C_2—Suitable for bands covered, split stator, .1 inch or wider air gap
C_3—10 μμfd. cond., .2 inch or wider air gap
C_4—16 μfd., 450 v. elect. cond.
C_5—25 μfd. 25 v. elect. cond.
C_6—.002 μfd. 5000 v. mica. cond.
C_7, C_8, C_9, C_{10}—.002 μfd. 1000 v. mica cond.
L_1—High C grid coil, tapped as described in text
L_2—250 w. rating tank coil, suitable for band (antenna coupling method optional)
M_1—0-15 ma. d.c. meter
M_2—0-200 or 0-250 ma. d.c. meter
R_1—100,000 ohm carbon, 1 w. res.
R_2—200 ohm, 2 w. res.
R_3—5000 ohm, non-inductive, 10 w. res.
R_4—250 ohm, 2 w. res.
RFC_1—2.5 mh. 125 ma. r.f. choke
RFC_2—1 mh. 250 ma. r.f. choke
T_1—Push-pull input (interstage) trans. secondary
T_2—2.5 to 1 step-down ratio (total pri. to sec.), capable of handling 15 w. with 150 ma. d.c. in secondary

Fig. 2. Diagram and partial schematic of an inexpensive 125-watt grid modulated transmitter (low-power stages omitted), incorporating several novel features discussed in the text. The use of r.f. driver plate voltage for bias on the modulated stage not only is economical, but actually results in improved performance.

output will fall off, until finally a point is reached where the output is zero. This means that amplitude modulation can be accomplished by modulation of the bias. But if this is attempted in an ordinary grid-leak-biased c.w. amplifier, the distortion will be terrific, because the relationship between bias variation and r.f. output voltage variation is about as linear as a pretzel.

To get distortion-free modulation, something must be done to improve the linearity. The greatest single improvement can be effected by substituting fixed bias for the grid leak bias. If the bias source is such that it is not affected by the value of d.c. grid current, the linearity begins to show some promise.

The next step that must be taken in our quest for adequate linearity is to provide sufficiently good regulation of the r.f. driving voltage. If no precautions are taken, it will be found that the r.f. voltage applied between grid and cathode will vary considerably as the bias is changed, because changing the bias (and therefore the grid current) alters the effective load on the preceding driver stage. For the time being let's just assume that the r.f. driving voltage has been stabilized, so that it does not vary appreciably with bias, without worrying as to just how it is accomplished.

If the output r.f. voltage of the modulated stage is now checked against bias voltage, it will be found that the variation in the former is substantially linear with respect to the latter, from zero or nearly zero output voltage to a saturation value having a peak voltage slightly less than the d.c. plate voltage.

We now have complied with the conditions necessary for modulation with low distortion, so far as the modulated amplifier is concerned. If the bias is adjusted to give a value of r.f. output voltage equal to half the saturation value, then modulation of the bias will provide high percentage modulation of the carrier with acceptable distortion. However, an important consideration is involved in the a.f. modulator: Little a.f. power is required for complete modulation of the carrier, but the modulator works under the same undesirable conditions as the driver for a class "B" audio stage, that is, the load impedance varies widely over the audio cycle, and a low driving impedance is required in order to avoid distortion.

Comparison with Class "B" Linear

Before going on to practical circuits and proper adjustment procedure, a comparison of the class "C" grid modulated stage with the classical class "B" linear r.f. amplifier is in order. Basically the two systems work on the same principle, and belong in the category of "variable efficiency" modulation systems.

In the case of the class "B" linear stage, the bias is held constant and the r.f. excitation voltage is varied. Usually the tube is run at "projected" cut off (plate voltage divided by mu), though sometimes the amplifier is run class "C" with an increase in efficiency and distortion. The latter case is not strictly class "B" linear operation, but it is interesting to note that such operation more nearly resembles class "C" grid bias modulation because the angle of plate current flow varies with modulation.

In the class "C" grid bias modulated stage, the excitation voltage between grid and cathode is held constant and the bias is varied, the net result being substantially the same as though the reverse were done, because as far as the grid of the tube is concerned it is the relationship between the two that counts, rather than absolute values.

It should be noted that when either the excitation *or* the bias is modulated with the mean bias value considerably beyond cut off, the angle of plate current flow is not constant over the modulation cycle. It is for this reason that there is some distortion inherent in class "C" grid modulation, making it unsuitable for high fidelity broadcast work except where rectified carrier inverse feedback is employed.

The chief advantage of class "C" grid modulation over the class "B" linear system, assuming that the latter is operated truly class "B," is the higher efficiency that can be obtained. The carrier or "resting" efficiency of a class "B" linear stage adjusted for 95 per-cent modulation capability is about 36 per-cent, assuming a triode and ignoring tank circuit losses. The efficiency of a class "C" grid modulated stage under the same conditions is about 44 per-cent. In both cases the efficiency is low enough so that the plate dissipation of the tube is the limiting factor with regards to maximum obtainable output, provided that the tube is run at or approaching maximum rated plate voltage.

The increase in output at the higher efficiency is greater than a first glance would indicate. Calculation will show that while the increase in efficiency is only 22 percent, the maximum output obtainable from a given tube is increased 41 per-cent.

Comparison with Plate Modulation

The over-all cost of a class "C" grid modulated transmitter is higher than that of a class "B" plate modulated transmitter of the same power, though the difference is very slight. Likewise, the average a.c. power drawn from the line is higher, but the difference again is very slight.

In a class "C" grid modulated transmitter considerable money is tied up in tubes, while in a class "B" plate modulated transmitter less is spent for tubes but a comparatively expensive modulation transformer is required. Tubes eventually wear out and have to be replaced, while a good quality

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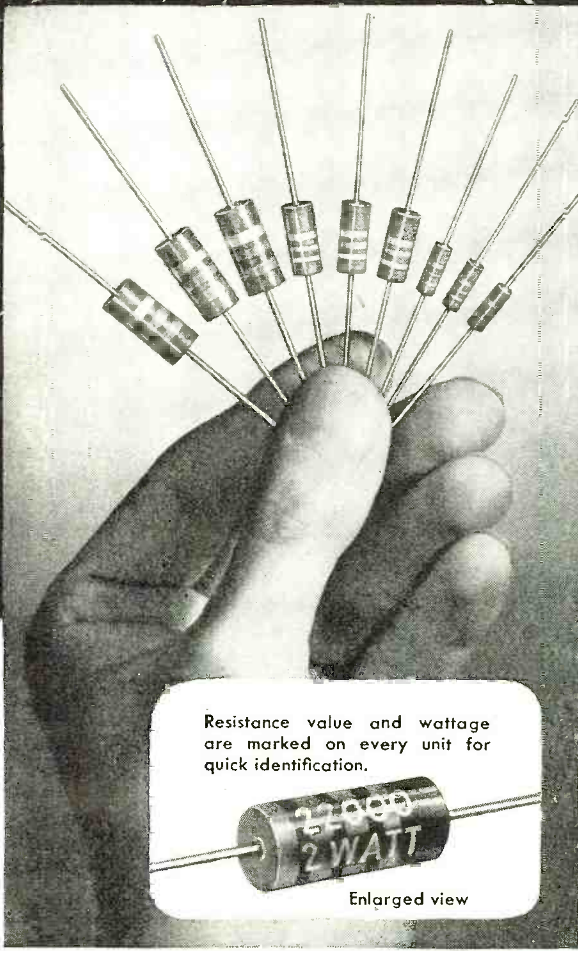

Resistance value and wattage are marked on every unit for quick identification.

Enlarged view

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AVAILABLE FROM STOCK IN STANDARD RMA 10% TOLERANCE VALUES

TYPE	SIZE		RESISTANCE RANGE	MAXIMUM VOLTS	LIST PRICE
	LENGTH	DIAM.			
½ Watt	⅜″	9/64″	10 Ohms to 22 Meg.	500	13c
1 Watt	9/16″	7/32″	10 Ohms to 22 Meg.	1000	17c
2 Watt	1 1/16″	5/16″	10 Ohms to 22 Meg.	3500	25c

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transformer *should* last indefinitely. Offsetting this is the fact that amateurs often come by large tubes "for free," used tubes which have seen commercial service and have been replaced after a given number of hours regardless of the fact that they are still good.

One reason the difference in cost between a grid modulated transmitter and a plate modulated transmitter is not greater is that a power supply feeding a class "B" modulator must have very good regulation, while the power supply for a grid modulated stage does not require good regulation.

Choice of Tubes

Tubes best suited to grid modulation are those having a high plate dissipation rating in proportion to their cost, because in a grid modulated stage the output is limited by the plate dissipation rather than filament emission (space current). If tubes are being purchased new at regular prices, the cost should not exceed 10 cents per watt of plate dissipation in order to compete with plate modulation on the basis of economy. Tubes such as the 250-TH, 805, 810, 812, 822, 8000, and HY-51 fall in this category.

With certain of the larger tubes it is possible to increase the allowable plate dissipation by 10 per-cent to 50 per-cent if a small dime store fan is used to maintain a flow of cool air on the envelope. Such operation is not harmful, because a tube running grid modulated is just loafing as regards peak voltage and peak current when the maximum safe plate dissipation is reached.

The d.c. plate voltage should preferably be the highest the tube(s) will stand safely, keeping in mind that the d.c. plate voltage remains constant with modulation. Ordinarily the plate voltage that may be applied with safety is the same as for c.w. service, and the rating for the latter may be used for grid modulation service if the tube does not carry a rating for low level modulation.

Either triodes, beam tetrodes, or pentodes may be control grid modulated, but because the ratio of plate dissipation to tube cost is much higher for triodes, their use will be assumed in this discussion except where otherwise noted.

Though the plate dissipation rating is the important one for grid modulation, it is, of course, necessary to choose a type of tube which operates efficiently at the highest desired operating frequency. Also, it is desirable that the transconductance be high, in order to minimize the size of r.f. driver, a.f. modulator, and bias pack required. Tubes having a medium or medium-high amplification factor are best suited for class "C" grid modulation service, assuming other considerations are satisfied. Triodes having a mu between 12 and 35 are recommended when a choice exists, but any-

thing between 8 and 50 is acceptable.

When a pentode or beam tetrode is grid modulated, the screen must be bypassed to ground for a.f., as well as r.f. A 1 μfd. condenser shunted across the usual r.f. bypass ordinarily will suffice.

If two tubes are used in parallel or push-pull, it is important that they be well matched. Otherwise, special circuit expediencies must be effected in order to obtain an output approaching twice that of a single tube. If both the plate resistance and amplification factor match within a few per-cent, then symmetrical circuit layout and a common value of bias will ensure that one tube does not do most of the work and thereby limit the output obtainable from the other tube.

The dynamic plate resistance of two tubes of the same type may be compared indirectly by returning the grid directly to cathode (zero bias), and applying a fixed plate voltage somewhere near the maximum that the plate *dissipation* rating will allow. Two tubes having the same plate resistance will draw the same amount of plate current under these conditions, and while this is not a direct measure of the dynamic plate resistance it serves as a useful method of comparing the dynamic plate resistance of two tubes of the same type which have the same mu.

To check the mu, determine how much bias is required to limit the plate current of one of the tubes to an arbitrary fixed value equal to about 5 per-cent of the plate current the tube draws at zero bias. If the bias required to bias the other tube to the same value of plate current is very nearly the same, say within 5 per-cent, then the tubes are sufficiently matched with regard to amplification factor.

Power Supply

Because the d.c. plate current drawn by a grid modulated stage is substantially constant, regulation is not an important consideration, and either a condenser input or a choke input power supply may be used satisfactorily. However, sufficient filtering may be obtained with a single section choke input filter consisting of a 20 henry choke and a condenser of 4 μfd. This combination will give a ripple of approximately 2 per-cent, which is sufficiently low for communications work. Increasing the size of the choke or condenser will lower the ripple proportionately.

If the power supply is being designed from scratch, a choke input filter is recommended, because the low ratio of peak to average current permits use of smaller rectifier tubes and a smaller plate transformer for a given power. But if a husky plate transformer is on hand which will not deliver sufficient voltage with choke input, condenser input will permit 20 per-cent to 35 per-cent more plate voltage to be obtained. Care should be taken to see that the peak plate cur-

(*Continued on page* 108)

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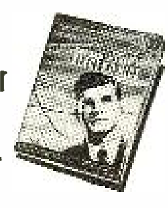

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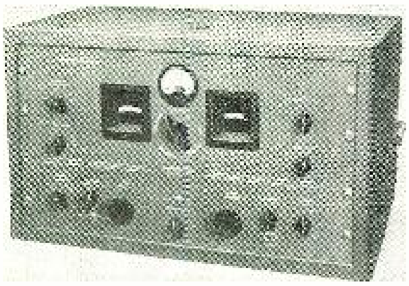
What's New in Radio

NEW HAMMARLUND RECEIVER

The Hammarlund Manufacturing Company, Inc. of New York has announced a new communications receiver in their Series 400 "Super Pro" line.

This receiver has an expanded tuning range to include the broadcast band as well as the ten-meter amateur band.



All commercial and amateur frequencies between .54 and 30 mc. are covered in five bands.

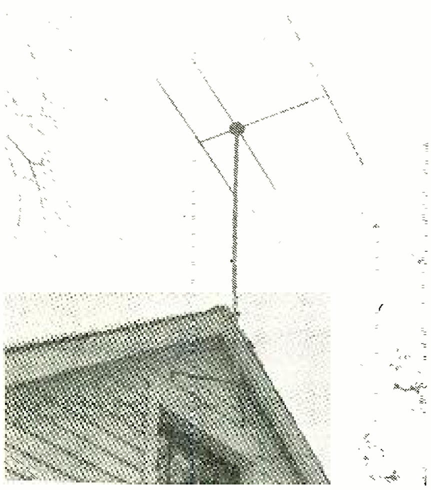
Automatic volume control operates on two r.f. stages and two i.f. stages, holding output at a steady level on voice and high speed code. A separate heavy duty power supply, designed to supply heater, plate and bias voltages, is available in both standard 115 volt, 50-60 cycle operation or in special models for other line voltages.

Details of this Model SP-400-X will be available to those requesting them from *The Hammarlund Manufacturing Company, Inc.,* 460 West 34th Street, New York 1, New York.

ANTENNA KITS

The Workshop Associates of Newton Highlands, Massachusetts have recently announced two FM antenna kits to meet specific localized reception problems.

Kit No. 1 is designed for the listener whose location is such that he will



want to receive programs from many directions. Kit No. 2 is for the listener who lives outside a metropolitan area and will want reception from one general direction.

Kit No. 1 for non-directional use includes a mast for which no guys are necessary; a mounting fixture for the edge of any type of roof; 60 feet of low-loss transmission line, wired ready for assembly; four aluminum elements that are firmly supported in the plastic head.

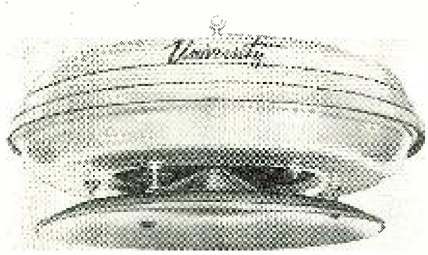
The second kit, for high gain directional use, includes all of the components in Kit No. 1, plus a simple assembly which converts the non-directional antenna into a high gain directional array using the principle of a dipole with reflector and director.

Full information about both of these units will be furnished by *The Workshop Associates,* Newton Highlands, Massachusetts.

RADIAL CONE SPEAKER

Two new model radial cone speakers, the Model RBP-12 and the Model RBP-8 have been announced by *University Laboratories,* of New York.

The infinite baffle design of these



units gives improved low frequency response. Both speakers are rubber-rim damped to eliminate mechanical resonance. They are engineered for 360 degree sound dispersion and incorporate construction features which reduce undue sound concentration directly beneath the speaker.

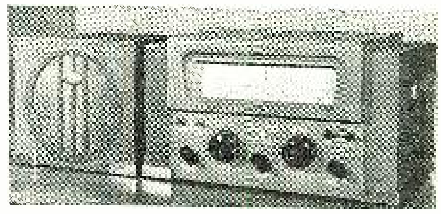
The Model RBP-12 is 27" in diameter, 11" high and weighs 19 pounds. It is designed to be used with any standard 12" cone speaker. The Model RBP-8 is 18" in diameter, 9" high and weighs 9 pounds. It may be used with any 8" cone speaker.

Additional details will be furnished by writing *University Laboratories.* Address the company at 225 Varick Street, New York, 14, New York.

NATIONAL RECEIVER

Production of a new receiver, known as the NC-46, has been announced by *National Company* of Malden, Massachusetts.

The NC-46 is a 10-tube superheterodyne featuring a series valve noise limiter with automatic threshold con-



trol, c.w. oscillator, separate r.f. and a.f. gain controls and amplified and delayed AVC. Power supplies are self contained and operate on 105 to 130 volts, a.c. or d.c. An increased audio output of 4 watts is provided by 25L6's in push-pull.

A straight-line frequency condenser is used in conjunction with a separate spread condenser. This combination plus the full vision dial, calibrated in frequency for each range covered, with separate linear scale for the band spread condenser, makes accurate tuning easy.

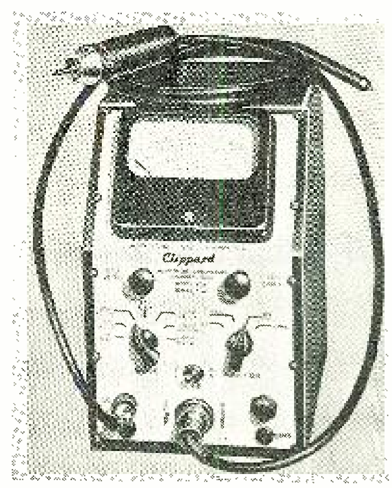
A coil switch with silver plated contacts selects the four ranges from 550 kc. to 30 mc. Provision is made for either headphone or speaker. The cabinet is gray metal and styled along modernistic lines. Matching speaker is available.

Additional information will be forwarded upon request to *National Company,* Malden, Massachusetts.

ELECTRONIC VOLT-OHMMETER

A new, laboratory-type electronic Volt-Ohmmeter, featuring extreme range and a new bridge type circuit, fully balanced through three stages, is now in production at *Clippard Instrument Laboratory.*

Known as Model 406, this unit is of special interest to the serviceman as it covers every a.c., d.c., a.f., i.f., r.f.,



and u.h.f. potential and resistance range encountered in the testing or

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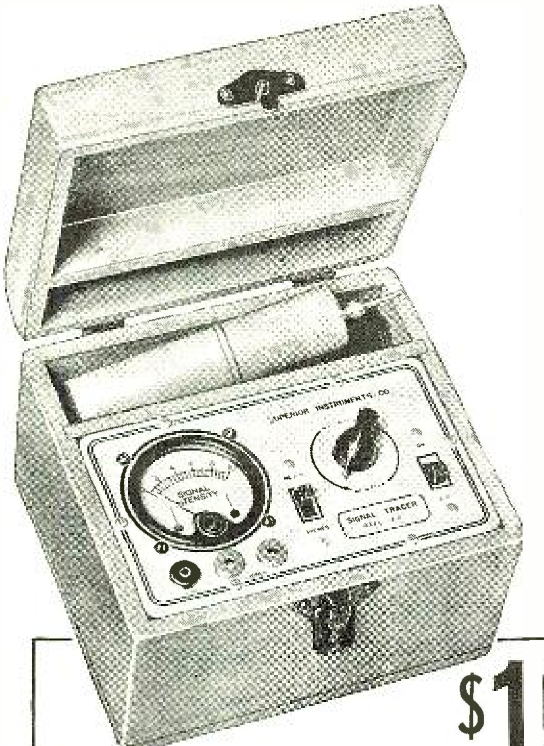

The New Model CA-11
SIGNAL TRACER

Simple to operate . . . because signal intensity readings are indicated directly on the meter!

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker — with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

Features:

★ SIMPLE TO OPERATE — only 1 connecting cable — NO TUNING CONTROLS.
★ HIGHLY SENSITIVE — uses an improved Vacuum Tube Voltmeter circuit.
★ Tube and resistor-capacity network are built into the Detector Probe.
★ COMPLETELY PORTABLE — weighs 5 lbs. and measures 5" x 6" x 7".
★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
★ Provision is made for insertion of phones.

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.....................Net price **$18.75**

The New Model 450
TUBE TESTER

Specifications:

- Tests all tubes up to 117 Volts including 4, 5, 6, 7, 7L, Octals, Loctals, Bantam Junior, Peanut, Television, Magic Eye, Hearing Aid, Thyratrons, Single Ended, Floating Filament, Mercury Vapor Rectifiers, etc. Also Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.
- NOISE TEST: Tip jacks on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.
- Works on 90 to 125 Volts 60 Cycles A.C.

SPEEDY OPERATION assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

The model 450 comes complete with all operating instructions. Size 13"x12"x6". Net weight 8 lbs. Our Net Price....... **$39.50**

The Model PB-210
MULTI-METER

Features:

★ SPEEDY!
★ PUSH-BUTTON OPERATION!

Measures:

★ A.C. Volts
★ D.C. Volts
★ D.C. Current
★ Low Resistance
★ High Resistance
★ Low Capacity
★ High Capacity
★ Decibels

Specifications:

5 A.C. VOLTAGE RANGES: 0 to 10/50/250/500/1000 Volts
5 D.C. VOLTAGE RANGES: 0 to 10/50/250/500/1000 Volts
5 OUTPUT METER RANGES: 0 to 10/50/250/500/1000 Volts
4 D.C. CURRENT RANGES: 0 to 1/10/100 Ma. 0 to 1 Amp.
2 CAPACITY RANGES: .0005 Mfd. to .3 Mfd. .25 Mfd. to 100 Mfd.
3 DECIBEL RANGES: —10 to +15; +10 to +35; +30 to +55
4 RESISTANCE RANGES:
0 to 2,000/20,000/200,000 Ohms. 0 to 20 Megohms

Model PB-210 comes housed in hand-rubbed oak portable cabinet, complete with cover, self-contained battery, test leads and instructions. Net Price.................. **$35.75**

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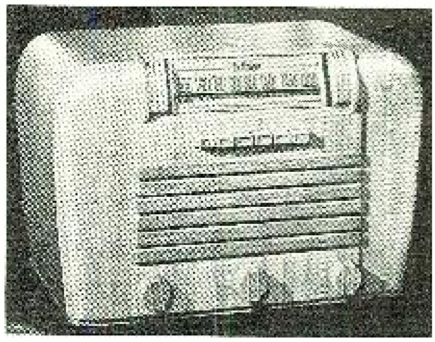
Complete details of this instrument and copies of an informative bulletin may be secured by writing the *Clippard Instrument Laboratory,* 1440 Chase Avenue, Cincinnati 23, Ohio.

TABLE RECEIVER

Hoffman Radio Corporation has announced production of a new table model receiver, Model A 301, "Laguna."

Styled with ultra modern lines, this receiver is available in grained mahogany, walnut or blonde wood. Push-button tuning is featured in addition to manual tuning on the fully illuminated slide rule dial.



A 6" oval electrodynamic dustproof speaker is concealed behind a wood grille. The receiver is a six tube, a.c. unit with tuned radio frequency amplifier, automatic volume control, variable tone control and built in loop antenna. The receiver is Underwriters listed.

Hoffman Radio Corporation, 3430 South Hill Street, Los Angeles 7, California, is the manufacturer.

COMMUNICATIONS RECEIVER

A new communications receiver, the S-40, which will cover the frequency ranges from 550 kc. to 44 mc. has been announced by the *Hallicrafters Company* of Chicago.

This receiver which was designed by Raymond Loewy, incorporates several new features. The set contains all essential controls for communications work, in addition, a unique method of marking the controls for

(Continued on page 80)

Additional Notes on....

R.F.-I.F.-A.F. SIGNAL TRACER

Original Article Published January 1946 Issue **RADIO NEWS**

By VINCENT CAVALERI

As described herein, the placement of parts are an important factor in the construction of equipment.

EDITOR'S NOTE: *Many readers who have constructed the r.f.-i.f.-a.f. signal tracer described in the January, 1946, issue of* RADIO NEWS *have written to us, and to the author, advising that they have experienced difficulty in obtaining proper performance from the final unit. The author, an instructor in testing and trouble shooting procedures, sensing that the difficulties could be attributed to an unfamiliarity on the part of the constructor with the oddities of high gain circuits, placement of parts, feedback, etc., instructed a group of his students to build this test unit from the instructions given in the original article. The results were similar to those indicated in many of the letters received from our readers. In general, the majority of these units built did not perform satisfactorily. Each unit presented a definite trouble shooting problem, and in the final analysis, it was found that if the constructor observed all of the techniques required for construction of equipment at r.f. frequencies, he would not experience difficulty in the operation of the final product. There are no errors in the diagrams or instructions which appeared in the original article. This article was prepared by the author in an attempt to point out possible errors which may have been committed by home constructors. He has included pictorial diagrams which some of the readers requested. By following these pictorials, the proper arrangements of parts can be visualized, thus resulting in shorter leads in critical circuits, which in turn will provide better performance.*

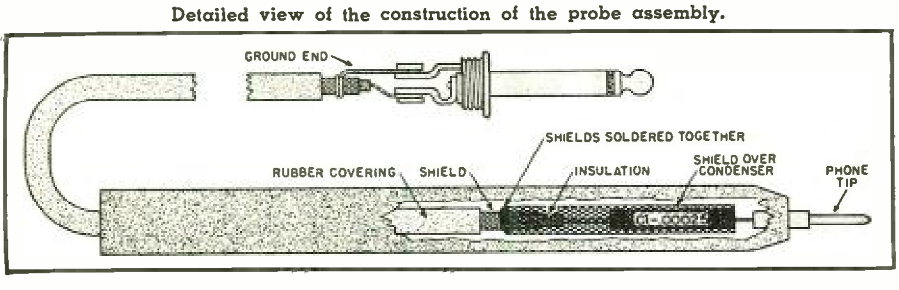
IN THE construction of any piece of equipment, from model airplanes to motor scooters, there are certain techniques which must be mastered and followed rigorously if the constructor wishes to have the completed project operate correctly and smoothly. The building of high frequency equipment is no exception to this rule, in fact, even greater care in "following the rules" must be taken if satisfactory results are to be secured.

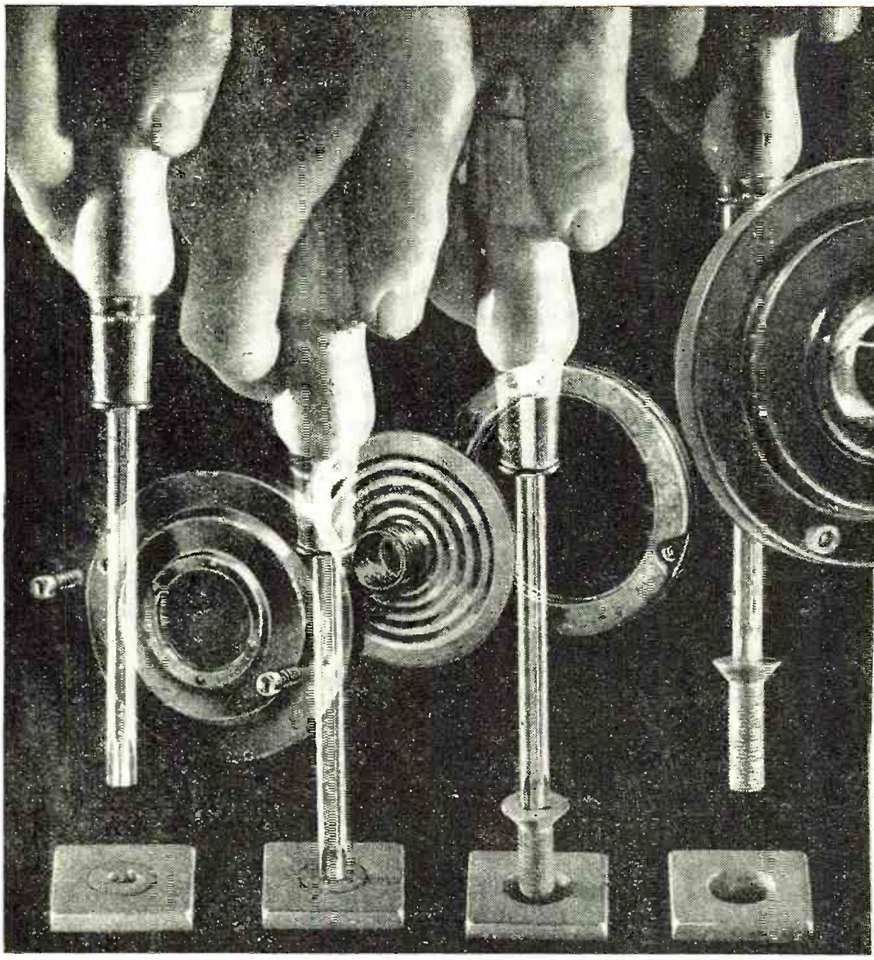
The most persistent bug in any high gain amplifier is feedback. Another bug is hum pick-up. Feedback may occur at an audio rate and be audible; but it may also be above the audio range and not be heard. Bear in mind that the plate circuit of a high gain tube will radiate a signal very readily. If, in any way, that radiated field reaches its own grid again, it will be amplified over again which in turn increases the strength of the radiated field or signal. That in turn reaches the grid again stronger than before. This process increases in proportion, to the point where the signal now is self-sustaining and continues on indefinitely as a squeal, or perhaps cannot be heard by the human ear if it is of very high frequency. This phenomenon is called oscillation. Feedback may not necessarily occur in the same tube circuit. The output of one tube may feed into another tube where the plate leads will radiate a still stronger signal and thus increase the possibility of feedback. When three tubes are used, the output of the third tube is tremendous and the amplifier becomes critical. You can readily see now that the plate circuit of the power tube can radiate an extremely strong field or signal that may reach the input leads of the 6SQ7 tube. Careful placement of parts and leads is therefore necessary. What has happened in many cases, is that the "magic eye" would close as the volume control was advanced, even though no signal was applied. This indicates that feedback or oscillation is occurring whether a squeal is heard or not. In some cases it was found that the plate lead of the 6V6 power tube was brought up in front of the chassis too near the input jack. Changing the lead to more remote position cured the trouble. On other tracers, unshielded or poorly shielded leads from the microphone jack to the volume control were found. Some of the students forget to shield the lead from the grid of the 6SQ7 to the center tap of the volume control. Lay the 50 μμfd. condenser C_2 flat against the wall of the chassis just above the volume control. Make the condenser lead as short as possible to the volume control. Shield the other end. In one case, condenser C_9, .00025 μfd. mica, caused feedback. It was placed near the grid of the 6SQ7 tube. Since it connects from the plate of the 6J5 tube it radiated a signal back to the grid of the 6SQ7. Altering its position stopped the squeal. C_3 should be pointed away from the grid. The pictorial diagram illustrates how to place parts and leads. The keyways on the sockets have been arranged to permit short leads. When using shielded wire, wind some bare wire around the ends of the shield and solder thoroughly. Then solder these ends to the chassis or convenient ground terminal.

