Waste is as damnable as sabotage

Electrical and mechanical design are the foundation of our military production. Small individual savings, when multiplied in mass production, add up to large savings in critical materials and labor time. Here are some examples from our organization:

Cumulative electrical and mechanical redesign reduced the quantity of critical materials in this unit 60%, reduced total size and weight in direct proportion.

Through proper mechanical redesign, the weight and volume of this unit were halved, yet the same mounting centers were maintained for field replacements.

This application employed three of our Ouncer cores. By combining the three in one case, we eliminated two aluminum housings, four terminals, and terminal strips, etc.

Electrical redesign reduced the amount of nickel iron alloy used in this filter by 50% ... the mechanical redesign eliminated a dozen brass brackets and screws and cut installation time one-half hour.

UNITED TRANSFORMER CO.

EXPORT DIVISION: 100 VARIICK STREET NEW YORK, N.Y. CABLES: "ARLA"
You will find Hallicrafters Communications Equipment working three shifts at our Country's "Listening Posts" ... searching the airways for illegal programs and espionage messages.

Hallicrafters Communications Equipment is engineered to "take it" on this constant operating ... there are no rest periods, no time out, it's constant performance!

The Hallicrafters Equipment you can buy—when communications equipment may again be sold for Civilian use—will incorporate all of the endurance and top quality performance you will ever demand.

Illustration—typical view of Hallicrafters Communications Equipment is a monitoring (listening in) station—somewhere in the U. S. A.

World's largest exclusive manufacturer of short wave radio communications equipment.
A Better FM Receiver!

... better because Hallicrafters are pioneers in FM. Model S-27 (illustrated) was the first general coverage U.H.F. Communications receiver to incorporate both AM and FM in one receiver. Hallicrafters, through continuous research, both for our armed forces and civilian use, have become the authoritative source for FM Communications receivers.

Hallicrafters Model S-27 FM-AM receiver, 15 tubes, 3 bands, cover 28 to 46 mc., 45 to 84 mc., 81 to 145 mc. Switch changing from FM to AM reception.

the hallicrafters co.
CHICAGO, U.S.A.
FEBRUARY 1943
VOLUME XXVII
NUMBER 2

STAFF
Editorial
Kenneth R. Warner, W1RM
Editor and Business Manager
Clinton B. DeSoto, W1CBD
Executive Editor
George Grammer, W1DF
Technical Editor
Donald H. Mix, W1TS
Byron Goodman, W1PE*
Assistant Technical Editors
Edward P. Tilton, W1HDQ
Contributing Editor, U.H.F.
Walter E. Bradley, W1FWM
Vernon Chambers, W1JES*
Technical Information Service
Louisa B. Durstbin
Editorial Assistant
James J. Lamb, W1LA*
Research Engineer, A.R.R.L.

Advertising
F. Chevney Beeley, W1GB
Advertising Manager
Grace H. Higelow
Assistant Advertising Manager

Circulation
David H. Hodgdon
Circulation Manager
Ralph T. Beldin, W1BAW
Asst. Circulation Manager

*On leave of absence

OFFICES
38 La Salle Road
West Hartford, Connecticut
subscription rate in United States and Possessions, $2.50 per year, postpaid; all other countries, $3.00 per year, postpaid. Single copies, 25 cents. Foreign remittances should be by international postal or express money order or bank draft negotiable in the U.S. and for an equivalent amount in U.S. funds.


Copyright 1943 by the American Radio Relay League, Inc. Title registered at United States Patent Office.

QST devoted entirely to
AMATEUR RADIO
PUBLISHED, MONTHLY, AS ITS OFFICIAL ORGAN; BY THE AMERICAN RADIO RELAY LEAGUE, INC., AT WEST HARTFORD, CONN., U. S. A.; OFFICIAL ORGAN OF THE INTERNATIONAL AMATEUR RADIO UNION

CONTENTS

It Seems to Us .................................................. 11
Splatter .......................................................... 12
QST Visits the Coast Guard .............................. Clinton B. DeSoto, W1CBD 13
The Tri-Part Plan ...................................... Clinton J. DeSoto, W1CBD 13
Australian Amateurs in Civilian Defense .............. 21
An Impedance-Matching Transformer .................. T. A. Gadwa, Sc.D., W2KHM 22
New Cathode Ray Tubes ...................................... 26
Silent Keys ...................................................... 26
U.S.A. Calling .................................................. 27
Elementary A.C. Mathematics ......................... George Grammer, W1DF 31
The Fifth Regional WERS ................................. Philip Gibbs 38
Rejuvenating Old Meters ................................. W. H. Triplett, W9OWW 40
In the Services ................................................ 42
Who Killed the Signal? ...................................... Clinton B. DeSoto, W1CBD 46
An Avocation Becomes a Vocation ..................... Herbert W. Hamilton, W9MRQ 49
A Gas-Driven Generator for Emergency Power Supply Will Landes, W8SID 54
Happenings of the Month ...................................... 55
What Is It? .................................................... 56
On the Ultrahighs .............................................. 57
A General-Purpose Play-Back Amplifier .............. Clinton B. DeSoto, W1CBD 58
Hints and Kinks
Happenings of the Month ...................................... 62
Strays ........................................................ 62
Correspondence from Members .......................... 65
Operating News ................................................. 68
Honors Roll ..................................................... 69
The Month in Canada ........................................ 70
Amateur Activities ............................................ 88
Hamads .......................................................... 123
QST's Index of Advertisers ............................... 126
Accurate and Dependable...recognized in engineering circles as the finest obtainable commercially, DAVEN ATTENUATORS are specified and used extensively in laboratory, electrical, broadcast, sound picture and television equipment.

Due to the specialized nature of high fidelity audio equipment, a large number of requirements must be produced to specifications. However, our catalog does list the most complete line of precision attenuators in the world: "Ladder", "T" type, "Balanced H" and potentiometer networks — both variable and fixed types. Refer to your DAVEN catalog. Ordering standard components may expedite your deliveries.

THE DAVEN COMPANY
158 SUMMIT STREET
NEWARK, NEW JERSEY
FROM that high resolve was born the Army-Navy Production Award which stands today as our fighting forces' joint recognition of exceptional performance on the production front...of the determined persevering, unbeatable spirit which can be satisfied only by achieving today what yesterday seemed impossible!

We're sincerely proud of our award — its significance will always be our goal.
SERVICEMEN

... your Distributor can STILL Supply you with Centralab

MIDGET RADIOHM REPLACEMENTS

Fortunately ... your distributor can still supply you with Midget Radiohms for replacements.

The smooth wall-type resistor for which Centralab Radiohms are famous will keep that now-precious radio in good working condition.

Stick to OLD MAN CENTRALAB for Replacements ... and always specify "CENTRALAB".

RADIOHMS • FIXED RESISTORS • FIXED AND VARIABLE CERAMIC CAPACITORS • SELECTOR SWITCHES

TUBES for war use and new industrial electronic applications are a most important part of Raytheon's power tube division... power tubes specifically designed and engineered for the secret electronic equipment for the war effort are the day and night assignment of Raytheon's vital part in bringing perpetual peace.

The knowledge and proven skill of Raytheon engineers obtained through years of advanced scientific research and gruelling laboratory tests are responsible for the high recognition of Raytheon's power tubes in the fulfillment of the important tube requirements of war.

When Raytheon tubes are again available for domestic electronic applications you will have the additional benefits obtained from our war-time research and development.

Raytheon
Manufacturing Company
WALTHAM and NEWTON, MASSACHUSETTS

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONICS
Section Communications Managers of the A.R.R.L. Communications Department

Reports Invited. All amateurs, especially League members, are invited to report communications activities, training plans, code classes, theory-discussion groups, civilian-defense building or planning each mid-month (18th of the month for the last 30 days) directly to the SCM, the administrative official of ARLU elected by members in each Section whose address is given below.

Radio Club reports and Emergency Coordinator reports representing community organizing plans and progress are especially desired by SCMs for inclusion in QST, ARLU Field Organization appointments, with the exception of the Emergency Coordinator and Emergency Corps plans, are suspended for the present and no new appointments or cancellations, with the exception noted, will be made. This is to permit full efforts of all in Emergency Corps plans.

ATLANTIC DIVISION

| Eastern Pennsylvania        | W3BES | Jerry Mathis | 6308 Master St. | Philadelphia |
| Maryland-Delaware-District of Columbia | W3CIZ | Herman R. Hobbs | 9701 Monroe St. | Silver Spring, P. O. |
| Southern New Jersey* | W3CJU | Fred Chichester | 625 E. Ray Tomlin St. | Lincolnwood, Ill. |
| Western New York | W3PLA | R. A. Krall | 204 Broadway | Seattle |

CENTRAL DIVISION

| Illinois | W9LHI | Mrs. Carrie Jones | 2407 Central Ave. | Alton |
| Indiana | W9YIV | Leddy L. V. Wagner | 1721 Winfield Ave. | Indianapolis |
| Iowa | W9ARU | Darrell A. Downard | 116 N. Longworth Ave. | Louisville |
| Ohio | W9KCI | D. C. McCoy | Normandy Lane, R. R. 7 | Dayton |
| Wisconsin | W9RH | Paul Balmer, Jr. | 1025 N. 18th St. | Milwaukee |

DAKOTA DIVISION

| North Dakota | W9YVF | John W. McBride | 118 N. Vankon Ave. | Bismarck |
| South Dakota | W9OY | P. H. S. Black | Room 11, Jefferson Hotel | Brooklyn, N. Y. |
| Northern Minnesota | W9FUIZ | Armond D. Brattland | 608 N. Huron Ave. | Spring Valley |
| Southern Minnesota | W9YNQ | Millard L. Bender | 356 Van Winkle Ave. | Dakota Dismal, N. D. |

DELTA DIVISION

| Arkansas | W9GED | Ed Bech | 2909 Bishop St. | Little Rock |
| Louisiana | W9WDD | W. J. Wildman, Jr. | 221 E. Monticello | Shreveport |
| Mississippi | W9EGE | S. Bentin Cain | R.R. 6, Shady Dell Trail | Brookhaven |
| Tennessee | W4SPP | James W. Minett | 367 Van Winkle Ave. | Knoxville |

HUDSON DIVISION

| Northern New York | W3HJ | Robert E. Haight | 356 West 34 St. | New York City |
| Western New York | W8PLA | Fred Chichester | 107 Central Park East, New York, N. Y. | B'ham. |

MIDWEST DIVISION

| Iowa | W9ARE | Arthur E. Wyberg | 1617 S. Seneca St. | Mitchellville |
| Kansas | W9AEP | A. B. Ohuff | 1611 West Third St. | Wichita |
| Minnesota* | W9PB | Leo E. Allendorf | Trumbull House | Minneapolis |
| Nebraska | W9PQ | Roy E. Ulmsl | 1617 S. Seneca St. | Milford |

NEW ENGLAND DIVISION

| Connecticut | W1KNO | Edmund R. Fraser | 38 Willow St. | New Haven |
| Massachusetts | W1BAY | Ameer E. Millard | 37 Morning St. | Boston |
| Maine | W1LBD | Frank L. Faber, Jr. | 91 Atlantic Ave. | Portland |
| New Hampshire | W1WAB | William J. Barrell | 239 Columbia Ave. | Manchester |
| Rhode Island | W1HTC | Clayton C. Gordon | 114 North Main St. | Providence |
| Vermont | W1KJG | Gilford G. Parker | 280 Franklin St. | Williston |

NORTHEASTERN DIVISION

| New York | W2FJ | Frank C. Faust | P. O. Box 368 | B'ham. |
| Maryland-Delaware-District of Columbia | W3CIZ | Herman R. Hobbs | 9701 Monroe St. | Silver Spring, P. O. |
| West Virginia | W3JL | Kenneth M. Zinn | P. O. Box 132 | B'ham. |

PACIFIC DIVISION

| Hawaii | K0KCL | Francis T. H. Clark | 837 16th Ave. | Honolulu |
| Nevada | K6KCL | Edward W. Heim | 509 Claremont St. | Reno |
| California | W6EHC | Karl P. Badeberg | 605 Arizona Ave. | San Diego |
| Oregon | W7AVZ | Horace E. Biddy | 414 Fairmount Ave. | Portland |
| Washington | W7EBE | Edward G. Gursky, Jr. | 114 North Main St. | B'ham. |

ROANOKE DIVISION

| North Carolina | W4CQY | W. J. Workman | P. O. Box 565 | Morganton |
| South Carolina | W4BRJ | Jack Ferguson | 1213 College St. | Columbia |
| Virginia | W4KRN | Walter G. Walter | 413 S. Main St. | Newport News |
| West Virginia | W6RJ | Kenneth M. Zinn | P. O. Box 132 | B'ham. |

ROCKY MOUNTAIN DIVISION

| Colorado | W9COL | Stephen L. Wiegand | 25 Emerson St. | Denver |
| Utah-Utah | W7UGZ | Henry L. Schroeder | 604 N. 10th St. | Laramie, Wyoming |

SOUTHEASTERN DIVISION

| Alabama | W4BRY | Lawrence E. Smith | 608 Winona Ave. | Montgomery |
| Florida | W4BRY | Frank C. Passett | P. O. Box 9298, Tallahassee |
| Georgia | W4XAP | Oscar Cederstrom | Second St. & Bruce Ave. | Delphos Springs |
| South Carolina (Puerto Rico-Virgin Islands) | CM2OP | Ernest L. Morgan | R.D. 4, Box 110 (Altoa) | Sun City |
| Georgia (Puerto Rico-Virgin Islands) | K4K | Mario de la Torre | 24 Lindburg St. | Santa Cruz, P. R. |

SOUTHWESTERN DIVISION

| Arizona | W3GQV | Paul W. Walker | 8412 Loma Vista | Hollywood |
| California | W6BZ | Paul W. Walker | 4023 S. Mesa Circle | San Diego |
| Nevada | W6EZ | B. D. Allin | 312 S. Main St. | Las Vegas |

WEST GULF DIVISION

| Texas | W4LAU | M. H. Collins, Jr. | 2312 W. Ambrose | Dallas |
| Louisiana | W4GF | Russell W. Batten | Box 290 | Shreveport |
| Oklahoma | W5HJ | Horace K. Boddie | 1764 S. Blaine Ave. | Oklahoma City |
| New Mexico | W5HIF | L. C. Hinojos | 116 S.E. Fonda St. | Santa Fe |

MARITIME DIVISION

| Maritime | V2BQA | A. M. Grooms | 49 Dublin St. | Halifax, N. S. |

ONTARIO DIVISION

| Ontario | VE8EF | Flying Officer Donald R. Dunn | C/A Canadian Bank of Commerce | New Toronto, Ont. |

QUEBEC DIVISION

| Quebec | VE2CO | Sub-Lieutenant L. G. Morris | 26506, 1111 Beaver | Montreal, P. Q. |

VANALTA DIVISION

| Alberta | VE8GJ | C. L. Johnison | 581 W. Riverside Drive | Drumheller, Alta. |
| British Columbia | VE8DD | C. O. L. Sawyer | 3634 West 31st Ave. | Vancouver |
| Saskatchewan | VE8AW | J. A. W. Merrell | 1014 7th Ave., N. W. | Moose Jaw |
| Manitoba | VE8TV | Arthur Chukiewicz | 92 Carlson St. | Winnipeg |

*Officials appointed to act until the membership of the Section choose permanent SCMs by nomination and election.
Coupled to the War Effort

in a hundred ways, Cardwell is also tied into almost every type of communication equipment through the extensive use of Cardwell Flexible and Rigid Insulated Couplings to isolate radio frequency controls.

When the type "A" Coupling was first designed, even though we believed it to be "tops", we hardly expected the tremendous acceptance it now enjoys. Since it seems minute in comparison to the larger units, we have "blown up" a separate view of this most popular of all the Cardwell Couplings, to better indicate its construction.

Type "FNF" is the most widely used of the rigid types, while type "C" and "E" are the standard flexible units for higher voltage and torque. Type "D" and "F" are special and not so readily obtained.

Manufactured of critical materials, including phosphor bronze springs, brass hubs, Alsimag No. 196 insulation, case hardened cup point steel set screws, etc., highest priorities are required to insure delivery of these small items, so vital, however, to communications equipment and therefore of priceless importance.

Cardwell Condensers

The Allen D. Cardwell Manufacturing Corporation, Brooklyn, New York
THE AMERICAN RADIO RELAY LEAGUE, INC., is a non-commercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is non-commercial and no one commercially engaged in the manufacture, sale or rental of radio apparatus is eligible to membership on its board.

"Of, by and for the amateur," it numbers within its ranks practically every worth-while amateur in the nation and has a history of glorious achievement as the standard-bearer in amateur affairs.

Inquiries regarding membership are solicited. A bona fide interest in amateur radio is the only essential qualification; ownership of a transmitting station and knowledge of the code are not prerequisite.

All general correspondence should be addressed to the Secretary at the administrative headquarters at West Hartford, Connecticut.

Past Presidents
Hiram Percy Maxim, W1AW, 1914–1936
Eugene C. Woodruff, W8CM, 1936–1940

Officers
President .................. GEORGE W. BAILEY, W1KH
Washington, D. C.
Vice-President ............ CHARLES E. BLALACK, W6GG
Yuma, Ariz.
Secretary .................. KENNETH B. WARNER, W1EII
West Hartford, Connecticut
Communications Manager ....... F. E. HANDY, W1BDI
Washington, D. C.
Treasurer ................... DAVID H. HOUGHTON
West Hartford, Connecticut

General Counsel .............. PAUL M. SEGAL
1026 Woodward Building, Washington, D. C.

*On leave of absence. Address correspondence to the Acting Communications Manager, George Hart, West Hartford, Connecticut.
DO YOUR PART

The question most frequently asked us these days is whether we can be assured of restored operating rights after the war, whether we'll get back our frequencies and have fun again. There are two ways of answering that. If we answer it in the spirit in which it's asked, we give an unhesitating affirmative; but both question and answer are in terms of American life as we have known it up to now. If we're accurate about our answer we'll have to say that it presupposes victory in this war. It takes this kind of a country to nourish the kind of amateur radio we have known. Amateur radio is part of the democratic institutions of this earth and it is in the United Nations that we have flourished. The preservation of the amateur radio we love so much will be assured by the preservation of the country we love more. It will come automatically that way, but only that way.

There is some emotion deep in the breast of every amateur still on the home front that simply cries out in yearning to operate again. We know how it is. Haven't we walked into the shack a hundred times this past year and eyed the rig, figured how long it takes filaments to come to temperature, and calculated that, except for those missing milliammeters, we could get back on the air in forty seconds flat after the whistle blows? Whenever we hams meet, that's what we talk about: the improved rig, the chances of using it, when that will be.