In order to keep the hum level down, twist the filament leads and keep them away from all grids, especially the 6SQ7 grid and the input jacks. Hum is readily picked up by a high gain, high impedance grid circuit. When the volume control is advanced to maximum, the input resistance is rather high, therefore leads that have a.c. through them should be kept away.

In some cases the signal tracer would hum only when the cable was plugged in. A poor or defective cable or improper ground connection at the plug will cause hum. The construction of the cable and probe is illustrated. A good grade of microphone cable is used. The reason for the .00025 μfd. condenser in the probe is to reduce the cable capacity and its shunting effect on a tuned circuit. The probe may be purchased or the builder may make one out of a half-inch dowel stick. Drill a hole through the probe large enough to admit the cable and the tiny tubular .00025 μfd.

Detailed view of the construction of the probe assembly.





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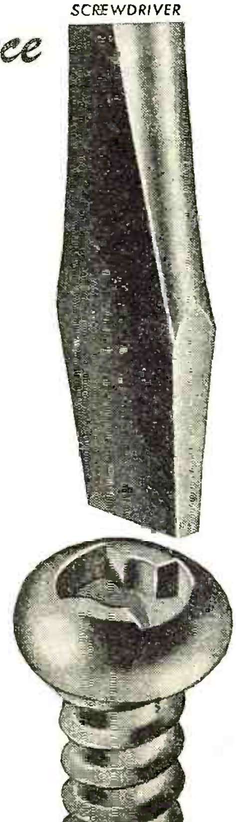

The Clutch Head Pay-Off in Performance

and lower cost is definite. Using this exclusive Lock-On feature for precision assembly of their "Adjust-A-Cone" Units, QUAM-NICHOLS CO., CHICAGO, record a 20% increase in assembly operation as well as the solution of two important problems. Damage from driver slippage went to zero and the simplicity of common screwdriver operation disposed of field service handicaps.

THIS LOCK-ON, available only with CLUTCH HEAD, is effected with a simple reverse turn of the Type "A" Bit in the head recess. This unites screw and bit as a unit for speedy, easy one-handed reaching to hard-to-get-at spots.

IN "UN-BUTTONING" THE JOB TOO, the reverse action automatically forms the Lock-On. Thus the Type "A" Hand Driver for field service withdraws the screw undamaged and safely held against dropping or loss for re-use. In many cases, this automatic Lock-On saves the dis-assembling of surrounding units.

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condenser. Drill this hole up to about a half-inch from the end. Drill a hole in the end for a phone tip. Solder the cable conductor to the condenser lead. Cut the shield back about a quarter-inch from the conductor so that the shield will not short to the conductor. Wrap a little tape around the conductor. Now slide a piece of shielding about an inch and a half long over the condenser till it reaches around the cable shield. Solder the shields together. This is done to prevent hum pick-up from your hand when you use the probe for testing. Slide the cable and condenser into the probe as far as they will go. Cut off the end of the condenser lead just long enough to solder into the phone tip sleeve. Put a little speaker cement in the end of the probe and force the phone tip into place. This completes the probe assembly. You can wedge a piece of rubber tape in the back end of the probe to help hold the cable tightly in place. If the probe is purchased, try to get one that is oversize. There is a type made that measures 7/16" in diameter.

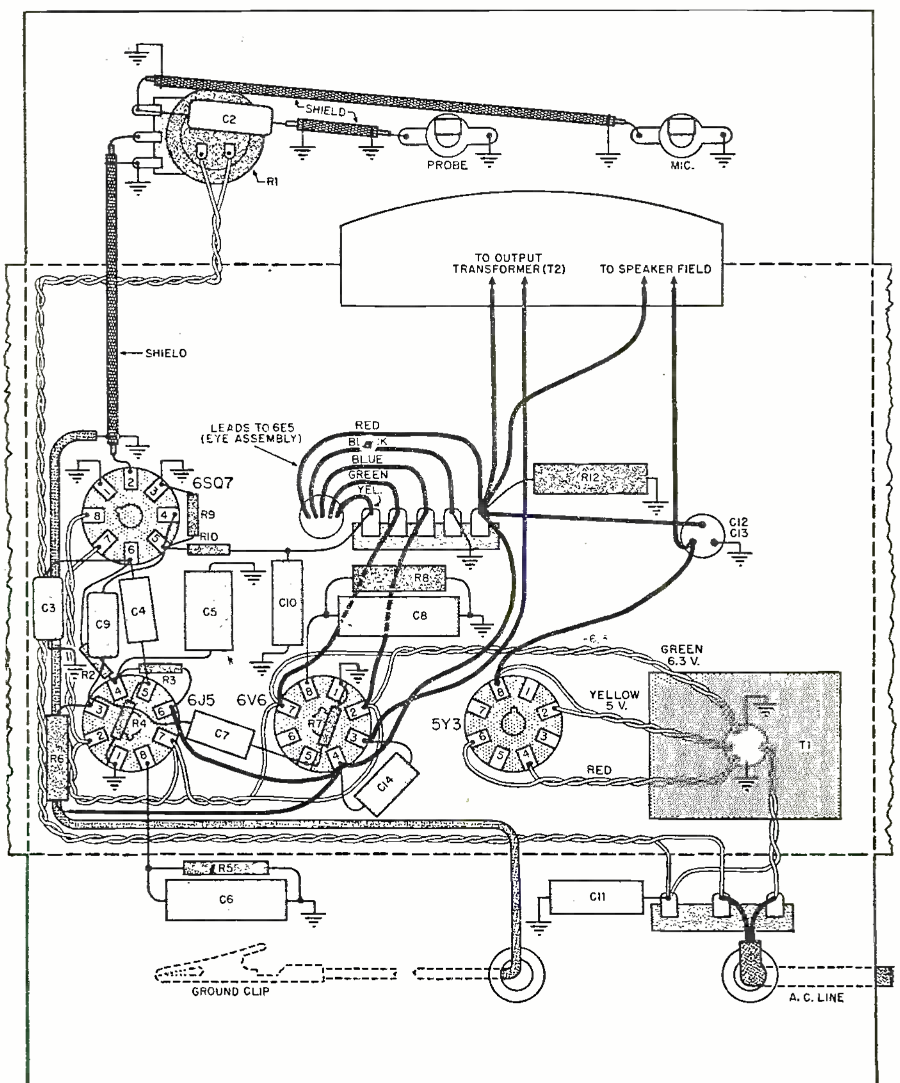
In answer to the queries about the various components; power transformers with 350-0-350 v. secondaries are also suitable. The voltages will be somewhat higher. If the 6 volt heater windings do not have a center tap, ground one side of the filaments. If a six inch speaker cannot be obtained, a five inch speaker will do. The importance of using high quality parts cannot be overemphasized. No matter how perfectly the instrument is made, if there is one single defective part, it certainly won't work properly. Condensers and tubes are the greatest sources of trouble, even though they are brand new.

The voltages tested from chassis with a 1000 ohm-per-volt meter are approximately:

6SQ7 plate, 60 volts; 6J5 plate, 140 volts; 6J5 cathode, 4 volts; 6V6 plate, 240 volts; 6V6 screen, 250 volts; 6V6 cathode, 12½ volts. 5Y3 filament terminal #8, 300 volts (d.c.).

A gassy 6V6 will show a slight positive grid voltage and will cause hum and distortion, even though it may test "good" in a tube tester.

In testing radios with loop antennas, attach an aerial with a 60 μμfd. condenser to the high side of the loop,



Pictorial diagram of the r.f.-i.f.-a.f. signal tracer, showing proper placement of parts.

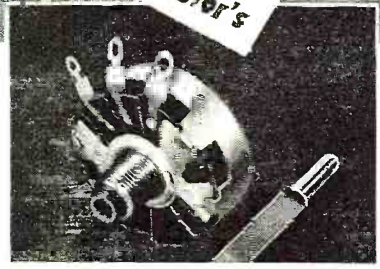
TYPE BT INSULATED *Metallized* RESISTORS
TYPE BW INSULATED Wire Wound RESISTORS

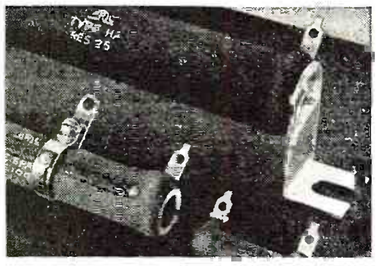
. . . the perfect combination for speedy, dependable servicing!

Almost any piece of carbon is a "resistor". But a really *good* resistor, scientifically designed to meet every requirement of exacting radio and other electronic servicing, is something else again. For example, users of the famous Type BT have found that IRC's exclusive *Metallized* filament-type construction is a far cry from ordinary resistors. Since the beginning of Radio, this unique design principle has made possible far greater stability, more rugged construction and complete dependability in a very compact, low-cost unit.

Now, two new BT types, the BTS and BTA, are available. Designed to meet all the exacting requirements of modern servicing, they are conservatively rated at ½ watt and 1 watt, respectively, and incorporate all the excellent characteristics of older, larger types in a much smaller, more convenient size.

For greater stability and all-around efficiency in the lower ranges, the IRC Type BW Insulated Wire Wounds are recommended. A stock of these units and the Type BT in assorted ranges and wattages give you the ideal combination to solve almost any servicing problem . . . quickly and profitably.





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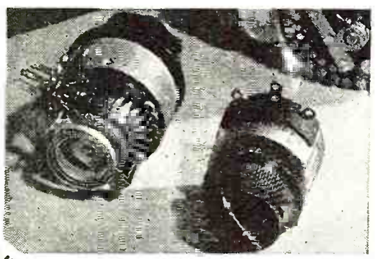

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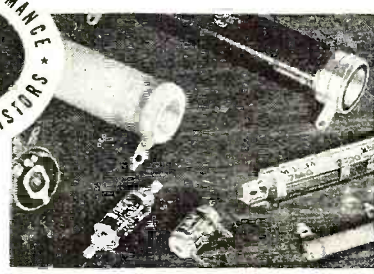

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unless an aerial connection is provided. This will increase the signal strength, so that it may be easily traced. In testing a.c.-d.c. receivers with a floating ground, strong hum may be experienced if the ground clip of the tracer is attached to the receiver chassis. Instead, connect the ground clip to the negative end of the filter condensers of the receiver. This connection is usually accessible at the "on-off" switch terminals. Make sure that no external ground is used on a.c.-d.c. sets.

Strict adherence to the points mentioned in this article will result in a smoothly operating signal tracer.

—30—

International Short-Wave

(*Continued from page* 45)

Cabuga No. 394, Recife, Pernambuco, Brazil. (While the Director-Presidente did not state that PRA-8 sends verifications, Swedish listeners report receipt of them from this station.)

* * *

LRI RADIO EL MUNDO

From the Manager, LRL Radio El Mundo, Buenos Aires, Argentina, comes this data:

Radio El Mundo is owned and operated by Editorial Haynes Ltd., publishers of "El Mundo" (illustrated daily), "El Hogar" and "Mundo Argentino" (weeklies), "Selecta" (fortnightly) fashion magazine.

Broadcasting hours are generally from 0730 to 2400 daily, Argentine Time. (Argentine Standard Time is 1 hour *ahead* of EST and Argentine Clock Time is 2 hours *ahead* of EST; it is believed these schedules were given in Standard Time, or 1 hour *ahead* of EST.)

The following wavelengths and hours (EST) are in force:

LR1, 1,070 kcs. (280.4 m.), 50 kw., 6:30 a.m.-11 p.m.

LRX, 9.660 (31.06 m.), 6 kw., 6:30 a.m.-11 p.m.

LRX1. 6.120 (49.00 m.), 6 kw., 10:45 a.m.-9:05 p.m.

"All broadcasts are in Spanish and the three wavelengths customarily broadcast the same station program. Occasional station identification is given in English; otherwise, all broadcasts are exclusively in Spanish. When relays are made from abroad, translations into Spanish of whatever material was broadcast follow immediately after the foreign language version. No foreign language newscasts are included in our program. Listeners in the United States and Canada, however, may be interested in programs of Argentine music, which are included throughout the daily broadcasts. Verification is sent to overseas listeners whether or not an International Reply Coupon is received."

Radio El Mundo's studios are located at Calle Maipu 555, Buenos Aires, Argentine Republic; the transmitting station is located at San Fer-

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FM

Collins FM research, begun long before the war, went into high gear immediately following VJ day. An intensive engineering program is developing a series of FM transmitters to cover the power range of 250 watts to 50,000 watts.

These transmitters will be available, beginning with the 250 watt type 731A in midyear, 1946, and the 1000 watt type 732A soon thereafter. 3, 10, 25, and 50 kw transmitters are scheduled to follow in rapid succession.

With typical Collins thoroughness, these FM transmitters are designed to specifications well within FCC and RMA requirements and recommendations.

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nando, F.C.C.A., just outside the city of Buenos Aires.

* * *

MADAGASCAR SCHEDULES

By airmail we have received the following schedules of Tananarive, Madagascar, as sent by Lars Kalderen, Sweden:

4.300—0.3 kw., 10-11 a.m.; 6.130—1.2 kw., 11:30 p.m.-12:30 a.m.; 3:30-5 a.m., and 10-11 a.m.; 9.693—0.3 kw., 11:30 p.m.-12:30 a.m. and 3:30-5 a.m.; 12.126—5 kw., 6-9 a.m.

* * *

HVJ, VATICAN CITY

Also from Lars Kalderen, Sweden, come latest schedules of HVJ, "Citta del Vaticano," Vatican City:

Daily—1:15 p.m., English, 9.660; 2 p.m., French, 9.660; 2:30 p.m., Italian, 5.969; 2:45 p.m., German, 5.969; and 3 p.m., Spanish, 5.969.

Tuesday and Friday—1:45 p.m., Polish, 9.660.

Tuesday—10 a.m., English, 17.445.

Thursday—1:45 p.m., Dutch, 9.660.

Saturday—1:45 p.m., Lithuanian, 9.660. (Other than Thursdays and Saturdays, at 1:45 p.m., Polish is heard on 9.660.)

Sunday—5:30 a.m., Holy Mass, 9.660 and 15.100.

On 17.445, HVJ is reported heard usually on Mondays and Saturdays, 8:15-9:40 a.m., in English to South Africa.

* * *

SUNSPOT ACTIVITY

Two large sunspots on the Eastern Limb of the sun (visible easily through dark smoked glasses or densely-fogged camera film negatives) caused bad to nil s.w. reception during the early part of February. (They produced an Aurora-Borealis at night.) This situation should have cleared up by this time and short-wave reception from most areas will be improving. There will be many seasonal changes right along now as to frequencies, time, and so on. The 25-meter band, which had been practically "dead" during the winter in many sections of the United States, is already opening up well again.

* * *

NEW

OLR3A, 9.550, Prague, Czechslovakia, has inaugurated a broadcast to North America, daily, 8-8:30 p.m.; signals are poor and generally fade out. (May announce this transmission as "tests.")

OIX3, 11.780, Lahti, Finland, is back on the air, but so far has been reported heard only at 7:15 in the morning news in English for North America; reception is poor; in the same transmission, OIX2, 9.503, is heard fair to good.

An airmail letter received from Lars Kalderen, Sweden, lists a new station in Athens, Greece, on 7.295, heard testing with records between 4-5 p.m., with Greek and English announcements. He understood call as XBG2 (?). This station has not yet been reported in America.

OZF, 9.52, Skamleback, Denmark, has been heard since December 12 in Danish, 12:35-5 p.m.; 6 kw. (Kalderen)

A new Oslo, Norway, transmitter on approximately 6.200 has been heard at 7:30 a.m. relaying BCB programs. (Kalderen)

Radio Audizioni Italia, 6.030, Rome, Italy, is being heard 1:30-6 p.m. in Italian. (Kalderen)

PHI, 17.775, a pre-war Dutch allocation, located at Huizen, Netherlands, is back on the air relaying PCJ's morning (15.220) transmission, 8-9:30 a.m. *only;* signal strength is good in East, but there is severe interference from Leopoldville, Belgian Congo, 17.770.

The Bern, Switzerland, transmission to Australia, 3-4:30 a.m., now uses a new frequency of 14.462, replacing 14.538; reception is poor; English is used on Tuesday, Swiss languages on Saturday (no transmission other days).

Several new frequencies allocated to the Geneva transmitters are HBQ2, 6.945; HBY, 7.696; HBX, 9.225; HBW, 11.465; HBJ2, 13.205; and HBV, 18.950; none are in current use. This information was recently received direct from Bern. (I am reliably informed, however, that HBY, HBX, HBW, and HBV are licensed for "A2 emission) (modulated radio telegraphy) only, so they will probably never be used for international short-wave unless licenses are altered.)

The new VLH transmitter at Melbourne, Australia, is now on the air, and the VLR schedule was adjusted late in January to accommodate the extension of facilities. VLR now relays the National Programs *only,* while VLH carries the Alternate Programs. The only exception to this is 1:30-3:30 a.m. on VLH4 when the National Program is relayed. The new ABC Home Service schedule is *daily* on VLR2, 6.150, 2:30-8:30 a.m. and 3-4:10 p.m.; VLR, 9.540 (changed from 9.580), 4:20-7 p.m. and 8:45 p.m.-2:20 a.m.; Saturday exceptions, 3:45 p.m. sign-on and 5:30 p.m. sign-off for VLR2, and VLR signs on at 6:30 p.m.; Sunday exceptions, VLR signs off at 3:30 a.m. and re-opens at 3:58 a.m. Schedule of the new VLH transmitter is: VLH5, 15.240, 7 p.m.-1 a.m.; VLH4, 11.880, 1:30-3:30 a.m.; and VLH3, 9.580, 3:45-8:30 a.m.; Saturday exceptions, VLH4 at 3:45-5:30 p.m. and VLH5 at 6-12 midnight; Sunday exceptions, VLH4 at 12:15-3 a.m. and VLH3 at 3:15-8:30 a.m.

From Hawaii it is reported that a Dutch-operated station on 9.360, located at Makassar, Celebes, transmits daily at 6:05-8 a.m., but some days opens earlier and signs off later.

Another Hawaiian report lists WXLJ, 5.510, as operated by the Signal Corps at Shanghai Racetrack, with studios in the British Cricket Club; heard with recordings to 6:50 a.m. and point-to-point with JVT, 6.750, Tokyo.

The new Chinese station on 6.230/6.235 (reported some weeks ago by Dilg) announces frequency as 12.2 (which is XLPA's channel) so may have been relaying XLPA when the

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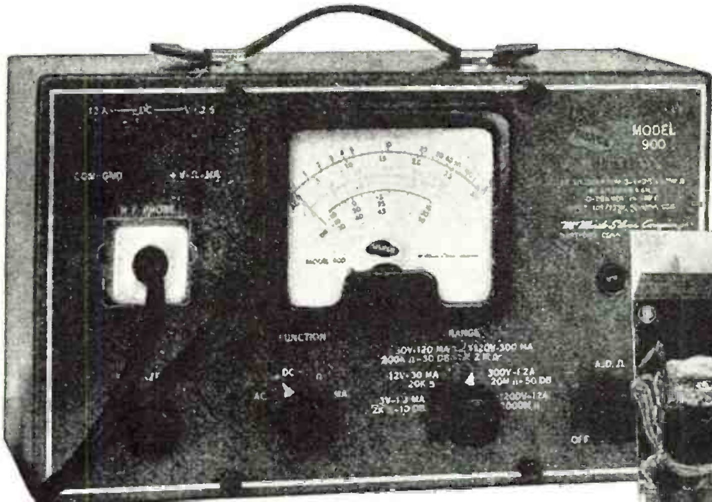

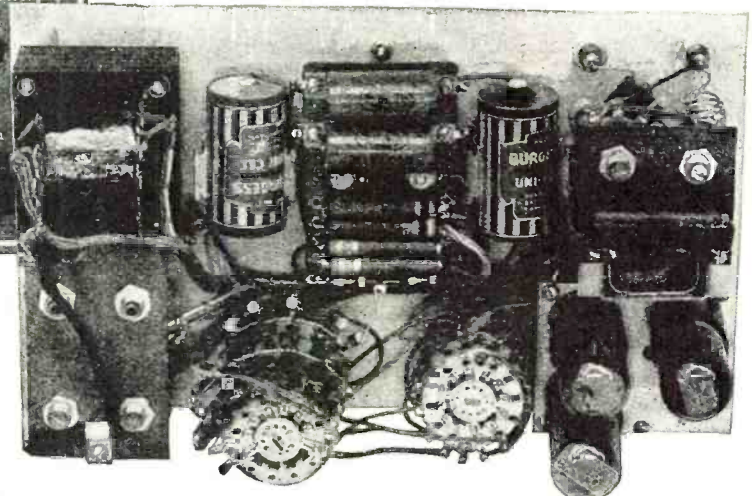

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ADVANCE ANNOUNCEMENT—Model 904 Capacitance—Resistance Bridge will go into production in April. With ± 3% accuracy over the tremendous range of a fraction of one mfd/ohms through One Thousand mfd/megohms. Model 904 at last gives the serious service technician laboratory accuracy and range—in the new, postwar instrument matching "VOMAX" for only $49.90.

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2. More than an "electronic" voltmeter, VOMAX is a true vacuum tube voltmeter in every voltage resistance db. function.
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4. 3 through 1200 volts d.c. full scale in 6 ranges at 51 and in 6 added ranges to 3000 volts at 126 megohms input resistance. Plus-minus polarity reversing switch.
5. 3 through 1200 volts a.c. full scale in 6 ranges at honest effective circuit loading of 6.6 megohms and 8 mmfd.
6. 0.2 through 2000 megohms in six easily read ranges.
7. − 10 through + 50 db. (0 db. = 1 mw. in 600 ohms) in 3 ranges.
8. 1.2 ma through 12 amperes full scale in 6 d.c. ranges.
9. Absolutely stable—one zero adjustment sets all ranges. No probe shorting to set a meaningless zero which shifts as soon as probes are separated. Grid current errors completely eliminated.
10. Honest factual accuracy ± 3% on d.c.; ± 5% on a.c.; 20 cps. through 100 megacycles; ± 2% of full scale, ± 1% of indicated resistance value.
11. Only five color-differentiated scales on 4½" D'Arsonval meter for 51 ranges (including d.c. volts polarity reversal) eliminate confusion.
12. Meter 100% protected against overload burnout on volts ohms db.
13. Substantial leather carrying handle. Size only 12¾" x 7¾" x 5⅛"

Send postcard for free catalog of measurement and communication equipment.

OVER 35 YEARS OF RADIO ENGINEERING ACHIEVEMENT

McMurdo Silver Company

1240 MAIN STREET, HARTFORD 3, CONNECTICUT call XOPA was heard; Dilg was not certain that the second letter was "O." At other times, however, this station has been heard to announce in English as XNTS, Fifth War Zone. XNTS is supposed to be at Tsingtao and on 6.235, but since this city is remote from Changsha, it is doubtful that it would relay XLPA.

VUDS, 7.240, and VUD5, 7.290, Delhi, are reported opening a new European program at 10 a.m., runs to 10:30 a.m.

Singapore on 4.780 and relays now operate 5:30-10:30 a.m. without break and identify as the "Blue Netwo k." According to announcement, a transmission at 9:30 p.m.-12:30 a.m. was added January 20. The Singapore transmitter on 7.180 (reported some weeks ago by Dilg) is not heard at present, but what may be the same transmitter is heard 5:30-10:30 a.m. on 7.215. This 7.215 transmitter is heard earlier also, at 3:20-4:30 a.m. in English and Dutch identifying as the Far Eastern Service. The 5:30 a.m. transmission is reported as mostly Malayan. The unidentified Malayan station on 6.090 has moved to about 6.180 (announced as 6.175) and closes its 5:30-10:30 a.m. transmission with separate announcement. Location may be Palembang, Sumatra, or similar sounding name in Malaya; it has been definitely established that this transmitter is *not* located at Penang.

Bangkok, 6.000, Siam, is reported from Hawaii with a weak signal to 8:45 a.m. sign-off with chimes.

In the East it is reported that international pelota matches—believed held in Buenos Aires, Argentina—were heard during the winter with running descriptions in Portuguese, irregularly 7:30-10 p.m. over LSM9, 9.980, LQA5, 10.350, LSA6, 10.367, and LSD8, 10.875, for Brazilian stations and networks, each with a different announcer. The same in Spanish for Paraguay (during Brazil-Paraguay match) was heard over LSC, 7.945. (According to Gutter and Johnson, Chicago, Brazilian stations carrying these special sports events included ZYB7, 6.095, Sao Paulo; PRE9, 6.105, Fortaleza; and PRL7, 9.72, Rio de Janeiro.

The new CE1190 transmitter in Chile uses 1 kw. and is located at Valparaiso, not Santiago, according to a verification letter received by a New Zealand correspondent.

St. Eustatius, Netherlands West Indies, is now on the air; first was on 11.900 identifying as "Statia" but now has moved to 9.045 with Saba and St. Martin for the daily contact with Curacao; all three are reported good on 9.045 after 8 a.m.

A new Moscow frequency of 9.045 is reported heard with press dictation to 1:58 a.m., resuming at 2:30 a.m.

KOFA, 7.215, Salzburg, Austria, is heard well now afternoons to 6 p.m. or later, relaying AFRS programs; English news from New York is carried at 6 p.m. Sometimes is badly QRM'd.

Teheran, 4.760, Iran, has English news at 10:45 a.m. (Kalderen)

CR7AU, 4.925, Lourenco Marques, Mozambique, is heard afternoons in Sweden. (Kalderen)

Nairobi, Kenya, 4.925, is heard 12 noon to 2 p.m. in English and relays BBC news at 1 p.m.

Direct from Sweden it is learned that the Swedish Broadcasting Corporation will soon inaugurate the use

THE HIDDEN POWERS OF RADIO

BY MALCOLM HYATT

THE wonders of radio will never cease. But according to Ed Franke, supervisor of WOR's transmitting station at Cartaret, New Jersey, there are greater and more astonishing wonders created by the electrical frequencies spawned by the station's 50,000 watt transmitter.

In the vicinity of the station is a small tributary which the radio men have dubbed 'Casey's Creek.' It seems that different kinds of music cause various electrical frequencies which are transmitted to 'Casey's Creek' by the miles of underground wire. When a soprano manages to reach high 'C' the fish in the creek float belly-up. Apparently a soprano creates frequencies which gives the water a soporific quality. "The fish seem kind of paralyzed," says the baffled Ed. "They simply can't move! Just lie there till the soprano stops singing. Then they roll over sleepily and dive for the bottom."

Symphony music has a military effect on the creek's population, causing them to line up snappily as though they were about to execute a close order drill. "Of course, they don't really march," admits Ed, sheepishly.

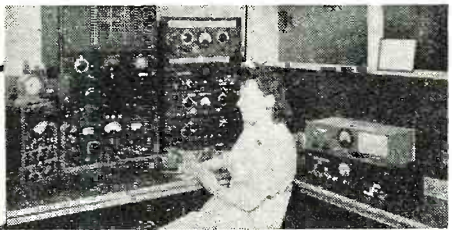
Such manifestations of the magic of radio on mundane activities are part of Ed's daily routine. A realistic radio engineer, he nevertheless, is constantly amazed at radio's hidden powers. Recently a few home owners, living in the vicinity of the station, complained that they heard the station every time their water faucets were turned on. It seems that the water picks up electrical energy as it flows from the faucet to the drain, creating "singing water." Then there was the farmer whose chicken-coop lights wouldn't turn off, resulting in greatly increased egg-production. The hens, thanks to the free current furnished by the radio transmitter, were put on a 24-hour shift.

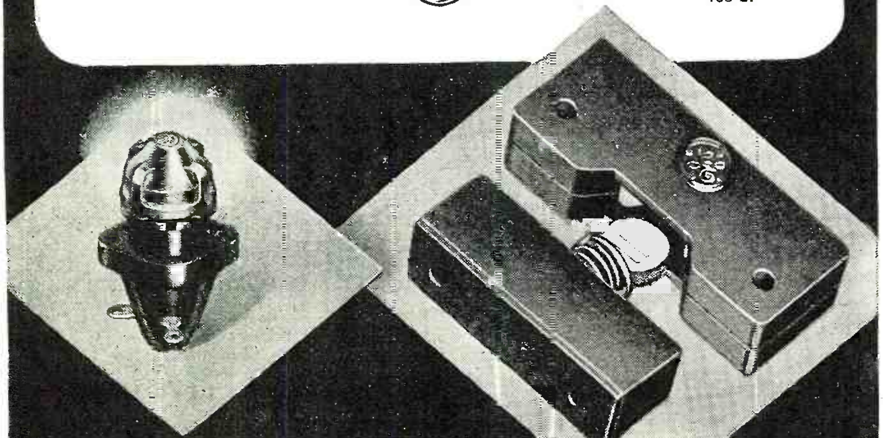
What has really confounded Ed is what radio does for the grass on the station's 33-acre tract. Whatever it is, he opines, it is good, for neighboring farmers jump at the chance to graze their cows there. They claim their cows yield milk twice as rich as that produced by cattle grazing on other pastures.