Now it deserves to be said that we can best help to bring about that happy day by each one of us doing his superbest to help get this war won. Think, boys and girls: our own beloved country, the land that gave us birth, the most precious place on earth, is pleading for the help of radio amateurs! Are you doing all you can, all you ought to, to join into this great effort the specialized abilities you acquired during your years as a ham? The amateur ear, trained to dig out signals buried six layers deep in murderous QRM, is the most prized ear in intercept work in all the world. Do you properly realize that? The skillful amateur traffic-handler is so infinitely better than the wartrained operators that in the armed forces he is certain to be put on a circuit of real importance, where to-day real operators are needed to take it and dish it out. Do you realize how valuable you are? The technical development jobs to be done with the new u.h.f. wizardry call for whole flocks of people who have the ham's intuitive and realistic approach. Do you appreciate that? You amateurs have that kind of skill. No other group in the world has it in equal or even in useful measure. It is needed — by every armed service, every branch's schools. Some tens of thousands of your fellows are doing something with their radio talents in this war — in the military service, in factories and laboratories and schools, at government stations, in government offices. Many of the directors and other officials of your League are included. Your Headquarters hums with special tasks and duties and even the newest clerk here can feel that he (probably she) is playing a part in the amateur's share in this job. What about you?

We submit, in short, that it is the duty of every radio amateur to do what he can to make effective use of his radio abilities in the cause of victory. That way we shall have earned the right to pound our own brass again and some blessed day the air waves will rejoice with the hum of our coursing signals once more. Do your part!

K. B. W.

QST's JOB—AND YOURS

Although this issue is datelined February, it is just approaching the turn of the year as we write — the time for thinking about the coming year. We aren't speaking now of such evanescent things as New Year's Resolutions, nor are we overlooking the evident fact that glib talk of future intentions is futile in these unpredictable times. What we have in mind is more a consciousness of the continual need for adjustment to meet the changing conditions of these swiftly-paced days.

Of course, we are thinking mostly of QST, because that's our job. The problem we face is that of continuing to make it of maximum usefulness in the prosecution of the war. A maga-
zine can't pick up a carbine and fight; what can it do to aid in the struggle? Specifically, what can a radio magazine, the organ of a noncommercial membership association, do?

A backward look over the issues produced during the first year of this war gives some of the answers. It can aid in recruiting, both direct and indirect. It can promote and sponsor and interpret and encourage a radio auxiliary-communications service for civilian defense. It can provide instruction, both for beginners and those more advanced, in radio fundamentals and allied specialized subjects. It can serve as a national bulletin board on which needs for apparatus and personnel may be posted. And it can continue its traditional functions of supplying technical information, affording entertainment to lighten the drearier moments, and disseminating news of membership doings.

If the magazine — this magazine, QST — continues to perform these functions, it will have discharged the major part of its responsibility. There is one more element to its job, however. That is to supply a common meeting-place wherein a widely-scattered and diversely-occupied membership can maintain a community of interest and a unity of purpose.

The foregoing is self-evident. If there is anything wrong with it, it is in the use of the pronoun “it.” “It” should be “we” — for QST is neither an inanimate nor an impersonal thing. It is the product of concerted, cooperative effort, and “we” means all of us, every ARRL member, every licensed amateur, every prospective post-war radio ham. “We” collectively make QST — by supplying the raw material in the form of contributions, by molding the shape of its issues by comment and criticism.

As the outcome of our thinking about the coming year, then, it is in our mind to say this: that QST can continue to perform its task in the fullest measure only if “we” continue to have your help. Of course you’re busy, and you’re going to be busier than ever. But find a moment, when you think of something we could or should be doing, to tell us about it.

Take the time, if you possibly can, to send along an occasional contribution — be it only a Stray or a note for Hints & Kinks. Is there a certain kind of article you’d like to see in the magazine? Then sit down and write us about it — or better yet, write the article itself and send it along.

But above all, let us hear from you. If QST has done an acceptable job during this first year of war, much of the credit must go to the many loyal members who have written us with useful material and worth-while advice. If that job is to be improved upon, it will only be done with your help.

C. B. D.

SPLATTER

OUR COVER

This is the kind of cover some of our members have been telling us they’d like to see on QST. Nothing fancy or arty — just an ordinary photo of a trio of happy hams proudly inspecting their handiwork. The generator is, of course, the one discussed on page 54.

FOOTNOTES

Among the non-staff contributors to this issue, we have five new writers not previously introduced in this column. The one familiar name is that of Dr. T. A. Gadwa, W2K1HM (p. 22) who, to quote a Correspondence contributor, presents complex subjects in a manner “sufficiently non-mathematical to permit easy understanding by the mass of amateurs and still not simplified to the extent of being an incorrect approximation.”

First among the newcomers is Philip Gibbs (p. 38), formerly communications advisor and coordinator to the Ohio State Council of Defense, and now senior communications protection advisor to OCD’s fifth regional office. He has been in telephone work with Ohio Bell since 1928. Genial and well-liked Herbert W. Hamilton, W9MRQ (p. 49) for years one of Chicago’s best-known hams, is well qualified to tell the story of an important amateur contribution to war work. Corresponding secretary of the Hamfesters, a Chicago club that has outgrown local boundaries and is now almost national in scope, Herb somehow finds time to do a little work for Western Electric, too. Will Landes, W8SID (p. 54) is one of those down-to-earth old-timers with a practical mechanical bent. His well-equipped machine shop comes in mighty handy when there’s some such gadget to be built as a 1-kw.-plus homemade generator. If names mean anything, W. R. Triplett, W8OWW (p. 40) is just the man to write about meters. Now taking an EE course at the University of Cincinnati, his other interests include YLs (he is 22 and blonde, f.y.i.), getting a B ration book and learning how to win friends and influence professors. After graduating, Ropp expects to find out what good he can be to Uncle Sam. Licensed since 1935, but remarks plaintively that he hasn’t been on the air much this past year.

Harking back to this column in January QST, we suppose every ham who read it said, “Why, Arthur Lynch’s call isn’t W2DKL; it’s W2DKJ!” That’s what we say, too — with apologies.
QST Visits the Coast Guard

How Proficient Radio Operators Are Trained at the Atlantic City School

BY CLINTON B. DESOTO, W1CBD

When you talk with a Coast Guardsman, it's very much like talking with members of the other armed services — with one fine shade of distinction. The others are each convinced that they belong to the finest military service there is, and they tell you so.

The Coast Guardsman doesn't bother to tell you. He takes it for granted you know that the Coast Guard is the finest outfit on earth.

There's some basis for that point of view, too. Not only is the Coast Guard our oldest existing U. S. military unit afloat, the one unit whose entire personnel is constantly on active duty in time of peace as well as war, but its members are often better trained and capable of more responsible assignments than those of equal rank and rating in other services.

If we begin to sound something less than impartial (and the screams of mortal affront from the Army and the Navy and Air Forces are already warningly audible!), please pardon our enthusiasm. We have just returned from a visit to the U. S. Coast Guard Training Station at Atlantic City, N. J. — that's the reason.

And lest you think that the magic words "Atlantic City" have something to do with this enthusiasm, we'd better tell the story of that visit in full. It wasn't the famous resort city that inspired our enthusiasm (notable as we understand the effect of its carefree atmosphere to have been at one time); no, what with the dim-out and the military-training invasion Atlantic City is now far from the vacationer's paradise it was in the past. It was the thoroughness and the efficiency of the training being given the future Coast Guard radio operators there that inspired us.

It wasn't necessary for the men with the little white or gold shields on their sleeves to tell us how good they are. They just showed us — showed us how, in the longest and most intensive training course now being given radio operators in any of the military services, they are turning out as fine a lot of thoroughly-trained radio operators as you'd ever hope to see. Men who can — and do — step from the school doors to the deck of a ship and take over the radio room.

Ready for Active Duty

"You must understand that, unlike the other services, a Coast Guard radio operator may be put on his own from his very first assignment," Commander D. G. Jacobs, the commanding officer on the station, explained at the beginning of our visit.

A veteran in the service who came to the school direct from a cutter command, Comdr. Jacobs spoke from first-hand knowledge. "On the smaller craft of the Coast Guard, a new man may be told to drop his sea bag in the corner and take over a watch the minute he steps on deck; "Not only that, but if anything goes wrong with the rig there's no radio technician aboard a Coast Guard patrol boat to do the maintenance work; the operator has to fix it himself — fast!"

In time of peace the nation's maritime police force, in time of war a functioning unit of the U. S. Navy, the Coast Guard always lives up to its motto, "Semper paratus — Always ready." In training the radio operators who provide fulcrum points for the communications system that vitalizes its duties of convoy and patrol, of reconnaissance and aid to navigation, the Coast Guard again fulfills its motto in the highest degree.

This is the story of that training and the school where it is given.

*Executive Editor, QST

February 1943
It takes a lot of paper work to run a radio school. Partial view of administrative offices on the main deck.

In turning out the kind of men who can deliver under such circumstances, no matter how stiff the assignment, the Coast Guard takes no halfway measures. Its student operators are given a six-month training course, in contrast to the shorter periods of the other services. They get a thorough grounding in basic theory, matériel and maintenance — something a Navy or Signal Corps radio operator doesn’t get. And above all, they are relentlessly drilled in the precept that absolute accuracy and infallible dependability are the important qualities in a radio man, important far above flashy code speed or jitterbug wagging of a weightless bug.

Yes, the old copybook maxims are liberally applied at Atlantic City — “Speed is secondary to accuracy,” “Hard work is the key to success,” “Only results count” and all the others.

The Training Program

The training program at Atlantic City is divided into five major divisions: code, procedure, watch standing, theory and matériel. The first three, of course, come under the heading of operating training, and are given in the order shown. The latter two are classified as maintenance training; they are given in parallel with the operator instruction.

The purpose of the Atlantic City school is to train radio operators, and the important item in a radio operator’s equipment is the code. Code instruction is, therefore, the heart of the training given at Atlantic City.

They do a thorough job of it, too — as thorough a job as you’ll find anywhere. It’s a soundly-conceived, scientifically-analyzed job, too.

Let’s look at the code instruction first of all, then. The men in charge of code training at the school have been in the game for years; they are conscientious and capable, and they know their stuff. There’s Lt.-Comdr. Meredith H. Griffith, the officer-in-charge of the school, who ranks as one of the country’s best code instructors. There’s Lt. (jg) Bernard M. Davis, supervisor of code instruction, with a dozen years or more in the teaching game; he was the one who set up the original code school at Gallups Island — a hallmark for successful operator training. And there is a seasoned corps of instructors — warrant officers and chief radiomen (including, we must add, CRM John Huntoon, on leave from the ARRL Hq staff), most of whom are old-timers in the service. Aiding these experienced veterans is a capable crew of assistants, mostly bright young thirds selected from among the school’s own graduates.

Standardized Instruction System

So much for the staff. The training they dispense is based on the new “standardized instruction” system. Only recently installed in the school, it represents the sum total of the years of experience and knowledge possessed by the instruction staff. In some respects it has a revolutionary sound; in others it seems like a revival of older methods recently considered outmoded.

The standardized instruction system is primarily based on the possibility that a student may be called out of the school for active duty at any stage of his training, and the work is arranged so that every phase progresses in parallel rather than in series. The student receives instruction in every subject during every week of the total of 21 weeks he is in the school.

This arrangement doesn’t shorten the course, but it does have advantages apart from the basic one of having the trainee ready to go on duty at any time. For one thing, accuracy is improved — a highly important virtue in itself. For another, it provides a constant check on student progress and helps to show up unavailables in a minimum of time, as we shall see a little later on.

To show how the system works, we’ll review the progress of a typical class. Here is how it goes:

His very first day in the school the student sits down at an operating position in the big code

These three men run the Atlantic City station, L. to r.: Lt.-Comdr. Thomas N. Huddleston, executive officer; Lt. Griffith, officer in charge of the school, and Comdr. D. G. Jacobs, commanding officer.
room, puts on a pair of headphones and listens to the entire alphabet, letter by letter, sent at a speed of 3 to 4 w.p.m.

That's the first innovation — the student gets the complete code in the first lesson instead of over a period of nine weeks, as in the old course. He just listens to it, learning the sounds; he doesn't have to write it down.

After this initial period of listening to the code, he is started out on typing — all during this same first day. And again he is given the entire keyboard in the first lesson, not just a couple of rows.

That's the way it goes for the first week. There is a daily period of listening to code — just listening, to every letter and every numeral. There is a daily typing session, copying down spoken letters heard over the headphones. Every bit of instruction is given over the 'phones, by the way, to accustom the student to using his ears.

Beginning with the second week he also begins to write down code on the typewriter. By this time, of course, he can type faster than he can receive, and this margin is retained throughout the course. This is accomplished by additional typing practice periods, using written material.

As soon as the student has the alphabet more or less memorized, it is broken down into the old "similar character" combinations. He hears "EI5SH" and then "EI5SH" and "EI5SH," etc., over and over, until the fact that these "similar" sounding characters actually are markedly different is indelibly impressed. Then the same with "TMO99" and so on, one group for certain periods each day.

"If the characters seem to sound alike, we put 'em alongside each other so the student can appreciate just how different the sounds actually are," Lt. Davis explained.

This seems like a throwback to the old-fashioned methods, but it works — how well, we are about to learn.

**Code Groups in Early Training**

At the outset code groups alone are used, to discourage the common fault of anticipating...
what's coming next. A little later some plain language text is interspersed with the mixed copy. This is made as realistic as possible; for example, since the Coast Guard uses an "X" between sentences for punctuation, the plain language text also contains the "Xs."

Practice in copying behind is also given from the beginning. The instructor sends, then pauses while the students write the characters down — first two, then three, and so on. Gradually the pauses grow shorter, until finally the student finds himself copying automatically a word or two behind.

All practice transmissions at the slower speeds are by hand sending. A speed key with the heavy weights is used; Lt.-Comdr. Griffith emphasizes that this method gives the clean-cut heavy dots that make the characters sound true at low speeds. The character speed is about 15 w.p.m., the characters being "letter-spaced" for slower word speeds. Above 12 to 15 w.p.m. regular tape transmitters are used — the perforated-tape Kleinschmidt type with Boehme and McElroy keying heads.

Standard commercial beat-frequency audio oscillators are used for tone sources, a tone of 750-800 cycles having been selected as optimum. "We find that the old Navy frequency of 500 cycles is too low," Lt. Davis explained, "and a 1000-cycle oscillator is too shrill. The students find it monotonous and tiring."

The instructors strive very hard to avoid monotony. That is why all the practice sessions are broken up into 15-minute periods, with code listening, typing practice, code transcription and sending all interspersed. Similarly, the nature of the text material is changed every few minutes, to give variety to the practice.

As each step forward is taken the instructor carefully explains what it is and the purpose behind it, so the student will understand just what it is he is supposed to do and why.

The course is laid out for an average rate of progress of about one word per week. That's in code instruction, of course — typing speeds keep well ahead of code speed, so the student can always put down everything he hears. After six weeks, for example, the average typing speed for mixed copy is around 30 w.p.m.

**Performance Under the New System**

How does the standardized instruction plan work out in comparison with earlier methods?

The records on student progress give the answer. We compared the records of the current class, the first to receive instruction under the new system, and one of the best of the older classes. Of the old class, from 25 to 30 per cent of the men made perfect copy in the weekly tests on coded groups at the progressive rated speeds. In the new class the percentage of perfect copies was approximately doubled — from 50 to 60 per cent of the students turning in perfect copy. The overall class average also showed an impressive increase, with a 65 average grade for the first class comparing with weekly averages of from 84 to 99 for the new one.

Now there was nothing particularly wrong with that first class. In fact, it made an excellent showing — at the end of 15 weeks most of the men were taking plain language at 18 per. The difference showed up when it came to coded groups, however, as pointed out above. Few of the men in the first class made more than two or three errors in a three-minute transmission — but in the Coast Guard that's two or three errors too many. In the new class the errors at rated speeds were negligible.

*Absolute accuracy* is the goal in this Coast Guard training, and they accept nothing less. That is true from the first week through to the end of the training period. It's Lt. Davis' observation that the average operator makes a few errors at all speeds, and that the percentage doesn't change markedly from low speeds to his normal maximum. Their way, therefore, is to strive for no errors at any speed. So stringent is this requirement that any student making more than six single-character errors in his weekly test — corresponding to a grade of less than 70 (5 points being deducted for each error) — is required to attend night classes until he catches up.
and turns in a passing grade for two consecutive weeks. The night classes give the student 1½ hours daily extra drill.

If this standard of absolute accuracy sounds like a utopian ideal, the Coast Guard replies that its radiomen can’t afford to make mistakes. As Comdr. Jacobs pointed out, “With the complex code groups now in use, a single error might lose an entire convoy.”

This tremendous responsibility is keenly felt by both students and instructors. It is impressed on them at every phase of the training. That’s the reason, for example, that so much of the practice is in coded groups — 5 character combinations (numerals counting as two characters), exactly as the student will hear them at that future time when he stands his own watch in a pitching radio room on an enemy-menaced vessel in the open sea.

**Low Attrition Rate**

Of course, not every man has the natural equipment to become a perfect operator. That brings up another interesting angle on the Atlantic City training. Even with the most careful preliminary selection, each class contains a certain proportion who are congenitally incapable of making the grade. At Atlantic City this attrition rate is kept very low, however. Moreover, the unqualified are weeded out at an early stage in training, avoiding wasted time and effort — most of them at the end of the first month, in contrast to other schools where they may hang on to the very end of the course.

The success of the standardized instruction...
Piled-high plates for the main course come steaming hot from the kitchen on continuously-running belts to students assembled in the Hotel Morton dining room for the noon meal.

The method is graphically shown by Lt.-Comdr. Griffith's charts of class progress. Unlike most such charts, these rise in a smooth curve instead of by a series of plateaus. Part of the answer to this is individual student instruction; the stepped curves result where the class as a whole must wait for the laggards to catch up. At Atlantic City there are no laggards; those who fall behind even a little get additional night instruction, while those who just can't keep up even then either drop behind a class or are disenrolled.

Yet it is safe to say that no potentially-qualified man is ever disenrolled. This result is accomplished first by the uncannily accurate aptitude test given at the beginning of the course and second by the careful construction and analysis of the weekly progress tests.

**Aptitude Test**

The aptitude test, a unique one devised at the school following prolonged experiment, alone calls the turn with an accuracy of 75 to 80 per cent. Three men out of every four who flunk it, even by only a point or two, will never make operators; the fourth will never be better than fair. While the details of this test can't be published, it may be described as a code-reaction test designed to determine the student's sensory coordination — specifically as between his hearing and his other senses. It departs from other such tests chiefly in its simplicity. The reason for this is that the more complex tests introduce a number of other errors which are not calculable and which only confuse the result.

In applying the test, each class is rated on the basis of a "normal." Those at or above normal almost invariably make good operators. Those who fall below by even a slight margin don't. To show how well it works, out of one group with a normal of 94 those men who showed up "sub-normal" with an aptitude grade of 84 were subsequently disenrolled. Of another group with a normal of 90, those who were below average, with a grade of 86 confirmed the analysis by failing to make the grade.

Even so, however, the aptitude test is not final and the student is given every opportunity to overcome his handicap. Every man receives at least one month's training before he is released. Those who are really trying may even be moved back a class to give them a chance to catch up. If such a student still doesn't come through, however, there is only one answer — he's not operator material.

This news — if it is news to him — is broken to the student with due consideration. In each case one of the staff interviews the student and explains that disenrollment from the school is in no way a reflection on his mental capacity or general ability.

"Radio operating is a natural skill," he is told. "The ability to copy code has no relation to intelligence. Some of us have got it and some haven't — just as some men are natural-born golfers while others forever remain dubs."

**What Makes a Radio Operator?**

Just what makes a radio operator, then? The instructors at Atlantic City frankly admit that (Continued on page 108)

Left — Students march from school to barracks along Atlantic City's Virginia Avenue. At the head of this street lies the famed Boardwalk.

Below — A Coast Guard radio class assembles for review. Visible in the left background is the Morton Hotel barracks.
The Tri-Part Plan

OCD's Recommendations for Selection of Frequencies for WERS

BY GEORGE HART,* WINJM

An OCD booklet entitled "The War Emergency Radio Service," long promised as a manual for organizing local WERS, is soon to be ready for distribution; in fact, by the time this appears in print it may already be in circulation. The publication will cover completely all phases of WERS organization, most of which have already been considered and treated in QST. It is our purpose here to dwell on one part of the proposed booklet that has not been discussed, namely, the "Tri-Part Plan" for frequency allocation, just announced as we go to press.

According to OCD's recommended plan for organization of WERS on the basis of a district warning area (Fig. 1), the warning district control center has the responsibility of receiving orders from the Army Information Center and relaying them to all local control centers in the warning district. In addition, the warning district control center will in all cases itself be a local control center for its own community. This, OCD points out, will require that several separate transmitting and receiving units be located at this center. The elaborate network plan, as illustrated, will therefore require that a careful allocation of frequencies to be used by the various services be made in order to eliminate the possibility of interference between networks.

The selection of these frequencies and their intended uses are what OCD calls its "Tri-Part Plan," a subdivision of the 112-116-Mc. band into various segments and a further subdivision of these segments into frequency channels 200 kc. apart (Fig. 2). Each such segment has a specific use. Nominally they are the local-district (LD) band (112-112.8 Mc.), the local-fixed (LF) band (112.8-114 Mc.), the local-mobile (LM) band (114-115.2 Mc.) and the Civil Air Patrol band (115.2-116 Mc.). We shall start at the low frequency end of the band and see what should go on in each segment according to the "Tri-Part Plan."

The local to warning district control center (LD) band provides supplemental communication to the next higher level of control. This is the band on which local control makes contact with warning district control, or vice versa, for dispatching facilities from one community to another or for relay of orders from the Army Information Center. It contains four channels, but OCD recommends that the same channel be used by as many communities as possible and that when more than one channel of this band is used they should be staggered between communities to avoid interference. Each channel in this band will require a separate transmitter and receiver at district control. This is the circuit to be used for intercommunication between communities of the same warning area, and OCD recommends its use for this purpose whether or not the area is under a single license.

The local to fixed-point (LF) band is used to establish supplemental means of communication between the local control center and the headquarters of the various emergency services such as hospitals, fire stations, police and wardens*...
The CAP band is to be used exclusively by the Civil Air Patrol in accordance with a mutual agreement between the Citizens' Defense Corps and the Civil Air Patrol, both divisions of OCD. OCD stresses that it is imperative, to avoid interference, that joint use of these frequencies be avoided.

In large metropolitan areas an expanded system is recommended to cover the greater number of local fixed and mobile stations required (Fig. 3). OCD here recommends that local subcontrol points be established, whose functions will be identical to that of local control centers as described heretofore with the difference that instead of having contact with district control they will make contact with a main local control center which will maintain an up-to-the-minute picture of conditions within the city by means of this connection as well as by means of separate receivers operating on each of all the frequencies being utilized by subcontrol stations throughout the community. The main control center for a metropolitan area will have two-way contact with district control on one of the LD channels to provide a supplemental service to a point outside posts. Six channels are available in this band.

According to OCD's recommendations, a separate transmitter and receiver with notched dials for quick frequency change should be provided at the control center for operation in this band. At the various service headquarters the transmitters and receivers should be permanently tuned to the operating channel assigned them. Through these circuits the control center then coordinates the activities of the various services in relation to incidents throughout the community.

The local to mobile (LM) band should be employed only for communication with mobile units in the field. In the small communities one channel may be used for all such services, but the six channels available provide room for expansion in larger communities where separate channels may be assigned separate services such as fire, police, medical, etc. At the control center one transmitter and receiver provided with notched frequency-changing devices should be used exclusively for this band when more than one channel is used; otherwise it should remain tuned to the operating frequency assigned. At the headquarters of the various services a transmitter and receiver should be installed to operate on the channel assigned to that service. The LM band thus provides a means of communication directly to the emergency service headquarters from the field, and also direct to the control center, where an up-to-the-minute picture is maintained for the purpose of coordinating all activities.

![Fig. 3 - The Tri-Part Plan expanded for use in large metropolitan areas where subcontrol centers are used.](image-url)
the city which is in close contact with military and state headquarters.

Let us summarize a bit to see what the execution of this plan will mean in the way of equipment. District and local control centers must have three separate transmitters and receivers able to operate simultaneously on the three different bands mentioned above, and each transmitter and receiver must be capable of being spotted (by notched frequency control) on any channel being used in one of these three bands. A main control center in the expanded plan for a large metropolitan area must be equipped with one transmitter and receiver to operate on the LD band, one transmitter and receiver with notched frequency control to operate on the LF band, and separate fixed-tuned receivers for each LM and LF channel used in subcontrol centers, to coordinate an up-to-the-minute picture of the progress of an incident. An ordinary local control center must have the same equipment as a main control station with the exception of the separate receivers. Fixed local stations and service headquarters must be equipped with one fixed-frequency transmitter and receiver to operate on the LF band to maintain contact with local control or local subcontrol (as the case may be), and another fixed-frequency transmitter and receiver to operate on the LM band for contact with mobile units. Finally, each mobile unit must be equipped with one transmitter and receiver on a fixed frequency to communicate with its service headquarters on the LM band.

It is absolutely essential that, in each self-sufficient region within which interference could occur, there exist some definite plan for coordinating the communications of the various emergency networks. Without it there will be no separation of messages, and interference with message transmission will be the rule rather than the exception. OCD strongly recommends the adoption of the above plan, modified if necessary to meet specific local problems, as the best basis for establishment of a system capable of handling an enormous amount of message traffic with a minimum of interference. It is probably a very satisfactory plan for the almost-hypothetical places where plenty of operators and plenty of high-grade equipment are available. We fear that in most cities the modifications of the plan “necessary to meet specific local problems” will be rather extensive.

**Australian Amateurs in Civilian Defense**

*We have been very pleased to see the recognition the Australian government has given the VK amateurs in making use of their services and apparatus for emergency communications. We think our readers will be interested in the following excerpts from *Amateur-Radio*, the official organ of the Wireless Institute of Australia.*

*From the August issue:*

“So the ban of experimental transmissions came into force shortly before the outbreak of war, Federal headquarters and the various divisions individually have submitted various schemes at different times to the Postmaster General’s Department for the use of the services of those licensed experimenters and their gear in the present emergency. The department has favorably commented upon one or two of these schemes, but unfortunately the Naval Board — the body controlling communications in wartime — could not see its way clear to grant permission for the breaking of the seals.

“Several divisions were far from discouraged by constant rebuffs, particularly New South Wales. With the entry of Japan into the war, considerable impetus was given to civilian-defense organizations in this state, namely the State War Effort Coordination Committee and the National Emergency Services. A scheme of radio communication embracing the services of amateurs and their equipment was placed before the former body, but at first received scant consideration. Shortly afterwards a state-wide emergency test was held, and ordinary means of communication did not function as well as was expected. With this knowledge, the Institute again placed its suggestion before the State War Effort Coordination Committee and this time it was favorably considered, and it was decided that the Postmaster General’s Department be again approached.

“After several months of protracted negotiations, amateurs throughout Australia will be pleased to learn that the Wireless Institute of Australia and Australian amateurs generally are the first in the world to be recognized by a national government and allotted a place in the defense of their country. On the 8th July, 1942, permission was received from the Department of the Navy for the operation of the Emergency Communication Network!*

“Briefly the operation of the network will be as follows: The Wireless Institute of Australia, New South Wales Division, will work in conjunction with the State War Effort Coordination Committee and will provide operators and equipment for 25 stations. These will be located in Sydney and outlying suburbs and frequencies have been allotted in the 25-Mc. band. In addition the Institute is to supply and train operators for a medium-frequency commercial installation. Thus the whole radio communication installation of the State War Effort Coordination Committee

(Continued on page 82)

*Our WERS regulations were adopted by FCC on May 26, 1942, released June 12th. July QST had not yet arrived in Australia when this was written. — Ennor.*

**February 1943** 21
An Impedance-Matching Transformer

A Simple Method for Matching the Antenna to the Transmission Line

BY T. A. GADWA, SC.D.,* W2KHM

While those of us at home don't have many opportunities these days to try tuning up antenna systems, the method described in this article will some day be useful to us. At present, it can be applied to WERS communication, design data for a suitable coupler being included in the article.

A ny simple and inexpensive method of coupling an antenna to a transmission line always is attractive to amateurs. Numerous articles on untuned feeders have outlined their advantages — lower losses, reduced feeder radiation and operation independent of line length. An antenna placed in a favorable location and supplied power by untuned feeders or transmission lines is frequently desirable, but coupling one end of the transmission line to the plate circuit and the other to the antenna does not solve the problem satisfactorily. To transfer power most efficiently on such a transmission line, the load resistance must equal the generator resistance. This means that power is absorbed by the load and none is reflected back to the sending end to produce standing waves. If the termination differs from this load resistance, standing waves appear on the line, representing wasted power that never reaches the antenna. The character of standing waves for various types of loads has been described previously and may be reviewed for reference purposes.

A transmission line of two parallel conductors has a characteristic impedance which is determined by the physical dimensions of the system: diameter of the conductors, their spacing and the insulation or dielectric. The equation for calculating the impedance of an open-air two-wire parallel line is:

\[ R_0 = 276 \log \frac{2S}{D} \]  

where \( R_0 \) = characteristic impedance of the line in ohms
\( S \) = spacing between conductor centers in any units
\( D \) = diameter of conductor in same units

*214 Hillcrest Rd., Mt. Vernon, N. Y.
These impedance-matching circuits are used when the antenna resistance is lower than the characteristic impedance of the transmission line.

**Impedance Transformation**

In some cases, the impedances of an antenna and transmission line are not equal and some sort of transformation must occur before the load can be matched to the line. It is possible to convert an impedance to a higher or lower value by utilizing a circuit known as a filter, network or impedance transformer, composed only of inductances and capacitances. When a filter of suitable design is inserted between the antenna and transmission line, the load presented to the line will be equal to the line impedance, and an impedance match for a flat line is possible. A parallel-resonant circuit of inductance, capacitance and resistance, such as is shown in Fig. 1, has different impedances between various points of the circuit. The impedance between any two points can be found by combining the series and parallel elements in the usual manner. A pi-section filter will accomplish the same transformation, which is equivalent to tapping the antenna across a portion of the inductance or capacitance. These arrangements, shown in Figs. 2, 3 and 4, are not recommended since they require one more element than the circuit of Fig. 1; also, it is impossible to obtain a correct impedance transformation for certain combinations of inductance and capacitance because of insufficient coupling. The impedance transformer should exhibit pure resistance at its terminals, and Everitt has shown what the values of the inductive and capacitive reactances should be to satisfy this condition. Equations which have been used in previous QST articles are:

\[
X_L = \sqrt{R_1 (R_2 - R_1)} = R_1 \sqrt{\frac{R_2}{R_1}} - 1
\]

(2) and \(2a\)

\[
X_C = R_2 \sqrt{\frac{R_2}{R_2 - R_1}} = \frac{R_2}{R_1} - 1
\]

(3) and \(3a\)

where \(X_L\) = inductive reactance in ohms

\(X_C\) = capacitive reactance in ohms

\(R_1\) = input or output resistance

\(R_2\) = output or input resistance

\(L = \frac{X_L}{2\pi f}\)

(4)

\(C = \frac{1}{2\pi f X_C}\)

(5)

\(f = \) frequency in cycles per second

\(L = \) inductance in henrys

\(C = \) capacitance in farads

A resonant antenna can be connected to one pair of terminals and its effective impedance at the second pair of terminals changed to equal that of the line. The antenna behaves like a series resonant circuit and is a pure resistance at resonance. It is reactive off resonance — capacitive at frequencies below resonance and inductive at frequencies above resonance. For the case where the resistance of the antenna is lower than that of the transmission line, the circuits in Fig. 5 can be employed. Circuits in Fig. 6 are used when the antenna resistance is higher than the line impedance. Symmetrical arrangements of the circuits for connection to a two-wire line are shown in Figs. 5-C, 5-D, 6-C and 6-D. In Figs. 5-C and 6-C, one-half the total inductance is put in each leg when the coils are not inductively coupled. In Figs. 5-D and 6-D, one fourth the total inductance (half the total number of turns) is put in each leg when the coils are inductive coupled.
or 1.00 microhenry. Using the
where

The required inductance, from equation (4) is

\[ L = \frac{13 \sqrt{625/13 - 1}}{13 \times 6.86} = 89.2 \text{ ohms} \]

The required capacitance, from equation (5), is

\[ C = \frac{1}{2\pi \times 14.2 \times 10^6 \times 91.1} = 123 \times 10^{-12} \text{ farads} \]

or 123 micromicrofarads. The voltage across the condenser is relatively low because of the low impedance involved. Receiving type condensers are satisfactory, since the plate spacing need not be large for most amateur powers. A two-section stator with sections in series is desirable because this construction eliminates losses in rotor connections. For 300 watts through a 625-ohm line, the voltage is

\[ E = \sqrt{PR} = \sqrt{300 \times 625} = 433 \text{ volts r.m.s.} \]

The peak is 433 \times 1.414 = 610 volts and on 100 per cent modulation the peak is 610 \times 2 = 1220 volts.

The tuning unit must be protected from the weather. One version of such an impedance transformer is illustrated in the photograph. The coil and condenser are mounted in a weather-tight

**A Practical Example**

To illustrate the various steps in the calculation, a typical case is solved. It is desired to match the antenna resistance at the center of one element of a 2-element close-spaced ½-wavelength antenna at 14.2 Mc. to an open-air parallel 2-wire line of No. 14 wire, with 6-inch spacing between wires. The characteristic impedance of the line is obtained from equation (1).

\[ R_s = 276 \log \left( \frac{2 \times 0.064}{0.004} \right) = 276 \log 188 = 276 \times 2.275 = 625 \text{ ohms} \]

The antenna resistance may be assumed to be equal to 13 ohms. Since the line impedance is higher than the antenna resistance, a transformer of type shown in Fig. 5 must be employed. The inductive reactance from equation (2a) is

\[ X_L = 13 \sqrt{625/13 - 1} = 13 \times 6.86 = 89.2 \text{ ohms} \]

The required inductance, from equation (4) is

\[ L = \frac{89.2}{2\pi \times 14.2 \times 10^6} = 1.00 \times 10^{-4} \text{ henrys} \]

or 1.00 microhenry. Using the Handbook formula

\[ N = \sqrt{\frac{3A + 9B}{0.24^2}} \]

where \( N \) = number of turns

\[ A = \text{diameter of coil in inches (let } A = 1.5 \text{ inches)} \]

\[ B = \text{length of coil in inches (let } B = 1.5 \text{ inches)} \]

\[ L = \text{inductance in microhenrys} \]

\[ N = \sqrt{\frac{3 \times 1.5 + 9 \times 1.5}{0.24^2}} \times 10^{-12} = 6.3 \text{ turns} \]

Within small limits, the inductance can be increased by spacing the turns closer together and decreased by spacing them farther apart. Antenna material is satisfactory for the coil, although heavier wire or copper tubing will keep the losses to a minimum.

The capacitive reactance, from equation (3a) is

\[ X_C = \frac{625}{\sqrt{625/13 - 1}} = 625/6.86 = 91.1 \text{ ohms} \]

The required capacitance, from equation (5), is

\[ C = \frac{1}{2\pi \times 14.2 \times 10^6 \times 91.1} = 123 \times 10^{-12} \text{ farads} \]

or 123 micromicrofarads. The voltage across the condenser is relatively low because of the low impedance involved. Receiving type condensers are satisfactory, since the plate spacing need not be large for most amateur powers. A two-section stator with sections in series is desirable because this construction eliminates losses in rotor connections. For 300 watts through a 625-ohm line, the voltage is

\[ E = \sqrt{PR} = \sqrt{300 \times 625} = 433 \text{ volts r.m.s.} \]

The peak is 433 \times 1.414 = 610 volts and on 100 per cent modulation the peak is 610 \times 2 = 1220 volts.

The tuning unit must be protected from the weather. One version of such an impedance transformer is illustrated in the photograph. The coil and condenser are mounted in a weather-tight

**QST for**
box made of quarter-inch tempered Masonite, with feed-through terminals brought out through the sides for the line and similar terminals at one end for the antenna.

Interference with the antenna radiation field by matching stubs, quarter-wave sections and delta matching sections are avoided when the transformer is used, since the transformer is concentrated in a much smaller space. The frequency response of such a low- Q parallel circuit containing a series resistance is broad enough to be used to advantage with close-spaced antenna elements having a sharp frequency-response characteristic. Its application is essentially to one-band antennas since impedance transformation is dependent upon the frequency of operation. It must be emphasized that one and only one combination of inductance \( L \) and capacitance \( C \) will match a given antenna resistance to a given line. As the ratio \( R_2/R_1 \) approaches unity, \( X_L \) approaches zero and \( X_C \) approaches infinity; that is, the inductance and capacitance both become smaller. The resonant frequency of \( L \) and \( C \) without \( R_1 \) may be considerably higher than with \( R_1 \) in the circuit.