One day last summer a man was found bathing his feet in one of the ponds on the transmitter property. They approached the trespasser who informed them that the water would be able to cure a bad case of athlete's foot. Upon investigation, it was found that the copper sulphate solution engineers dump into the pond is a recognized treatment for the ailment.

"Yes," says Ed, candidly, "we've got our problems, but there's more to radio than meets the ear. Who said life is dull around a radio transmitting station?"

—30—





of QSL cards; address is Sveriges Radio, Stockholm, Sweden. (Want reports.)

Swedish listeners reporting Budapest, Hungary, on 3.400, say it may be a harmonic.

U. S. International Broadcasting is now conducted by the Office of International Information and Cultural Affairs of the State Department. KNBI, 6.060, San Francisco, has replaced KNBX and is scheduled 4-10 a.m. WOOW, 6.120, New York, is off the air. Present schedule of KCBA, 6.170, Delano, California, is 4-10 a.m. KNBA, 7.805, San Francisco, broadcasts 4-10 a.m. KNBA, 7.565, San Francisco, is off the air as is KCBA, 7.575, Delano. KNBX, 7.805, San Francisco, is off the air. KNBX, 9.490, San Francisco, verifies with a red, white, and blue card, present schedule is 5-6:45 a.m. and 7 a.m.-3:30 p.m. WCBN, 9.650, New York, is scheduled 5:45-7:30 a.m. and 1-4:45 p.m. WLWR1, 9.750, Cincinnati, WCBN, 11.145, New York, are off the air. KCBR, 11.770, Delano, is scheduled 10:15 p.m.-1 a.m., has vacated 13.050. KCBA, 11.770, Delano, is scheduled 1-4:45 and 5-7:30 p.m.

From C. E. Kelly, Deputy Director of Broadcasting, Dublin, Eire, we have this letter: "We cannot yet give you any details of short-wave transmission from Ireland. The new transmitter will not be erected and working for the better part of a year, if, indeed, so soon."

Confirmation has arrived from New Zealand of tests last autumn by two transmitters of the Post & Telegraph Department, Wellington, which beamed programs to North America, using 5,000 watts. ZLM5, 15.500, relayed 2YA, while ZLN4, 9.870, relayed 2YC during these tests. (The 2YA and 2YC calls are for BCB stations on 570 kcs., and 840 kcs. respectively, both located in Wellington.

Incidentally, ZLT7, 6.715, is putting through a good signal daily, 4:30-4:45 a.m., when an English newscast and usually a sports summary are relayed from 1YA (650 kcs., 10 kw., Auckland) for the Forces. Lately, however, I have heard ZLT7 as early as 4:15 a.m. with classical music, preceding the 4:30 a.m. news period. Sign-off is rather abrupt, usually they say "ZLT7, operated by the Post & Telegraph Department, will cease transmission until 9:30 tomorrow evening." New Zealand stations operate on NZDST which is ½ hour ahead of New Zealand Standard Time, or 17 hours ahead of EST.

* * *

CHANGES

Paris to the United States and Canada in the daily North American Service, 8:55-10:45 p.m., is now heard regularly on 9.550; English program runs from 9-9:30 p.m., French repeat is at 9:30 p.m., French variety program comes at 10 p.m., and there is a repeat of the English news at 10:30 p.m. The parallel transmitter, 11.847, is generally inaudible at present due to seasonal conditions; should be heard better soon.

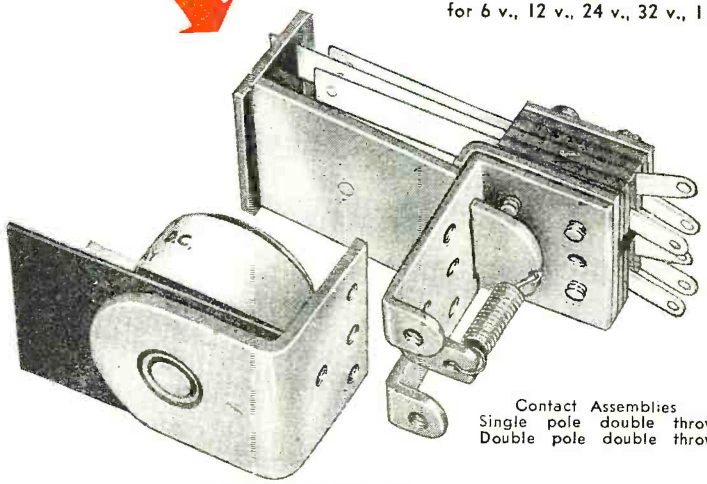
New! Series 200

A RELAY BY GUARDIAN with *Interchangeable Coils*

BUILT IN TWO PARTS

A.C. Coil Assemblies available for 6 v., 12 v., 24 v., 115 v.
D.C. Coil Assemblies available for 6 v., 12 v., 24 v., 32 v., 110 v.

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



Contact Assemblies
Single pole double throw
Double pole double throw

SERIES 200 RELAY

On Sale at Your Nearest Jobber NOW!

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

TWO CONTACT ASSEMBLIES

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

NINE COIL ASSEMBLIES

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

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

GUARDIAN ELECTRIC
1630-D W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

The French National Program from Paris is relayed daily on 11.886 and 9.620 now from noon to 4 p.m.; news is at 1:30 p.m. Paris on 11.700 has lately been used *only* between 5:30-6:45 a.m.

All Burma schedules were recently advanced one hour, due to time change in that country; complete schedule of Radio Rangoon on 6.035 is 11:30 p.m.-1 a.m., 5:45-7:15 a.m., and 7:15-8:45 p.m., with news at 12:30 a.m. (this is a weekday schedule). The 5:45-7:15 a.m. transmission is reported with powerful signals in the East. On 11.840 (also reported as 11.850), Radio Rangoon has a new schedule of 1:15-1:45, 7:30-9 a.m., and 9-9:30 p.m., with English news at 1:30, 7:45, and 8:55 a.m.; on Sundays is heard 8:30-10 a.m., but recently I have heard this transmitter signing off Sundays at about 9:12 a.m. with a march; has a ten-minute sermon Sundays at 9 a.m.; has been sending a good signal here since around the first of the year; sometimes there is slight interference from WGEA.

Colombo (not Southeast Asia Command), Ceylon, appears to have moved back to 4.900 from 4.890; heard late mornings with relays of the local medium-wave station. (Dilg)

XORA, Shanghai, China, does *not* transmit on 11.780, as indicated by Chinese sources, but is being heard on 11.690/11.700 (formerly XGOO/XGRS); English news is given at 7 a.m. XMHA, another Shanghai transmitter formerly using 11.860, is at present transmitting on medium-wave *only*.

PMH, 6.720, Bandoeng, Java, is being heard with better signal now on the West Coast to late sign-off at 9:30 a.m. Recently was heard at 9:20 a.m. saying in English that they were on 24 and 44 meters, announcement concluding with "Until tomorrow, goodnight, everybody." The final sign-off at 9:30 a.m. is in Dutch or Indonesian. (Dilg, Balbi) Mr. Dilg reports that PMH really has good modulation now, not only for the phono-input, but on voice mike as well.

CBFX, 9.630, Montreal, has moved to 9.610 to make way for the new Sackville International station, CKLO, which has taken over 9.630 between 3:15 and 7 p.m. CBFX and ZYC8, a Brazilian on same frequency, interfere severely with one another evenings.

HJFK, Pereira, Colombia, which moved up to 6.115, has now returned to 6.100.

TGNA, Guatemala, has changed frequency from 7.170 to 6.255; TGOA from 7.495 to 6.497; TGWB from 6.460 to 6.540. TGWA has been off the air most of the time during late winter.

XEBT, Mexico, has changed frequency from 6.000 to 9.625; reception is good from 10:30 p.m.—when GWO, London, leaves the air—to sign-off of XEBT at 12 midnight.

The Venezuela station on 3.580 has been identified as YV3RS, moved from 3.490; transmitter trouble cleared up after the first week of operation on 3.580; they were still announcing 3.490.

The Berlin s.w. relay testing in midwinter on 11.762 has moved to about 6.038 where it has been reported heard poorly between 3-6 p.m. and 12 midnight-4 a.m.; frequent time announcements are given in the morning period, with Central European time (6 hours ahead of EST) being quoted.

The ICA transmitter at Vienna, Austria, has been moved to Nuremberg to augment the DPGH station. DPGH thus may be heard on ICA frequencies. DHSH4, approximately 7.110, Nuremberg, is reported heard 11 a.m.-12 noon with reports from BBC correspondents in English, German, Portuguese, and Arabic.

Radio SEU, Madrid, has been jumping about during the winter, mostly between 7.065 and 7.109, scheduled from about 3 to 7 p.m. sign-off.

SBO, 6.065, Motala (Stockholm), Sweden, has replaced SBP, 11.705, at 8-8:55 p.m. in the North American transmission; is reported as poor to inaudible in most of the United States; SBO is reported to be used now afternoons also, instead of SDB2, 10.780, weekdays scheduled 1:30-5 p.m., and on Sundays, 1:30-4:15 and 4:20-5 p.m. SBU, 9.535, is now *only* scheduled 8-8:55 p.m. to North America, paralleling SBO. SDB2, 10.780, is used now *only* 11 a.m.-1:15 p.m. SBP, 11.705, is scheduled 1:45-2:10, 6-7, and 8:45-9:25 a.m. SBT, 15.155, is scheduled now weekdays, 6-6:50, 10-11 a.m., 11:45 a.m.-12:55 p.m., and 1-1:15 p.m.; on Sundays and holidays SBT is heard 2:45-7 and 9-11 a.m., 11:05 a.m.-1:15.

HER3, 6.165, Bern, Switzerland, is reported heard after 3 a.m.; schedule is 12 midnight-9 a.m., 11 a.m.-1 p.m., and 4-6 p.m. with Red Cross messages. HEF4, 9. 185, Bern, is reported to have English news now at 4 p.m., usual sign-off in afternoon being 5:15 p.m., but has been heard to 6 p.m.

TAQ, 15.195, Ankara, Turkey, is now reported heard 12-midnight-2 a.m.

Latest schedules reported for XUPA, 9.695, Taihoku, Formosa, are 5-9:20 a.m., 6-7:30 p.m., and 11 p.m.-12 midnight; the unlisted relay on approximately 6.015 is still reported on the morning transmission, best around 9

(*Continued on page* 116)

GREATER NEW YORK HAMFEST

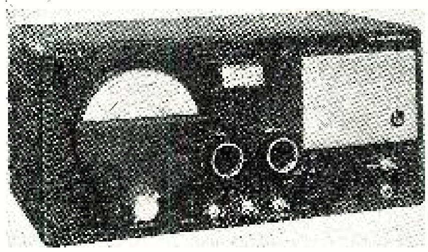
THE North Shore Radio Club of Long Island will sponsor the second annual "Hamfest" to be held in Greater New York, since the war, on Friday evening, April 26th at the Commercial Hotel, 96-43 Springfield Boulevard, Queens Village, Long Island, New York.

This "Hamfest" is open to all persons interested in amateur radio. The program, although informal in nature, will have as its theme "The Radio Amateur Looks to the Future" and will feature prominent speakers from both the amateur and professional communications field. Entertainment and door prizes are also included on the evening's program.

Tickets are available at a nominal fee at Greater New York radio stores handling amateur radio equipment, from North Shore Radio Club members, or at the door. —30—

What's New in Radio
(Continued from page 64)

the reception of standard broadcast has been utilized. The normal positions for standard broadcast reception are marked in red and when the controls are at those positions, only standard broadcasts can be heard. Markings for other types of reception are in light gray.



The top section of the cabinet is of "airodized" steel which swings open on a piano hinge. The cadmium-plated chassis may be removed as a unit with the panel without disconnecting any controls.

The receiver is housed in a steel cabinet, finished in deep satin gray with an external trim of satin chrome. Dials are a light translucent green to prevent glare.

Details and prices of the S-40 will be furnished by *Hallicrafters Company,* 2611 South Indiana Avenue, Chicago, Illinois.

CRYSTAL PICKUP

Shure Brothers, of Chicago, has announced the development of a new crystal phonograph pickup, the "Glider."

This unit features two innovations, the lever-type cartridge and the low-mass tone arm. The cartridge houses the lever-driven crystal which results in lower needle impedance and higher needle compliance. The lever is so designed that it gives greater shock immunity to the crystal.

The light aluminum tone arm is curved and is free from resonance. It has an adjustable swivel screw that prevents the needle from striking the turn-table if the arm is dropped.

The standard output voltage of the unit is 1.6 volts. Production on another unit with higher output voltage is under way. The "Glider" is designed for easy replacement of older type pickups.

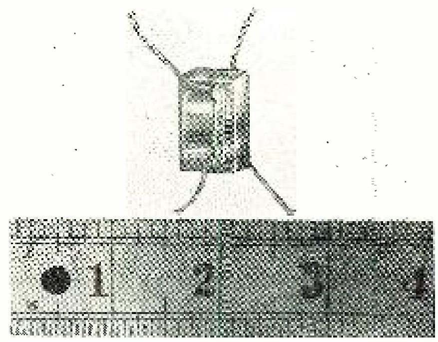
Details of this unit will be sent upon request to *Shure Brothers,* Chicago, Illinois.

MIDGET TRANSFORMERS

A new series of midget transformers for applications in hearing aids, vest pocket radios and other consumer items has been announced by *United Transformer Corporation.*

These transformers, the UTC Sub-Ouncers, measure 9/16" x 5/8" x 7/8" and weigh only 1/3 ounce.

The coil is uniform layer-wound of Formex wire, on a molded nylon bobbin. Insulation is of cellulose acetate. The leads are mechanically anchored externally. Core material is Hipermalloy and the entire unit is triple (waterproof) sealed.



Five standard units are now available and details of the line will be furnished to those requesting them from *United Transformer Corporation,* 150 Varick Street, New York 13, New York.

TUBE AND SET TESTERS

Two all-purpose radio tube and set testers have been announced by *Hickok Electrical Instrument Company.*

These testers have been designed to include the dynamic mutual conductance circuit engineered by the company. Model 532C is designed for counter use, while the Model 532P is a portable unit. Both of these testers test and reject all bad tubes.

The testers are fitted with easy-to-read scales having micromho ranges from 0-3000; 0-6000; 0-15,000 with legends indicating "Replace", "Doubtful" and "Good".

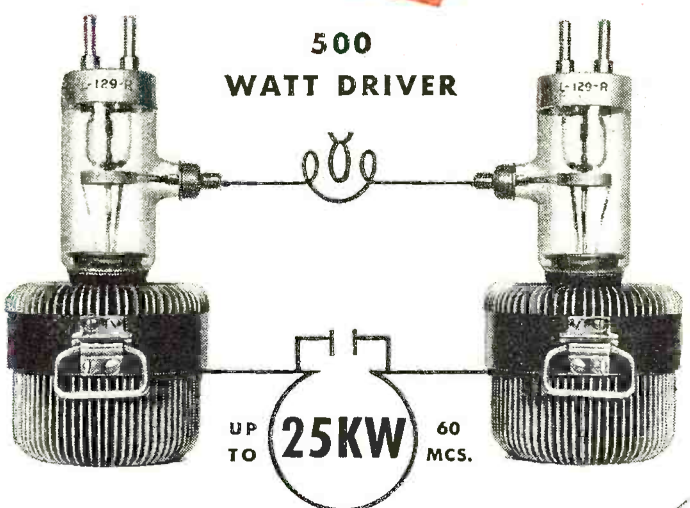
The unit makes provision for noise, gas, and hot and cold shorts tests. Diodes are tested separately with low voltage to prevent paralysis of the elements. Line voltage from 100 to 130 volts is indicated on a large test meter. Rectified current is used to energize plates and grids, and tests can be made of grid controlled rectifier tubes.

Tests can be run on all present-day tubes, including octal, loktal, miniature, ballast and magic eye tubes. Pro-

INDUSTRIAL POWER

IN A SMALL PACKAGE

L-129R



ANOTHER "Lewis at Los Gatos" TRANSMITTING TUBE

Licensed Under RCA Patents
List Price $375.00

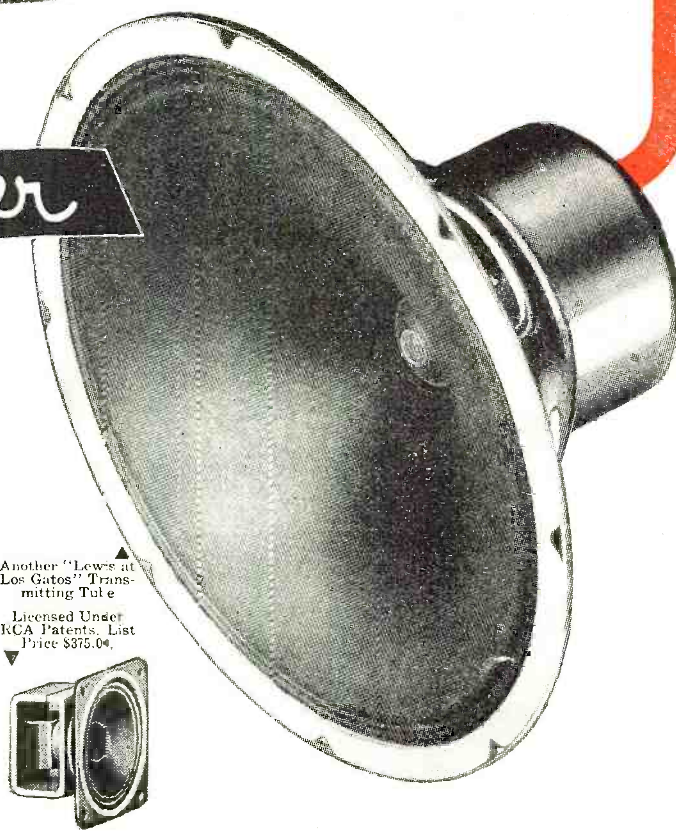
Only 14 inches high and approximately 6 inches in diameter at maximum dimensions—yet two Lewis L-129-R transmitting tubes can deliver 25 kilowatts of useful power at industrial heating frequencies. This, with a self-excited oscillator or, if frequency stability is essential, with an external driver of only 500 watts capacity.

No extensive heat transfer unit is required as only 650 cubic feet of air per minute are necessary for forced air cooling of 2 tubes. Expensive water systems for anode cooling are eliminated.

Built "rugged and reliable" by "LEWIS AT LOS GATOS" the L-129-R will give long and trouble-free life under strenuous industrial operating conditions.

Wire or write for our representative.

There's a better Aireon



Cinaudagraph Speaker

for Every Electroacoustical Application

Aireon Cinaudagraph Speakers, Inc., has the facilities, experience and engineering ability to design and produce better speakers for any purpose. Whether it is a two-inch unit for portable model radios, or a fifteen-inch for commercial phonographs, the same research, precision construction and superior materials are employed.

As a result, electroacoustical perfection never before achieved has been incorporated in Cinaudagraph Speakers—for public address systems, radio, commercial phonographs and many special purposes.

▲ Another "Lewis at Los Gatos" Transmitting Tube

Licensed Under RCA Patents, List Price $375.00 ▼

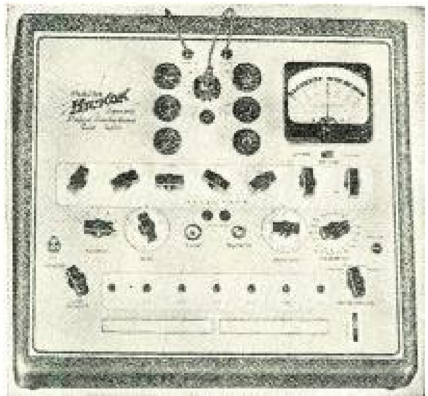
Lewis Electronics
Los Gatos, Calif.

Subsidiaries of
Aireon
MANUFACTURING CORPORATION

Cinaudagraph
Speakers, Inc.
3911 SOUTH MICHIGAN AVENUE
CHICAGO, ILLINOIS

vision for future tube designs has been made.

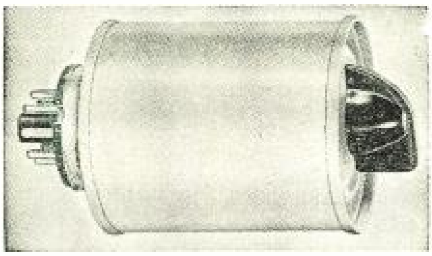
Further details of this tube tester



will be provided by *Hickok Electrical Instrument Company,* 10524 Dupont Avenue, Cleveland 8, Ohio upon request.

SELF-TIMING INTERRUPTER

A new, enclosed self-timing interrupter unit is being offered by *Electronic Controls, Inc.* for applications as warning signals, flasher lights, industrial controls, life testing circuits,



truck or bus blinkers, process timing and aging equipment controls.

The device can be supplied with a fixed, predetermined rate of interuption or with an external variable adjustment. The fixed unit is available in either open frame construction or in plug-in metal enclosures, dust cover or hermetically sealed. The adjustable unit is available in plug-in dust cover enclosures only.

Time range is one to twelve pulses per second. The unit will operate on voltages up to 32 volts, d.c. or 125 volts, 60 cycle, a.c.

Additional data on this device may be secured by writing *Electronic Controls, Inc.,* 44 Summer Avenue, Newark 4, New Jersey.

PORTABLE SPEAKER STANDS

Walker-Jimieson, Inc. of Chicago have announced the availability of a new type of portable speaker stand which is suitable for mounting public address speaker units, flood or spot lights, FM antenna, photographic reflectors in auditoriums, airfields, or temporary outdoor installations.

Four "music stand" type folding leg supports cover an area of about 10 square feet, which gives added stability. The unit is of all welded construction.

The stand will hold 100 pounds of equipment at any desired height up to 20 feet. The unit weighs 35 pounds.

Inquiries addressed to *Walker-Jimieson, Inc.* 311 South Western Avenue, Chicago 12, Illinois, will be handled promptly.

PLUG-IN TEST LAMP

The *Hanlan Company* of Los Angeles has announced a new plug-in test lamp which is designed to fill the need for a portable test lamp which can be plugged into any outlet.

The lamp is capable of instantly locating grounds, shorts, or opens in any piece of electrical equipment. Recommended uses include the testing of appliances, motors, vacuum cleaners, radio circuits, all types of bulbs, fuses, radio tube filaments and other devices.

Complete details and prices will be

INTRA-AUDITORIUM TELEVISION

By W. S. STEWART

FROM Hollywood comes a report of a new suggested use for television. For the convenience of remote members of audiences in large auditoriums, theaters, and even outdoor assemblies the intra-auditorium vision relay will do for the eye what the public address system now does for the ear.

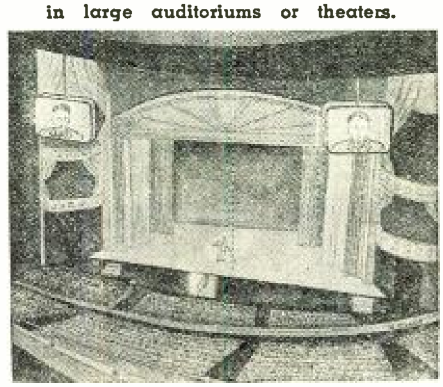
This application of television would benefit the actor, the speaker, and especially the comedian whose facial expressions are an important part of a routine.

Eventually, the physical dimensions of such vision relay equipment may be reduced to the point where it is portable in the same sense that public address systems are portable today.

Motion picture exhibitors might relay, for short intervals, portions of the films being screened inside to a screen in front of the theatre. This could supplement the marquee as a patron "teaser."

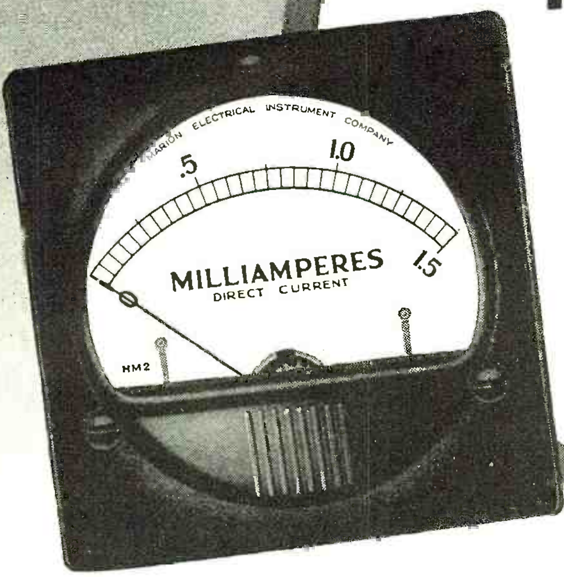
Commercial development of such a system will make opera glasses obsolete, as well as create new jobs in the manufacture, operation and maintenance of this equipment. —30—

Suggested scheme for relaying performer's features to remote audiences in large auditoriums or theaters.



MARION "HERMETICS" ARE HERE TO STAY

because . . .



. . . they're dustproof and moisture-proof — foreign matter which oxidizes pivots and attacks bearings and thus shortens the life of an instrument cannot enter.

. . . sustained performance over a longer period of time is assured and rejects of complete equipment due to instrument failure are minimized, if not eliminated.

. . . the magnetic and electrostatic shielding obviates the need for special calibration for different types of panels or separate shielding of instruments in order to prevent RF leakage through the case.

. . . interchangeable colored flanges, in both round and square shapes, are available at no extra charge; finer in performance, Marion "hermetics" are also smarter in appearance.

. . . they are 100% guaranteed for six months — after that, regardless of condition and provided the seal has not been broken, we will replace any 2½" or 3½" instrument from 200 microamperes upward for $1.50; any 2½" and 3½" type with sensitivity greater than 200 microamperes for $2.50.

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

Note: Marion "hermetics" cost no more than most standard unsealed instruments—and they are positively interchangeable. Write for the new Marion Catalog.

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE
EXPORT DIVISION • 458 BROADWAY • NEW YORK 13, N. Y., U. S. A. • CABLES: MORHANEX

IN CANADA: THE ASTRAL ELECTRIC COMPANY, SCARBORO BLUFFS, ONTARIO furnished upon request to *Hanlan Company,* 1419 West Jefferson Blvd., Los Angeles 7, California.

-30-

Radar Reaches the Moon

(*Continued from page 27*)

fore another pulse is transmitted to the moon.

And each radar pulse must be of appreciable duration—from ¼ to ½ second—to insure a strong signal at the receiver after reflection by the moon.

A three-kilowatt radar transmitter was available for the experiments, and this was modified to supply an output of fifty kilowatts. Through the use of a high-gain antenna, effective radiation was raised to about 10 megawatts, or 10 million watts.

Strength of the received echo reflection has been estimated to be only a few tenths of a watt. Thus the most difficult step in contacting the moon was not so much in the transmission, but in the design and construction of an extremely sensitive receiver.

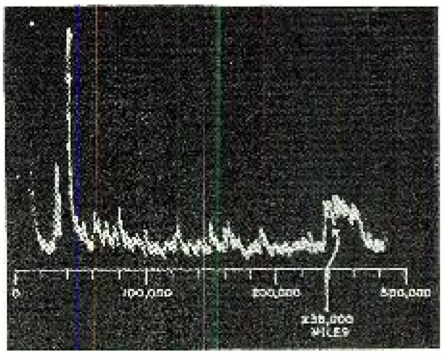
This receiver—using 34 tubes, and four different intermediate frequencies—has a sensitivity of about 0.01 microvolts.

A good idea of the over-all equivalent sensitivity is that the radar set could pick up an airplane at a distance of more than 1900 miles—assuming, of course, that the target was within the set's line of sight.

The complete radar set incorporates a number of new design techniques, thus a detailed analysis of the Diana Project is worthy of further study.

Details of Components

The radar transmitter consists of a series of frequency multiplying stages which raise the frequency of a 516.20 kc. crystal to 111.6 megacycles (the carrier frequency). A pair of type WL-530 tubes are used in the output. These are driven by a pair of type 450-TH tubes (triplers) which, in turn, are driven by a pair of type 257-B tubes (doublers) which, in turn, are driven by an 807 which, in turn, is driven by tubes in the radar receiver.



Photographic record of reception of radar signals reflected by moon on night of Jan. 22, 1946. Heavy pulse at 0 represents initial transmission of energy toward the moon. Jagged lines indicate general noise reception. Distinct echo at about 238,000 miles represents reception of radar echo 2.4 seconds later, after echo had actually traveled a round trip distance of over 477,000 miles between earth and moon. Actual mean distance from earth to moon is 238,857 miles.

The same crystal controls both the transmitter frequency and the heterodyne voltage for the receiver.

A pulse of variable width is supplied the transmitter by the electronic keyer or timer—a physical part of the indicator unit. A pulse duration of from ¼ to ½ second can be used.

Pulse recurrence frequency is also variable. The electronic keyer or timer can supply a pulse once every three to five seconds. This is equiva-

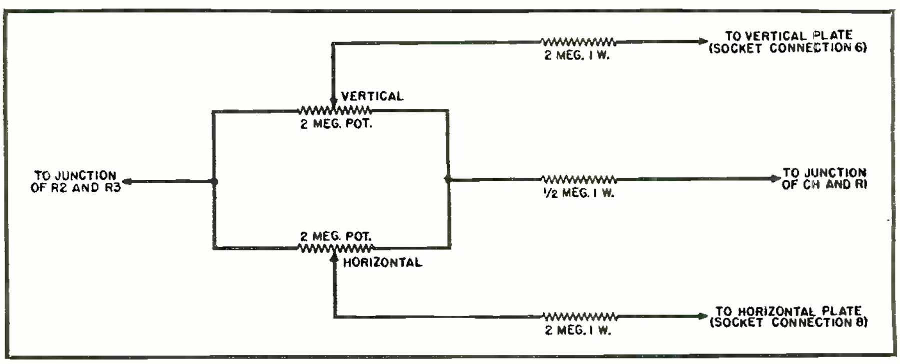
BEAM CENTERING CONTROL FOR 5" OSCILLOSCOPE

RADIO NEWS has received innumerable letters from its subscribers commenting favorably on the article entitled "5" Oscilloscope Design" appearing in the August, 1945 issue of RADIO NEWS. Interest indicated that many of those who constructed the unit would like to add beam centering controls to their new instruments.

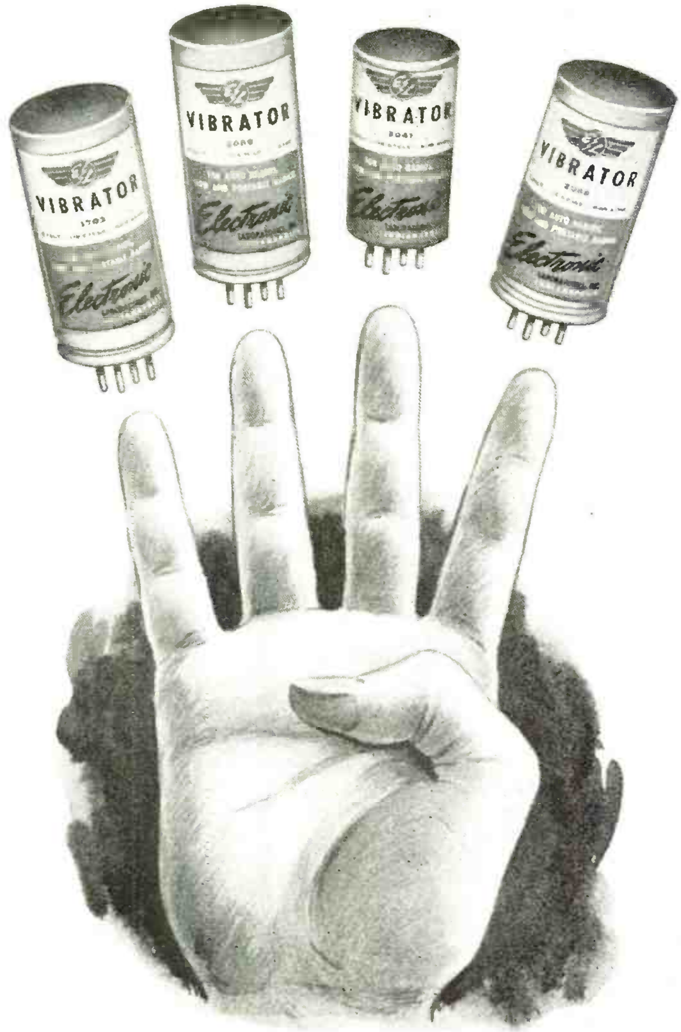
In view of this demand, we are presenting the schematic diagram for the addition of such controls. The circuit is exceptionally simple and consists of five components, namely three resistors and two potentiometers.

-30-

Schematic diagram for beam centering control to be used in conjunction with the 5" oscilloscope design appearing in the August, 1945 issue of Radio News.



4 Good Reasons!



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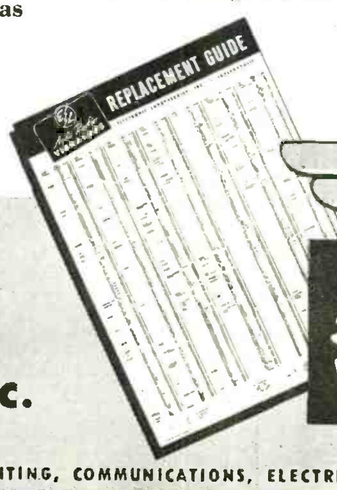

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Auto Radio VIBRATORS

VIBRATORS AND VIBRATOR POWER EQUIPMENT FOR LIGHTING, COMMUNICATIONS, ELECTRIC AND ELECTRONIC APPLICATIONS lent to p.r.f. of ⅓ to ⅕ cycles per sec.

The peak output of the radar transmitter during pulses is fifty kilowatts.

The transmitter feeds through a mechanical, low-loss *T/R* switch to the antenna system. The *T/R* switch consists of specially constructed relays to obtain positive low-loss action on the long and relatively low peak power pulse used.

The antenna consists of a broadside array of 64 half-wave dipoles. The array is movable and mounted 100 feet above ground.

The antenna system has a forward power gain of about 200. It has a beam width of 15 degrees at half power points—in both the vertical and horizontal planes.

Received echoes are applied to the radar receiver—the real secret of the set's ability to pick up reflections from such distant targets. The receiver is a 4-mixer superheterodyne, with all but one of the mixer injection frequencies directly controlled by the transmitter crystal—to provide locking with the transmitter frequency. Fourth mixer is provided with an adjustable frequency crystal; this sets exactly the final intermediate frequency and depends upon the actual radio frequency being received. The received frequency of the radar signal differs from the transmitted frequency by an amount depending upon the Doppler effect which, in turn, is caused by the moon's relative velocity.

Operating noise factor of the receiver is about 8 db. The receiver bandwidth is about 50 cycles.

A loudspeaker is coupled to the output of the last i.f. amplifier to provide audible indications of echoes.

A long-persistence oscilloscope is used to display the echo output from the detector. The scope uses a type "A" time base with a three to five second sweep, depending upon the desired pulse recurrence frequency. Direct coupling is used for both sweep and deflection circuits.


Servicing and aligning intricate circuits of the sensitive radar receiver. Col. DeWitt discusses procedure with Herbert Kauffman and Dr. Harold Webb.

New Equipment

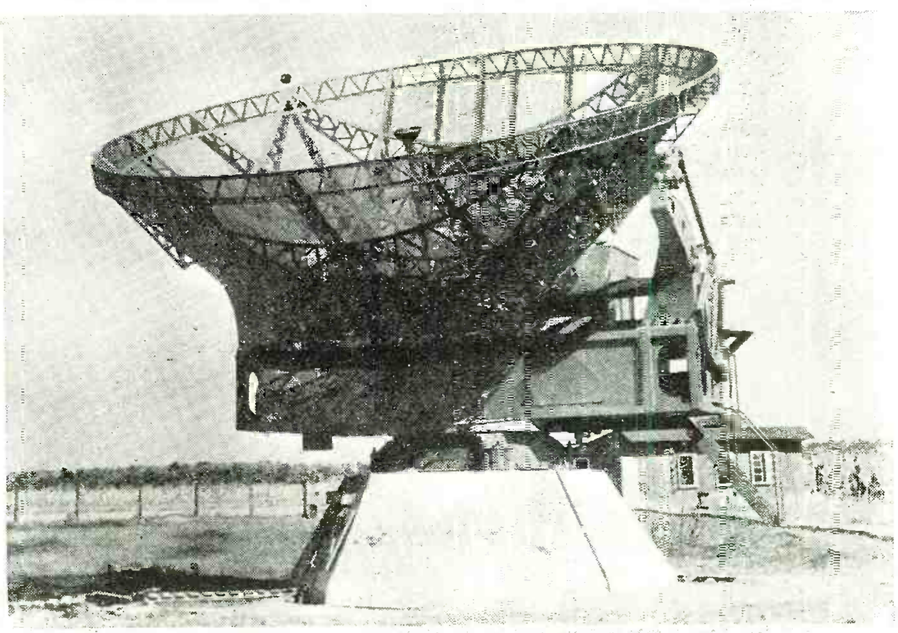
Work has already begun on the design of new and more compact permanent equipment to replace the composite gear used on the first experiments.

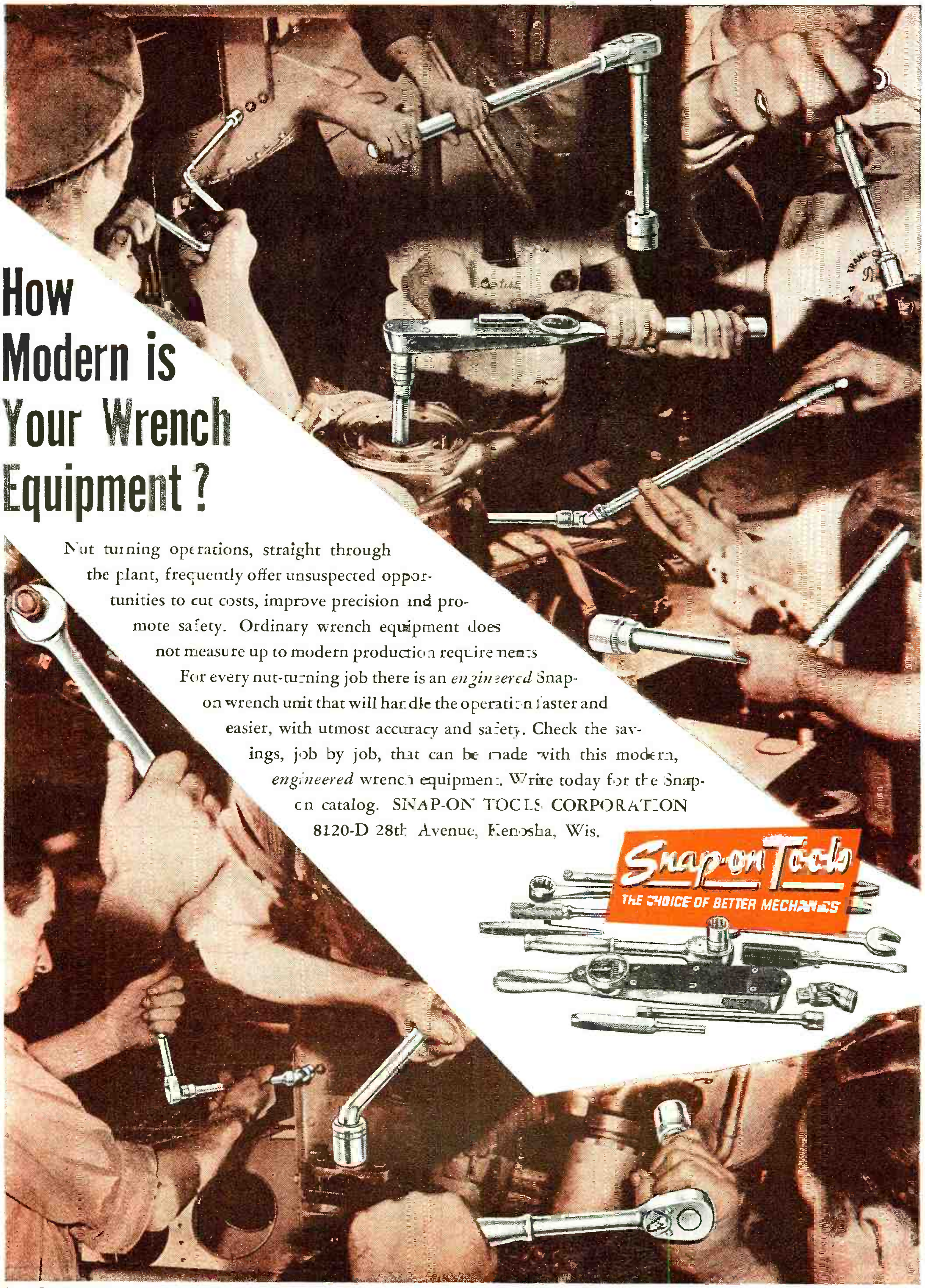
The multi-dipole antenna array will probably be replaced by a parabolic reflector—forty or fifty feet in diameter—capable of movement in three dimensions. The base will be comparable in design to bases used for large telescopes at astronomical observatories.

It is also fairly certain that the operating frequency will be considerably increased, when the present radar transmitter is replaced with a more powerful one—possibly using magnetrons.

Other improvements will be incorporated in other components in an at-

One of the German radars successfully jammed by the Allies. Used for ground control of fighters and, later on in the war, for direction of anti-aircraft fire.





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tempt to increase both the output power and the sensitivity of the lunar radar.

The Signal Corps intends to continue experiments in this fascinating new realm of exploration and discovery. The War Department has already embarked upon a long-range research program to develop more reliable and informative techniques for radar study of the moon and the ionosphere.

Study of the effect of radio waves in traveling through the atmosphere is of utmost importance. This includes bending and refraction of radio waves, and more complete data concerning the Doppler effect on radio signals passing beyond the earth's atmosphere.

Another valuable application of lunar radar will be the provision of new meteorological and astronomical information. Cosmic dust in space can be detected and located. And not only may it be possible to construct topographical maps of distant planets with the aid of radar data, but scientists may be able to determine the composition and atmospheric characteristics of other celestial bodies by means of long-range radar.

—30—

Pulse Modulation

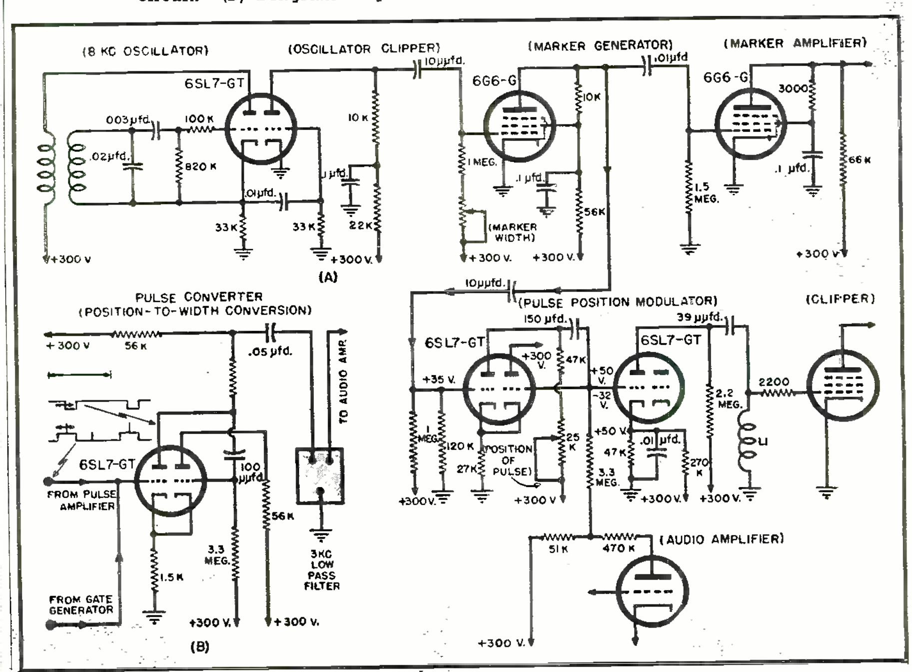
(*Continued from page* 44)

of marker pulses—makes use of two tubes, known as the "cyclodos" and the "cyclophone," developed specifically for this purpose. The essential features of these tubes are shown schematically in Fig. 10. Both tubes make use of an electron beam which, by means of an ordinary circular sweep circuit, is made to strike the aperture plate in a circular path. (For ordinary telephone communication, 8000 revolutions per second is a suitable frequency of rotation for the electron beam.) The aperture plate contains radial slits, so that during the time the beam is passing each slit the electrons go through and strike the collector segments, while at all other times they are intercepted by the aperture plate. Thus, once in each complete rotation of the electron beam a short pulse of current is passed to each collector segment. The tubes shown in the diagram, having aperture plates with four slits, would be suitable for a multiplex system having three channels, one slit serving for the marker pulse and the others for the three time-modulated signals.

In the modulating tube (the cyclodos) the slits are placed at an angle to the radius of the circular plate, as shown in Fig. 10A. It can be seen from the diagram that because the slits are tilted at an angle, the time when the beam crosses the open slit changes either forward or backward as the radius of rotation of the beam changes. Thus, audio-frequency amplitude variations may be converted into pulse-time variations by varying the instantaneous voltage on the deflecting plates and thereby changing the radius of rotation of the electron beam. The dotted circle in Fig. 10A represents the circular pattern obtained when all three channels are unmodulated. The solid path represents modulation in all three channels—instantaneous peak positive modulation in channels 1 and 3, negative modulation in channel 2. (The marker pulse, of course, is always unmodulated.)

In the demodulator tube (the cyclophone) shown in Fig. 10B, the slits are placed along the radius of the circular aperture plate instead of being tilted. To convert the time-modulated pulses into amplitude variations, the electron

Fig. 8. (A) Schematic diagram of pulse-time transmitter modulating circuit. (B) Diagram of pulse-time receiver demodulating circuit.



for any type of application

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* *Acid etching quartz crystals to frequency is a patented Bliley process.*

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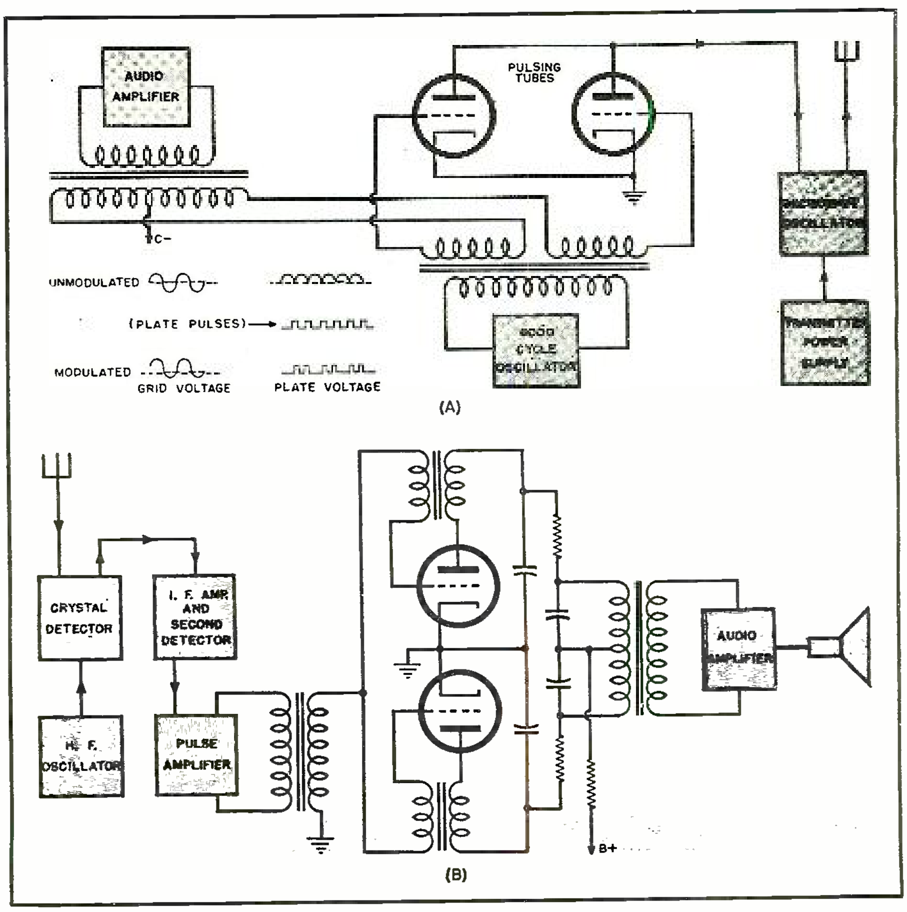
BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA beam is made to rotate in a circular path, but the control grid is kept sufficiently negative so that the beam is normally cut off except when one of the time-modulated pulses arrives. The pulses are applied to the grid and, depending upon where the electron beam is directed with respect to the slit at the time when the unblocking pulse arrives, there will be a variation in the amount of beam current passing through the slit and reaching the collector segment.

At the present time the cyclodos and cyclophone tubes are not commercially available. When they do become available the cost of the tubes, although expected to be moderate, will be a factor in determining their suitability for amateur use. For the time being, a reasonable substitute can possibly be improvised for amateur service by making use of an ordinary cathode-ray tube and phototube arrangement. This can be accomplished by cutting slits in a piece of black cardboard which fits over the face of the cathode-ray tube. Light shields and phototubes are placed in front of the slits so that each phototube records the light coming through one slit. In this manner, the slotted piece of black cardboard is made to act as an aperture plate and the phototubes take the place of the electron-collecting segments.

(b) A method of accomplishing pulse-time transmission and reception without requiring the use of the cyclodos and cyclophone is shown in Figs. 7 and 8. A block diagram explaining the operation of the transmitter is shown in Fig. 7A with the basic details of the modulating circuit—the oscillator clipper, the marker pulse generator, and the pulse position modulator—given in greater detail in Fig. 8A. The recurrence frequency is determined by the 8000-cycle oscillator, which at the same time provides a waveform suitable for starting the marker pulse generator and the pulse position modulator circuits for each channel. The marker pulse is obtained from the 8000-cycle sine wave by means of the oscillator clipper and the marker pulse generator. The pulse position modulator consists of a double triode connected as a biased multivibrator, and a single triode used as a pulse generator. Its operation may be explained briefly as follows:

In the normal state (represented by the upper set of voltage values in the schematic) the second section of the multivibrator conducts current. The application of the marker pulse causes the first section to become conducting and the second section non-conducting, even after the initiating pulse has ceased. This condition persists until current flowing through the 3.3 megohm resistor charges the coupling condenser sufficiently to permit the plate current to flow in this section of the tube, at which point a rapid reversal takes place. Modulation is produced by variation of the potential to

Fig. 9. Transmitter (A) and receiver (B) for time-modulated pairs of pulses.



which the 3.3 megohm grid resistor is connected, by connecting it to the output of an audio amplifier tube. The mean length of the square wave generated by the multivibrator is adjusted to place the channel pulse in its normal unmodulated position by means of the variable load resistor in the plate circuit, which adjusts the time constant of the multivibrator. The transient in the pulse generator tube when the reversal takes place causes the position-modulated pulse, by pulsing into one-half cycle of oscillation the tuned circuit formed by the inductance L_1 and the input capacity of the following tube. The remaining features of the transmitting circuit are quite conventional, as can be seen from the block diagram.

The operation of the receiver circuit can be understood from the block diagram in Fig. 7B and the demodulator schematic in Fig. 8B. The pulse position modulation is converted to amplitude variation by first converting it to pulse length modulation, then filtering out the voice frequencies below 3000 cycles from the pulse length-modulated signal. This conversion is accomplished by means of a multivibrator circuit. For each multiplexed channel there is a gate pulse which is generated in a fixed relationship to the marker pulse, as shown. When the voltage of the modulation pulse is superimposed on the gate pulse, the multivibrator is triggered and remains operative until the end of the gate pulse interval. This results in an output square wave whose leading edge is varied at the voice frequency. The remaining features of the receiver circuit are quite conventional, as can be seen from Fig. 7B.

The circuits for pulse-time modulation and demodulation employing conventional tubes are seen to be somewhat more complicated than those making use of the cyclodos and cyclophone tubes, especially for multiplex communication. However, for single-channel operation the circuit is not too complex, and it has the advantage of using standard tubes which are readily available. At the same time, it affords the radio amateur an interesting opportunity to experiment with extremely useful pulse and non-standard wave-form techniques.

(c) Circuits for pulse transmission and reception by variation of the timing between pairs of pulses without the use of a reference pulse are shown in Fig. 9. In the transmitting circuit the pulses are generated by connecting the grids of the pulsing tubes in push-pull, and the plates in parallel. The manner in which the pulsing and pulse timing is accomplished can be seen from the wave-shapes shown in the diagram. With no modulation applied, one or the other of the pulsing tubes passes current at all times except when the input from the constant-frequency source is near the zero value. For near zero values, both tubes are simultaneously cut off and a short

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ANOTHER REASON WHY IT PAYS TO QUALIFY AS A RAYTHEON BONDED ELECTRONIC TECHNICIAN

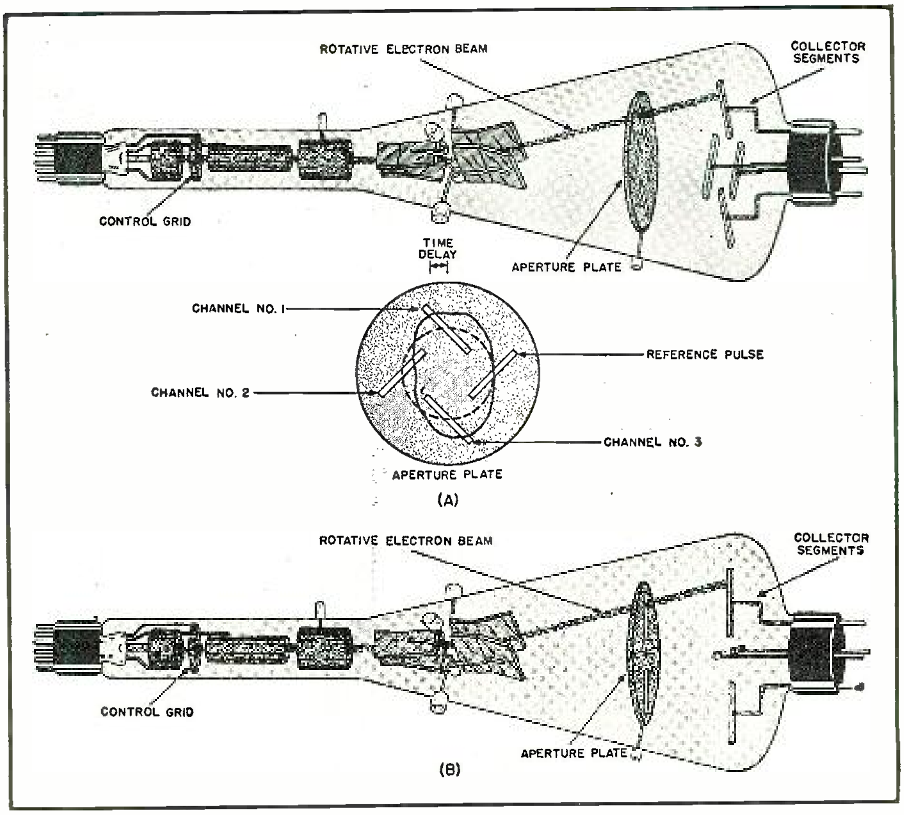


Fig. 10. Artist's illustration of the cyclodos tube (A) and the cyclophone (B).

pulse of relatively high potential is passed into the transmitter. With no modulation these pulses are uniformly spaced. When modulation is applied the bias potential of both grids is varied in opposite directions, thus drawing alternate pulses together. Reversing the polarity of the modulation potential causes the pulses to be pushed apart.

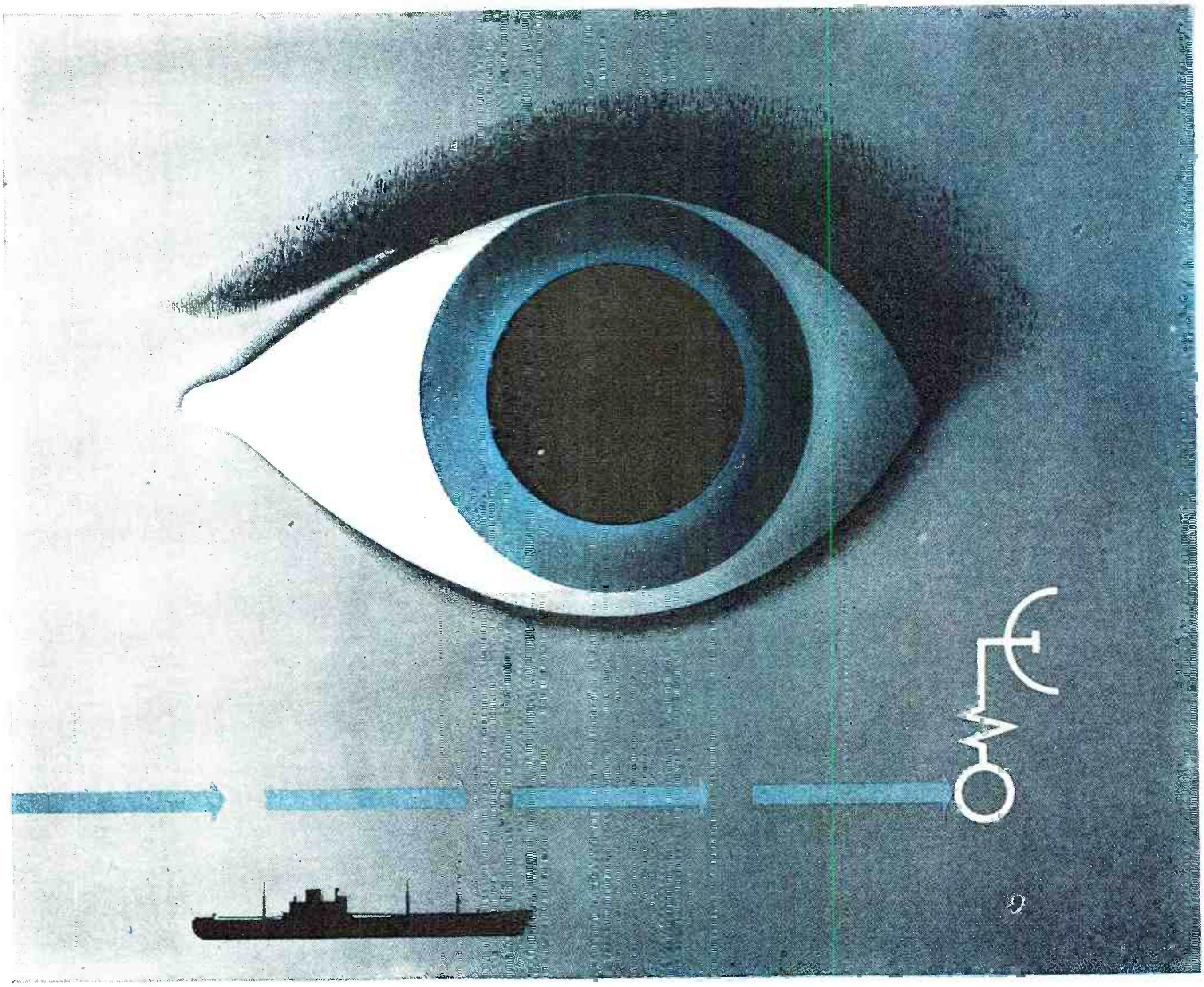
The demodulator in the receiver makes use of two pulsing oscillators of the type used to produce saw-tooth potentials in television receivers, each adjusted to the same frequency as the oscillator in the transmitter, with a common plate resistor to make them tend to operate 180° out of phase. The received pulses synchronize the operation of the oscillators, alternate pulses controlling each oscillator. Thus, when a received pulse advances the pulse of one oscillator, it retards the pulse of the other. Since the received pulses modulate the phase or timing of the oscillations of each pulse oscillator, but not the frequency, they vary the average current through the tubes. Therefore once the oscillators have dropped into synchronism with the received pulses, the average plate current will be modulated by the pulse modulation. This provides the original audio signal which was transmitted.