**Adjustment**

It is highly desirable to be able to tune the unit when it is in its operating position at the antenna. This may be done by varying the capacity until maximum antenna current is shown by an r.f. ammeter or lamp bulb connected in the antenna at the junction to the transformer. Alternatively, one may adjust for minimum line current at the line junction to the impedance transformer. Where this is impossible or inconvenient, it is permissible to tune the coil and condenser to resonance before connecting the antenna and transmission line. Since the resonant frequency of the coil and condenser alone always is higher than with the antenna in the circuit, the capacity is then reduced sufficiently to compensate for the insertion of the antenna when the unit is in operating position. If the antenna is resonant and the correct values of inductance and capacitance are employed, the line will be correctly terminated. A constant current at all points along the line, or a slight increase of current toward the transmitter or sending end, is the final test of a perfect impedance match.

A thermomilliammeter connected across a portion of one feeder line at various positions is a good indicator of standing waves. A flashlight bulb connected across a short length of one feeder is also a good current indicator and is inexpensive. The bulb should be shielded to direct the light to the observer so that the neighbors' curiosity will not be aroused by night operation. If bulbs are permanently located at intervals of 1/16 wavelength along the line, starting from the antenna, the brilliancy vs. position shows the location of maximum and minimum line currents or standing waves.

If the antenna is nonresonant, its length must be adjusted or tuned to resonance. Excite the antenna parasitically and obtain maximum antenna current by tuning. Noting the position of the standing waves on the transmission line, as outlined in the article on standing waves, also is recommended. One exception must be observed because the resistance across the terminals of a parallel-resonant circuit increases when the series resistance decreases. In other words, the load resistance presented to the line is increased for a decrease in antenna resistance and, conversely, the load resistance presented to the line is decreased for an increase in antenna resistance. This may be understood by analyzing the approximate relationship that holds for a parallel-resonant circuit of low series resistance or high \( Q \).

\[
R_2 = \frac{L}{C R_1} \quad (6)
\]

This is true when \( R_2 \) is relatively small and is approximately so for higher values of \( R_1 \). It means that the parallel impedance is increased by using larger inductance \( L \) and a smaller capacitance \( C \) (increasing \( L/C \) ratio), and by reducing the series resistance \( R_1 \). Conversely, the parallel impedance is decreased by using a smaller inductance \( L \) and a larger capacitance \( C \) (decreasing \( L/C \) ratio) and by increasing the series resistance \( R_1 \). The parallel resistance always is greater than the series resistance.

If the antenna is resonant but incorrect values of inductance and capacitance are used in the impedance transformer, a current loop or node will appear near the 1/4 wavelength point measured along the line from the transformer. If a current loop or maximum occurs at this position the terminating resistance is too high, and a smaller inductance \( L \) and a larger capacitance \( C \) are re-
quired. If a current node or minimum occurs near the $\frac{1}{4}$ wavelength position, the terminating resistance is too low and a larger inductance $L$ and lower capacitance $C$ are required.

If the antenna and line resistances are known, the ratio of the line and antenna currents for an impedance match can be calculated from the square root of the antenna-to-line resistance ratio. This is based upon the assumption that the power input to the transformer equals the power output; i.e., that the losses in the transformer are negligible.

$$P = I_2^2R = I_1^2R_1 = I_2^2R_2$$

or

$$\frac{I_1}{I_2} = \frac{\sqrt{R_2}}{R_1}$$

(7)

If an r.f. ammeter is available, measurement of the antenna and line currents will reveal the correct impedance match from their ratio.

$$\text{Antenna} \rightarrow$$

$$\text{Line}$$

$$\begin{align*}
L &= \frac{1}{4} \\
C &= \frac{S}{N/2}
\end{align*}$$

$$(8)$$

Fig. 9 — This circuit is used for matching a half-wave antenna to a line having an impedance of the order of 500 ohms. Constants for 114 Mc. operation are given in the text.

With 2½ meters active for civilian defense, transmitting antennas and associated problems are under consideration once again. A design is given in Fig. 9 for matching a half-wave antenna at 114 Mc. to an open-air 2-wire line of No. 14 wire spaced 2 inches:

$$\begin{align*}
S &= 2 \text{ inches spacing} \\
D &= 0.064 \text{ wire diameter, inches} \\
R_2 &= 495 \text{ ohms, line impedance} \\
R_1 &= 73 \text{ ohms, antenna resistance} \\
f &= 114 \times 10^3 \text{ cycles per second} \\
XL &= 175.8 \text{ ohms} \\
L &= 0.245 \mu\text{H} \\
A &= 1 \text{ inch (coil diameter)} \\
B &= 1 \text{ inch (coil length)} \\
N &= 3.8 \text{ turns} \\
N/2 &= 1.9 \text{ turns} \\
X_C &= 206 \text{ ohms} \\
C &= 6.8 \mu\text{fd.}
\end{align*}$$

It is hoped that this method will not be overlooked when considering the problem of matching the antenna to the transmission line. Because of its simplicity, it might well be adopted by the amateur radio fraternity.

New Cathode-Ray Tubes

RCA has recently announced the following new types of cathode-ray tubes:

The type 3BP1 is a 3-inch high-vacuum cathode-ray tube having electrostatic deflection, electrostatic focusing, green fluorescence and medium persistence. It has a 2-inch bulb neck, separate leads to all deflecting electrodes and the cathode, and an overall length of about 10 inches. All leads terminate at the dishedal base. Cut-off voltage is -60 and deflection sensitivities are 0.115 and 0.155 millimeters per volt at an anode No. 2 voltage of 2000. Heater ratings are 6.3 volts, 0.6 amp.

The type 3EP1/1806-P1 is similar to the type 3BP1, but it has a different bulb with a 1½-inch neck and a magnum base. The cathode is connected to the heater within the tube.

The type 7CP1/1811-P1 is a short 7-inch high-vacuum tube having magnetic deflection, electrostatic focusing, green fluorescence and medium persistence. It has a 1½-inch bulb neck and an overall length of about 13½ inches. Except for anode No. 2, which is connected to a snap terminal on the side of the bulb, the electrodes have separate leads terminating in an octal base. Cut-off voltage is -45 at an anode No. 2 voltage of 7000. Heater ratings are 6.3 volts, 0.6 amp.

Silent Keys

It is with deep regret that we record the passing of these amateurs:

Joseph A. Boratyn, WIKVG, Whitinsville, Mass.

E. J. Botimer, W8NZW, Akron, Ohio

Henry Leonard Brock, W5HGE, Tuckerman, Ark.

Ellsworth O. Dumas, W5LE, Scottville, Mich.

George S. Fravel, W8PML, Buffalo, N. Y.

Edward J. Hedrick, W6MVM, Long Beach, Calif.

W. O. Ron G. E. Knightley, RCAF, VE3ES, Agincourt, Ont.

Walter H. Kurtz, W9VVF, Kansas City, Mo.

Herbert Wadsworth, ex-W3JJ, Washington, D. C.

Strays

We are happy to say that the listing of W6BFA under Silent Keys in the December issue was an error. According to latest reports, he is alive and well and is teaching code at the CPT field near Prescott, Arizona.
AS TO ENLISTMENTS

The ban on voluntary enlistments between the ages of 18 and 38, and the decision to procure men for all of the armed services by means of the Selective Service, of course profoundly affects all of the items we have hitherto published in this department concerning enlisted service. It is necessary to make a fresh start. We attempt hereunder to bring the story up-to-date but must frankly warn you that the information may again be out of date by the time you read these lines. For up-to-the-minute details of anything in which you're interested, wire or write George W. Bailey, 2101 Constitution Ave., N. W., Washington, D. C.

We understand that the mechanism to supply men to the Navy, Marine Corps and Coast Guard through Selective Service will not be established until at least February, and probably considerably later, and that until that is done a registrant between the ages of 18 and 38 may volunteer for induction into any one of those arms (or into the Army) by making an application to his local draft board. This is not enlistment, since it operates through the draft, but it has much the same effect since it will permit a man to get into the Navy, Marine Corps or Coast Guard if he is acceptable and the quotas are not filled. Eventually, possibly beginning in February, even this mechanism for volunteering for induction ahead of one's regular order is to be discontinued for men between 18 and 38, and thereafter the needs of all arms are to be filled by draft levies, except that the following opportunities will still exist for enlisting by those outside these age limits:

Eighteen is the minimum age in the Army, so the opportunity for enlisting there is confined to those above 38. We understand that men between 38 and 50 may still enlist in the Signal Corps for duty as radio operator or technician, and similarly in the Army Air Forces up to the age of 44. The Navy is still enlisting lads of 17 with their parents' consent and, men over 38. The upper limit may vary for various types of work but for the V-6 radio technician, which has been of the greatest interest to amateurs, the top limit is 50. Volunteering for the Marine Corps staff sergencies, of course, is now closed to men between the ages of 18 and 35; but it is possible that the Corps might make an exception for very well qualified seventeen-year-olds who are mature for their age; or for some men over 38 who have especially good qualifications, although 35 has been the top limit up to now. The Coast Guard informs us that youths of 17 can enlist with parents' consent and that they are also accepting enlistments from men 38 to 55.

According to a Selective Service bulletin to local boards, regulations are being amended to remove the requirement that volunteers under 21 furnish the local board with the written consent of parents, and this change probably will be made by the time these lines are in print.

At the present time all selectees actually drafted are being inducted into the Army. The Navy, Marine Corps and Coast Guard for the immediate present are obtaining substantially all of their required manpower from registrants who volunteer for induction. Any registrant between 18 and 38, who wishes thus to volunteer for one of these services, may make application to his local board, provided he has not previously been ordered to report for induction. These three services have established quotas which govern the number of men accepted for induction, but until a local board is notified that a service cannot accept any more men, it will forward all who volunteer for that service. Note that it is possible that about February procedure will be established so that calls may be levied for all branches of the armed forces. Note again that men who are drafted will be assigned to the Army. Only by going to your local board and volunteering to be inducted can you be assigned, at the present time, to the Navy, Marine Corps or Coast Guard, and then only provided the quota is not filled.

A volunteer found unacceptable for induction into the service for which he volunteers, and whose defects do not manifestly disqualify him for service somewhere on land or sea, will be retained in Class I-A or Class I-A-0 and not again forwarded for induction until regular combined calls are levied for all branches of the armed forces.

An amateur who volunteers for induction in the Navy, Marine Corps or Coast Guard should be prepared to prove his capabilities as a radio man at the induction station or the recruiting station, to whichever one he may be sent, by showing his amateur radio license, school certificate and proof of experience in the field of radio.

Our recent items on ROTC and the Naval Reserve's Classes V-7 and V-11 are canceled. See the item "College Training" in this issue.

SIGNAL CORPS OFFICERS

The Electronics Training Group of the Signal Corps is still open to acceptable candi-
dates: graduates of an accredited college, either in science with a major in electronic physics, or in electrical engineering, age limits 16 to 46. This Group is not affected by the ban on enlistments and presents a wonderful opportunity for a qualified applicant. Send full particulars of your history to G. W. Bailey, Office of Scientific Research & Development, 2101 Constitution Ave., N. W., Washington, D. C.

NAVY & MARINE CORPS OFFICERS

The Marine Corps is still accepting applications for commission in its Aircraft Warning Service in accordance with the announcement in January QST, page 36. While the prime candidates are those with bachelor degrees in EE or radio engineering, in top physical condition, there is a bit of flexibility as outlined in our last article.


The Navy also is still accepting applications for commission in three classes of the Naval Reserve. One of these is AV(S), reported on page 36 of our last issue, whose work deals with radio detection. Another is Class EV(S), dealing with both detection and communication work; and finally there is CV(S), the well-known classification dealing with communication work. Further information may be had by direct correspondence with The Commandant of your Naval District.

If uncertain of your qualifications for either Navy or Marine Corps, write for advice to G. W. Bailey, 2101 Constitution Ave., N. W., Washington.

YL's TAKE NOTICE

Every one of the opportunities noted in the YL department in December QST is still available. Take particular notice that enlistments in WAACS, WAVES and SPARS are still being accepted.

WAACS

Women with amateur radio operator licenses may enlist in WAAC on exactly the same basis as other women and receive the regular basic training. Age limits are 21 to 44. If they have a high-school education, including physics, and are mechanically inclined, they may be selected from the ranks of WAAC auxiliaries and be given the Signal Corps aptitude test. If they pass these requirements they will be trained at a civilian school in Kansas City, Mo., under Signal Corps supervision. Training has already begun. The next group will start March 1st. Those who pass the course will be assigned to positions replacing Army Air Forces enlisted men. All officers are commissioned from the ranks.

WAVES

Women with radio amateur licenses may enlist in the WAVES and will be classified as apprentice seamen and sent to the radio school at Madison, Wis. Applicants must be at least 20 and not over 36 years of age. If unmarried at the time of appointment, they must agree not to marry prior to the completion of the indoctrination and training period. If married, they must not have children under 18 years of age. They must be high-school or business-school graduates and have a good reputation in their communities. The pay is the same as in the Navy. Applications for commissions will be received from women over 21 and under 50 years of age who have a baccalaureate degree from an accredited university or college, or two years' work towards a degree plus two years of business or professional experience in fields acceptable to the Navy.

Candidates for midshipman training leading to a commission will be enlisted as apprentice seamen in Class V-9. Ages, over 20 but not over 30. These women will receive approximately 30 days' indoctrination, upon successful completion of which they will be appointed as reserve midshipmen. Satisfactory completion of the prescribed course of instruction at Women's Reserve Midshipman School at Smith College, Northampton, Mass., will qualify for commission as an ensign, WVP, USNR, and assignment to active duty ashore.

SPARS

Women with amateur radio licenses may enlist in the Coast Guard's SPAR if they are not less than 20 and not more than 35. They must be graduates of high school or business school. Married women may enlist, provided their husbands are not in the Coast Guard and provided they do not have children under 18. Unmarried women must agree not to marry until they have finished their period of training. Applicants must be not less than five feet in height and 95 pounds in weight. Applicants for a commission must be not less than 20 and not over 49 and must have a college degree, or have passed two years of college work and at least two years of acceptable business and professional experience. Same rules as to marital status as apply to enlisted women.

RADIO ENGINEERS AND PHYSICIANS

This paragraph is directed to the attention of radio engineers, physicists and electrical engineers with radio communication experience, ages 31 to 45, with particular reference to the older men. It is directed to those engineers or physicists who are employed but who feel that they should look into the opportunities for military service, yet who do not wish to disturb their present occupations until they are well informed as to the possibilities of commissions in the armed forces. If they will address their inquiries to the personal attention of George W. Bailey, Office of Scientific Research & Development, 2101 Constitution Avenue, N. W., Washington, D. C., he will gladly
treat these inquiries as entirely confidential and will supply interesting information as to the possibilities of military service.

VOLUNTEER OFFICER CANDIDATES

The so-called “VOC” plan is still in force and is not affected by the cessation of enlistments. Under this plan, registrants classified in III-A for reason of dependency may volunteer at their local board through the Selective Service System to compete for selection as officer candidates in the Army of the United States. Full particulars on page 31, December QST.

Incidentally, this is a good place for us to remark that men in Class II are not considered for Army commission these days, unless they obtain written release from their employers.

INSTRUCTORS NEEDED

The radio training schools of the nation continue in large need of instructors. So far as we know, all of the items we have published on this subject in the last couple of months are still applicable. The largest single need is in the Army Air Forces Technical Schools (about which you read in QST last month) and the Navy Aviation Service Schools. The Civil Service says that it is still searching for teachers and that its offers are considered for promotion to supervisory instructorships at increased salary. While for initial appointment to Junior Instructor the applicant must have a college degree or have had considerable teaching or technical experience, the average licensed amateur or commercial radio operator is qualified for appointment as Student Instructor at $1620. Student Instructors are themselves given a course of instruction lasting from three to six months, and are then promoted to Junior Instructor and put to teaching. Thus amateurs are to be found everywhere in the teaching staffs of the service schools.

SI applicants must be high-school graduates or have at least 14 high-school units and have, in addition, either one year’s college study; or one year’s progressive technical experience as operator, engineer, maintenance or repair man; or six months in a radio school or war-training course; or possess an amateur or commercial license. No written test; qualifications judged from record of training or experience. Ages, 20 up. Further particulars on page 35, January QST. Qualified persons are requested to file applications at once with the Secretary, Board of Civil Service Examiners, Chanute Field, Rantoul, Ill. Forms may be obtained at any first- or second-class post office, or from the Civil Service Commission at Washington.

In the vocational and technical schools where Signal Corps civilian employees receive instruction, and in the innumerable high schools where pre-induction training in radio is beginning, the need for radio instructors is increasing. See full information on this subject in December QST, beginning on page 29, including a list of Signal Corps schools by states.

COMMERCIAL OPPORTUNITIES

If you have not registered with the ARRL Personnel Bureau you’re overlooking a good bet. Almost daily we have calls for radio men of every type and description, from service men to graduate electronics engineers with plenty on the ball. Amateurs, operators, broadcast engineers, high-speed code men, instructors, executives, superintendents, radio men of every age and qualification, licensed and unlicensed — they are all needed by the government or defense industries sooner or later.

The variety of radio jobs for which men are needed is endless. For instance, a branch of the Army wants amateurs with AARS or NCR net experience, a school wants a man with teaching experience to organize and superintend a radio course, a well-known aircraft manufacturer needs communications engineers, a large radio factory must have service men and inspectors, a broadcast station wires for a chief engineer, the Merchant Marine and commercial airlines companies are in need of operators. There are many more interesting opportunities we are not allowed to mention.

These calls are for men needed immediately. They won’t wait for the next issue of QST to appear in “U.S.A. Calling” and some cannot be given publicity. They are not positions involving enlistment in the armed services. Some are Civil Service, some civilian jobs connected with the government indirectly, some with defense industries. Some are for women only. Some carry draft deferment, some require IV-F men. The salary range is wide, depending on the importance of the work, qualifications of the employed, and location.

Names of likely-looking candidates who can qualify are carefully chosen from the Personnel Bureau files and furnished the agency needing them. The agency writes the man direct for full particulars concerning qualifications and technical background. From then on it is up to the candidate to sell a bill of goods if he is interested.

Are you one of those waiting patiently for a defense job to ferret you out? You’re apt to wait, unless you are a big-name radio engineer. If you are an average ham or just a darned good technical man, you need the Personnel Bureau and the Personnel Bureau needs you.