From the above discussion of the theory of pulse-time modulation and from the circuits that have been described, the amateur who desires to experiment in microwave communication should be able to design and construct a pulse-time modulation rig to use on these frequencies.

—30—

NEW ADDITIONS TO AMATEUR CALLS

W1HNN	Solomon Smith	16 Parkman	Brookline, Mass.
W3BIZ	Maurice Davis Corson	508—73rd, N. E.	Carmody Hills, Md.
W3CJT	James Alvin Sutherland	4950 Chesapeake	Chevy Chase, Md.
W3DF	George Edward Sterling	1003 Noyes Dr.	Silver Spring, Md.
W3KAI	William Lawson Vandal, Jr.	4336 Lily Ponds Dr.	Washington, D. C.
W3KAJ	George R. Boardman	5416 Kansas Ave.	Washington, D. C.
W3KAK	Morris M. Goodman	557 E. Frederick	Lancaster, Pa.
W3KAL	Thomas Arens Pendleton	7605 Dellwood Pl.	Bethesda, Md.
W3KAM	Thomas William Kelley	906 Garland Ave.	Takoma Park, Md.
W3KAN	Charles Warren McDormand	6708 Cockerille	Takoma Park, Md.
W4ERE	John Galbraith Cormack	1411 Flagler Ave.	Key West, Fla.
W4IIS	John Douglas Morgan	2006 Ohio Ave.	Augusta, Ga.
W4IIT	Carl H. Hatch	3075 N. Pollard	Arlington, Va.
W4IIV	William E. Albert	601 Queen	Alexandria, Va.
W4IIW	James Aaron Spraggins	4851 Manchester	Jacksonville, Fla.
W5KTB	Grady Lee Breece	3105 Metairie Rd.	New Orleans, La.
W6AIW	John Wesley Crews	Lawndale Rd., 2½ Mi. S. W. of	Kenwood, Calif.
W6QUT	Freeman F. Gosden	720 N. Alpine Dr.	Beverly Hills, Cal.
W9ECJ	Allen Don	7716 N. Marshfield	Chicago, Ill.



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• This year, Sperry Gyroscope Company introduces its new *Radar* equipment for marine use.

Sperry *Radar* has been conceived to function better in this fundamental service: *To enable ships to operate on schedule regardless of visibility*...through thick fog, heavy rain, dense smoke, darkness.

As an aid to navigation it picks up channel markers and buoys; assists in making landfalls with assurance; spots icebergs, floating derelicts and other hazards projecting above surface. It also permits vessels to enter harbors and proceed with all due safety and caution through fog. Another important feature: Sperry *Radar* provides a Gyro-Compass-controlled image and can be operated by bridge personnel without extensive technical background.

In design and construction, Sperry *Radar* reflects this company's many years of experience in precision manufacture of marine equipment—as well as its outstanding achievements in the field of electronics. In simplicity and dependability, this new *Radar* exemplifies again Sperry's ability to build superior products for merchant ship service.

Sperry Radar Features:

- Designed to meet all Class A specifications of the U. S. Coast Guard.
- Maximum range 30 miles—minimum, 100 yards.
- 10-inch picture on a 12-inch screen.
- Images presented in true or relative relationship at option of operator.
- Gives accurate ranges read from indicator instead of estimated from scope.
- Backed by world-wide service.

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..... LETTERS .....
FROM OUR READERS

"I AM just a newcomer to the radio servicing field and your magazine is a godsend. Every little hint I get is very useful to me and the varied selection of articles just fits this need.

"Another point that I would like to mention is that many able radio and appliance repairmen work only in off hours as I do and do not want to lay out a lot of cash for test equipment and service Manuals. I have to get along with a VOM, tube tester, and signal generator. I cannot possibly afford a set of service manuals and, therefore, have to waste much valuable time in hunting up someone who does possess some. Many letters have been written to manufacturers asking, pleading, appealing to them to include circuit diagrams with their sets. Many have not complied and this feature could be added at such a negligible cost that it seems downright outrageous to us *off time* repairmen."

A. H. Ismach
New York City

We heartily agree that set makers should paste a schematic in every cabinet. It's inexpensive and practical.

* * *

HIS SHACK INSTALLED

"IN THE June 1945 issue of RADIO NEWS, a letter of mine was published, topic of which was postwar planning of 'ham shacks.'

"I have since been discharged from the Army, November 14, 1945 to be exact. I didn't go back to my former job until December 17, 1945. This gave me a month to get a 'shack' installed.

"The entire room and furniture is done in light blue and yellow. The various cabinets I have in the room hold my radio parts, supplies, tubes and my photographic equipment. Each drawer or shelf has certain items, all antenna equipment in one drawer, condensers in another, etc.

"I have branched out in my radio hobby since going into the Army, having gone into making recordings of radio programs, short-wave signals, this replacing letter writing in some cases. Thanks to RADIO NEWS, I was able to buy a GE Recorder from a lad in Pennsylvania. I also want to thank RADIO NEWS for publishing my letter in the June, 1945 issue. It brought me a letter from Henry (Hank) M. Henriksen, Model Radio & Sound Company of Racine, Wisconsin. He wrote me that he liked my letter and idea of a postwar 'ham shack.' We have been writing and sending each other recordings ever since. He gave me a lot of helpful hints in wiring my GE recorder to my Hallicrafter SX-28A receiver.

"My radio equipment consists of a 9-tube Postal short-wave set, speaker being at the bottom of the rack. Other radio is a Hallicrafter SX-28A which is working out swell. Speaker is on top of receiver. Earphones are used during late hours.

"The PA equipment is a homemade job, being a 10 watt outfit. Speaker for that is on top of rack, baffle board of said speaker has my initials. It was made by a ham in Oklahoma some years back. There is a double button mike to left of rack.

"I have three antennas. One a copper wire some 220 feet long, running east and west. Second antenna is a 62 inch car aerial with a twisted pair. Both of these antenna lead-ins go to a double-pole, double-throw switch. They are used with the Hallicrafter receiver. The third antenna is a wire run from a cold water pipe to my Postal receiver. This wire is connected to a single-pole, double-throw switch. The reason for that is, when I am not using the ground for an antenna, I use it as a ground to a filter I have on the power line to the Hallicrafter.

"One Sunday of recent date I tuned in Sweden and made a recording of some music. This made a hit with my wife and mother-in-law as they are Swedish.

"It sure feels good to get back to my short-wave hobby again and read my RADIO NEWS in the comfort of my shack and home.

"I intend to set up a speaker or two upstairs (my shack is in the cellar) so that when I get some 'hard to get' short-wave stations, others can hear them too. We are all 'radio minded' here.

"Might add that the Postal receiver is worked on a drawer system in changing coils for various bands. I expect to get my 5 meter receiver back into operation soon.

"I am always ready to swap shack photos with readers of RADIO NEWS.".

Alfred G. King
8010—97th Avenue
Ozone Park, 17, Long Island

Our thanks to Reader King for the photographs of his shack. Sorry we haven't space to publish them here.

* * *

PARASITICS

"ORCHIDS to RADIO NEWS and to John S. Jackson for his article in the February issue on "Parasitics in Transmitters."

"Here at the northernmost spot of civilization on the North American continent I had no end of trouble in trying to cure the ills of a 1 kw. T/5 FRC transmitter. The unit was designed to work down to 150 kc. and specifications called for operation on 130 kc. on a point-to-point net. I had

Thanks to 7 tough Years . . .

. . . this greatest of test instruments has been tested into top ranking reputation

The Simpson 260 has out-sold and out-performed every other even remotely similar test instrument in the electronic and electrical fields ever since its introduction in 1939. Through the ensuing seven years, covering the War period, circumstances gave it a gruelling test for accuracy never visioned by its makers. It stands today as irrefutable proof that Simpson design and Simpson quality produce accuracy that *stays* in an instrument year after year.

The demand for the 260 from men who first used it in the Armed Services (in laboratories of 300 government agencies and universities, and on the battlefields the world around) has now been added to its enormous popularity among radio servicemen. The Simpson 260 is easily the world's most popular high-sensitivity set tester for television and radio servicing.

The basic reason for this out-selling and out-performing by the Simpson 260 is this: It out-values every other similar instrument in the field. You cannot touch its precision, its useful ranges, or its sensitivity in any other instrument selling for the same price or even substantially more.

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SIMPSON 260, HIGH SENSITIVITY SET TESTER FOR TELEVISION AND RADIO SERVICING

Ranges to 5000 Volts—Both A.C. and D.C.
20,000 Ohms per Volt D.C.
1000 Ohms per Volt A.C.

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. The practically negligible current consumption assures remarkably accurate full scale voltage readings. Current readings as low as 1 microampere and up to 500 milliamperes are available.

Resistance readings are equally dependable. Tests up to 10 megohms and as low as ½ ohm can be made. With this super sensitive instrument you can measure automatic frequency control diode balancing circuits, grid currents of oscillator tubes and power tube, bias of power detectors, automatic volume control diode currents, rectified radio frequency current, high-mu triode plate voltage and a wide range of unusual conditions which cannot be checked by ordinary servicing instruments. Ranges of Model 260 are shown below.

Price, complete with test leads....................$33.25
Carrying case 4.75

Volts D.C. (At 20,000 ohms per volt)	Volts A.C. (At 1,000 ohms per volt)	Output
2.5	2.5	2.5 V.
10	10	10 V.
50	50	50 V.
250	250	250 V.
1000	1000	1000 V.
5000	5000	5000 V.

Milliamperes D.C.	Microamperes	Ohms	
10	100	0-1000	(12 ohms center)
100		0-100,000	(1200 ohms center)
500		0-10 Megohms	(120,000 ohms center)

(5 Decibel ranges: —10 to +52 DB)

ASK YOUR JOBBER

tried a number of schemes, being hampered by the lack of practically everything in test equipment and the great distance to supply depots.

"I was at the end of my rope and was practically stumped. Then my eye fell on that copy of RADIO NEWS and in turning through the pages I came across Mr. Jackson's article. That was the spark I needed. Since the final in this transmitter consists of four 810's in parallel, I was convinced that the trouble I had encountered lay in the fact that no parasitic suppressors had been put in, either in the plate or grid circuits. Using a 350 ohm resistor with 5 turns of No. 12 wire around it, in series with the four plate connectors, and four 50 ohm resistors with 7 turns of No. 20 wire around them, one each in series with each grid, I was very pleased to find that my trouble had vanished. The values of the resistors probably are not critical, but they were all I had on hand.

"Since this is probably the largest installation of its kind north of the Arctic Circle, and probably the most northerly transmitter set-up on the continent, I thought you might be interested in the helpful part your magazine played. I have been a reader of RADIO NEWS for nearly ten years but I can assure you that no issue meant as much as the February issue did.

"Fairbanks reads us 5-5 and stations as far south as Great Falls have read us loud and clear. 130 kc. seems to be able to get through when all other frequencies are blocked by the Northern Lights.

"In closing, I join with Mr. Jackson in saying that while parasitics *may* be an "Act of God" it was certainly a similar "act" that brought that copy of the magazine at just the right time."

S/Sgt. F. B. Andrews
U. S. Army Signal Corps

Thank you Sargeant for your kind words. It's nice to know that occasionally the "crystal ball" is right.

* * *

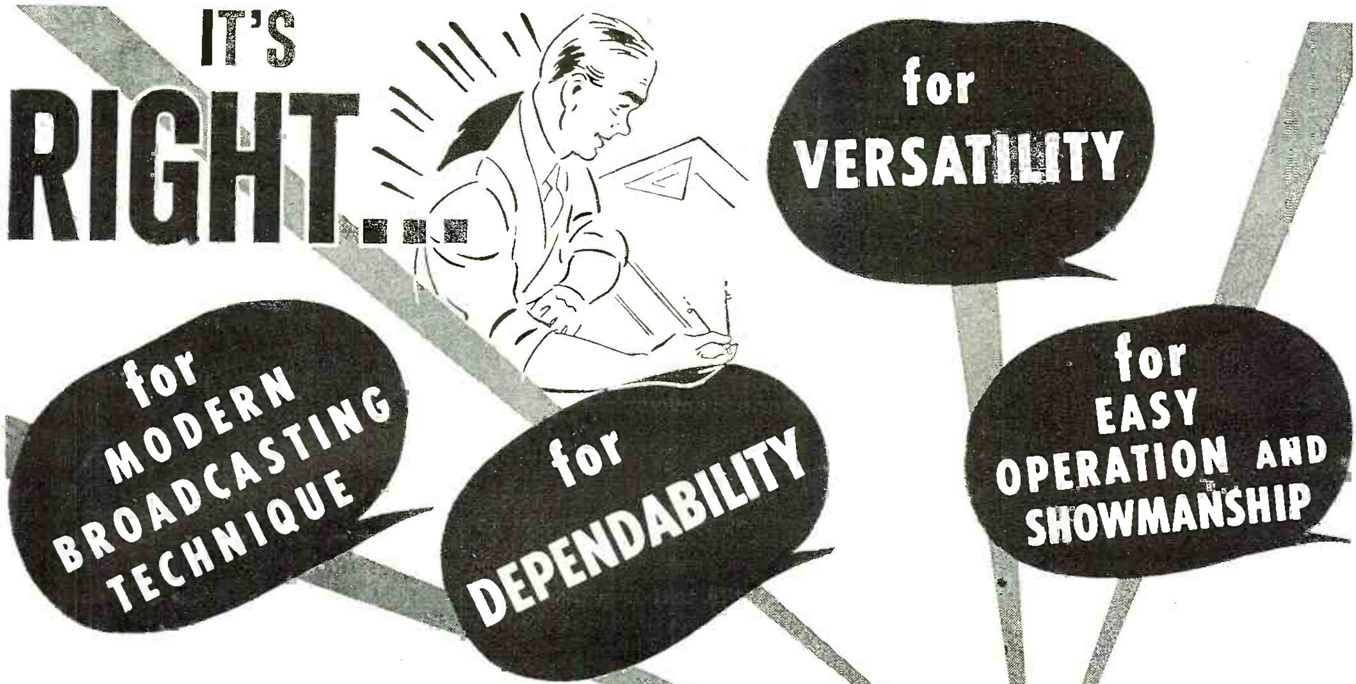
CORRESPONDENTS WANTED

"THANK you for starting my subscription to RADIO NEWS. your review is very interesting, above all for us French who were cut off from the world for five years.

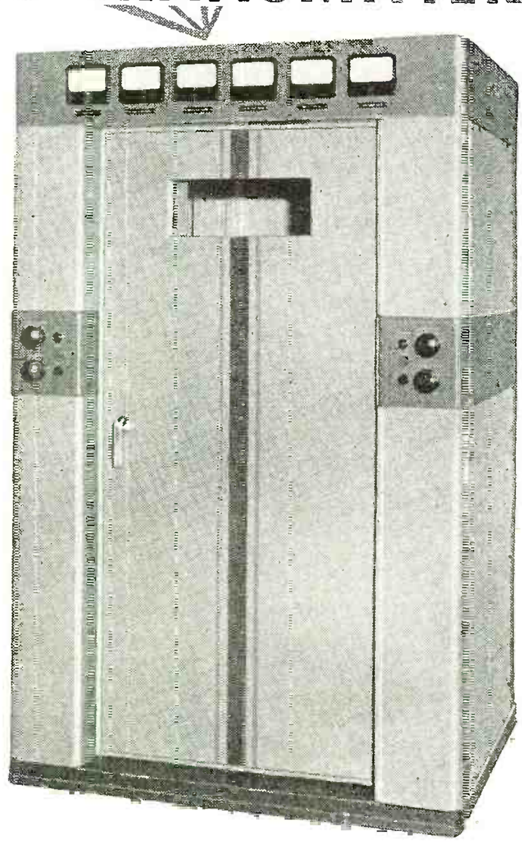
"Could you get for me the address of one or two young American engineers working as professional radio men (sending or receiving—one each) because I would like to have correspondence with them. I am, myself, a technician (the grade below engineer) for the sending of broadcasting."

M. Drieu
19 rue de Turenne
Brive, Correze
France

How about some of you broadcasting engineers writing to Reader Drieu? You should write him direct, at the address given.



The GATES 1-KILOWATT TRANSMITTER



IT has everything you want in performance—modern broadcasting technique from circuit developments, now incorporated, which are the result of proved laboratory tests. It is versatile to meet all demands. Yes, and it is dependable under all circumstances. In addition to these mechanical perfections which Gates engineers assure, the BC-1E Transmitter combines easy operation and beauty in appearance to make your Station outstanding in showmanship. It is RIGHT for the 1-Kilowatt Station. Investigate it!

CONDENSED SPECIFICATIONS

FREQUENCY RANGE: 530 to 1600 K. C.

FREQUENCY STABILITY: Plus or minus 10 cycles maximum.

POWER OUTPUT: 1000 Watts. May be operated as 500 Watt Transmitter. Power reduction for night operation may be incorporated to suit requirements.

POWER SUPPLY: 230 Volts, 60 Cycles, single phase, regulation not to exceed plus or minus 5%.

FREQUENCY RESPONSE: Within 1½ Db. from 30 to 10,000 cycles.

DISTORTION: Less than 3% from 50 to 7500 cycles. O-95% modulation.

NOISE LEVEL: 60 Db. below 100% modulation.

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EXCLUSIVE MANUFACTURERS OF TRANSMITTING EQUIPMENT.....SINCE 1922

TECHNICAL BOOK & BULLETIN REVIEW

"TWO-WAY RADIO" by Samuel Freedman. Published by *Ziff-Davis Publishing Company,* Chicago. 468 pages. Price $5.00.

This book covers the various applications of two-way radio for railroads; police, fire and forestry services; highway and public transportation; marine applications; aircraft; and personal communications.

The author has developed the theory and construction of various types of two-way radio equipment, including AM, FM, carrier and microwave, and has then proceeded to discuss the various applications of this equipment to certain specific communications problems.

Included in the text is a discussion of power supplies, mobile stations, fixed stations, antenna systems, maintenance, repair, licenses and regulations.

While the book cannot be classified as an elementary text, much of the material included could be easily understood by the layman. This book is recommended as a source book for organizations employing two-way radio or those contemplating such an installation.

"TELEVISION SHOW BUSINESS" by Judy Dupuy. Published by *General Electric Company,* Schenectady, New York. 233 pages. Price $2.50.

This book is a combination analysis of past television performances and a guide book for future television productions. Miss Dupuy spent seven and a half months at the General Electric television studio WRGB in Schenectady where she gathered information about video programs from the viewpoint of the producer, engineer, and actor.

Up to the time that this book was written, WRGB had produced 958 live talent shows, ranging from puppet shows to full length operas. The experience gleaned from these over-all productions has been carefully analyzed and catalogued by the author for the benefit of those who follow. The book is divided roughly into two parts, the first part dealing with the production and telecasting of programs at WRGB and the second part dealing with the engineering and production aspects of television from behind the scenes.

The book is complete, in that all types of programs are discussed on the basis of technical problems involved, techniques for color, lighting, costuming stage settings, and the use of moving pictures.

This book is recommended for those whose future plans calls for their participation in some phase of the television industry, whether technical, production or acting. Written in clear-cut, understandable style, it should prove to be a valuable "guide book" for the newcomer to the field as well as to the "seasoned" trouper in the industry.

"PRACTICAL RADIO AND ELECTRONICS COURSE," M. N. Beitman, editor. Published by *Supreme Publications*, Chicago. 332 pages. Price $3.95.

This volume is a combination of three previous publications by this company, namely, "Fundamentals of Radio and Electronics," "Receivers, Transmitters and Test Equipment" and "Applied Electronics and Radio Servicing."

This text has been designed for home study of the subject and progression is logical and orderly. Self-testing questions are included on each page of the text in order that the student can be assured of complete mastery of the subject matter before proceeding to advanced material.

The book is profusely illustrated with photographs and diagrams in order that the student may become completely familiar with various radio and electronic components, and their operation.

Each volume has its own index for easy reference to subject matter covered by the text. This book is suitable for home study by the layman without an extensive mathematical or scientific background.

"TELEVISION SIMPLIFIED" by Milton S. Kiver. Published by *D. Van Nostrand Company, Inc.* 369 pages. Price $4.75.

Since the servicing of television receivers may well be a profitable source of income for the radio serviceman in the near future, it is not too early for the serviceman to become acquainted with some of the operating principles and servicing techniques for television receivers.

In this book, the author has presented an easily understood picture of the television art as it has been developed up to the present time. The discussion includes color receivers, black and white reception, projection type of equipment, and direct-viewing screen types of receivers.

The first chapter is an over-all picture of the television field at the present.

The book then treats specific subjects in detail; u.h.f. waves and the television antenna; wide band tuning circuits; the h.f. oscillator, mixer and i.f. amplifiers; diode detectors and AGC circuits; video amplifiers; d.c. reinsertion; cathode-ray tubes; synchronizing circuit fundamentals; deflecting systems; an analysis of a typical television receiver and alignment procedures, color television, frequency modulation and servicing television receivers.

This book is suitable for home study and is recommended for the radio serviceman to whom a working knowledge of television will mean his bread and butter in the future.

—30—

Practical Radio Course

(*Continued from page 48*)

The control voltage developed by the discriminator is fed to the oscillator frequency control stage. Various methods have been used to cause the positive or negative d.c. control voltage to alter the tuning of the oscillator stage to the correct value, but space limitations prevent a discussion of all of them here. In general, the final circuits are quite simple, but their design and a calculation of their constants is quite involved.

In general, the basic circuit arrangement shown in Fig. 6 is usually employed, although modifications of this circuit will be found in different commercial receivers. The control voltage supplied by the discriminator is used to control a second tube, termed a *reactance* tube, which is arranged to draw a reactive current (current changes lag behind corresponding voltage changes by 90°), having a value depending upon the control voltage developed by the discriminator.

The reactance tube usually is a pentode (the 6J7 is widely used for this purpose). Its plate-cathode circuit is shunted across the tuned circuit of the oscillator, and the control-grid electrode is supplied with an exciting voltage derived from the alternating voltage existing across the oscillator tuned circuit but 90° out of phase with it. In such an arrangement, the amplified grid voltage acting in the plate circuit draws an alternating plate current that is 90° out of phase with the voltage across the oscillator tuned circuit. The tube then acts as a shunting reactance having a magnitude depending upon the amplification of the tube, and hence upon the bias or control voltage developed by the discriminator system. The system is so arranged that when the i.f. carrier does not have the desired value of frequency, there results a control action in the reactance tube that shifts the frequency of the oscillator so that the i.f. carrier is closer to the desired frequency value. In this way, deviation of the i.f. carrier frequency can be reduced by a factor of 100 to 200.

The required 90° phase shift of the grid-exciting voltage of the reactance tube may be obtained by a resistance-capacitance phase splitter arrangement, as shown in Fig. 6. The potential divider consisting of R_2 and C_2 is designed so that the voltage at the grid is lagging behind the alternating voltage existing across the oscillator tuned circuit by nearly 90°, and hence the plate current of the control tube lags behind this voltage by the same amount. Consequently, the control tube behaves like an inductance. Blocking capacitor C_1 keeps the d.c. plate voltage from the grid of the control tube.

The effect of the plate resistance of the oscillator-control tube paralleling the oscillator tuned circuit is illustrated in simple diagrammatic form in Fig. 7 by the automatically varying apparent inductance L_1 in shunt with the oscillator tuned circuit. This apparent inductance is shown in dotted lines.

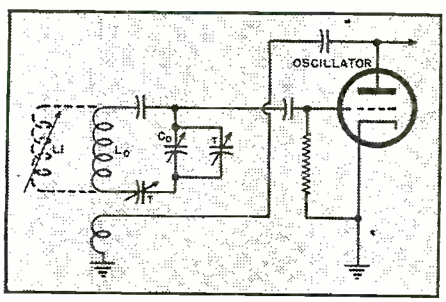
Summary of AFC Action

To summarize the entire AFC action, the osc. control tube is biased negatively to give a standing condition of impedance when the AFC control voltage received from the discriminator is zero, that is, when the oscillator frequency is the exact required value.

If the oscillator frequency drifts, the discriminator circuit develops a control voltage that is applied to the grid of the oscillator control tube, making it more, or less, negative according to the direction in which the tuning error lies. This makes the control tube behave virtually as a variable inductance, and this, being effectively shunted across the oscillator tuning circuit, alters the effective inductance of this circuit, and therefore its tuning. The oscillator frequency thus shifts until the AFC control voltage produced by the discriminator is reduced to zero, that is, until the i.f. carrier frequency is corrected, and the oscillator frequency therefore has been shifted to the correct value. Care has to be taken to arrange the circuits so that the d.c. control voltage applied to the oscillator control tube by the discriminator has the right sense, as otherwise the receiver pulls *out,* instead of pulling *in* to the received signal. It is evident that in receivers employing an oscillator frequency *higher* than that of the incoming signal, a drift in oscillator frequency towards lower frequencies makes it necessary that the discriminator apply a *positive* voltage to the negative grid bias circuit of the oscillator control tube. This reduces the value of the internal resistance of the control tube and so allows the plate current to increase, thus decreasing the apparent inductance effect of the tube and so decreasing the oscillator tuning inductance and causing the oscillator frequency to increase.

Fig. 6 shows how the oscillator control tube may be tied in with a conventional tickler-type oscillator circuit employing a separate oscillator tube. The AFC circuit of the *Grunow* Model 12-B receiver, illustrated in Fig. 8,

Fig. 7. The effect of the oscillator control tube is to shunt the oscillator tuning circuit with an automatically varying inductance (reactance) L_1.



shows how the discriminator, oscillator-control circuit, and oscillator (a frequency converter type tube is used here) are arranged and tied together in a commercial receiver. Notice that the circuit arrangement differs little from the basic discriminator and oscillator control circuits explained here.

Releasing AFC During Automatic Tuning Cycle

In those push-button tuned receivers that employ a conventional variable tuning capacitor (motor-operated types, etc.) and AFC, it is necessary to provide some means of rendering the AFC system inoperative during the automatic tuning cycle. The reason for this is that depending on the band width of the AFC control (as determined by the design of the discriminator system), a strong local station will continue to hold the AFC for a few channels beyond its point of tune, thus preventing the system from "locking" on the stations of nearby channels. This makes it necessary either to remove the AFC action during the automatic tuning cycle, or to remove it for an instant as tune is established on a desired station. It is also desirable to render the AFC system inoperative during manual tuning for the same reason.

Several methods have been applied to accomplish AFC release; the one that is used depends upon the particular system of automatic push-button tuning employed in the receiver. In many mechanically-operated types, and a few of the motor-driven types employing the latch-gate principle of stopping the motor by locking a pin in the latch gate, the gate is made to control a switch which shorts to ground the AFC voltage for an instant before the pin locks in the gate. The position of an AFC "release" switch in the AFC control voltage lead to accomplish this is illustrated in the circuit diagram of Fig. 8. In the *General Electric* motor-driven "Touch Tuning" series of receivers, a relay controls the switching off of the AFC. In other motor-driven types, control of the AFC circuit is effected by movement of the motor drive shaft. Another method is to apply a high negative bias to the r.f. and i.f. amplifier tubes to render the receiver insensitive during the automatic tuning cycle. This accomplishes the desired result, since the signal voltage at the discriminator is below the threshold of action even for strong local signals. Bias is returned to normal at the completion of the tuning cycle. The extra bias voltage may be obtained in any of several ways. In some receivers the tuning motor operates a switch that automatically removes a short from across an extra bias resistor. In receivers using low-voltage a.c. tuning motors the extra bias is obtained by diode rectification of the voltage applied to the motor's winding. In this way, as long as the tuning motor is running during the tuning cycle the additional bias voltage is produced and the r.f. and i.f. amplifiers are rendered insensitive. Consequently, the AFC control system does not function, due to absence of i.f. carrier. It is allowed to regain control when the tuning motor stops. The bias thereby returns to normal, and the amplifiers once again become sensitive.

Limitations and Disadvantages of AFC

AFC does not make the need of precise oscillator frequency adjustment and stability entirely superfluous. There is a definite limitation to its ability to pull in a station that is only roughly tuned by the oscillator, or to keep a station tuned in if the oscillator drifts excessively off-frequency later due to temperature changes, vibration, or other causes. For example, if a receiver employing AFC has been tuned to a station for some time and the natural oscillator frequency has tended to drift away to such an extent that the station is held only by virtue of the AFC, a short break in the signal may be sufficient to lose the station permanently. This may happen when the natural oscillator frequency (and the frequency of the resulting i.f. carrier frequency) has drifted away more than half the width of the i.f. amplifier pass band so that the i.f. carrier will be so greatly attenuated that it will not be of sufficient strength to cause the discriminator to produce enough corrective voltage to pull the oscillator in tune. Even if the oscillator drift has been less than this, or the push-button controlled oscillator tuner is not well adjusted, during a short break in the signal the tuning may jump to receive the signal of a powerful neighboring station instead of the desired station. This is especially true if the AFC system employs a fairly wide bandwidth (say 5 or more kc.). Similar problems also arise in case of strong fading of the signal, unless the AFC bandwidth is narrowed down, so AVC is always used in receivers employing AFC.