Don’t wait to be asked. ARRL member or non-member, ham, service man or engineer, register your availability with us without delay. There is no charge or obligation. This is a wartime service of the League, a definite contribution to the war
effort, a duty to connect the man and the need in the shortest possible time. Mail us the Registration of Personnel Availability from page 38 of October QST, make up a facsimile, or write us for a blank. We'll do our best to do the rest.

COLLEGE TRAINING

The old arrangements for enlisted reserves for college students have been completely redone. Here is the latest information we have up to press time. It will be found of interest not only by college students but by all young high-school graduates.

Army

The Army will contract with selected colleges and universities, not yet announced, for the use of their facilities in training selected soldiers in courses prescribed by the Army.

Selection for such training will be made from enlisted men who have completed or are completing their basic military training and who apply for specialized training. The War Department will control all selections and only enlisted men under 22 years of age will be eligible.

To cover the transition from the Enlisted Reserve program, now in effect, to the Army Specialized Training Program, the following action will be taken:

1) Medical students in the Enlisted Reserve will be called to active duty at the end of the next academic semester and will be detailed to continue courses of medical instruction under contracts to be made by the War Department.

2) Seniors taking advanced ROTC will be ordered to active duty upon graduation or upon completion of the next academic semester. Upon entering active duty they will be ordered to their respective branch schools and commissioned upon successful completion of the course.

3) Juniors, students in the Enlisted Reserve Corps, or inducted before June 30, 1943, who are pursuing approved technical engineering courses, will continue in an inactive status until the end of the next academic semester and will then be called to active duty. Those selected, at the completion of their basic military training, for further technical training will be detailed for such instruction under the Army Specialized Training Program.

4) All other Enlisted Reserve Corps students will be called to active duty at the end of the current semester, and upon completion of basic training will be eligible for selection for training under this program or for other military duty.

At the termination of any phase of specialized training under this program, the soldiers will be:

1) Selected for further training in an Officer Candidate School.

2) Recommended for technical noncommissioned officer.

3) Returned to troops.

4) In exceptional cases, detailed for very advanced technical training.

5) In very exceptional cases, made available for technical work to be done out of the Army, but deemed to be highly important to the war effort.

The assignment of soldiers to the Army Specialized Training Program will be placed in effect during the month of February, except for such action as may be required under the same prior to that time.

Navy

The Navy college training program is designed to use the facilities of selected colleges and universities, not yet announced, for the training of prospective officer candidates in the Navy, Marine Corps and the Coast Guard. Under this plan selected high-school graduates or others of satisfactory educational qualifications, having established their mental, physical and potential officer qualifications, will be inducted as apprentice seamen in the Navy or Coast Guard or privates in the Marine Corps, placed on active duty with pay, and assigned to designated colleges and universities to follow courses of study specified by the Navy Department.

High-school graduates or students having equivalent formal education, 17 years old at the time of enlistment or 18 through 19 years of age at the time of induction, will be eligible for the program. (Boys 17, not yet 18, may still enlist in the Navy.) Men already enlisted in the Navy, 17 through 22 years of age, who have proper educational qualifications and are recommended by their commanding officer, are eligible to apply for the program. Successful candidates will be assigned on active duty to selected colleges and universities for instruction. As far as possible, the preference of any candidates for particular colleges will be respected. Candidates may also express their choice of branch of the service at the time of enlistment, but this preliminary choice will not be binding on them or the Navy Department.

During their attendance at the college or university, which must accept all men ordered to it for training, the men will wear uniforms and receive regular pay of the lowest enlisted grade. Quarters, food, and medical service, as well as instruction, will be provided under contracts entered into by the Navy with the various institutions. Men assigned to this program are eligible at any time for transfer at their own request to aviation training. The length of programs of study will be from 8 to 21 months, depending upon the requirements of the several branches of the Navy.

Courses for the first 6 months will be similar for all students and will emphasize fundamental college work in mathematics, science, English, history, engineering drawing and physical training. (Continued on page 118)
In line with the war-stimulated interest in the technical side of radio, our correspondence at Headquarters indicates a desire on the part of readers both in and out of the Services for more QST articles dealing with radio mathematics. The accompanying article and the further sections to follow will, it is hoped, help to clear up some of the difficulties which confront those radio students who have had relatively little mathematical training.

The reputation which mathematics has of being difficult must have some basis in fact. We do not hold with those who airily dismiss the difficulties by the simple process of repeatedly asserting that the subject is "easy." It is true that many mathematical ideas are essentially simple, and a great deal is gained if at the start the ideas rather than routine methods of manipulation are emphasized. But straight, logical reasoning from a premise to a conclusion is seldom easy — and such reasoning is the essence of mathematics.

There is no attempt here to present the material in formal fashion. That has been done in innumerable articles and textbooks, and it is not believed that much would be contributed by further efforts along similar lines. Our purpose, rather, is to discuss some of the occurrences in electrical circuits and to show how and why particular kinds of mathematics are especially adaptable to giving a description of those occurrences. The writing of such descriptions is, in the end, the primary reason why mathematics is associated with a technical subject.

Lack of adequate mathematical background can be a formidable obstacle in the path to an understanding of some of the things that go on in electrical circuits. While the average individual can take Ohm's Law more or less in his stride, since it involves little more than the simplest algebra, when he comes up against alternating currents something more is required. And, as it happens, practically all radio work deals with alternating currents of one form or another. To feel thoroughly at home with a.c. it is just as essential to know the mathematics that goes into at least the simpler a.c. equations as it is to know the elementary algebra necessary for applications of Ohm's Law to d.c. circuits. Many of the mathematical ideas involved are new to the person of average schooling. Also, several distinct branches of mathematics are called upon — branches which in themselves cover a great deal more territory than it is necessary for us to explore, since we are interested in a specific application.

Direct and Alternating Currents

To begin with, let us consider some of the characteristics of an alternating current as compared to direct current. By definition, a direct current is one which always flows in the same direction through the circuit. In most d.c. circuits the value (or "amplitude") of the current also is constant, although there is nothing in the definition which prohibits the amplitude of the current from changing more or less rapidly. (In many cases, as in the plate circuits of vacuum tubes, the amplitude of the current does vary, although the direction of current flow is unchanging. But for the present purpose we can regard this as an exception.) In setting up rules for the operation of d.c. circuits, therefore, we are dealing with steady quantities; i.e., one value of current and one direction, under a given set of conditions. Such a case can be handled by relatively simple methods.

The alternating current presents a more difficult problem. In the first place, it periodically reverses its direction of flow. In the second place, the amount of current flowing is continually changing, even during the periods when the direction is constant. (There can be exceptions to this, but again they represent special cases with which we are not concerned at present.) Any mathematical expression which attempts to describe such a current must be capable of telling us how much current is flowing and the direction in which it is flowing, at any instant of time we may select. We obviously must select some instant, because both the amount and direction of the current are
different at different times. Thus we have three things, amplitude, direction and time, to take into account.

So far nothing we have said obligates the current to vary in any particular way with time, aside from changing direction periodically. We now add a restriction; a restriction which is justifiable because it is met in actual practice when current flow is well established in a circuit — that is, under what are called “steady state” conditions. (All the ordinary rules are called off during the “transient” state — the time when the current is just beginning to flow in a circuit, just ceasing to flow, or the circuit conditions are undergoing a change. These transient periods usually are very short, and can be neglected for most purposes.) The restriction is that, having gone through a certain set of variations in its flow in one direction and another set in its flow in the other direction, the current must thereafter vary in exactly the same way, with time, in its consecutive reversals. That is, every cycle must be exactly the same as the one preceding and the one following it. Without such regular behavior no simple mathematical description of the current is possible, except in a few specialized cases.

A series of events which repeats over and over again is called “periodic,” and belongs to the general classification known as “periodic phenomena.” There is a somewhat fearfully scientific sound to such a phrase, but it is simply a concise way of describing some very familiar sights and sounds. The swing of a clock pendulum, the vibrating string of a musical instrument, the sound wave which the string causes — these are only a few examples of periodic phenomena. In every case the motion follows some law (it may or may not be a simple one) which makes each new cycle have the same form as the preceding one.

**Simple Harmonic Motion**

It is always wise to start with the easiest case, and since periodic phenomena are not confined to electrical circuits, we can expect to find a mechanical example which will illustrate the simplest type of periodic action. If we consider some moving object going through periodic motion, we should naturally expect that a smooth motion would be simpler than one characterized by irregularities. The clock pendulum is a good example of such movement, provided it is not swinging over too great a distance. The pendulum weight or “bob” certainly swings smoothly, and to the eye the motion seems to meet the requirement of simplicity. In fact, it is rather difficult to imagine how the movement could be less complicated and still be periodic.

This type of movement is actually the simplest. It has a special name, simple harmonic motion — and is worth examining in some detail. Suppose, as in Fig. 1, we have a pendulum swinging between the points P1 and P2. Its rest position, or the position it would assume if the motion died down and the pendulum came to a stop, is at O, in the center of the swing. The path of the swing is shown by the dotted line, which is an arc, or section of the circumference, of a circle since the pendulum has a fixed length and swings from a fixed point. To describe the motion we need to determine the position of the bob at any instant of time. To do this we can use the point O as a reference and measure the distance along the arc from O to the actual position of the bob. To distinguish between positions to the right of O and those to the left we can call the former “positive” and the latter “negative.” Since the pendulum swings just as far to the left as it does to the right, the distance OP2 along the arc is the same as the distance OP1. This maximum distance from the center is called the amplitude of the swing. The time required for the bob to swing through all its possible positions is called the period of the swing. The movement through these same positions is called a cycle. We can start from any position of the bob to measure a period or cycle, just so long as the bob goes through all its possible positions before returning to the selected starting point. It is frequently convenient to select the zero position as a starting point, but it is not at all necessary.

If by some means we measure the distance of the bob from O at a number of different times and then plot the results of such measurements along a scale of time, we should find that the resulting plot would be a curve of the type shown in Fig. 2. This is to be expected from inspection of the pendulum’s swing. First, the bob spends just as much time to the right of O as it does to the left, so it crosses through O at equal intervals of time. Second, the speed of the bob is greatest when it passes through O, becomes progressively less as the bob moves farther from the center, and eventually becomes zero at the very peak of the swing. In Fig. 2, where we have assumed that the period is one second, this variation in speed is shown by the fact that in a given time interval — say 1/10 second — the distance covered becomes smaller as the actual distance from the center becomes greater. The problem now is to determine just how the distance varies with time; or, in mathematical language, to find the particular function of time which the curve represents.
An Equivalent Motion

It is necessary here to accept on faith the statement that the motion can be proved to have a rather simple equivalent, for the methods of proof require the use of advanced mathematics. The equivalent motion itself is easily described. Let us suppose we have a line of the same length as the distance OP1 or OP2, with one end at a fixed point but the whole line free to rotate about the point, as in Fig. 3. The direction of rotation will be assumed to be counterclockwise; that is, in the opposite direction to that taken by the hands of a clock. We draw the line YY′ (or Y axis) vertically through O, and allow the distance line (here labeled simply OP, since OP1 and OP2 in Fig. 2 are the same length) to rotate at a constant speed such that the line returns to its starting point in the time of one period of the pendulum's swing.

Suppose that at any position of the rotating line OP a second line is drawn, perpendicular to YY′, from YY′ to the point P. In Fig. 3, AP is such a line, intersecting YY′ at A. The distance OA is called the projection of OP on YY′. It is obvious that the length of the projection varies with the position of OP. If OP is horizontal, for example, the projection OA is zero, since in that case a line drawn from P perpendicular to YY′ will coincide with OP, and thus O and A are the same point. On the other hand, if P is at P1 or P2, the projection is equal to OP because then OP and OA coincide. With the exception of the two instants of time when OP coincides with either OP1 or OP2, the projection OA is always smaller than OP. Distances along YY′ above O are considered positive and those below O are considered negative, so that if the projection OA lies above O it is positive, while if it is below it is negative.

Now if we allow OP to rotate with uniform speed and plot the length of the projection OA against time, we obtain a curve of exactly the same shape as that shown in Fig. 2. If, as in the case of the pendulum, we assume that the period — that is, the time required for OP to complete one rotation — is one second, we obtain exactly the same graph. It is not hard to see why the two curves should be alike. First, the length of the projection varies in exactly the same way during each successive rotation of OP, so that the variation in the length of the projection is periodic. Second, since the speed of rotation is constant, the projection is positive during half of each period and negative during the other half. Furthermore, the rate at which the length of OA changes depends upon the rate at which P is moving upward or downward. P is actually moving in a circle, so that it is covering space both horizontally and vertically at the same time. P is moving mostly vertically when OP is nearly horizontal, and moving mostly horizontally when OP is nearly vertical. Consequently, if OP is moving with uniform speed its projection OA changes most rapidly when OP is moving through its two horizontal positions and least rapidly when OP is moving through its two vertical positions. If OP1 in Fig. 3 corresponds to OP1 in Fig. 1, and OP2 in Fig. 3 to OP2 in Fig. 1, then the way in which OA in Fig. 3 changes with time is of the same general nature as the way in which the distance of the pendulum bob from the center O changes with time. As we have said before, the exact correspondence of the two movements can be proved.

The simplest kind of alternating current will be one which has the same form as simple harmonic motion. All that has been said, therefore, applies equally well to an alternating current as to the more easily observable swing of the pendulum. The value of the current at any instant will be given by the length of the projection of the rotating line, if the length of the line is taken to represent the maximum value reached by the current during the cycle. For example, if the current has a maximum value or amplitude of 5 amperes we may draw the rotating line to a scale of 1 ampere to the inch, thereby making it 5 inches long. If its projection at a certain instant is 3 inches long, the value of the current at that instant will be 3 amperes. If the projection is above the O point on the YY′ line or axis, the current will be flowing in the “positive” direction; if below the O point it will be flowing in the “negative” direction.

In itself, the transition from the pendulum bob to the rotating line does not seem to have simplified our problem, since all we have done is to assert that both the pendulum and the varying projection of the rotating line are examples of

Figure 2 and Figure 3
simple harmonic motion. However, the mathematical formula which gives the length of the projection of the rotating line can be obtained rather easily by making use of the principles of trigonometry, or that branch of mathematics which deals with the relationship between the sides and angles of triangles.

**Time and Angle**

Probably those who have some acquaintance with trigonometry will have encountered it in its more familiar applications to the measurement of distances and angles. These aspects of the subject are not of primary interest to us here. The value of trigonometry to us lies in the fact that it establishes a definite numerical relationship between the length and position of the line OP (Fig. 3) and the length of its projection OA. The position of OP is specified by the angle which OP makes with a second line which conventionally is assumed to be a horizontal line starting at O and extending to the right. This reference line is the portion of the line XXY', in Fig. 4, which extends to the right of O to the point A.

![Figure 4: Diagram illustrating the concept of time and angle](image)

It will be recognized that either OA or OB in this figure corresponds to OP in Fig. 3, since all three lines are radii of a circle. The angle \( \alpha \) in Fig. 4 is generated by movement of the radius from the position OA to the position OB. If the radius is permitted to rotate through the whole circle and return to the starting position it will generate an angle equal to the total angle at the center of the circle — four right angles or 360 degrees. As we have seen before, such a complete rotation corresponds to one cycle of simple harmonic motion. If the rotation is permitted to continue indefinitely, each additional complete circle corresponds to an additional cycle. In the process the angle continues to grow larger, an idea which becomes understandable when we remember that the angle is considered to be generated by the rotating radius. Of course each time the radius returns to its starting point it is starting out over the same ground once again, so that any two angles differing by any whole number of circles (or whole-number multiples of 360 degrees) must correspond. Thus an angle of 45° and one of 1125° are the same in all respects except one. The second contains 45° plus 3 \( \times 360° \), and thus occurs three cycles later in time than the first. This is the only difference. The utility of this concept of angle lies in the fact that it gives us a method for measuring time that is peculiarly applicable to periodic phenomena; instead of seconds, minutes, or hours, we use units of angle.

Now this is not at all a strange idea; in fact, it is the most natural thing in the world. We use the principle every day and it has been the basis of time measurement for centuries. Both the sundial and the ordinary clock use angle as a means of measuring time, although they are not calibrated in angular units.

In a clock, the “minute hand” is a rotating line which makes one rotation each hour. When it has moved from the zero position to the “3 o’clock” position, it has generated an angle of 90 degrees; at “half past,” the hour it has generated an angle of 180 degrees; at “quarter to” the next hour it has generated an angle of 270 degrees; and finally, on the hour, it has generated a complete circle or 360 degrees. It then starts over again, just as our rotating radius did. In order to identify the particular hour — that is, the cycle — we add an “hour hand” to count the number of complete revolutions made by the minute hand. In trigonometry we omit the hour hand and simply allow the angle to increase indefinitely with time, just as though the minute hand of the clock were allowed to count minutes indefinitely. If the clock indicated, for example, 200 minutes, it would not be difficult to translate it into hours and minutes. We should simply divide 200 by 60 to find the number of complete hours in 200, getting as a result 3 hours and 20 minutes. Neither is it difficult to translate an angle of more than 360 degrees into something more familiar. We simply divide the angle by 360 (if the angle is measured in degrees) to find the number of complete cycles, and the remainder is the equivalent angle. Thus an angle of 2250° divided by 360° gives 6 complete cycles plus a remainder of 110°. An angle of 2250° is, therefore, equivalent to one of 110°, except for the fact that it occurs 6 cycles later in time.

Whereas “zero” in the clock is directly upwards (12 o’clock), in the trigonometric system zero is directly to the right of center, corresponding to 3 o’clock in the ordinary clock. Our direction of rotation is opposite to that of the hands of the clock — “counterclockwise.” We use only one rotating arm instead of two, and the speed at which it rotates can be changed to fit our particular conditions. But whatever the speed, the position of the arm with respect to some fixed instant — in other words, the angle — measures off time in terms of a fraction of a period, just as the minute hand of the clock measures off time in terms of a fraction of an hour.
Angular Measure

At this point it is necessary to digress for a moment and examine some of the methods by which an angle can be measured. We know, of course, that an angle (or rather, a set of angles) is formed by the intersection of two lines. This observation does not give us any special basis for measurement, since there is no specific relationship, except position, between the angle and the lines forming it. However, the rotating radius of Fig. 4 does give us something to work on.

There is a direct relationship between the length of an arc of a circle, the length of the radius, and the angle between the two radii joining the ends of the arc to the center of the circle. Specifically, the length of the arc is directly proportional to the length of the radius and the size of the angle. In mathematical language this would be written

\[
\frac{\text{Length of arc}}{\text{Length of radius}} = \text{Angle}
\]

If the arc and the radius both have the same length, the value of the angle obviously must be 1, since a number divided by itself is 1. Hence the unit angle is one which intercepts an arc having a length equal to the length of the radius of the circle. This unit is called a radian, and like most units simply represents a ratio. The total angle of a circle therefore must be equal to the circumference divided by the radius. Thus there are \(2\pi\) radians in a circle, since the circumference is \(2\pi\) (\(\pi = 3.14159 \ldots\)) times the radius. As there are also four right angles in a circle, there must be \(2\pi/4\), or \(\pi/2\) radians in each right angle.