Owing to the fact that the AFC circuit involves the use of at least two extra tubes and associated resistors, capacitors, coils, wiring, etc., its cost has prohibited its use in all but ex-

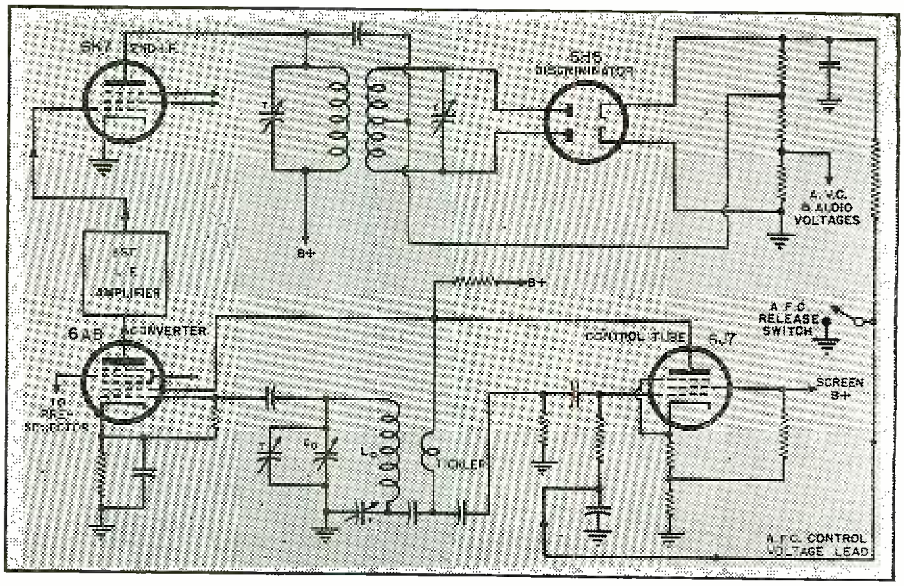


Fig. 8. AFC circuit of Grunow Model 12-B receiver. A conventional Foster-Seeley type discriminator is employed (see Fig. 4). However, the oscillator control tube circuit differs in some respects from the basic arrangement illustrated in Fig. 6.

pensive types of receivers. It has been used particularly in push-button tuned receivers of the motor-driven type. AFC is both expensive and tricky. These are its most serious handicaps. While its use made possible those early forms of elaborate push-button tuned receivers in which an appreciable amount of oscillator tuning drift due to temperature effects and to lack of mechanical and electrical stability in the tuning circuits and devices employed was present, it is now used in only a very small percentage of receivers even of the push-button type. It served to show the value of good oscillator frequency stability. It was after the advent of the early push-button tuned receivers employing AFC (particularly those receivers using motor-driven automatic tuning systems) that designers began to delve into the possibilities of designing push-button tuning systems that would be sufficiently accurate and stable to make the use of AFC unnecessary. This encouraged the improvement of component parts and compensating techniques generally to the point where in most cases AFC is not necessary.

It might be mentioned here that some manufacturers of push-button tuned receivers get around the use of AFC by employing i.f. amplifiers having a fairly wide acceptance band, on the assumption that only strong local stations are set up for automatic tuning and therefore selectivity and sensitivity can be sacrificed. Also, the high-frequency audio response is thereby improved, providing better fidelity. Widening the i.f. acceptance band permits the i.f. carrier to be a little off frequency without spoiling the quality of reception.

It should be remembered that AFC is a purely electrical circuit arrangement for automatically pulling in the oscillator frequency to the correct value required for reception of a station that has already been tuned in. It will not, by itself, find the station required, but once the receiver has been tuned to some point within the sideband range occupied by the wanted station the AFC takes charge of affairs and will automatically bring the oscillator into exact tune—more exact, in fact, than can normally be accomplished by hand. This means that in an automatic tuned receiver employing AFC the receiver need not select the stations as accurately as would be necessary if AFC were not used. This is very important in some of the motor-driven types of push-button receivers, where precise stoppage of the motor-driven gang tuning capacitor is difficult to arrange and maintain.

AFC has been incorporated in some receivers of the manually-tuned type to enable unskilled persons to get the maximum results (from the point of view of tuning and tone quality) of which the receiver is capable, for mistuning and the distortion that accompanies it are eliminated and the best possible response is thus always secured without any necessity for precise manual tuning.

Furthermore, within the limits already mentioned, AFC will take care of errors due to mechanical wear and electrical drift in the oscillator tuning circuits.

Although at first thought it might not seem absolutely necessary to have the signal-tuning circuits of the preselector accurately aligned with each other in a receiver that employs AFC, a little thought will show that the operation is impaired by misalignment of these tuning circuits. The AFC control of the oscillator only assures that the i.f. carrier is of proper frequency. If the r.f. amplifier is very seriously off tune, the quality, sensitivity and signal-to-noise ratio of the receiver will be impaired, and adjacent-channel interference may be objectionably high.

(To be continued)

QTC

(Continued from page 49)

and accommodations offered by the foreign lines. Today these conditions do not prevail and U. S. shipping concerns have or will have shortly better ships than any foreign competitors and will be in a position to offer superior services. As for world-wide air travel American airways are acknowledged the finest. . . . The merchant fleet of the United States has emerged from the war with almost four times as many vessels as its prewar strength and its tonnage is almost five times the 1939 figure. Wartime building has left this country with 5529 seagoing merchantmen of 1600 tons or more compared with 1401 in 1939, at which time less than one quarter of the fleet was engaged in foreign trade. . . .

D. K. CROSBY was recently transferred from his Victory back to the old Talamanca, Jack Hajim and H. McKenzie are along with "Bing" as 2nd and 3rd. . . . Henry J. Decker arrived a while back all decked out with a new ship, the Sea Skimmer. . . . J. F. Welch was in town for a few days during an overhaul job aboard his Liberty. . . . Charles E. Fraser has taken out one of the "Cape" boats. . . . Herman Meyerhoff is now back on the Carrillo after much shifting around. . . . Frederick J. Bold took out a Liberty from the East Coast. . . . Carrol J. Jones, dropped dead just as he was leaving his 'Victory' in San Francisco, we are sorry to report. . . . Another old timer, Eben S. Pitman, ex-chief of the Shawnee, Clyde-Mallory Lines, died recently at Scott Field where he had been teaching radio operating. . . . Jerry Travis, well known along the waterfront in both Eastern and Agwilines is still sailing his 'Cape' craft out in the Pacific. . . . James J. Delaney, founder of ARTA sailed during the winter aboard a U. S. Lines Liberty 73

Grid Bias Modulation

(*Continued from page* 60)

rent rating of the rectifiers is not exceeded, however, as a result of using too high a value of input capacitor.

"Modulation Gaining"

The power supply to the r.f. driver stage must be exceptionally well filtered, because of the "modulation gaining" characteristic of a class "C" stage driven to less than saturation. The same applies to the bias source. A small amount of ripple in either of these supplies will show up as a much greater percentage modulation of the radiated carrier. The condition is aggravated as the bias is raised, so that if 5 times cutoff bias is employed on the modulated stage, the ripple content of the bias pack and driver plate supply must not exceed a small fraction of 1 per-cent. Fortunately, the voltage and current involved in these power packs is comparatively small, and the expense of good filters is therefore a minor item.

Bias Considerations

The recommended bias for a grid modulated class "C" stage is between 3 and 5 times cutoff, the higher value giving slightly higher efficiency. The increase in efficiency resulting from a still higher value of bias is insignificant, and is not considered justified because of the greater driving power required. Also, with very high bias, correct transmitter adjustment is upset by moderate line voltage variations unless special precautions are taken.

The prime requirement for a bias source is that the voltage is not appreciably affected by grid current excursions during modulation. An audio bypass capacitor will take care of the variations over an *audio cycle,* but such a bypass of itself does nothing to keep the *average* bias from increasing with d.c. grid current, and such an increase has the same effect as lowering the carrier amplitude during heavy modulation. Under this condition it is impossible to take full advantage of the upward modulation capability without overmodulating on negative peaks.

Bias Packs

If the bias is supplied from a regulated bias pack, from batteries, or from any other source which does not vary in accordance with the line voltage, it may be necessary to "touch up" the r.f. excitation adjustment whenever the line voltage varies more than a few per-cent *unless* a regulated pack is used to supply plate voltage to the r.f. driver. However, if not more than 5 times cutoff bias is used on the modulated stage, slight variations in line voltage normally encountered will not require readjustment of the r.f. excitation.

The reason why variations in plate

voltage to the r.f. driver have such an appreciable effect upon the correct adjustment and modulation capability of the modulated stage is explained as follows: When a fixed bias of several times cutoff is used in conjunction with comparatively low excitation (substantially less than saturation), it is necessary to reduce the r.f. driving voltage only by perhaps 20 per-cent (depending upon the number of times cutoff bias is employed) to reduce the output of the stage to zero. This same characteristic is responsible for the "modulation gaining" effect and consequent multiplication of driver power supply ripple previously mentioned.

It is possible to avoid this difficulty by employing an *unregulated* a.c. power pack for bias. Then, as the line voltage changes, both the bias and r.f. driving voltage will change in the same ratio, and the *effective* excitation to the modulated tube remains approximately correct even with a rather large line voltage change.

When using an unregulated a.c. power pack for bias, it is necessary to waste considerable power in a bleeder resistor in order to keep the bias voltage constant with modulation. If too high a value of bleeder resistance is employed, the increase in average grid current that occurs with heavy modulation will cause the operating bias to increase excessively. This is the chief disadvantage of using an unregulated a.c. power pack for bias. It is necessary to use a bleeder which draws at least 10 times the maximum d.c. grid current under modulation in order to have an acceptable bias pack.

The Inverted "B" Supply As Bias

A method sometimes used in the past to avoid the waste of power in the bleeder and to save the cost of a separate bias pack was to run the crystal oscillator with the *positive* high voltage grounded and the negative hot to ground. Sometimes another r.f. stage was run from the same pack, but not the r.f. driver for the modulated stage. However, by "inverting" the power pack *feeding the r.f. driver, an actual improvement is obtained.*

This is explained by the fact that when the pack voltage is altered in any way, whether from line voltage changes or from variations in d.c. grid current during modulations, the excitation and bias more or less track. This "tracking" occurs because the bias always is equal to the plate voltage on the driver, and the driver r.f. output voltage will vary in proportion to the plate voltage.

With this system the r.f. voltage at the grid of the modulated stage must be made greater than the r.f. potential at the plate of the driver, otherwise the grid would not be driven into the positive region under carrier conditions. This requires that a step-up arrangement be used. The only convenient method of making excitation adjustments with this biasing arrangement (outside of using link coupling) is to employ several taps on the driver plate coil in conjunction with a switch, as illustrated in Fig. 2. Obviously it is not possible to vary the effective drive by altering either the bias on the modulated stage or the plate voltage on the driver stage with this arrangement, as the two are common and not separately adjustable.

V.R. Tubes for Bias

Where the line voltage is reasonably constant and the resting d.c. grid current is not less than 5 ma., "V.R." tubes may be used as a sort of "fixed bias grid leak" as shown in Fig. 1A. The current through the voltage regulator tube(s) may kick up to 60 ma. or more on peaks under heavy modulation without appreciably shortening the life of the V.R. tube, as these tubes will stand considerably more than their rated 40 ma. without damage so long as it is intermittent. A combination of V.R. tubes should be chosen which gives the desired bias voltage.

The V.R. tube(s) must be bypassed for audio frequencies, because on negative modulation peaks there is no grid current for a fraction of an a.f. cycle, and a V.R. tube requires at least 2 ma. and preferably 5 ma. in order to function properly.

If the d.c. grid current kicks up to more than 60 ma. on heavy modulation peaks but less than 120 ma., the arrangement shown in Fig. 1B may be used for a push-pull stage. The resting current should be at least 5 ma. per tube for satisfactory operation.

When medium or medium-high mu tubes are biased as illustrated, no damage will occur to them should the excitation fail. However, in some cases the tubes will tend to "motorboat" due to relaxation oscillations of the V.R. tube(s). This will make it necessary to open the primary voltage on the plate supply to the modulated stage on "standby."

Cathode Bias

Cathode bias is suitable for a grid modulated stage, because the plate current is substantially constant with modulation. The cathode resistor should be bypassed for audio frequencies. An 8 μfd. electrolytic will serve nicely.

Because considerable power is wasted in the cathode resistor, this arrangement should be confined to fairly high mu tubes and the bias limited to about 3 times cut-off. This will minimize the d.c. power dissipated in the cathode resistor. One disadvantage of this system of obtaining bias is that the stage will be highly sensitive to changes in loading, as might occur when the antenna system becomes wet or a rotary beam is rotated and the load on the stage is thus altered.

The reason for this is that when the load is increased slightly after being properly adjusted, the plate current will increase, increasing the bias and lowering the effective excitation, when in order to maintain 100 per-cent modulation capability the excitation actually should be *increased* slightly to compensate for the lower load impedance. In addition to making the stage very sensitive to changes in load, this effect makes the stage somewhat more difficult to adjust than a stage using a bias source which is not affected by antenna loading.

Battery Bias

Battery bias is one of the most straightforward methods of bias, and is satisfactory where line voltage variations are not excessive. Fresh 45 volt blocks in the heavy duty size will stand up to about 50 ma. average reverse current without damage, and give reasonably long life under such service.

One thing to keep in mind is that the voltage of a 45 volt block will build up to between 55 and 60 volts under typical reverse current conditions, often making an excitation readjustment necessary after the first few minutes of operation. The voltage then will stay near this value until an extended period of inoperation. Unless one happens to be in a position to get used but still good batteries free, other methods of bias are to be preferred to battery bias.

(In the second part of this article which will appear in the May issue of Radio News, the author will discuss r.f. driver regulation, the disadvantages of link coupling, the a.f. modulator, cathode injection, a practical transmitter, standard adjustment procedures, and a design summary.)

(To be continued)

Aircraft Radio Servicemen

(*Continued from page* 31)

ing the motor mounts, the motor, and all metal braces, etc., does not prove adequate.

It is important in any aircraft, that the primary, as well as the secondary of the ignition system be completely shielded.

In some cases, control surfaces or moving metallic parts will produce noise in the receiver. Bonding of such offending points will usually eliminate this interference.

Antennas

Antenna selection is a matter controlled by the flight operations of the ship in which the radio equipment is to be installed. Generally speaking, the results obtained with various antennas are as follows:

A whip antenna, while it gives the least signal pickup, does have the desirable characteristic for range or instrument flying of accurate and true radio range signals. It also gives a sharp "cone of silence" indication.

The fixed antenna, mounted either overhead from the vertical stabilizer to a mounting or mast, forward on the top of the fuselage or the "belly" version mounted underneath the fuselage to another mast or to the landing gear struts, is called a "T" antenna when the lead-in is taken off the center. When the lead-in is taken from the forward end, this is known as the "L" antenna.

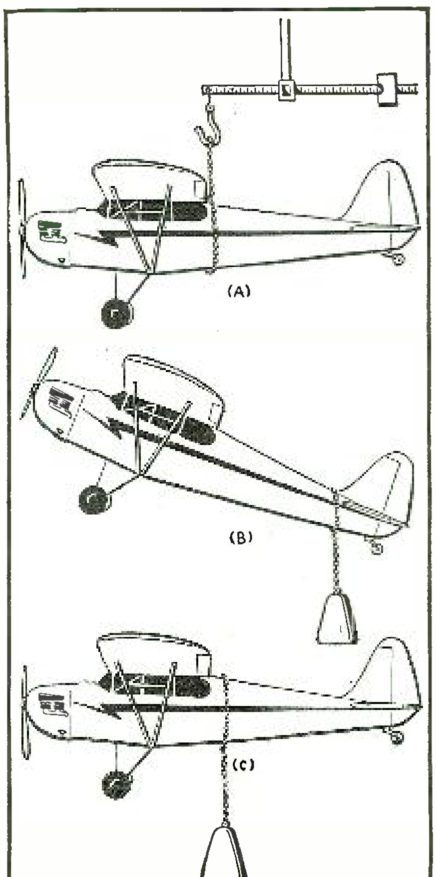
When the receiver is mounted so that the antenna lead will be run nearly vertical to the "T" antenna, a truer range signal may be generally expected than with the "L" type. The signal pickup with both of these antennas is good.

The trailing antenna, whether of the retractable reel or of the permanent trailing type, will give the maximum signal, and consequently should be used when trying to receive long distance or weak stations. The use of the trailing wire antenna, when an accurate range signal is desired, is dangerous. This is especially true when "close in" or "on instruments."

It is feasible to have the benefits of all of the aforementioned antennas by the proper installation of a switching system. A suitable switch, or remote operated relays may be used for switching from whip to trailing.

The selection of antennas on such a switching system should be clearly marked to prevent using the wrong

Fig. 6. (A) The stipulated center of gravity of any particular plane should always be maintained. If, when adding radio equipment, the center of gravity shifts as depicted in (B), the plane will be rendered uncontrollable. (C) The maximum load limit of the plane should never be exceeded. In designing airplanes, the specified maximum load limit is considered when allowing for safety factor sufficient to cover all stresses and strains.



antenna and possibly receiving erroneous range signals.

It is desirable to mount the antenna so that the lead-in will be kept to a minimum. Insulated ignition wire (unshielded) makes good lead-in wire.

Power Supplies

Most aircraft radio equipment is operated from a 12-volt storage battery, with a generator being employed to charge the radio battery during periods in which the aircraft engine is in operation. Voltage regulators are used to maintain proper charging rate, as in the conventional automobile electrical systems.

The open lead from the volume control switch should be connected through a 10 ampere fuse to the nearest source of +12 volts. Most aircraft have a master switch or master fuse panel, with an additional fuse and connector provided for a radio circuit. All wire in this circuit should be number 14 or larger, copper stranded, and well insulated. Don't route this lead near any receiver antenna lead or near the magnetic compass.

The shield of this lead is the negative return and should be securely fastened to the nearest metal portion of the ship's fuselage.

Upon completion of installation, check the operation of the receiver and the dial calibration, with the ship's engine running.

Failure to operate or improper performance means that the installation wiring must be checked. Refer to troubleshooting recommendations on page 30.

Operation

The on and off switch is incorporated in the receiver volume control and the battery power is supplied to the receiver through this switch.

One or more pairs of low impedance (200 ohms) headphones may be used, plugging them into either of the two headphone jacks, which are connected electrically in parallel.

The band selector switch is set to the number of the band to be tuned as indicated on the main tuning dial.

Control tower reception is facilitated on band 1 by the 278 kcs. frequency being "spotted" on the dial.

Sidetone connection is provided through a binding post on the power supply, permitting the pilot to monitor his transmissions over and above the receiver reception.

Interphone communication is possible through the *INT.* connection on either of the power units.

Code reception is possible by the use of the telephone-telegraph switch.

Trouble Shooting

Servicing, with the exception of the aircraft itself or mechanical troubles, should be done by competent radio service personnel having technical ability and the necessary test equipment to perform such service.

Faulty operation should be localized in (1) the equipment, (2) attached accessories, such as headphones, antennas, etc., or (3) in the aircraft, its battery, the engine, or the installation.

Trouble in the equipment itself should likewise be isolated in the following order—in power supply, audio and output section, second detector, intermediate frequency amplifier, or in radio frequency input section.

Unless it is definitely known that radio frequency circuits are in need of realignment and the necessary test equipment and tools are at hand, "tinkering" with these circuits should not be tolerated.

Shorted armatures are indicated by low output voltages and high input current. By disconnecting the output leads and running the dynamotor at its rated input voltage, if the input current of the G-3-AB dynamotor (without load) is in excess of 1.5 amperes, a shorted armature is usually indicated. Input current in excess of 3 amperes (without load) on the G-30-AB dynamotor is also the usual indication of a shorted armature. The armature should be removed and tested on a growler.

Trouble shooting noise in aircraft equipment is difficult because of the many possible sources. Noises must be isolated, such as (1) in the equipment; (2) in the installation; (3) at the antenna, battery, or other accessories; (4) in the aircraft or its engines, or finally, (5) whether the interference is of non-man-made sources, such as the various static conditions encountered.

Alignment—Equipment Required

1. A good signal generator covering the range of frequencies used in the receiver.
2. An output meter, 0-50 milliwatts, 200 ohms impedance.
3. An insulated, non-metallic screwdriver for condenser trimmers.
4. A small metal screwdriver for r.f. coil core screws.
5. One .1 μfd., and one 100 $\mu\mu$fd. condensers.

Alignment Procedure

1. Connect signal generator ground on output lead to receiver chassis ground.
2. Connect output meter in parallel with audio output.
3. Allow receiver and signal generator to "heat up" for accurate alignment.
4. Connect recommended dummy antenna condenser in series with signal generator output lead.
5. Before aligning, set dial pointer to small dot at low frequency end of dial scale when rotor plates of tuning condenser are closed.
6. Receiver volume set to maximum unless noise level is excessive.
7. Signal generator output set to limit receiver output to 50 milliwatts or less.
8. 30% modulation on signal generator output.
9. BFO switch set to "phone."
10. Sensitivity—50 milliwatts output with 2 microvolts input; 4:1 signal-to-noise ratio.

Maintenance

The length of time between periodic maintenance checks on aircraft radio equipment will vary under the particular conditions of usage, i.e., temperature, humidity, and corrosive elements, etc. An arbitrary period of 200 actual-equipment-operating hours may be used, checking the following:

Dynamotor

When lubrication is needed, remove the end covers and bearing plates, clean with gasoline and apply enough *Royco* 6A grease (or equivalent) to cover bearings. Do not pack bearings. Keep grease off commutators.

The dynamotor should be given a periodic visual inspection for armature shaft alignment; smooth, free-running bearings and end play in armature.

The commutators, especially, should be inspected. Keep them clean by the use of "wet-or-dry" sandpaper. (Don't use emery cloth.) When commutators show signs of excessive wear, the armature should be removed and commutators "dressed."

Brushes must be kept well seated and not allowed to wear so short that the spring pressure is insufficient. Any excessive sparking of the commutator should be investigated as to cause and the trouble then remedied.

Relays

All relays should be checked and kept clean and the contacts trimmed only when necessary. Fine sandpaper should be used on heavy duty relay contacts, followed by carbon tetrachloride, to remove sand grit. When low current, small contact relays, are cleaned, special relay tools should be used whenever possible. Don't adjust relay arms and springs unless necessary.

Dial Calibration

While the user will usually detect any error in dial calibration, it is well to check it closely during any inspection. This should include mechanical inspection of pointer and knob, as well as circuit alignment check. The 278 kc. control tower spot on the dial should not be overlooked.

Sensitivity

When equipment is at hand, the receiver sensitivity should be checked and when low, proper service be effected.

Field Etiquette

The aircraft radio serviceman will find it necessary, on many occasions, to check frequencies with the control tower while he is working on a ship, either on the line, or in the parking area. He should familiarize himself with correct control tower and voice procedure.

Avoid personal remarks or "rag chewing," and limit each transmission to strictly business. Don't use a normal tone when speaking into the microphone; raise your voice slightly and make pronunciation distinct. Knowledge of the standard phonetic alphabet is very useful. The control tower may, at times, find it necessary to resort to use of a signal light gun to flash you a warning or instructions. Learn to interpret signals properly and obey them, as your safety or that of someone else may be at stake.

For the "wide awake" radio serviceman, the foregoing will serve to reaffirm his belief in the future—a future filled with opportunities and compensations.

The era of the business lull being filled with toaster, washing machine, and vacuum cleaner fixing, is strictly passe. The radio serviceman is a bona fide member of the electronics fraternity, and as such, he should devote his time and energy to furthering his accomplishments there, leaving the maintenance of mechanical "household gadgets" to others.

Installing and servicing radio aircraft equipment is vital to air travel, destined to become even more so in the future. Being in on the "ground floor," established at a field with a "future" and making it pay, will be the reward of those who are far-sighted enough to reserve a "front seat center" for themselves, in the drama of tomorrow.

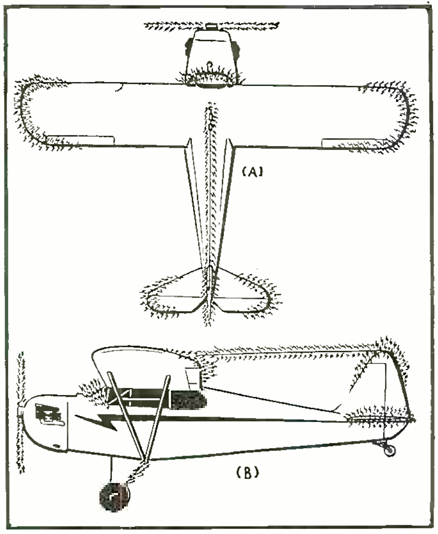


Fig. 7. Illustration of precipitation static collected on plane in flight.

Contrary to widespread opinion, installation and servicing of aircraft radio is not as complicated or intricate as it might seem. Although there are problems, such as precipitation static, bonding, electrolysis, vibration, and a few others encountered in servicing aircraft radio, there is not a great deal of difference between its installation and maintenance and that of the household radio receiver.

Amateur Radio

WRITERS WANTED

To write articles on transmitters, receivers, antennas, test equipment, and any material of general interest to amateurs. Articles should be typewritten, between 2000 and 2500 words in length, accompanied by suitable diagrams, photos, and parts lists. Liberal payment made upon acceptance.

Address all communications to

Box 419

RADIO NEWS

185 North Wabash Avenue, Chicago 1, Illinois

Many radio servicemen have veered from familiarizing themselves with the aircraft radio field—why, we don't know, as it is definitely a lucrative field, and one in which every "go-getting" serviceman should become interested. Of course, all servicemen will not be interested in changing their clientele—either because they are firmly entrenched in household radio servicing, or because of other interests. However, we have endeavored to awaken and kindle an interest for this vital field by showing that it is not only a profitable, but a long-lived enterprise.

Qualified radio men are needed now, and servicemen who have both sound and dependable training behind them should "climb on the bandwagon," in order to be assured of not "missing the boat" in the bumper field of electronics.

The author is indebted to a number of individuals and organizations for assistance rendered in the preparation of this article. Mr. Henry J. Hamm, of *Lear, Incorporated,* made many of the photographs, circuit diagrams, and much of the data on aircraft radio equipment available. Thanks are also due *Piper Aircraft Corporation* for the use of photographs, diagrams, and data.

—30—

International Short-Wave

(*Continued from page* 79)

a.m. when XGOY's English news pick-up is carried.

Although not listed as such by All-India Radio, VUB2, Bombay, is being heard 8-9 a.m. on 4.880, and re-opening at 9:15 a.m. on 3.365 with market reports; signals have been quite strong on West Coast during the winter. VUC2, 3.305, Calcutta, has news in English at 8 a.m., followed by news in Hindu. Delhi's 8:30 p.m. Forces' transmission has shifted from 6.190 to VUD7, 6.100, although still announced as 6.190, with 4.860 being heard weekly in parallel. (Dilg)

Radio Guadeloupe, Point-a-Pitre, Guadeloupe, has been wandering a great deal, latest reported frequency being 6.192, 6-7:30 p.m., weak modulation.

* * *

BEST BETS FOR BEGINNERS

Canada—Best Bets for Beginners in Toronto, Ontario, are listed by Albert E. Bromley of that city, as CKCX, 15.190, Sackville, N.B., around 2 p.m.; HCJB, Quito, Ecuador, daytime, also on 9.958 and 15.105; GRF, 12.095, London, afternoons; FZI, 11.970, Brazzaville, afternoons; CHOL, 11.720, Sackville, N.B., afternoons and evenings; PRL8, 11.720, Rio de Janeiro, Brazil, 9:30-9:55 p.m. except Saturday and Sunday; CSW6, 11.040, Lisbon, Portugal, afternoons; OTC, 9.745, Leopoldville, afternoons and evenings; VLC5, 9.54, Shepparton, Australia, mornings at 8-8:45 a.m.; XEWW, 9.500, Mexico City, mornings and evenings; KRHO, 6.120, Honolulu, Hawaii, mornings; ZNS2, 6.090, Nassau, the Bahamas evenings; ZFY, 6.000, Georgetown, British Guiana, evenings; VONH, 5.-970, St. John's, Newfoundland, evenings; ZRK, 5.885, Cape Town 3, South Africa, nights around 11:45 p.m.-1:30 a.m.; in addition to most other Canadian, American, British, and Cuban transmitters.

For beginners in the Preston, Ontario, area, Glynn Moss suggests PZH5, 5.75, Paramaribo, Dutch Guiana, 5-8:28 p.m., off with Dutch National Anthem; OAX4Z, 5.905, Lima, Peru, 6-11:30 p.m.; HJCT, 6.198, Bogota, Colombia, 6-11:15 p.m.; HI2N, 6.24, Ciudad Trupillo, Dominican Republic, evenings to 11:30 p.m.; Radio Nacional de Espana, 9.37, Madrid, Spain, afternoons and evenings, English news at 3 p.m.; OTC, 9.745, Leopoldville, Belgian Congo, evenings; XEWW, 9.500, Mexico City, day and night; HH3W, 10.105, Port-au-Prince, Haiti, evenings to 10:30 p.m.; CMCY, 11:74, Havana, Cuba, almost anytime in day and evenings; FZI, 11.97, Brazzaville, French Equatorial Africa, 11 a.m.-6:45 p.m., midnight-1:30 a.m., news in English at 5:15 and 6:30 p.m.; HCJB, 12.455, Quito, Ecuador, morning, late afternoon, evening to 10:30 p.m., relays news from San Francisco at 5 p.m.

Oklahoma — Don Brewer, Tulsa, sends along these Best Bets for Beginners for the spring: VLC5, 9.54, Shepparton, Australia, Eastern North America beam, 8-8:45 a.m., news at beginning and at 8:35 a.m.; FZI, 11.97, Brazzaville, English news at 3:45, 5:15, and 6:30 p.m.; YV5RM, 4.97, Caracas, Venezuela, in Spanish only, good between 7-10 p.m.; HCJB, 12.455 and 9.958, Quito, Ecuador, very good signal, 9-10 p.m.; PRL8, 11.72, Rio de Janeiro, Brazil, "Radio Nacional," 9:30-9:55 p.m. daily except Saturday and Sunday, in English; CKLO, 9.63, Sackville, N.B., good 3:15-7 p.m. sign-off, sends nice QSL card; Komsomolsk, 15.23, Siberia, relays Radio Centre, Moscow, 7-7:30 p.m. (English); GRH, 9.825, London, 4:15-9 p.m. in North American Service of BBC; OTC, 9.745, Leopoldville, Belgian Congo, heard best after 11:45 p.m.; GRC, 2.880, London, 9:30-11:45 p.m. in North American Service of BBC.

* * *

LAST MINUTE TIPS

Radio Wein, Vienna, Austria, approximately 7.180, is reported fair with messages in German to 6 p.m. when London's GRX, 7.185, opens.

OLR2A, 6.010, Prague, Czechoslovakia, is scheduled 2-5:15 p.m.; OLR3A, 9.550, is scheduled 9:30-10 a.m., 12:45-1:55 p.m., and 8-8:30 p.m.; OLR4A, 11.840, is scheduled 3:45-4 and 5-5:30 a.m. Address for reports is Le Ministre des Postes de la Republique Tchecoslovaque, Praha, Czechoslovakia.

Call letters of Radio Club Portugues, Parede, Portugal, 12.405, are given as CS2WI in a letter of verification to Swedish correspondents. Relays CS2ZA. This station is still heard regularly best around 2:30 p.m. Reported heard by Bromley in Toronto, Ontario, at 5 p.m. on a recent Sunday.

A Swedish correspondent also corrects power of Radio Falange, Alicante, Spain, 7.950, from 12,000 watts to 1,200 watts.

Radiations from Bern, Switzerland, of the Short Edition to North America, 2:20-2:50 p.m., over the new channel of HED4, 10.405, are sometimes marred by bad c.w. interference, although signal strength is good, particularly in the East. English news begins the transmission. The Full Edition to North America, 8:30-10 p.m. over HEK3, 7.380, and HEF4, 9.185, deteriorated greatly during the winter months, especially the 9.185 channel, but should be improved by now. (Bern's North American transmissions are heard daily *except* Saturdays.)

Radio Belgrade, 9.420, Yugoslavia, is reported with fair strength on the Pacific Coast daily, 11 a.m.-12 noon, in Eastern European languages.

Latest schedules of the Anglo-Egyptian Sudan transmitters are: Khartoum, 9.220, and Omdurman, 13.320, in Arabic, daily *except* Thursday, 11:30 a.m.-1 p.m. and 2-2:30 p.m.; on Thursday the first period signs off at 12:30 instead of 1 p.m., second period remains the same; additional programs in Arabic are scheduled Friday, 3-4:30 a.m. and Sunday, 3-4 a.m.; the only English program listed is Thursday *only* at 12:30-1 p.m.

"Radio Somali," 7.126, Hargeisa, British Somaliland, is reported with a fair signal at 10 a.m. when the BBC news is relayed.

Johannesburg, South Africa, on 4.382, was recently reported as heard in Hawaii on Sunday at 10:40 a.m. to fade-out at 11:00 a.m.; according to the South African Broadcasting Corporation, power of this transmitter is only 200 watts.

Radio SEAC, Ceylon (reported as Kandy or Colombo), is being heard in Hawaii at 10 p.m. on 3.395 in parallel with 11.765.

XGOA, 5.918, Chungking, China, is being heard with a Chinese transmission (and possibly other Asiatic languages), 3-4:45 a.m.

The American Forces' station on 4.759 (announced), varying up to 4.810, is XUSA at Chungking, China; it is operated by the Signal Corps, rather than by the Armed Forces Radio Service; is heard with record request, 9:45 a.m. to sign-off at 11 a.m. or later.

New Zealanders report that Guam's KU5Q has often been heard on an unlisted frequency of 13.390, also that The British Forces' program on VUD10, 7.210, Delhi, India, is heard very well, 9:30 a.m.-12:30 p.m.

From Hawaii it is reported that Y15KG, 7.085, Baghdad, Iraq, is heard in Arabic, with clock striking four o'clock (p.m.) at 9 a.m.

Art Cushen, New Zealand, reports that the Armed Forces Radio Network in Tokyo verifies by letter from Program Director (Sgt. Earl Moreland), Armed Forces Radio Network, GHQ, AFPAC, Advanced Echelon, APO 500, c/o Postmaster, San Francisco. Power of JLG4, 7.55, was given as 25 kw., JLP, 9.605, as 20 kw. Cushen reports that in December, AFRN programs were being heard on 5.765 to 9 a.m. sign-off with bad CWQRM.

Relay of correspondents from Tokyo to San Francisco is now heard mornings on JLS, 9.652, and a new Osaka frequency, JGF, 7.780.

AFRN, Tokyo, on an announced frequency of 3.075 now signs off at 9:03 a.m., and the other AFRN transmitter in Tokyo, JLR, 6.015, now signs off at 4:15 a.m.

Reception from the Soviet Union is reported as erratic in most parts of the country, with almost constant changes taking place. Kiev on 6.020 is reported heard 10 p.m. until after 3 a.m., as well as during the afternoon, with good signals. Moscow on 7.330 is reported from 1 a.m. until after 2:15 a.m.; I have heard this station in English some evenings around 10 p.m., poor quality. The only dependable Soviet transmitter in the evening broadcast to North America in English seems to be Komsomolsk on 15.230, which is at peak around 7 p.m. when English news is generally relayed. Moscow on 15.320 is reported on daily at 8 a.m. in French, and a Moscow station on 15.340 is reported irregularly to sign-off at 8 a.m. The 15.750 frequency, which was used widely for morning transmissions, now seems to be heard only irregularly; some mornings I do not even get a carrier on 15.750. Radio Centre, Moscow, on 9.480, is reported to be carrying the 8 a.m. news in English to North America, along with the Siberian transmitter located at Komsomolsk (9.565).

Algiers stations include Algier 1, 6.025, 12 noon-6 p.m., 50 kw.; Algier 2, 1.176, 10:30 a.m.-6 p.m., 50 kw.; Algier 3, 6.040, 12:30-6 p.m., 50 kw.; and Algier 4, 6.760, 12:30-6 p.m., 1 kw. (Kalderen)

Brazzaville's transmitter on 6.024 (measured) is reported heard well from opening of transmission in French at 12 midnight; I have heard this station opening around 6 p.m. in French, also.

Dakar's 2:15-2:25 a.m. French news transmission is still well heard on about 7.210 (FGY), and is usually preceded by fifteen minutes of flute-like interval signal.

Radio Noumea, 6.208, New Caledonia, is reported signing on at 2 a.m. in French, stating the broadcast is not only for local listeners but for France and Madagascar also; French news is given between 2:05-2:15 a.m.; sign-off reported was 4 a.m., but Australians report a concert of classical music precedes 5:05 a.m. sign-off. New Zealanders write that this station (FK8AA) is now controlled by the French Representatives, uses 80 watts, and is scheduled 7-8 p.m., 2:30-4 a.m., and 4:30-5 a.m.

Verifications are being widely received from ZFY, 6.000, Georgetown, British Guiana, which is heard well in most parts of the U.S. now early mornings and to sign-off between 7:20-7:50 p.m., uses English.

Radio Rodina, 9.310, Sofia, Bulgaria, uses 600 watts power in a dipole antenna, relays 100 kw. station on 850 kcs. BCB, according to Swedish correspondents who do not give schedule.

ZOH, 4.890, Kandy or Colombo, Ceylon, is now being heard on this frequency, having moved from 4.900; local news in English is heard at 9 a.m. (Dilg). A letter verification received in the East from ZOJ, Colombo, states that both the 11.810 and 15.275 transmitters went off the air at the end of November; this does *not* apply to the Forces' broadcast heard announcing as Southeast Asia Command.

Swedish sources report that "The Voice of Ethiopia," 9.620, Addis Ababa, operates with 1 kw., 6-6:30 and 8:45-11:15 a.m. daily, and Saturdays *only*, 12:30-2 p.m. BBC news is reported relayed at 11 a.m.

Best signals in the East from Delhi lately have been in 8 a.m. English newscast on frequencies of 9.67/9.68 and 7.275.

ZQI, 4.700, Kingston, Jamaica, B. W.I., is reported to sign off at 6 p.m. with "God Save the King." Signals are usually poor to inaudible.

From Australia, it is reported that Headquarters Radio, SEAC, 15.450, Singapore, Malaya, is heard strongly at 3:15 a.m. with special programs for Delhi, India.

Complete schedule of JCKW, 7.220, Jerusalem, Palestine, is 11:30 p.m.-1:30 a.m. and 4 a.m.-4 p.m., news periods at 1 a.m. and 12 noon. Has been heard opening as early as 11:15 p.m. with a "Musical Clock" program and giving frequent time checks in Palestine Time (7 hours ahead of EST). After 4 months, I have just received a nice verification card from JCKW, signed by K.E.S. Ellis, Director, Forces Broadcasting, Middle East. Address is still given as AW3 GHQ MEF, and the veri was postmarked in Cairo, Egypt. Veri shows an antenna mast.

PY5, 9.305, Manila, Philippines, is reported heard 8-10 a.m. and occasionally relaying WXOI with the AFRS.

Phillipsburg, 11.900, St. Martin, N.W.I., is sometimes heard calling Curacao around 8 a.m. or 3:30 p.m.

Radio Tetuan, 6.067, "The Voice of Spain in North Africa," is reported heard well in the East, 2:30-3 a.m.

PZX3, 5.75, Paramaribo, Suriname, is reported signing off at 8:25 p.m.; verifications are being received from PZC, 15.405, also in Paramaribo.

ZRK, 5.885 (measured at 5.878), Cape Town 3, has been sending the most consistent daily s.w. signals from South Africa during the winter. Is heard 11:45 p.m. (comes on with bugle call, followed by exercises in Afrikaans—sometimes English is also used—with piano accompaniment, and a clock strikes 7 a.m. their time at 12 midnight EST) to 1:30 a.m. sign-off, with BBC news relayed at 1 a.m.; is also heard some afternoons and has

BBC news relay at 3:45 p.m.; sign-off weekdays is 4 p.m., runs to 4:45 p.m. Sundays; some afternoons is entirely buried under aircraft communication signals. ZRH, 6.007, Johannnesburg 3, parallels ZRK generally, and is sometimes heard around 11:45 p.m.-12:30 a.m. fade-out, but weak. The South Africans are reported heard on the West Coast around 10-11:30 a.m., with BBC news relay at 11 a.m. These stations send out beautiful veri cards.

ZAA, 7.850, Tirana, Albania, is still being reported 1:10-3:10 or 3:20 p.m., with last 10 minutes in English. (Howe)

From Sweden it is reported that ZNS2, Nassau, the Bahamas, has been heard with a noonday test on 4.770, paralleling 6.090.

A later report on the Makassar, 9.360, Celebes, transmitter mentioned elsewhere, indicates the schedule is Sunday, Tuesday, Thursday, and Saturday, 5:05-8:30, and on Monday, Wednesday, and Friday, 6:05-8 a.m.

The Yenan (Communist) China station that has been heard for some time on 7.500 with a solid hour of Chinese (by a woman) between 5-6 a.m., has moved to 7.048 (varies to 7.090).

From Sweden comes a report that EQB, 6.155, Teheran, Iran, parallels 4.760 at 10:45 a.m. with English news.

It is reported that Lusaka, Northern Rhodesia, uses 7.220, 4.900, 3.800, 11:30 a.m.-2 p.m.

SUV, 10.05, Cairo, Egypt, heard at 3 p.m.; PRE9, 15.165, Fortaleza, Brazil, heard 6:30-8:30 p.m. (Croston).

* * *

ACKNOWLEDGMENTS

ARGENTINA—LR1 Radio El Mundo. AUSTRALIA—Radio Call, Rex Gillett, Hallett. BRAZIL—Radio Club de Pernambuco S/A. CANADA—Gauvreau, Quebec; Dolbec, Montreal; Kennedy, Bromley, Toronto; Moss, Ontario; CBC. CALIFORNIA—Curtiss, Kreisher, Dilg, Balbi, McCarthy, Teague. DISTRICT OF COLUMBIA—Havlena, Royal Egyptian Legation, Legge. EGYPT—Cairo Calling, Middle East Forces' Radio Times. ENGLAND—Harrison. EIRE—Director of Broadcasting, Dublin. FLORIDA—Rowland. ILLINOIS—Johnson, Gutter, Rand, Hester. INDIA—Wadia, The Indian Listener. INDIANA—Green. KANSAS—Seckler, Steinmetz. ITALY—Mohr. MASSACHUSETTS—Harris, Kernan. MICHIGAN—Johnson. MINNESOTA—Ecklund. MISSOURI—Fullerton. NETHERLANDS—Edward Startz, PCJ. NEW YORK—Kentzel, BBC, ABC, Yates, Taylor, Sink, Bogdan. NEW ZEALAND—Milne, Radio Hobbies Club, Coombe, N.Z. DX Club. OHIO—Sutton, Croston, Hacker, Leoni, Riggle. OKLAHOMA—Brewer. PENNSYLVANIA—Starry, Woodington, Black, Jones. SOUTH AFRICA—Eksteen. SWEDEN—Kalderen, Gilbert Anderson, Ekblom, Skoog. SWITZERLAND—Swiss Radio, Berne. TEXAS—Giles, Freund, Spoonts, Ekstein. VERMONT—Greenwood. VIRGINIA—How, URDXC.

—30—

Within the INDUSTRY

GWILYM A. PRICE has been elected to the post of president of *Westinghouse Electric Corporation,* succeeding George H. Bucher who resigned recently.

At the age of fifty, Mr. Price is one of the country's youngest directing heads of a major corporation. He was elected a vice-president of *Westinghouse* in 1943 and has been an executive vice-president since May, 1945.

Prior to his election as an officer of the company, Mr. Price was president of the *Peoples-Pittsburgh Trust Company* of Pittsburgh.

* * *

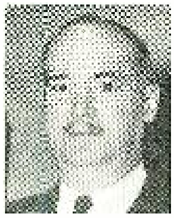
CLAROSTAT MFG. CO., INC. of Brooklyn has announced the election of new officers and directors, following the retirement of the three Mucher Brothers who founded the company 25 years ago.

The new president of the company is Victor Mucher, who formerly held the post of general manager; George Mucher, in addition to retaining the post of chief engineer, has now assumed the duties of vice-president. William Mucher is the treasurer and Charles Burnell, who has been long associated with the firm in a legal advisory capacity, is the new secretary.

The company manufactures resistors, controls and resistance devices for radio and electrical assemblies.

* * *

ALEXANDER NORDEN has been elected president of *Interstate Manufacturing Corporation* of Newark, New Jersey.



Mr. Norden is the founder of the *Norden-Hauck Company* of Philadelphia and was, for many years, vice-president of the *L. S. Brach Mfg. Company* of Newark. He is a member of several engineering societies.

Interstate is the first post-war licensee of *Amy, Aceves & King* covering antenna system patents, and the new expanded activities of the company will include a complete line of home and automobile antennas, as well as present line of wiring harness for automobile and appliances, aviation, and electrical specialties.

* * *

JENSEN INDUSTRIES, INC. has announced the removal of the entire company from 737 North Michigan Avenue, Chicago, to larger quarters at 329 South Wood Street, Chicago 12.

The company manufactures a line of phonograph needles.

* * *

PHILLIPS CONTROL CORPORATION of Chicago has announced its entry into the relay field through the acquisition of the design, manufacturing and selling rights of relays formerly made by *G-M Laboratories, Inc.* of Chicago.

John E. Mossman, co-founder vice-president of *C. P. Clare & Company* has purchased controlling interest in *Phillips Control Corporation.*

The company's line of relays will include light and heavy duty power relays, telephone, and midget multiple contact relays.

* * *

FRY & ROBERTS, West Coast representatives for leading manufacturers of electronic and electrical products have announced the removal of their offices to new and larger quarters.

The company's new address is 6516 Selma Avenue, Hollywood 28, California. In addition to enlarged office and display space, the new location provides a sizable parking area.

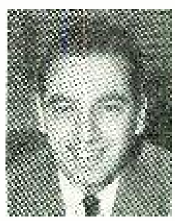
* * *

CHARLES T. SARNECK has returned from the Armed Forces to resume his position as assistant manager of the *Harrison Radio Corporation,* electronic equipment and parts distributor of New York.

Mr. Sarneck was associated with the company for four years prior to entering the Army.

* * *

HOWARD T. HORWICH has been named advertising manager of *Shure Brothers.*



In his new position Mr. Horwich will be responsible for publication advertising, catalogue designing, direct mail and jobber-help activities. These promotion activities will include the company's line of microphones, phonograph pickups and pickup cartridges.

Mr. Horwich brings to his new position seven years of advertising experience and three years of military experience.

* * *

PAUL J. BRAUN, has joined the *Leonard Ashbach Company* of Chicago as vice-president and director of the firm.

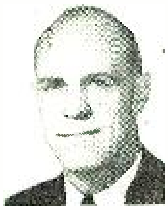
Mr. Braun was formerly associated with *Western Electric Company.* During his 19 years with *Western Electric,* he held various positions, the last being that of buyer for the purchasing department.

The company also announced that

Roy C. Dahl, formerly with *Press Wireless* has been appointed secretary of the company. He also holds the post of director of the company.

* * *

GEORGE D. CLARK has been named to the post of chief engineer of the *Russell Electric Company,* Chicago manufacturers of phonograph drives, record changer motors and other fractional horsepower motors.



Mr. Clark is a graduate in engineering from Ohio State University and has done research and development engineering work with *Westinghouse* and *Delco.*

He also has served as an instructor in the Electrical Engineering School at the University of Wisconsin. Immediately prior to joining *Russell Electric,* Mr. Clark was Chief Motor Engineer of the *Packard Electric Division* of *General Motors.*

* * *

S. A. KELSEY, formerly director of distribution for *Templetone Radio Mfg. Corporation* of New London, Conn. has been named Sales Manager of the organization.

Mr. Kelsey is well-known in the industry, having served as sales manager of the *Connecticut Electrical Contracting Company,* district manager for *Nash-Kelvinator* and as division manager of *Bendix Home Appliances, Inc.*

During the early days of the war, he was in charge of all expediting, purchasing, and sub-contracting for the *Precision Mfg. Company.* Before joining *Templetone,* he served as an industrial specialist for the War Production Board.

* * *

E. EUGENE WILLIAMS has been appointed general sales manager of the *James Millen Manufacturing Company* of Malden, Massachusetts.

Mr. Williams comes to the *Millen Company* from *General Electric* where he held various engineering and sales positions since 1928. His most recent post at *General Electric* was that of sales manager of Laboratory and Measurement Equipment for the Electronics Department of the company.

* * *

C. P. CLARE & COMPANY, Chicago manufacturers of relays have opened new engineering and sales offices at 420 Lexington Avenue, New York and in the Commercial Trust Building, Philadelphia.

J. W. Conceagh will be in charge of the New York office, while Frazier O. Stratton will be in charge in Philadelphia.

According to D. R. Dooley, vice-president in charge of sales for the company, these new offices will enable the concern to service Eastern manufacturers more promptly and completely.

* * *

ROBERT S. KNAPP, son of A. S. Knapp, president and founder of *Knapp-Monarch Company,* was recently elected to the post of vice-president of the company.

Mr. Knapp has been associated with the company since 1938 and has been on a leave of absence with the U. S. Army since 1941. He served as an Industrial Officer of a gun plant in Houston, Texas. He recently completed a study of German industrial techniques in the iron and steel industry for the War Department.

* * *

DON E. PETTY has assumed his new duties as General Counsel for the *National Association of Broadcasters.* He succeeds John Morgan Davis who resigned to devote full time to his law practice in Philadelphia.

Mr. Petty, who practiced law in Los Angeles from 1933 to 1943, was released from the Navy on January 10th with the rank of Lieutenant Commander. Mr. Petty entered the Navy as a Lieutenant (j.g.).

He is a partner in the Los Angeles law firm of Scarborough and Petty.

* * *

FRANK ROSE, veteran appliance and radio sales manager, has been named sales executive in charge of the New Jersey territory for the *Electronic Corporation of America.*

Mr. Rose served as appliance and radio sales manager for the *General Electric Supply Corporation* of New Jersey from 1930 to 1941 at which time he acted as general manager of *Michael's Department Store* in Newark, New Jersey.

Mr. Rose has been in the radio and electrical industry since 1918 when he started working for the *Newark Electrical Supply Company.*

* * *

SAMUEL GUBIN, formerly associated with the *Radio Corporation of America,* has joined the staff of *Spectrum Engineers, Inc.,* a newly organized engineering and consulting firm with laboratories in Philadelphia.

In his capacity of vice-president in charge of engineering, Mr. Gubin will assume responsibility for the design and development of electronic equipment.

His most recent activities at *RCA* included the supervision of the aviation advance development section and the supervision of the microwave beacon group.

* * *

RAY M. REILLY has been named general manager in charge of sales and production for the *Kluge Electronics Inc.,* of Los Angeles, California.

Mr. Reilly is well-known in the radio and appliance field, having been employed by *Columbia Phonograph Com-*

pany, Sonora Company, and *Westinghouse.*

Mr. Reilly joins *Kluge Electronics, Inc.* from the *Westinghouse Company.*

* * *

JEFFERSON-TRAVIS CORPORATION of New York which recently announced its acquisition of the *Musicraft Corporation* has now announced that it has also acquired *Guild Records, Incorporated.*

The new plant provides a phonograph record pressing plant in South Norwalk, Connecticut and will be used to expand the Musicraft catalogue of released and unreleased recordings.

* * *

MAJOR FRANK O. BLAKE has been named to the post of sales chief in charge of New York state by *Electronic Corporation of America.*

Mr. Blake will handle all of the New York territory with the exception of metropolitan New York.

Before entering the Army Air Forces, Mr. Blake was general manager of the *Albany Distributing Company.* Prior to this connection he was associated with *Graybar Electric Company* for 13 years as a merchandising executive.

* * *

STROMBERG-CARLSON has announced the appointment of two new district merchandisers.

E. V. Hyde of Dallas, Texas will cover the South Central states from his Dallas office, while Donald E. Galloway of Rochester, New York will serve the upstate New York and New England area.

* * *

FRED E. DOLE, recently associated with the Radiation Laboratory at M.I.T., has been appointed technical representative and research consultant for *The J. M. Ney Company* of Hartford, Conn.

In his new position, Mr. Dole will work on the application of precious metal alloys to the radio and electronic parts field. He will be available for consultation by manufacturers and design engineers.

He is the author of the section on potentiometers in a publication being prepared on the research work done by the Radiation Laboratory during the war.

* * *

ARMIN E. ALLEN has rejoined *Philco* as a product manager in the radio division after serving two years in the Navy.

Mr. Allen was on duty in Washington, D. C. as Procurement Officer for communications equipment, Bureau of Ships, Navy Department. Prior to entering the service he was connected with *Philco's* purchasing department.

He first went to work for the corporation in 1934.

* * *

MAJOR H. H. "PETE" SEAY, JR., formerly vice-president of *Bell Sound Systems, Inc.*, has returned to the company to assume the position of executive vice-president and general manager of the company.

Major Seay, a reserve officer since 1932, was called into service in January, 1942. In the Army he served as Radar Production Coordinator for the Dayton Signal Corps Procurement District and later became production executive for the entire Airborne Radio and Radar equipment and Ground Radar equipment used by the Army Air Forces. His last job in the Army was a Chief, Radio and Radar Equipment, Supply Division, Spokane, Washington.

* * *

HERMAN N. LUBET has been named Advertising Manager of the *Fada Radio and Electric Company, Inc.* of Long Island City, New York.

Mr. Lubet brings to his new position many years of experience in the consumer advertising field, having served as Advertising Manager of Lane Bryant, New York for three years, and prior to that he was an account executive with the Peck Advertising Agency.

Mr. Lubet will specialize in the promotion of the *Fada* line of radios.

* * *

JOHN F. RIDER, Lt. Col. Signal Corps (retired), was recently presented with the Legion of Merit Medal at a formal military ceremony held at Fort Monmouth.

During Mr. Rider's service with the Signal Corps, he was responsible for the preparation of a total of 1906 different publications, of which 797 were packed with equipment going direct from manufacturers to the theaters of operation.

* * *

FRANK M. DAVIS, general manager of the Research and Engineering Division of *Collins Radio Company* of Cedar Rapids, Iowa, passed away suddenly February 4th.

Mr. Davis was widely known for his research and development work in the field of radio communications. He held an engineering degree from the University of Arkansas and was a member of the A.I.E.E., the Acoustical Society of America and the I.R.E.

He was chairman of the Cedar Rapids Section of the I.R.E. during the first year of its formation and was a charter member of that section. He joined the *Collins* company in 1934.

—30—

Recording Studio

(Continued from page 35)

When the playback machine is used the customer is warned as to the initial placement of the pickup arm. The pickup, similar to the recording arm should operate from the center of the disc outward. If, as is often the case, the client desires more than one copy of the disc both turntables are simultaneously employed to prepare the initial two copies. If more than two records are desired one of the original copies is placed on the playback unit —and with blanks placed on recording turntables any number of succeeding copies can be made as the client may desire.

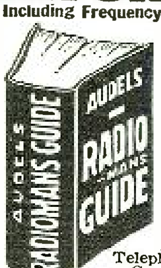
Doyle advises that there are six potential markets in the typical community for "record-making services."

(1) The businessman who wishes to make records of a speech he has to give before a group of business associates—playing it back to ascertain correctness of copy and length of discourse. Many businessmen, on occasion, wish a recorder permanently installed so that recordings may be made of important sections of conversation. Doyle installs the recorder "on-off" controls in a business office desk drawer so that at the flick of a switch the recorder may be set in motion when it is desired to record a conversation. The recorder unit is installed in an adjacent or outer office and connecting wires run underneath the floor with desk switch providing instantaneous recording facilities. The microphone can be placed openly on the desk or hidden in a flower vase as the client desires.

(2) Everyone in the community has friends, and acquaintances, to whom they would enjoy sending a personal record carrying birthday greetings. In addition almost every resident has close friends or loved ones temporarily on the sick list to whom a "get well soon" record may be dispatched.

(3) Music instructors are interested in bringing their pupils to the recording studios so that they may prepare a record displaying proof of their mu-

Portable recorder and playback unit manufactured by RCA, used by Doyle when making recordings outside studio.



sical progress to take home to their fond parents. In addition local orchestras will wish to record various arrangements of top flight dance tunes to play back in advance of actual dance dates.

Doyle has air conditioned his recording studio, which is insulated throughout making it thoroughly soundproof. He used *Shure* microphones, *RCA* recording equipment and a *Webster* wall amplifier with *Jensen* wall speaker.

Doyle also provides a special home service which is also used at all meetings of fraternal organizations, business meetings, stockholders meetings and at recitals given by local music instructors. For a yearly retaining fee he waxes weekly meetings of Rotarians, Kiwanis, Elks, and Eagles.

On all service calls his "recorder" accompanies him so that when he has completed repairs on a home radio he may suggest bringing the recorder in and making waxings of a family group or of individual family members for playback on the family combination. For home recording he uses a crystal microphone, or for family groups, playing musical instruments two mikes are utilized.

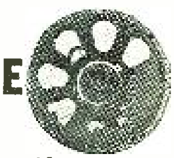
Doyle visits the hospitals twice weekly with his apparatus. Many patients desire to issue instructions via record to associates at the office or "reassuring messages" to those at home. On these occasions he uses a hand mike which is convenient for the patient. On occasion hospital medical officials are interested in recording discussions on medical technique to be played back at group meetings of internes.

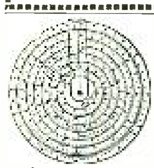
Radiomen who plan to operate a recording studio in their service establishment will do well to experiment considerably with seating arrangements for various musical instruments in relation to microphone placement. Faulty instrument placement will cause a "boomy or tinny" tendency which would be no credit to radioman or client. Where patrons use the desk for speech recordings, care should be taken to have the customer speak into the mike not once but several times before the records are placed in action.

Doyle uses various advertising maneuvers to publicize his recording activities. Each week he inserts a small newspaper ad listing the names of 15 great men and women and 15 local citizens enjoying a birthday during the ensuing week and suggests that well wishers pay their compliments via a "recording of congratulations" on the happy occasion. In addition he sponsors a weekly half hour program known as the "Community Presents." On this program local dance orchestras, musical conductors, vocalists and other local entertainers are heard.

This radioman has established a price for the "record sitting" of $1.00 which includes one copy of the record. If additional copies are desired Doyle charges 60c apiece for a 3 minute recording.

—30—





Precision Frequency Standard
(*Continued from page 37*)

4600 or 1000 is not essential for the crystal frequency. All that is necessary is for the crystal and its circuit to produce stable check points without variation in frequency. Whenever a receiver is used with the meter for frequency measurements there is the possibility of a check point every 10 kc. between 630 and 1040 kc., using broadcast stations.

A rather good "find" came about in the selection of the broadcast coil L_2. Alternately, one of the replacement type "long-wave" coils could be used in its stead. This one was removed from the broadcast band antenna coil position of an *RCA* AVR-7H aircraft receiver when it was equipped with a loop antenna. The iron core slug was adjusted for maximum inductance and the shield removed. Antenna winding became the plate feedback coil and grid coil is tuned as such.

This coil, L_2, may be replaced by a small iron core i.f. transformer of the 175 kc. type, provided the windings are coupled more closely than originally. This may usually be accomplished by heating the dowel or tubing on which the windings are placed, by means of a soldering iron, and after the wax is softened, sliding the windings together until they are separated by about 1/8 inch.