The radian measure of angle is a "natural" system, because it evaluates angles in terms of the radius. The familiar "degree" unit of angular measurement is based on similar considerations, except that in this case the circumference of the circle is arbitrarily divided into 360 arcs of equal length, each arc being the measure of one degree. The relationship between degrees and radians is easily established. In a circle there are \(2\pi\) radians or 360 degrees, so that one radian equals \(360/2\pi\), or 57.3 degrees, approximately, while one degree equals \(2\pi/360\), or 0.01745 radian.

Trigonometric Functions

To review briefly for a moment, we have thus far described the simplest type of periodic action, found an equivalent graphical motion which we expect to be more amenable to analysis, and then found it necessary to establish a relationship between time and angle. We are now about ready for the next step, which is to show the relationship between angle and the length of the project-
Since the value of $b$ is immediately determined when a value is assigned to $a$ ($b = 90° - a$), the values of the functions of $b$ are always constant in any right triangle having one angle $a$. The functions of $b$ are consequently known as the co-functions of $a$, or
\[
\begin{align*}
\text{cosine } a &= \frac{B}{C} = \text{sine } (90° - a) \\
\text{cotangent } a &= \frac{B}{A} = \text{tangent } (90° - a) \\
\text{cosecant } a &= \frac{C}{A} = \text{secant } (90° - a)
\end{align*}
\]

In electrical and radio applications the sine, cosine and tangent are most frequently used. They are usually abbreviated $\sin$, $\cos$ and $\tan$, respectively.

**Quadrants and Signs**

The definitions just given can be extended to include angles larger than 90 degrees. Suppose that a circle of radius $r$ is drawn on rectangular coordinates, as shown in Fig. 6. Then the angle $a$ is generated by rotation of the radius from the $X$ axis to the position shown in the figure. If a line is drawn perpendicular to the $X$ axis through the end of the radius, the distance $x$ along the $X$ axis corresponds to the adjacent side of a right triangle and the perpendicular line corresponds to the opposite side, while $r$ is the hypotenuse. The perpendicular line has the length $y$, the projection of the radius on the $Y$ axis. Then
\[
\begin{align*}
\sin a &= \frac{y}{r} \\
\cos a &= \frac{x}{r} \\
\tan a &= \frac{y}{x}
\end{align*}
\]

Values of $x$ lying to the right of the origin, $O$, are considered positive and those lying to the left of the origin are considered negative. As previously described, values of $y$ above the origin are positive and values below the origin are negative. The radius, $r$, is always considered positive. With these definitions the equations just given hold for any angle.

The $X$ and $Y$ axes divide the circle into four parts, each forming a right angle at the center, as shown. The four sections of the circle are called quadrants, and are numbered counterclockwise starting with the one at the upper right. In the first quadrant both $x$ and $y$ are positive; in the second quadrant $x$ is negative and $y$ is positive; in the third quadrant both $x$ and $y$ are negative; and in the fourth quadrant $x$ is positive while $y$ is negative. These relationships determine the signs of the angles in the various quadrants.

For example, in Fig. 6 angle $b$, which lies in the third quadrant, is considerably larger than a right angle. The distance $x$ lies to the left of the origin and is negative; $y$ lies below the origin and also is negative. Then
\[
\begin{align*}
\sin b &= -\frac{y}{r} \\
\cos b &= -\frac{x}{r} \\
\tan b &= -\frac{y}{x}
\end{align*}
\]

Thus the sine is negative, the cosine is negative, and the tangent is positive in this quadrant. By applying similar reasoning it will be evident that the signs of the functions in the four quadrants are as follows:

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>$\sin$</th>
<th>$\cos$</th>
<th>$\tan$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st quadrant</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2nd quadrant</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>3rd quadrant</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>4th quadrant</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

**Range of Values**

When the angle $a$ in Fig. 6 is zero ($r$ coinciding with the $X$ axis), $x$ is equal to $r$ and $y$ is zero. Hence the sine and tangent are both zero and the cosine is 1. As the angle $a$ increases, $r$ moving counterclockwise, $y$ increases and $x$ decreases. The sine consequently grows larger, the tangent increases, and the cosine becomes smaller. When $a$ is 90 degrees or $\pi/2$, $x$ is zero and $y$ is equal to $r$, hence the sine is 1, the cosine is zero, and the tangent is infinitely large ($\tan a = y/0$). In going from zero to 90 degrees, the tangent thus changes from zero to infinity, the cosine from 1 to zero, and the sine from zero to 1.

As $r$ moves through the second quadrant it generates angles between 90 and 180 degrees ($\pi/2$ to $\pi$). The value of the sine now decreases from 1 to zero, since at 90 degrees $y = r$ and at 180 degrees $y = 0$. The cosine changes from 0 at 90 degrees, where $x$ is zero, to $-1$ at 180 degrees, where $x = -r$, but is negative. The tangent be-
comes negative and decreases from infinity to zero. If \( r \) continues to move through the remaining two quadrants it will be found that similar cycles recur in each quadrant. The numerical values of the functions pass through the same range in each quadrant, but the signs of the functions change as described in the preceding paragraph.

Obviously there will be some set of numerical values which will correspond to an angle in each of the four quadrants, only the signs being different. If the signs are disregarded, the relationship between these angles can be summed up as follows:

1st quadrant: \( a = b \)
2nd quadrant: \( a = 180^\circ - b \)
3rd quadrant: \( a = b - 180^\circ \)
4th quadrant: \( a = 360^\circ - b \)

where \( a \) is the angle in the first quadrant which corresponds to the given angle \( b \). If \( b \) is larger than 360 degrees, it is necessary first to subtract from the value of the angle the largest integral multiple of 360 degrees contained in the angle. Then the formulas above may be applied.

Numerical values of the functions are given in tables to be found in many mathematical textbooks and handbooks.\(^2\) Because of the relationship between functions and cofunctions it is only necessary to carry such tables to 45 degrees, values for angles between 45 and 90 being given by the cofunction. Angles larger than 90 degrees can first be reduced to equivalent angles in the first quadrant, from which the proper numerical value of the function can be obtained. The user must supply the proper sign.

**Use of Trigonometric Functions**

It is necessary here to mention a few details in connection with the writing of trigonometric functions in equations. A trigonometric function is of course always associated with an angle. If the angle is represented by \( a \), then the value of the sine of \( a \) is indicated by writing “\( \sin a \)” the value of the cosine of \( a \) is indicated by writing “\( \cos a \)”, and so on. In such an expression the function and the angle are inseparable; in the expression \( \sin a \), for example, “\( \sin \)” and “\( a \)” must not be thought of as factors; it is simply necessary to write both of them in order to identify a single number. Therefore in an expression such as the following:

\[
\sin a
\]

the \( a \) in the numerator and that in the denominator cannot be cancelled out, because the \( a \) in the numerator is not \( a \) multiplied by “\( \sin \)” but is part of “\( \sin a \)”.

The number represented by the expression “\( \sin a \)” (or any similar expression) may be subjected to the usual methods of algebra.

Before the numerical solution of an equation involving such expressions can be found, it is necessary to look up the indicated trigonometric functions and substitute them for the expressions. If \( a \) in the above example is equal to \( \pi/2 \) (90 degrees), then \( \sin a = 1 \) and

\[
\frac{\sin a}{a} = \frac{1}{\pi} = \frac{2}{\pi} = 0.636
\]

Remembering that an expression such as \( \sin a \) is one number, equations involving such expressions can be written in the usual way. Thus, to indicate that \( \sin a \) is to be multiplied by \( N \), we write

\[ N \sin a \]

This cannot be written \( \sin an \), however, because this would indicate that the angle whose sine is to be taken is \( an \). If a factor is written after the trigonometric expression, the latter must be enclosed in parentheses; thus, \( (\sin a) \) \( N \) means the same thing as \( N \sin a \). When the angle itself is represented by two or more factors, however, it can be written in the form \( \sin abc \), where \( a \), \( b \), and \( c \) are to be multiplied together to find the value of the angle whose sine is to be taken.

If the angle is the sum or difference of two or more angles, it will be enclosed in parentheses. Thus, \( (\sin a + b) \) means the sine of the angle obtained by adding angle \( a \) to angle \( b \). If \( a \) is 15 degrees and \( b \) is 30 degrees, then \( \sin (15^\circ + 30^\circ) \) equals \( \sin 45^\circ \). However, an expression written as follows:

\[ \sin a + b \]

means, “find the sine of the angle \( a \) and add the number so found to the number \( b \).”

When a trigonometric function of an angle is to be raised to a certain power, the operation is usually indicated by writing the exponent after the name of the function. Thus, to indicate that the cosine of the angle \( a \) is to be squared, we may write \( \cos^2 a \), meaning the same thing as \( (\cos a)^2 \).

If the angle rather than the function is to be raised to a power, the exponent is placed after the angle. For example, \( \cos^2 a \) means that the angle is to be squared and the cosine of the square looked up in the tables.

The exponent -1 placed after the name of the function indicates the inverse function; that is, that the angle whose function is given is to be found. Thus \( \sin^{-1} b \) means “the angle whose sine is the number \( b \).”

With these details of the construction and writing of trigonometric functions in mind, we can tie the varying projection of Fig. 3 to the angle made by the radius with the starting position. The relationship is obvious: The length of the projection is equal to the length of the radius multiplied by the sine of the angle, since the sine is the ratio of the projection to the

\( (\text{Continued on page } 78)\)

February 1943

37
As communications men we should not rely solely on one form of communication. The necessity for transmitting intelligence rapidly and effectively is of the utmost importance in winning the war on the home front as well as on the war front. With this in mind, members of local civilian defense corps should work out detailed plans for the use of WERS to the fullest possible extent in supplementing existing telephone and messenger service.

Considerable interest was evidenced by communications men throughout the Fifth OCD Region when the War Emergency Radio Service was announced. It was felt we now had the framework for a system of communication to supplement local telephone facilities, and which could immediately be set into operation in the event of partial or total destruction of the telephone system either through enemy aircraft bombing or sabotage attack.

With this in mind the regional office of OCD took three important initial organizational steps: (1) establishment of official state maps for WERS; (2) dissemination of information on WERS to state, and through them to local, defense councils; (3) organization of a radio communications committee for each state in the regional area. These initial suggestions were made by the regional office, but it was up to the states themselves to carry them out. While good response was received from all four states—Ohio, Indiana, Kentucky and West Virginia—the best response was from Ohio. Let us therefore consider what was done in Ohio as a typical example of the procedure followed.

**WERS Maps**

A conference was held with the traffic officials of the telephone company and their cooperation and aid obtained in subdividing each of the ten Ohio District Warning areas into a number of sub-district areas based on the existing toll center boundaries. Each telephone toll center point which is also either a district or sub-district warning center point was then designated as a WERS headquarters city. WERS activity in that area was centered at that headquarters city, which would probably also be the licensee. Each one of these WERS areas does not constitute a district warning area in itself but is merely a sub-control point for the d.w.a. Licenses may be applied for either by the district warning center city for the entire district warning area or by the WERS area headquarters city, depending upon the circumstances. Since it is contemplated that WERS networks will be developed over the natural toll areas, radio communication will supplement existing telephone toll networks throughout the state and will be organized on that basis.

Copies of a map showing the system as laid out were submitted to the executive director of the Ohio State Council of Defense and to the governor of the state, for their official approval and signature. John A. Kiener, W8AVH, Emergency Coordinator for metropolitan Cleveland, was also consulted for his unofficial approval of the locations of the WERS headquarters cities.

It will be noted (Figs. 1, 2 and 3) that each district warning area is divided into WERS areas,
each of which has a central city which will be the center of WERS activities in that area. One city in the district is designated the district control center (in addition to being the headquarters city for that WERS area), while the activity centers of WERS areas are designated as sub-control centers. Each such sub-control center thus organizes WERS to work into the district plan if possible; in any event, the area to be served by any particular sub-control city is specifically defined by the map.

**Dissemination of Information**

ARRL Section Communications Managers were consulted about the information to be disseminated, and enough copies of the state maps were supplied for distribution to key amateurs throughout the respective states. The state defense council then went into action to see that all local defense councils were thoroughly informed of the plan. Each defense council director was supplied with a copy of the WERS map of his state, showing him the proposed organization in the district in which he was located. This was accompanied by a letter urging the immediate establishment of WERS in his community, including a memorandum covering items which should be considered in establishing this service, such as available equipment and personnel, facilities for operator training, locations of units, and financing of the program. Also included was a list of the names and addresses of the ARRL emergency coordinators in the state, and a copy of the “Rules Governing Stations in the War Emergency Radio Service” (FCC Rules and Regulations, Part 15).

The value of disseminating such information from a well-informed central point cannot be too strongly emphasized. Each local defense council is thus duly informed of the existence of WERS and of its value to them as a supplementary means of communication in the event of wire failure or overloading. This procedure helps to point out the existence of licensed radio amateurs who are not only willing but eager to assist in establishment of WERS locally.

ARRL field officials are recognized and referred to as those best suited to assist in the administration of WERS. “The American Radio Relay League... has established Emergency...” (Continued on page 100)

---

Figure 3 — WERS areas in Ohio.

Figure 2 — WERS areas in Kentucky. As indicated, Cincinnati, Ohio, is d.w.c. for the extreme northern region.
Rejuvenating Old Meters

Practical Hints for Servicing D.C. and A.C. Instruments

BY W. R. TRIPLETT,* W8OWW

If that meter with the stationary pointer isn’t actually burned out, there’s a chance that it can be put back into operating condition with a little careful work. Here’s how to go about it.

It is hardly necessary to say that at present, and probably for the duration, amateurs will be unable to buy new meters — or get old ones repaired — without top priorities. So there is no alternative but to make use of what we have.

This article has been prepared for the amateur who needs meters, and who has some which may be inoperative but can be fixed up to be serviceable. But let not false hopes arise; the majority of damaged meters are beyond repair by the amateur. Nevertheless, if there is nothing seriously wrong it should not be difficult to put many of them back in operating condition. Consideration will be given only to small moving-coil d.c. and moving-iron a.c. meters, since these are the most common types.

Meter Terms

For those not familiar with the terminology, some of the terms used will be explained.

Sticky meter — As the term implies, a sticky meter is one in which the pointer stops at some point along the scale when the applied current is gradually increased or decreased. The cause of a sticky meter usually is lint, dirt or metal chips which interfere with coil movement in d.c. meters or movement of the vane in a.c. meters. If the meter has been uncased and exposed to the average debris around the shack, it will probably be sticky.

Friction — A meter is said to have friction when, after gradual application of current to cause the pointer to advance slowly to a specified point, tapping the meter gently causes the pointer to show an increase in reading. For most commercial meters the change in reading caused by tapping should not exceed $\frac{1}{2}$ per cent. However, the amateur can allow considerable leeway depending on the particular application. Friction is caused by dirty points and jewels, dull pivots, cracked jewels, or lint. If the meter has been handled roughly it may have excessive friction.

Balance — Theoretically the pointer should remain on zero (with no current, of course) no matter in what position the meter is held. If this is not the case, the meter is said to be off balance. Practical limits permit one degree deviation from zero. The movement is balanced by small adjustable weights, or else by a flexible “tail weight” which is bent until balance is obtained. Another method is to use small amounts of quick-drying paint or shellac, though this is not recommended because of changes in balance due to humidity and temperature.

Overthrow — This term applies to the distance the pointer can move beyond full scale or below zero. The amount of overthrow should be at least 3 per cent of the total scale and can be adjusted by moving the pointer stops, which frequently are porcelain beads mounted on wire.

Accuracy — Commercial tolerances permit variations from the true reading of ± 2 per cent. This is understood to mean ± 2 per cent of full-scale deflection.

Repairing D.C. Meters

In repairing any meter it is advisable to proceed as follows: On a clean, well-lighted table place a clean white piece of glazed paper. Using a small paint brush, clean off any metal chips that may be on the tools you use. Do not use a cloth since the lint will float around and eventually get in the meter.

Carefully uncase the meter, but do not unsolder

---

*333 Campus Drive, Bluffton, Ohio.
shunts or springs. No attempt should be made to remove the coil and movement from the magnet.

A quick check will indicate whether further labor is worthwhile. If the springs or coil are burned, the meter is beyond repair by the amateur. If the case or glass is broken, it is a sure bet that the pivots are dull, causing excessive friction. However, considerable friction may be tolerated in some applications. The amateur should not try to replace or sharpen the pivots.

If the coil and springs appear satisfactory, set up a battery or power supply and potentiometer so the pointer can be slowly run up and down the scale. Then check for stickiness and friction.

Stickiness — Stickiness is usually caused by chips (see Fig. 1). These can be seen by looking through the pole pieces against the white paper. Bend a steel paper clip and file it as shown in Fig. 2. Brush off the filings before using. Carefully insert the straightened end between the pole piece and the core, being careful not to touch the springs or the coil. The chip will be attracted to the steel clip and can usually be pulled out. A few tries may be necessary until you get the knack of it.

Stickiness is also caused by lint touching the coil or pointer. Look for this with a magnifying glass or eye loop. The least amount of lint can cause erratic readings, so examine thoroughly all possible places where lint may interfere with a moving part. Lint can sometimes be removed with tweezers, but frequently must be burned out with a heater unit as is shown in Fig. 3. If the heater is used, care must be exercised not to burn the springs or coil wire.

If stickiness is caused simply by the pointer touching the dial, straighten the pointer with tweezers. If you chip the paint, a little India ink will fix it up.

Friction — If there is excessive friction, look for fuzz or lint and remove as explained above. If the friction is not caused by lint, probably the pivots are dull or the jewel is cracked. Neither of these can be fixed at home.

Sometimes the bearings are too tight. Try loosening the jewel screw a half revolution or so.

Meters with excessive friction may be used where accuracy is not too important.

Balance — Before rebalancing the meter, be sure the pointer is perfectly straight and that any retouching where paint was chipped off is completed.

The method of balancing will be readily ascertained from an examination of the meter. Perhaps a special tool or tweezer will have to be made to move screw-type weights. The design of such tools must be left to individual ingenuity, depending upon the particular construction.

The balancing procedure is indicated in Fig. 4. After completing the process, repeat it for checking and making final adjustments. As little pressure as possible should be used in adjusting the weights because the pivots can easily be damaged in this operation. Also be careful not to touch the springs. After finishing with the balancing, check for any fuzz or lint that may have been left on the weights.