L_2 and the home wound short-wave coil may be seen side by side in Fig. 5. The high frequency coil, L_1, has 18 turns of No. 18 enameled wire wound to a length of one inch on a 5/8 inch polystyrene tube, with a 10 turn plate feedback winding located at the "cold" end.

The choke coil, L_3, should be selected to be resonant to the frequency of the crystal used. An adjustable iron core type is desirable in this position, as the slug may be adjusted to tune the inductance to the correct frequency. If no commercially made chokes of the proper range are available, very often an iron core i.f. transformer may be pressed into service for this purpose, removing turns so that the correct frequency is covered.

L_4 and L_5, the plate reactors for the detector and amplifier, are microphone transformers originally used in SCR-274-N transmitters. Only the secondaries of these transformers are used. The grid winding of any small audio transformer may be used if units of this type are not available.

Tests performed upon this instrument indicate it is rather stable. Without any warmup period, it was adjusted to station WWV on short-wave range at 10 megacycles, and over a 10 minute period the frequency drifted 200 cycles low. Then for the next 10 minutes it drifted half way back to the initial setting and settled down. The broadcast band was much the same with a 20 cycle decrease from zero adjustment with a broadcast station

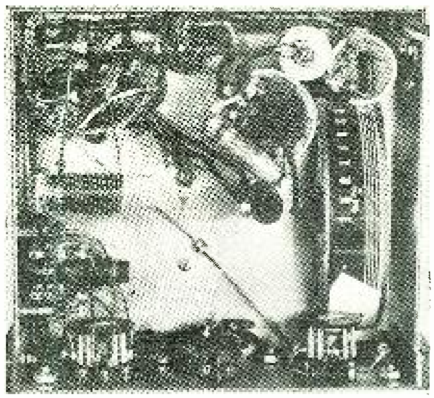
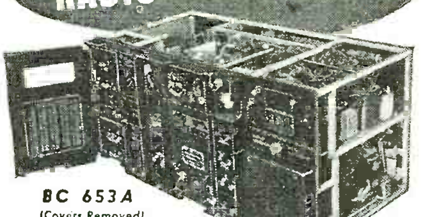


Fig. 5. Under chassis view showing wiring and placement of component parts. The triple .05 microfarad condenser is shown in upper right hand corner.

on 910 kc. over a 15 minute period. This action gave rise to a question of whether the check points were drifting too. A recalibration with the nearest check point of 910 kc. brought the signal back to within a few cycles when reset to the broadcast station. Next, the meter was thrust into a refrigerator for a cold treatment, and in 15 minutes the frequency rose to plus 250 cycles. Again a recalibration brought the dial frequency to within 5 cycles of 910 kc. This indicates the BT-cut crystal used for check points was being affected very little by temperature, and if the meter is checked and adjusted to the nearest check point of a frequency to be measured just prior to measurement, considerable accuracy can be attained.

Let's take a look around and see what this instrument can do. For measurements on 3105 kc. it is handy and fast to use since there are no warmup waits. At this frequency each division on the "tens" dial figures 349 cycles. Careful attention in reading tenths of the dial division will reduce the possible error of measurements to below 50 cycles or .0016% whereas the tolerance permitted aircraft stations on this frequency is .02%. Police services have a definite need for such a meter to measure their 30 to 40 megacycle mobile equipment. However for that specific higher frequency a better choice of coils and coverage might be made.

For spotting the amateur bands it quickly proves its worth. By using the broadcast band oscillator and harmonics any band up through the 14 mc. one can be located well within 1 kc. The 144 megacycle band is easily found between 14th and 15th harmonic of 10 megacycle fundamental of the shortwave coil after adjustment to station WWV, and any frequency within the band is measured by zero beating with a known harmonic of the meter. 144 megacycles, the upper range of a Hallicrafters S-27 receiver, was the highest frequency used with the frequency meter, yet it gave off a lusty signal at that point. And while with the amateurs, let's imagine what a good VFO (Variable Frequency Oscillator) it could make with slight variations. The



"hundreds" dial might be calibrated in frequency, still keeping the "tens" dial for a band spread.

The short-wave listener could use an instrument of this kind to his advantage in spotting frequencies of DX stations he wishes to tune in. No trouble should be experienced in positively identifying any 10 kc. channel below 20 megacycles. He could even keep his receiving equipment in alignment with it. Intermediate frequencies may be aligned by adjusting the i.f. trimmers for maximum response of a local broadcast station when the receiver local oscillator is set to the sum of the local broadcast station frequency and the intermediate frequency of his receiver by using the meter.

—30—

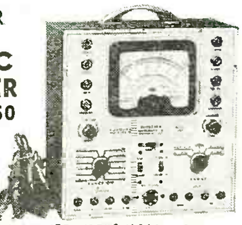
CIVILIAN TECHNICIANS SOUGHT TO RELEASE GI'S

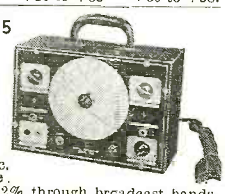
IN AN effort to release enlisted technicians now stationed in the Philippines, Japan, and Korea for shipment home, the Army Signal Corps today announced that it is recruiting civilians to take their places. Attractive jobs are being offered civilians skilled in the maintenance and repair of radio, radar, telephone and electric power equipment, and in several other classifications.

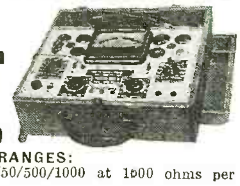
These appointments, for a minimum of one year with transportation furnished both ways, carry salaries ranging from $1.50 to $1.70 per hour for a 40 hour week, with provisions for overtime and night work differential. Quarters and subsistence will be provided by the Army at a cost not to exceed $40 a month. These civilian employees will participate in annual and sick leave credits. They will receive necessary medical care, hospitalization, and compensation for service-connected injuries. They may make purchases at quartermaster sales stores and outlets of the Army exchange service, and they may participate in Army recreational facilities.

Positions to be filled include electricians, electrical instrument repairmen, radio repairmen of several classifications, high speed automatic radio operators, fixed station transmitter attendants, cryptographic repairmen and technicians, and radar repairmen as well as installation and maintenance technicians for all types of telephone equipment.

Persons interested in any of these positions may secure additional information from any U. S. Employment Service office, or at these Signal Corps installations: Office of the Chief Signal Officer, Pentagon, Washington, 25, D. C.; Chicago Signal Depot, 1903 West Pershing Road, Chicago, 9, Ill.; Sacramento Signal Depot, North 7th Street, Sacramento 15, Calif., Lexington Signal Depot, Lexington, Ky.; Holabird Signal Depot, Baltimore, 19, Md.; Signal Corps Engineering Laboratories, Bldg. 666, Fort Monmouth, N. J.; Signal Corps Photographic Center, 35-11 35th Ave., Long Island City 1, N. Y.; Philadelphia Signal Depot, 5000 Wissahickon Ave., Philadelphia 44, Pa.; and Alaska Communications System, 550 Federal Office Building, Seattle, 4, Wash. —30—







Saga of the Vacuum Tube

(Continued from page 54)

and far between. Periodicals in particular were of limited circulation, aimed at the experimenter of high-school age and pocketbook and, except in a few cases, were not deemed of sufficient importance to be included in the permanent files of public libraries. Few books were written, since the men who were doing the work were too busy doing it to write about it.

With the advent of broadcasting and the great increase in adult popular interest in radio there came into being a number of widely circulated periodicals, technical and popular, both here and abroad, which published large quantities of information on current radio and vacuum tube development. These were preserved in most libraries of any size and are usually available to the earnest student of vacuum tube history.

For this reason little space has been devoted to cold-cathode, cathode ray, multi-grid, and higher powered transmitting tubes, such as the silica envelope type made by *Philips-Mullard*, the water-cooled copper-to-glass seal type developed by *Housekeeper*, and the larger radiation cooled types. Information on these phases of development can be obtained from these sources by the student or collector who seeks information on a specific type, and its collation and republication here is considered unjustified.

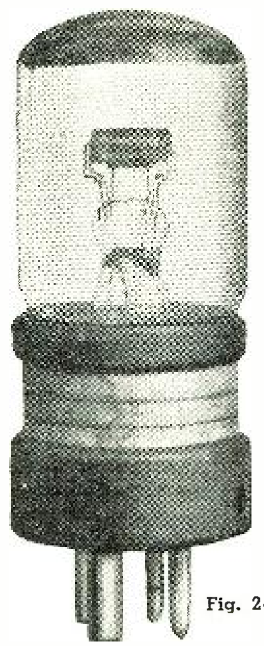


Fig. 244

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313. *Rukop, Hans—"25 Jahre Telefunken—Die Telefunkenrohren und ihre Geschichte" Telefunken Festschrift*—1928, *p.* 49.

314. *Banneitz, F.—"Taschenbuch der drahtlosen Telegraphie und Telephonie" Springer—Berlin*—1927, *p.* 476.

315. *Harper, A. E.—"Amplifying Bulbs" QST, Vol.* 4, *No.* 7, *February* 1921, *pp.* 27-28.

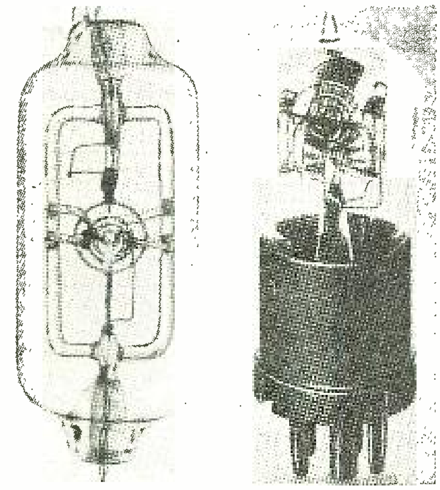

Fig. 245

316. *Dr. Erich F. Huth Gesellschaft fur Funkentelegraphie.*
317. *(R.I.W.) Seddig, Wurzburg.*
318. *Auer Studiengesellschaft fur elektrische Leuchtrohren.*
319. *Groskowski, J.—"Les lampes a plusieurs electrodes et leurs applications en radiotechnique" Etienne Chiron—Paris*—1925, *p.* 125.
320. *Schottky, W.—"Uber Hochvakuum Verstarker III Teil: Mehrgitterrohren" Archiv fur Elektrotechnik, Vol.* 8, *No.* 9, *December* 8, 1919, *pp.* 299-328.
321. *D.R.P.* 310605, *issued March* 19, 1915.
322. *D.R.P.* 87745, *issued May* 31, 1916.
323. *See reference* 323, *p.* 320.
324. *Pohlmann, B. and Gehrts, A.—"Werdegang einer Verstarkerrohre" Elektrische Nachrichten-Technik, Vol.* 2, *No.* 3, *March* 1925, *pp.* 65-74.
325. *See reference* 316, *p.* 142.
326. *"TKD" is the trade mark of Suddeutsche Telefon-, Apparate-, Kabel-, und Draht-Werke, Nurnberg.*

CAPTIONS FOR ILLUSTRATIONS

Fig. 234. RE11 tube with ballast resistor. Photograph courtesy Bell Telephone Laboratories.

Fig. 235. Telefunken RS1. Reproduced from Telefunken Festschrift—1928.

Fig. 236. Telefunken RS5. Photograph courtesy R. McV. Weston and Electrical Communication.

Fig. 237. TKD ST-12 tube.

Fig. 238. Huth LE219 tube, front and side views. Reproduced from Nespers' "Der Radio Amateur"—1924.

Fig. 239. Left—Seddig tube. Filament 0.56 ampere at 2.8 volts. Right—Auer receiving tube.

Fig. 240. Development of Telefunken RS17. Reproduced from Niemann's "Funkentelegraphie fur Flugzeuge"—1921.

Fig. 241. Development of the SS (Siemens-Schottky) type tube. Reproduced from "Veroffentlichungen aus dem Gebiete der Nachrichtentechnik"—1935.

Fig. 242. Left RE20 tube. Right—RE26 tube. Reproduced from Banneitz "Taschenbuch der drahtlosen Telegraphie"—1927.

Fig. 243. Development of the space charge grid tube. Reproduced from "Veroffentlichungen aus dem Gebiete der Nachrichtentechnik"—1935.

Fig. 244. RE16 tube. The top is painted red. Reproduced from Nesper's "Der Radio Amateur"—1924.

Fig. 245. Development of the Schottky three grid tube. Reproduced from "Veroffentlichungen aus dem Gebiete der Nachrichtentechnik"—1935.

—30—

Direct-Wire Television

(*Continued from page* 40)

apart from the oscillographs which translate light and power values to moving graph-like lines, three monitoring screens. Two show the image being picked up by the cameras. The third is the "output" image being fed to the other receivers or monitors attached to the direct-wire installation.

Switching relays, three simple push-buttons, at the console permit the operator to select which of the two camera's pick-up images is to be fed to the line amplifier, or he may choose a combination of both. To effect fades, he slowly cuts the gain, rides it all the way down to the light image and then, when the image is virtually imperceptible, he switches images. Lap dissolves and ghost images may also be accomplished by shifting the light levels.

From the engineer's control console, the signal is fed to a line amplifier and distribution panel. The line amplifier's function is to build the video signal to sufficient volume to feed the various monitors plugged into the distribution panel. In the department stores which will be equipped with many of the monitors, it may be desirable to have more than one line amplifier and distribution panel on other floors to intensify the signal and send it elsewhere to feed other monitor units or distribution panels. Such a system permits considerable saving in cable required and leaves distribution of monitors more flexible.

In operation, the monitors to receive the program at any one time can be selected at will. In the evening, after hours, the store may prefer to feed the program to monitors on the windows. Or it might prefer to concentrate its television appeal to audiences on different floors at different hours of the day.

It will be possible for the store to arrange to pick up the programs broadcast by local television stations by use of a receiver in the studio or by tapping a network line to bring selected programs to the store monitors or to relieve the store's programming staff at intervals.

The sound system for this television arrangement is entirely independent of the video system. It can be built into the video unit or handled as an autonomous public address installation with outlets adjacent to the monitors. It is important, though, whichever type of sound system is used, that the appearance of the sound coming from the characters speaking on the monitor be retained lest the whole illusion of television broadcasting be lost.

Classified

Rate 20c per word. Minimum, 10 words

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1,000 PL 68 PHONE plugs. No reasonable offer refused. Communicate Box 429, % Radio News.

BEEDE Foundation Meters, 3" square, 425 Microamp movement with scale marked 60, 120, 150, 300 AC-DC Volts, also Decibels, Ohms—$5.95; Same in a 2" square—$4.95; 3" square, 150 Microamp movement with similar scale—$5.95. Belmont Radio Supply, 1921 W. Belmont Ave, Chicago 13, Illinois.

VIBRO-PLEX, Bunnel Bugs-Army J-36, some new, some used, guaranteed good condition, $5.95; Roller-Smith 3½" round meter, 0-1 Milliamp movement, 0-4 KV scale, $4.95; Westinghouse 2½" meter, 0-200 Milliamp, $4.95; Westinghouse oil filled condensers, 10 mike, 600 WV, rectangular can, $2.49. Belmont Radio Supply, 1921 Belmont Ave., Chicago 13, Ill.

LOWEST Prices. Radio Tubes, parts. Bargain lists 3c. Potter, 1314 McGee. Kansas City 6. Mo.

U.S. NAVY Aircraft Surplus Control Boxes. Two types, both for $2.00 postpaid. Radio parts worth $10.00. Van Sickle Radio Supply, Indianapolis 6. Indiana.

VACUUM Tube Volt-Ohmmeter, $6.95! Twelve ranges! 6000 volts! Billion ohms! Complete kit. Tubes. Instructions. Radiocrafters; 166 N. Sierra Bonita; Pasadena, California.

SURPLUS UHF Radar Transceiver, 13 Tubes, $15; other items, list, 10c. Engineering Associates, Far Hills Branch Box 26, Dayton, Ohio.

CRYSTALS, all types. Blanks, Direct from Brazil's foremost crystal laboratories. For details write: Radio Cristais do Brasil, Ltda., Rua Dr. Satamini 84, Caixa Postal 1965, Rio de Janeiro, D. F. Brazil.

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MISCELLANEOUS

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RADIO-RADAR Technician, Veteran, Ten Years' Experience, Navy School Grad., Army Signal Corps Instructor, age 37, married, desires position. W. S. Dickson, Box 128, Clayton, Georgia.

HELP WANTED

MANUFACTURER'S representatives for microphone line. Several good territories open. Contact St. Louis Microphone Company, 2636 Roseland Terrace, St. Louis, Mo.

In the television sound pick-up unit, procedure is exactly like that of regular broadcasting or public address work save that care must be taken to keep the microphone out of the picture, just as they do in the movies.

Needless to say, these units are far less costly than those for broadcasts. No r.f. pick-up unit is needed. Monitors will probably be built-in installations, so the cabinet costs are obviated, no antenna or license is called for and the transmission system is greatly simplified over that for broadcast television. Yet, the application of much of the equipment to broadcast television is not difficult and, very probably, many a department store installation will serve as the nucleus for television broadcast stations of the future.

The possibilities of expansion are tremendous. In more advanced direct-line television systems, more than two cameras may be desired. Some will install motion picture television pick-ups of the 16 mm. or 35 mm. types. Monitors may be expanded in number; at any rate it's sound practice to put in twice the number of outlets anticipated to give the system flexibility.

The installation requires determination of the number of outlets required. It entails the running of the coaxial cable to key positions throughout the store or buildings. There will be major construction work in the studio to arrange for sound-proofing walls and shielding the console from sounds and some alteration work on the building may be needed to install concealed monitors and wires.

It will be necessary to charge some department of the operation with the necessity for planning programs, for translating the installation to entertaining or informative or otherwise useful purposes.

A maintenance job will exist and take up some of the time of the operators of the installation between broadcasts.

But, all in all, the direct-wire installation is one of the simplest and most significant applications of television. Certainly it justifies considerable attention on the part of prospective users of the medium and prospective workers for it. Soon it will be a major industry apart from and/or integrated with broadcast television.

—30—

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April 1946

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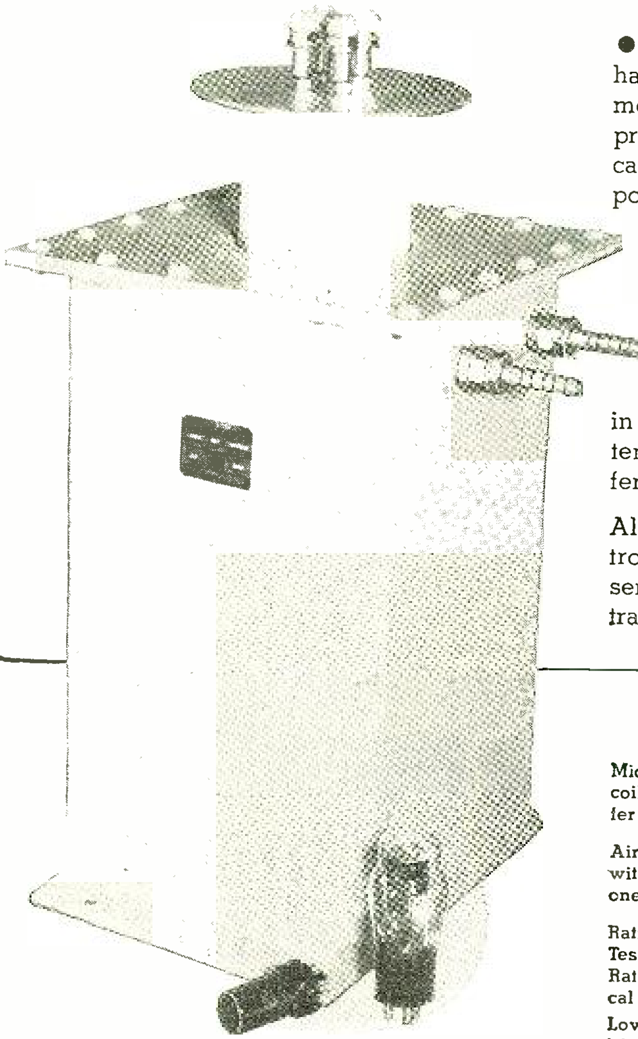
AEROVOX SERIES 1780

Water-cooled

MICA CAPACITORS



● This new water-cooled oil-filled mica capacitor handles exceptional KVA loads for its size. This means that more power can be handled than with previous capacitors of similar size or, conversely, capacitor size can be greatly reduced for given power ratings.

Series 1780 capacitors attain their higher KVA ratings in two ways: (1) By exceptional design such as critical arrangement and location of sections; choice of materials; specially-plated parts; large cross-section of conductors; careful attention to details and true craftsmanship in production. (2) By the use of a water-cooling system so designed as to provide maximum heat transfer from capacitor section to cooling coils.

All in all, here is a sturdy, compact, hard-working, trouble-free mica capacitor for extra-heavy-duty service, such as induction furnaces and high-power transmitters.

Featuring...

Mica stacks in oil bath. Cooling coils in oil bath for efficient transfer of heat.

Air-cooled operation, 200 KVA; with water-cooling, 1000 KVA—a one-to-five ratio.

Ratings up to 25,000 volts A.C. Test. Capacitances up to .01 mfd. Rated loads up to 1000 KVA. Typical unit: 20,000 V. at .01 mfd.

Lower power factor (.01%). Long life and large factor of safety.

Provisions for making connections with high-current-capacity conductors. Four-stud terminal. Grounded case.

Heavy welded metal case, hermetically sealed. Exceptionally sturdy construction.

Series-parallel mica stack designed for uniform current distribution throughout.

Silver-plated hardware for minimum skin resistance. To minimize or eliminate corona, terminals are finished with large radii of curvature. Steatite insulator shaped to hold gradients below corona limits.

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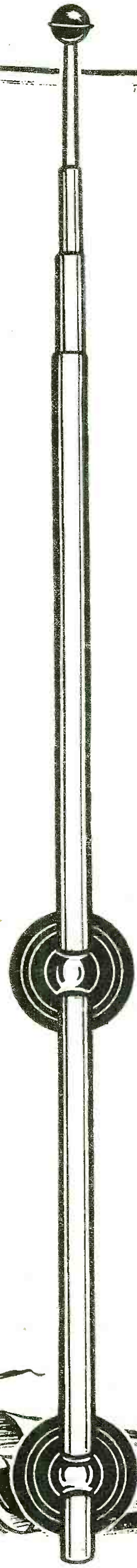

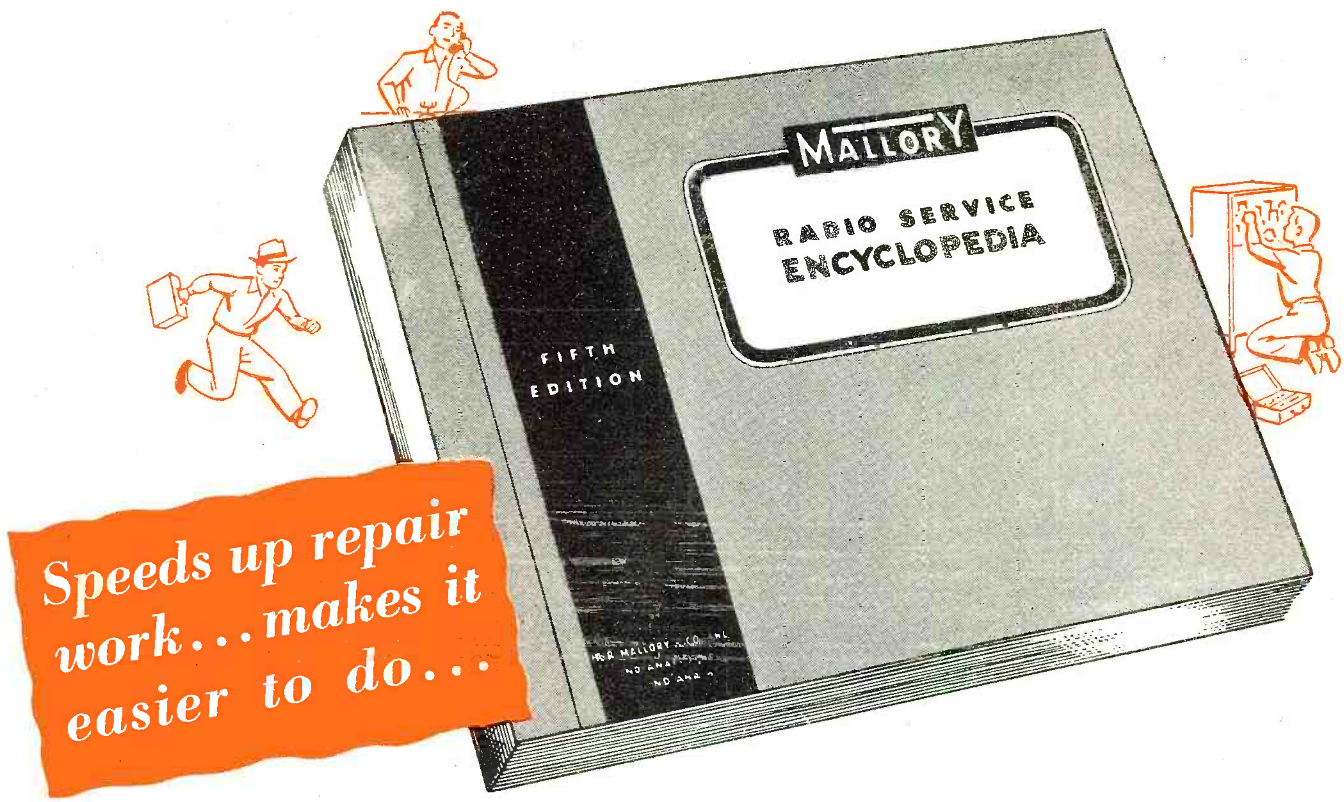

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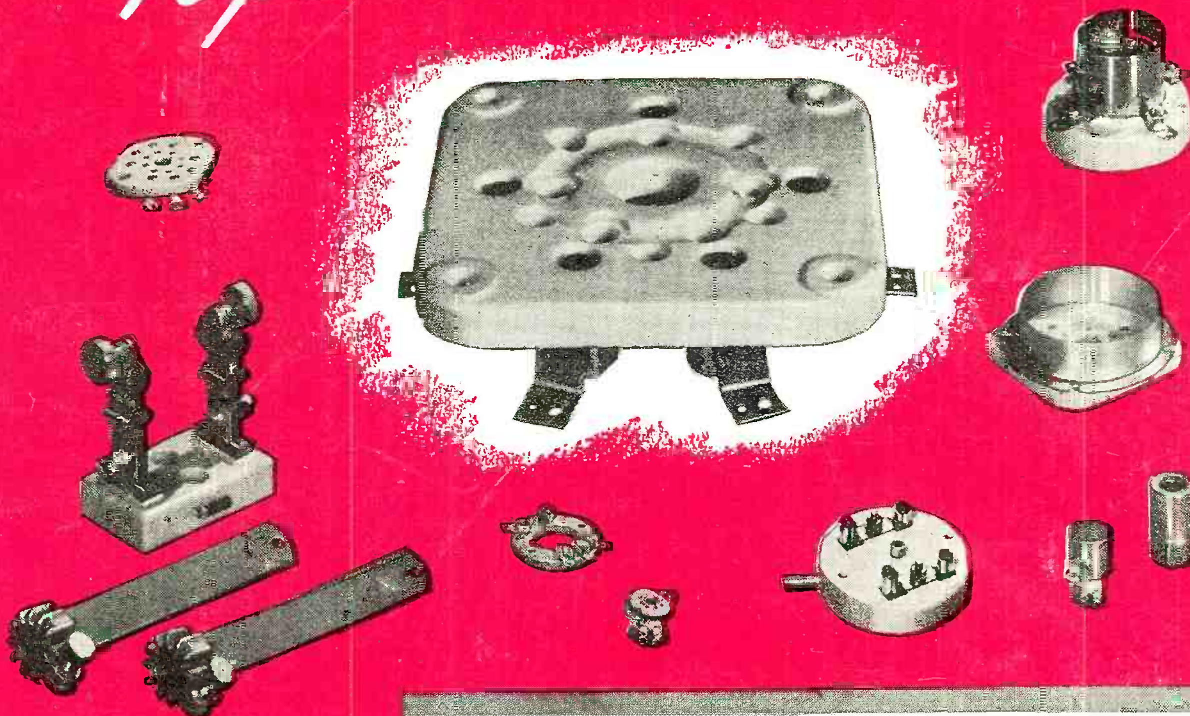
Tops in the Field



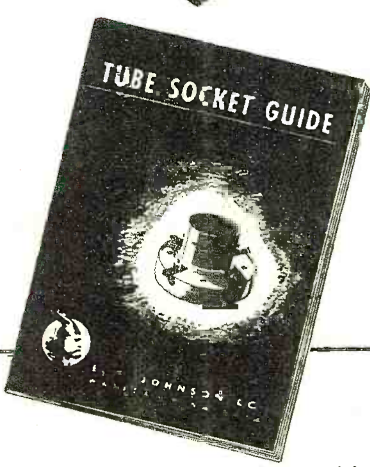
The latest addition to the famous line of Johnson tube sockets is the 275, Giant Five Pin tube socket with all the outstanding features which have made other Johnson sockets superior. A special feature of the 275 is the provision that has been made to allow forced ventilation from below the chassis, as required for the recently announced Eimac 4-125A and 4-250A. This socket may also be used for other Giant Five Pin tubes when a wafer type socket is desired.

Johnson sockets are engineered to meet the most exacting requirements of industrial, commercial broadcast and "ham" applications. For more than 20 years Johnson engineers have designed, and Johnson production lines have produced, transmitting components known throughout the industry as tops in the field. With this background and the close association with tube manufacturers, Johnson is continually leading the way with tube sockets designed to meet the rigid requirements of present day electronic circuits and equipment.

If you have a special tube socket problem, write Johnson, today.

Write for

TUBE SOCKET GUIDE



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