Follow a similar procedure if a flexible tail weight or shellac is used for balancing.

Overthrow — If the meter has pointer stops, these can be adjusted to get an overthrow of a few divisions above full scale and behind zero. Make certain the pointer hits the stop before the moving element hits in order to prevent sticking at end scale.

Cleaning — Dial marks can be removed with a rubber eraser. Clean the case with the paint brush; again take care not to use a cloth rag.

Put the meter back in its case, being careful not to break the tip on the zero adjusting screw which is mounted in the cover.

Calibration — If the springs have not been damaged and if the internal shunt or resistance wire has not been unsoldered, the meter should be fairly accurate. However, age or proximity to transformers and leads carrying heavy currents may have weakened the magnet. If the shunt or series resistance wire has been unsoldered, errors may be caused by resoldering at a different point.

If no other meter is available to check the accuracy of the repaired meter, a multimeter can be used with fair results. Perhaps the local service man will loan his.

Using the potentiometer set-up mentioned before, check the calibration using the multimeter or other instrument as the standard. If the accuracy is not satisfactory, remove the cover and make

(Continued on page 84)
Welcome, you "VE" hams of Canada!
At long last we are going to include you in this column. Should have happened long ago and we're sorry it didn't. We've much material from past correspondence but will be glad to have you give us up-to-date information. Will you drop us a card or such with your call, name, rank, outfit and P. O. address?

Requests have been coming in for a listing of hams in the Merchant Marine. Up to now we have only had a few, but if you men will send us word we'll eventually include you.

With all this talk about foreign hospitality how about some of you "W" hams who live near army camps extending invitations to men in the armed forces? We have a ham in New Jersey inviting men at Ft. Monmouth to come pay a call. If any of you wish us to put word in this column, just drop us a note.

Always more pictures — and now comments and observations just to make it interesting. We like to hear from you!

Army — Signal Corps

Attention, Ft. Monmouth Hams! A. D. Middleton, W2OEN, ex-W9AOB-7GLH, Kilicycle Hilltop, Middletown, N. J., invites you to visit him. Latchstring is OUT. Contact him at Box 153, Middletown, N. J., to arrange for transportation from Red Bank to Middletown, 3½ miles north on Route 35.

1FYH, Walsh, address unknown.
1HOV, Boulay, address unknown.
1JLL, Manitseas, Lt., Drew Field, Fla.
1KHX, Barrows, Pvt., Sioux Falls, S. D.
1NMO, Sokoloski, address unknown.
2EOH, Harvey, Cpl., Ft. Monmouth, N. J.
2EVD, Avery, Pvt., Sioux Falls, S. D.
2GS, Hudson, Lt., foreign duty.
2IFY, Spirek, Tech. 4th, foreign duty.
2JEY, Caltagirone, Pvt., Ft. Riley, Kansas.
2JTX, Melkonian, Pvt., Ft. Riley, Kansas.
2KNE, Marcus, Pvt., Ft. Riley, Kansas.
2LFJ, Petrucci, Cpl., Ft. Monmouth, N. J.
2LXO, Jackie, Cpl., Ft. Monmouth, N. J.
2MHP, Albrecht, Pvt., Camp Crowder, Mo.
2MOR, Kovacs, Cpl., Ft. Monmouth, N. J.
2MRI, Kolen, Pvt., Camp Lee, Va.
2QG, Charles, Lt. Col., Ft. Dix, N. J.
3FXM, Santomos, Sgt., address unknown.
3IKI, Friend, Pvt., Scott Field, Ill.
4FEA, O'Neal, Lt., Drew Field, Fla.
4GKZ, Costopoulos, Cpl., Camp Crowder, Mo.
4HTJ, Jacobs, Lt., Camp Carson, Colo.
4JBU, Blench, Major, Memphis, Tenn.
5CNO, Serrur, Sgt., foreign duty.
5EZ, Bowers, Lt., Ft. Monmouth, N. J.
5GBK, Forgy, Pvt., Camp Crowder, Mo.
5HD, Davis, Sgt., Hensley Field, Texas.
5ISA, Hibdon, Sgt., foreign duty.
5IL, Dunten, Lt., Ft. Monmouth, N. J.
5ANM, Ebers, Major, foreign duty.
6BAM, Trotter, Tech. 5th, Camp Crowder, Mo.
6CLV, Broderick, Presidio of San Francisco, Calif.
6RUJ, Mitchum, Tech. 3rd, foreign duty.
6RVR, Paige, Pvt., foreign duty.
6TPR, Alexander, Pvt., foreign duty.
8CPW, Oliver, Cpl., Camp Davis, N. C.
8CTP, Peck, Lt., Ft. Monmouth, N. J.
8DHP, Farber, Cpl., Ft. Monmouth, N. J.
8LQ, Ludwig, Pfc., Camp Carrabelle, Fla.
8LPE, Kleiber, Pvt., Camp Breckinridge, Ky.
8JJR, Weiller, Pvt., Camp Crowder, Colo.
8TK, Timmerman, Pfc., Camp Bowie, Texas.
8SUBN, Hazleton, Capt., St. Augustine, Fla.
8VID, Puhak, Pvt., address unknown.
9AID, Midgley, Pvt., Athens, Ga.
9BFO, Gabardy, Lt., Ft. Monmouth, N. J.
COAST GUARD

GLENN MUNRO, WSGLS, now a CRM in the Coast Guard, says the more you have to offer the more you receive — and receive it you will if you have what it takes! We gather that the chances for radiomen are almost unlimited but every man must be more than a specialist. By the way, let's hear from some more of you in the CG!

1AAR, Hobart, RT1c, Chelsea, Mass.
1AOP, Harris, RT2c, New Bedford, Mass.
1BB, Perry, RM1c, Boston, Mass.
1CTO, Burns, Lt., Boston, Mass.
1EZP, Wood, RM1c, Salem, Mass.
1GVN, Lekberg, RM1c, address unknown.
1IMD, Fraser, Newport, R. I.
1ISR, Sokoloski, RTlc, Providence, R. I.
1JEL, Harrington, RT1c, Chelsea, Mass.
1KSA, Sapienza, address unknown.
1LVQ, Huntoon, CRM, Atlantic City, N. J.
1MKC, Nault, RT1c, Chelsea, Mass.
2DBF, Enos, RT1c, Ellis Island, N. Y.
2NAK, McCarthy, RM3c, New York, N. Y.
3IQI, Robinson, RM3c, Miami, Fla.
ex-K7EBR, Smith, RM2c, address unknown.
7GKS, Killen, RT2c, Seattle, Wash.
8GILS, Munro, CRM, New York, N. Y.
8SQS, Schmidt, Sea2c, Buffalo, N. Y.
9EGE, Shaw, CRM, Portsmouth, Va.
9WAY, Caspers, RM1c, Fire Island, N. Y.
Operator's license only:
Arsenault, RM1c, Southampton, N. Y.
Fields, RT1c, New York, N. Y.
Forsberg, RT2c, New Bedford, Mass.

NAVY—GENERAL

AN INCIDENT: E. J. Drozdick, W1NBK, supposedly joined the Navy January, 1942, in Boston as an RM2c. In November, eleven months later, he was again sworn in. It seems the commissioned officer who administered the oath the first of the year was not legally qualified for this function. Now "Eddie" has been in the service less than a year and is already signed up for his "Second Cruise"!

1BEW, Chuvala, RT3c, address unknown.
1GIC, Callan, address unknown.
1LWD, Lamplugh, RE, Washington, D. C.

February 1943
ARMY—AIRCRAFT

Overseas somewhere in the Pacific they have a maxim, "On to JU!" That typifies the spirit of all you ops who contacted those Js on the field of battle, if not in the field of radio. . . .

NAVY—SPECIAL DUTY

A recent graduate of a radio material school, Floyd R. Clarke, W9RUI, has a word for men coming into the group. Code isn't necessary to get in or out — but procedure is, if a first-class rating is expected. Code is very necessary afterwards when it comes to fleet duty. So keep that speed up!
8JHK, Baumgärtner, RT2c, Treasure Island, Calif.
8KEC, Doney, ARM2c, Anacostia, D. C.
8ORD, Hall, ARM1c, Anacostia, D. C.
8TBU, McCarthy, RM3c, Noroton Heights, Conn.
8TSR, McIntyre, RT2c, Grove City, Pa.
8TW, Barnhart, RT3c, Chicago, Ill.
8UDW, Orzech, RM2c, Chicago, Ill.
8VBB, Perry, RM2c, Corpus Christi, Texas.
8VNA, Searl, ARM1c, Anacostia, D. C.
8ATG, Corderman, Sea1c, Chicago, Ill.
8GUS, Dykes, EM3c, Anacostia, D. C.
8OKW, Schorm, ARM2c, Anacostia, D. C.
8JRN, Shearer, RT2c, Treasure Island, Calif.
8UAS, Foster, RT2c, Chicago, Ill.
8WJM, Pechulis, RT2c, Chicago, Ill.
8Wxd, Whitecomb, RT2c, Treasure Island, Calif.

Operator's license only:
Chase, RT2c, Grove City, Pa.
Lawson, Sea2c, Corpus Christi, Texas.

MARINE CORPS

1LWU, Perry, New River, N. C.
1MTG, Griswold, Staff Sgt., New River, N. C.
1NFF, Latimer, Pfc., Quonset Point, R. I.
2NAQ, Quinlan, New River, N. C.
2OLA, Bragdon, New River, N. C.
3LJ, Collins, Staff Sgt., Quantico, Va.
4JJ, Fincher, Staff Sgt., New River, N. C.
4GTV, McCoy, address unknown.
4GVJ, Jenkins, New River, N. C.
4HHI, Heuer, address unknown.
4HUI, Jordan, New River, N. C.
4HII, Battle, New River, N. C.
5CT, Barelay, Lc., Cambridge, Mass.
5HHQ, Garrett, Pvt., foreign duty.
6FHQ, Harris, Staff Sgt., San Diego, Calif.
6TTY, Van Kol, HAlc, Camp Pendleton, Calif.
KCBUSC, Buchanan, foreign duty.
7GRO, Paddon, Staff Sgt., Corpus Christi, Texas.
8NDR, Mason, Pvt., address unknown.
8RGB, Kennedy, New River, N. C.
8RNG, Bowman, Staff Sgt., address unknown.
8ROD, McCurry, New River, N. C.
8RTK, White; Sgt., foreign duty.
8TDI, Hull, New River, N. C.
ex-9DPK, Storm, New River, N. C.
9FPW, Brendiar, New River, N. C.
9JYA, Milnor, Staff Sgt., Corpus Christi, Texas.
9OF1, Duncan, New River, N. C.
9PUM, Mitchell, New River, N. C.
9YOC, Luebbe, New River, N. C.

Operator's license only:
Gumb, New River, N. C.
Kahl, New River, N. C.
Solomon, New River, N. C.
Vadney, Staff Sgt., New River, N. C.

NAVY—FOREIGN OR SEA DUTY

Censorship regulations do not allow us to connect men with ships or with places, so suffice

February 1943
Who Killed the Signal?

A Radio Mystery Serial

BY CLINTON B. DE SOTO, WICBD

Chapter 1 — "The Thin Man"

If you're a newcomer to the game, it may seem that radio theory already has enough mystery without adding more. True, the technical journals — even QST, sometimes — do make it a mysterious subject with their textbook language and complex notations. But radio isn't really any more mysterious or complex than many a detective story — at least not after you've read the last page and know "who-dunit." The difference lies in the method of presentation. There may be some utility, then, in the idea of presenting radio fundamentals in the manner of detective fiction.

That's what this is — a series of radio lessons in the guise of a detective-mystery yarn. Instead of human characters we'll use another kind — but we'll try to make the characterizations true and the background and incident realistic. Our purpose is to divert and entertain you, and perhaps amuse you a little. And if, by accident, you happen to learn something from this series — if it helps to clarify your understanding of basic radio theory — that's all right, too.

* * *

The radio receiver stood silent and dark in the dimly-lighted corner. In other days it had been a thing of vibrant life, its ornate window brilliantly illuminated with a rich, golden glow. From its recesses spoke miscellaneous voices — crisp, mellow, inveigling, brusque, authoritative, shy. Sometimes the flute-like notes of code skittered brightly from its tightly-curtained front, and now and then sparkling music poured forth melodiously.

But that was before. Now the receiver stood in forlorn neglect. Dust gathered on its metal cover, and a spider spun suspension cables for his web between its louvres and the wall. The receiver did not much care; indeed, it had no way of knowing. For the heart had gone out of it. The Signal was dead.

That was the mystery the Great Sleuth faced when he was called in on the case — who killed the Signal?

Even from the start it was apparent that this was one of the toughest cases of his career. The Great Sleuth was an amateur, but that implied no reflection on his ability. Any loyal detective-story reader knows that the amateur sleuths — from Sherlock Holmes down to Nick Charles — are better than the professionals (and if, like Nick, they are professionals turned amateur or vice versa, that only makes them better still).

Like any good detective, the first thing the Sleuth did was survey the scene of the crime. Blowing the dust off the receiver's metal cover, he lifted the lid and peered inside. It was of two-story construction. Upstairs, on top of the metal floor called the chassis, lived the larger occupants — an odd assortment of characters with equally odd names. These characters belonged neither to the animal nor vegetable kingdoms, but to a special classification of fauna called "parts."

Most of these parts seemed to be members of either the Condenser or Transformer families. There was Tuning Gang — he was the head of the Condenser family, of course — and an upright cousin called Filter. Then there were Power, Intermediate Frequency (invariably called I.F. by his buddies in the shop), and Audio Output — all Transformers. Tuning Gang had a business associate named Tuning Dial who lived there with him. Output Transformer lived in another small house nearby with his inseparable pal Loud Speaker.

A strange thing about the chassis set-up was that most of its occupants had very little to do with each other directly. Instead, they had a flock of servants called Tubes who carried things back and forth between them. These Tubes seemed to be everywhere — half a dozen or more of them. Mostly they were dressed in neat black outfits, but a couple of the biggest — Power Tube and Rectifier Tube — wore gleaming glass ensembles.
Downstairs there was a motley collection of smaller characters. These the Sleuth was at first inclined to dismiss, but he reflected that it is usually the most unsuspicious character in a mystery story who turns out to be the guilty party, and so he looked them over, too.

There were too many of these little fellows for the Sleuth to remember all their names, but he noted that quite a few were lesser members of the Condenser family — R.F. By-Pass, Mixer Coupling, Oscillator Trimmer and so on. Most numerous of all were the Resistor family; there were dozens of these tough little fellows. Over near the back there was a mysterious, solitary character called Filter Choke. Finally there were a number of minor parts — Sockets, Switches, Terminals, and in a corner a lean, Gary-Cooperish fellow called Power Cord and his assistant, Power Plug.

One thing the Sleuth noticed was that a certain social order seemed to exist among these parts. Most members of both the Resistor and Condenser families used the title "Fixed" before their names, for example. The most distinguished, however, were called "Variable" — approximately equivalent to "Honorable" as opposed to plain "Mister," he supposed.

The Sleuth looked each part over carefully, but he saw none that seemed an obvious suspect. Finally he called together his trusted assistants — Ohm Meter, Volt Meter, and their attractive sister Milly Am Meter — and took them over into the corner. There they held a conference in whispered tones.

"It's one of those blanked color-coded Resistors, I'll bet," Ohm Meter muttered before anyone else could speak. Sleuth listened tolerantly. Ohm was a mighty valuable man, but quick to jump to conclusions. It was a toss-up as to whether he or Volt Meter was the most valuable; but Sleuth knew he could count on either when he needed to verify a connection. Milly was the one who gave him the most concern — she was a sensitive creature, but she had little resistance and Sleuth was always afraid that she would get mixed up with a load beyond her range and burn out.

"Now let's go at this thing in a logical way," Sleuth restrained them. Milly was already beginning to tremble. "There are a lot of suspects here, and the only way we can track down the guilty one is to investigate them one by one.

"First of all, though, we've got to decide if this really was murder. Could it have been an accident — something like a loose connection, you know?"

"Well, there's the wiring —" Ohm said doubtfully. "But I'm a pretty good judge of continuity and if there was anything wrong I'd know it. I can spot a bad joint before I ever open the door!"

The Sleuth was pensive. "You're usually right, at that," he said. "OK — for the present, at least. Now for the next point — how do we know that it was an inside job? Could an outsider have had anything to do with it?"

There was a moment's silence, and then all three started talking at once. The Sleuth held up his hand. "All right — all right! I'll say it for you. There are three entrances to the chassis, which means three places where an outsider might have got to the Signal."

He counted on his fingers. "One, there's the outlet Power Cord uses to take in the family power supply. Two, there's the cable path between the chassis and the housing where Output Transformer and Loud Speaker live. Three, there's the little service terminal where Antenna makes its deliveries."

"Which do we tackle first, boss?" Volt Meter asked alertly, his pointer quivering with eagerness.

"Might as well take them in order," Sleuth replied. "Let's have a talk with Power Cord first."

Leaving the rest of the parts to wonder what was happening, they went over to the rear of the chassis.

Power Cord was a thin, elongated character with a chocolate-brown complexion. He was more than willing to talk.

"Sure, I knew the Signal was dead," he told them eagerly. "I knew it the minute everything went quiet and all the noise stopped." He lowered his voice. "It all sounds like noise to me," he added confidentially.

"Can you tell us anything more?" Sleuth asked.

"Well, I remember that about that same time the current stopped coming the way it always did. I don't know for sure whether it was just then or a little later, but it was about the same time."

"How did you know?"

"Why, I have to carry the current to the set," Power Cord answered in some surprise. "Naturally I'd know when I didn't get any."

"That's your job, is it?" Sleuth asked. "To deliver current to the rest of the set?"

"That's right. And it's an important job, too. Why, they have to have that current in just the

February 1943
right cycles and everything. If they don’t get it — well!” His voice dropped to a whisper. “Do you know what I think? I think the Signal died from electron starvation, just because there wasn’t any current!”

Sleuth looked at him carefully. “Maybe you’d better explain all about your job here and the current and so on.”

“Well,” Power Cord began, “it’s all very simple. This whole set here needs current — no current, no play. Current is our food. It’s all filled with little electrons — vitamins, maybe you’d call ’em. You want me to tell about the electrons, too?”

The Sleuth nodded. Power Cord sighed, and said, “I guess I’ll have to start from the beginning then.

“Even if you don’t know about electrons, you must have heard of molecules. They’re the smallest units to which anything — wood, metal, water — can be broken down. Everything is made up of molecules — I am, and you are, too. These molecules are made up of various combinations of atoms, which are the basic chemical elements. Every substance known is made up of various combinations of these atoms. There are more than 90 varieties of them.

“That part’s simple enough, but here’s where it gets tougher. When you try to go inside the atom in order to learn what it is made of, you leave the field of solid physical matter and must think in terms of force. For atoms are made up of electrons, and electrons, as you might guess from their name, are nothing more or less than electrical charges — little bits or particles of energy or force. Each atom contains a number of these electrons, together with a nucleus; the electrons are believed to rotate about the nucleus much like the planets about the sun.

“The nucleus, in turn, is made up largely of protons and neutrons. The protons are the opposite of electrons; they have a positive charge, while the electrons have a negative charge. There is also a large difference in the mass of the two — the proton being about 1860 times heavier than the electron. The neutron has the same mass as the proton but has no charge.”

“That’s all well enough, but what has it to do with who killed the Signal?” Ohm Meter interrupted impatiently.

“Plenty — wait and see,” Power Cord replied. “The Signal was no different from the rest of us — it was made up of electrons, too. And it needed more electrons all the time to live. You see, the Signal was an electric current.”

“All right — what is an electric current, then? You’ve been talking about it enough.”

“I’ll explain it this way. You know that when two permanent magnets are placed together with the north and south poles facing they exert a mutual attraction. In the same way, a positively-charged nucleus attracts negatively-charged electrons. In many substances the attraction is so great that the electrons are rigidly held and can be knocked off only with great difficulty. In other substances, however, the electrons are not so strongly attracted, and it is fairly easy to knock them off. If an electron is dislodged from an atom in one of those substances, this atom in turn attracts a new electron from a neighbor, and the neighbor from its neighbor down the line, and so a regular chain of motion is set up. This motion of the electrons is called electric current.”

Hmmph.” Volt Meter seemed out of his element, but Milly’s response could be read on her face.

“Now,” Power Cord continued, “you’ll have noticed that only in some substances did I say that this movement of electrons occurred with relatively little resistance. Such substances are known as conductors, because they find it easy to conduct electric current. These materials include most of the metals, especially silver, copper, aluminum and steel. I’m made of copper inside and I’m a conductor,” he asserted proudly.

“In other substances the electrons are so firmly fixed in their atoms that they can be moved only with great difficulty, and little or no electric current can flow. Such materials are known as dielectrics or insulators. They are useful, too, because they can be used to insulate electric currents by being placed between the conductors of those currents. Bakelite, ceramics, wood, rubber, air — these are good insulators. My skin is rubber, you see, and these other parts around here wear some of the other insulators such as bakelite and ceramics.”

The Sleuth’s face was impassive. “That’s all very interesting, but I don’t see that it gets us anywhere,” he replied. But Milly begged, “Tell us more about the electric current.”

“Oh, yes. Well, as I was saying, there are two kinds of current. There’s direct current, or d.c., which means that the electrons move steadily in one direction. Not in a constant stream, you understand, but jumping from one atom to the next and knocking other electrons loose when they land.

(Continued on page 74)
An Avocation Becomes a Vocation

The Amateur Makes a Vital Contribution in the Manufacture of Military Radio Equipment

BY HERBERT W. HAMILTON,* W9MRQ

IT WOULD be difficult to find another peace-time hobby that could be converted to all-out war production in a way to compare with amateur radio. The very fact that our American backlog of trained radio personnel was found ready and able during past emergencies has set the stage for our present critical situation. Once again the amateur has been given the opportunity to serve a cause, not only in the Signal Corps and the other services but, equally important, as part of the group whose job it is to supply our fighting forces with the finest radio communications equipment that can be produced.

Thousands of amateurs are now in the armed services, carrying out their missions with traditional fortitude. Their long experience in peace-time emergencies has given them pre-training in the art of handling traffic and in the maintenance of equipment so that there will be no interruption in the transmission or reception of vital messages.

Recent articles in QST have given us a picture of the part that these amateurs are playing on the fighting front. What about those on the home industrial front?

The combination of manufacturers and home-builders has been of tremendous importance in the job of turning out military equipment to "get the message through." If it were not for the fact that American radio manufacturers had been producing transmitters and receivers for amateur radio operators throughout the world, the job of setting up plants and the training of personnel for the vast requirements of war would have been most difficult. Radio men are not made overnight. Like the family doctor, a certain amount of basic training is essential. Furthermore, a radio man does not become skilled in mechanical and electrical operations simply by reading a textbook. He must acquire a technique whereby he can use his common sense and ability to diagnose minor troubles by the simple process of "sight" or "smell."

Amateur radio having been in existence for many years, there are among its thousands of participants a large number of "deferred essentials" and III-A men who can devote their time to the construction, design and other duties associated with the production of military radio equipment. Hundreds of them are engaged as engineers, purchasing agents, servicemen, phasers, testers, shop foremen and in executive capacities.

It was fortunate for the nation that these men understood the requirements for continuous duty on the field of battle and were able to undertake the construction of new military sets and build

*6110 S. Campbell Ave., Chicago, Ill.
them to government specifications. The amateur has been an important factor in making our war production of radio matériel what it is to-day.

Radio Production Converted to War Needs

The production of radio equipment for public consumption was ordered to cease last April. Little time was lost in converting manufacturing plants to all-out production of equipment for our growing military machine. It is a matter of record that many of these factories are now flying the Army-Navy “E” flags high above their plants.

Overnight these plants increased their production capacity many times. New tools and machinery replaced older machines not suited to the arduous task of day and night operations. New methods were adopted which save valuable hours in turning out an elaborate transmitter or receiver. Better parts and tubes made it possible to standardize so there is no needless waste and so that replacement of a damaged part will be made easier — particularly on the fighting fronts, where speed is essential in the maintenance of communications equipment. There can be no failures when lives are at stake.

That is why Uncle Sam has placed so much confidence in American radio manufacturers. They are doing an outstanding job.

Perhaps the best way to see how this job is being done is to go on a tour around one of these plants and take a look at the actual processes of manufacture. A logical choice for such an inspection trip is the Hallicrafters plant in Chicago.

From raw material to finished parts.

_Above_ — These sturdy metal chassis will support parts of highest quality and will be wired by expert American craftsmen — many of them amateur radio operators. All holes must be free from burrs or rough edges that could cause damage to the wiring system.

_Right_ — Insulated wires of various colors are wound about headless nails. They designate the exact position where a connection will be made. Later they are carefully laced together with heavy waxed cord. Each “breadboard” is marked with an identifying number.

_Below_ — This YL is putting the finishing touches on a transmitter cable. Inspectors examine each completed unit and check to determine whether or not the cable will meet government specifications. The spools of wire on the rack in the foreground show why copper is so badly needed!
logical not only because before the war it was one of the world's largest manufacturers of amateur communications equipment, but because it is now producing such a large volume of military equipment based on these amateur designs.

In fact, right there lies one of the major contributions flowing from amateur radio to the war effort. The Hallicrafters make much special equipment based on new developments for military needs, of course, but the greatest part of their production is in transmitters and receivers the basic design of which was originally created to meet amateur needs. It is significant that this "amateur" gear — some of it designed as long as four or five years ago — is now given top rating by the armed services for military needs.

The fact that this amateur-type equipment has been selected by the military, often in competition with the best of the specialized commercial designs, is a striking commentary on the discrimination and technical achievements of the American amateur fraternity. It will be a strong chapter in our record when the war is over and the details can be told.

**Mass Production of Military Radio Equipment**

The accompanying photographs are illustrative of the many tasks performed in the 24-hour a day production of military radio equipment in the Hallicrafters plant.

The various mechanical and electrical operations in building a transmitter or receiver are most interesting to the observer. Large metal

**February 1943**
chassis are carefully drilled to close tolerance. Any burrs left on the chassis must be removed during this operation in order that wires will not be cut. Every chassis must be protected against rust or corrosion; this becomes most necessary when units are sent to damp climates or for operation on naval vessels. Many improved formulae have been developed for plating and otherwise protecting the metal surfaces. Electrical conductivity has been improved, eliminating many of the older set noises.

Small parts such as terminal strips are riveted in place. Nameplates are attached and stamped with the model number and other information required. The larger parts, such as transformers, condensers and inductances, are then bolted or otherwise fastened in place, and the assembly is ready for wiring.

Radio equipment made for continuous service must be wired by skilled hands. The adoption of color-coded cabling is an important contribution to simplicity in wiring or servicing complicated circuits with their maze of connections. Large boards, slightly bigger than the chassis, are used in preparation of these multi-wire cables. Nails with heads removed are driven into the boards at the spot where a turn is to be made or where a socket or other part is to be connected. Various colors indicate the particular classification of circuit, such as filament, plate, cathodes, etc. Most grid circuits are omitted from the cable — for obvious reasons. Cable boards are marked for identification.

It is amazing to watch the women who do this work prepare an elaborate cable in a few moments' time. They become highly skilled and rarely make a mistake. Inspectors examine each cable after it has been completed, before it goes to the wirers.

There is a right and wrong way to wire a radio receiver. Each operator must follow a prescribed procedure in order to avoid confusion with the balance of the assembly line. Special racks are constructed to hold the working chassis at a convenient angle for good visibility during the wiring procedure. Each operator has a designated series of wires to connect. The number of operations on the assembly line is dependent upon the complexity of the set. Techniques are developed to do the job in the shortest possible time and with the most consistent wiring finesse.

Amateurs on the Assembly Line

Many of the experts employed in the construction of this equipment hold amateur licenses and have had plenty of experience in the construction of their own gear. When they return to the air it is certain that their equipment will not break down due to faulty wiring or mechanical failures. We predict that many of them will contribute in no small measure to the new radio art that is to follow the war. The radio bug has also bitten many of those engaged in the production of equipment who have never had any part in amateur radio. Their training will aid them greatly to get on the air when amateur operation is resumed.

Women are playing an increasingly important part in supplying the military with radio units. Delicate operations are executed in quick time by their nimble fingers. With the adoption of ultra-compact sets, we expect many of these YLs to design and develop highly efficient gear for their own stations after the war.

The activity of amateur personnel is not limited to the construction of receivers. We find many of them on the transmitter assembly lines. One of the photographs shows a group of employees busy assembling high-powered units for service where several frequencies must be available at a moment's notice. Modern engineering has resulted in tremendous improvements in this type of transmitter. After hostilities, the amateur will be given the opportunity to take full advantage of these late developments.

New methods for switching tank coils, new and improved means for neutralizing, smaller and better components, stabilized crystal oscillators, economical tube operation and many other features are most intriguing. These must remain a secret until final victory is won. The men and women who are in contact with these late developments will be among the first to enjoy this new equipment at their stations.

Many hams have in the past been a bit careless in constructing their own rigs. The American manufacturer has been responsible in many ways for changing the entire technique in assembly, layout and wiring of units. Bad habits have been corrected. Building a large transmitter, for example, is done by following a carefully-planned system. Heavy tables equipped with steel rails permit these bulky units to be moved along the
assembly lines in orderly fashion. Each operation is conducted with precision by men and women especially trained to do their job in as short a time as possible. Experience has shown that the radio amateur is particularly well-suited to almost any operation that may be assigned to him.

In making these large transmitters each assembly line is charged with the responsibility for turning out individual sections. A portion of one of these lines is shown in one of the photos. These units, after receiving final tests and inspections, will later be placed into their steel cabinets.

Final tests are conducted with extreme care. Actual on-the-air conditions must be simulated in order to observe the conduct of the transmitter under full operating conditions. Tubes must be carefully checked and tested with overloads to insure that they will not fail while in service. Amateurs selected for these responsible jobs have the ability to detect any fault in operation by a glance at the various indicating instruments. Here is where experienced operators must be employed. Students having completed a short-cut radio course cannot possibly have gained enough background to be able to assume responsibility for so important a job.

The United States was fortunate in possessing the great majority of the world’s radio amateurs and skilled radio technicians. These men and women were accustomed to the tedious tasks met in the design and construction of complicated sets. They had learned that patience was a virtue, and that the pace set by the American ham was the envy of the entire amateur world. If it were not for these ‘phone and c.w. hounds, we would not have the radio equipment we now possess.

New Techniques

Up to a few years ago most amateurs assembled and wired their own receivers. Some of them were very efficient and reliable; others were not. The American manufacturers of communications equipment undertook to design highly-efficient sets that could be offered to the amateur at little more than the cost of a homemade unit. Bugs were eliminated and many improvements added that could not be handled in the average shack. The result was a trend to purchase ready-made sets in preference to others. We hams will never be satisfied with a mediocre receiver in our shacks. We would rather lay out a few extra bucks now and then in order to acquire the latest sets that are more selective, equipped with better crystal filters and possess all of the other refinements needed to combat the heavy QRN that existed on our crowded bands prior to the QRT order.

That trend toward manufactured equipment has paid huge dividends in our war effort. Thousands of sets were available from jobbers and operators for military use that would not have been on hand were it not for this trend. Not so long ago an urgent plea was sent out by the Signal Corps and other services asking owners of standard manufactured sets to offer these to the government at a fair purchase price, to be used in our training centers. Only those sets having diagrams and instruction books were included. It would have been sheer folly to accept units that were not duplicates of others or lacked pertinent information that could be used to insure continuous duty. Thousands of hams responded by giving up their cherished sets.

(Continued on page 78)
A Gas-Driven Generator for Emergency Power Supply

BY WILL LANDES,* W8SID

I think it was sometime last fall when one of the boys dug up a copy of QST for November, 1937. No, the magazine did not fall open to page 26, but somehow that article on "Rewinding an Auto Generator for Portable-Emergency 110-Volt A.C. Supply," by H. J. Burchfield, W6JVT, caught the eye of Eugene Copp. He is a brother of Warren Copp, WSZQ—who, by the way, is the father of little Carolyn Lee of cinema fame. Gene carried the magazine around with him and showed it to several of his friends around his home town of West Alexandria, Ohio.

About this same time Company C of the Miami Valley Emergency Net put on an emergency test in the school yard at West Alexandria, using portable-emergency power. In the group were Orville Wood, W8VYE, as captain; Harry Elbridge, W8AZH; Charles Whitehead, W8FVW; Earl Heaton, W8SEK; Don Cook, W8STJ; and Will Landes, W8SID.

All the members of the local defense council turned out, as well as the chief of police, the superintendent of the Water Works, the editor of the local paper, and the light-plant engineer. The boys reported into the net with R9 reports all over the valley, with their little 10-watt rig using a 375-ft. Marconi tied to the local water tower. This performance, successful as it was, demonstrated the need for additional emergency power.

Leonard Nilson of the light and power company; Richard Shaffer, then superintendent of the water works, and the writer got together. After months of cutting and fitting we finally finished up a complete generator, which was turned over to WSZQ. WSZQ, you remember, is the brother of Gene—the man with the magazine. Really, Gene had more to do with this generator than any of us. He is now a technical sergeant in the Signal Corps, by the way, and says he will have a ham ticket when this is over.

The second generator, which is the one shown on the cover of this issue of QST, has been completed, and a third machine is being built.

These generators are built around salvaged 12-volt Dodge generators, rebuilt according to W6JTV's dope, belt-driven by Briggs & Stratton gasoline engines nominally rated at 1 3/4 hp. but capable of 2 1/2 hp. maximum in this service. Under actual load this generator has delivered over 1400 watts.

Another 6-volt d.c. auto generator is used as the exciter for the field coils of the a.c. unit and is driven by the same engine. Dual V-belt drive, with ordinary belts and pulleys of the kind used for driving light machine tools, is used between the Dodge generator and the engine. A single-belt drive serves for the d.c. exciting generator. The three units are mounted on a two-wheel dolly truck for convenient transportation.

The estimated cost—given by W6JTV as $7.50—is, we find, slightly "under-exaggerated," but the finished product is well worth the labor and expense incurred.

It will be noted that all terminals from the field coils are brought out to a panel on top of the generator. In this way, by external connection the coils may be used in series, series-parallel or parallel. The series-parallel connection seems to give the best results. The coils each have 1 ohm resistance and the armature also measures 1 ohm.

To Mr. Copp goes the credit for the ingenious arrangement of the coil hook-up. Mr. Shaffer furnished the machine shop and most of the tools. Mr. Nilson provided the technical instruction and W8SID did the testing and soldering. Together we furnished the labor and materials to turn out these generators—of which we are just a little bit proud.

* 14 West Dayton St., West Alexandria, Ohio.

---

54 QST for
Believe it or not, so swell has been the response to our plea for meters on behalf of the Signal Corps that a sufficient number for the present program has been received and no more can be accepted at present. So please QRT; do not send any more meters to ARRL unless the appeal is renewed.

It will be the end of February before the present program is finally cleaned up. By that time everyone who sent meters should have received payment or got his rejected meters back.

We are asked to say that the Signal Corps is mighty grateful for your assistance; you have helped them over a very tough spot. They join ARRL Hq. in congratulating you fellows on the showing you made when the call came. It was the old ARRL spirit!

ELECTION RESULTS

No changes in directors, and only one change in alternate directors, is the story of the 1942 autumn election in the four League divisions where balloting occurred. By divisions, here is the report:

The Central returned its incumbent director, Goodwin L. Dosland, W9TSN, by a comfortable plurality:

<table>
<thead>
<tr>
<th>Name</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lt. Dosland</td>
<td>596</td>
</tr>
<tr>
<td>Lee R. Kemberling, W8EBN</td>
<td>342</td>
</tr>
<tr>
<td>Harold M. Baker, W9MDJ</td>
<td>294</td>
</tr>
</tbody>
</table>

"Dos" is now a Navy lieutenant, the Commanding Officer of the Naval Training School (Radio) at Miami University, Oxford, Ohio.

The Hudson Division was the only one having elections for both director and alternate. Robert A. Kirkman, W2DSY, the incumbent, was reelected over Dr. Lawrence J. Dunn, W2CLA, by 495 votes to 347.

W2LV, having removed from the division, was not a candidate for reelection as alternate director. This election was between George Rulffs, Jr., W2CJY, and Leslie J. Fitz Gibbon, W2BCW, the former winning out 440 votes to 398. Mr. Rulffs, the new alternate, is an administrative officer in the Board of Transportation of New York City. Active in club affairs, he is president of the Sunrise Radio Club and was one of the founders of the Federation of Long Island Radio Clubs.

In the New England Division, the only contest was for alternate director and here the incumbent, Clayton C. Gordon, W1HRC, was successful over his only rival, William J. Barrett, W1JAH, by 335 to 258.

The Roanoke had its first election for director in many years, but its present representative, Major Hugh L. Caveness, W4DW, was again returned to office by the impressive score of 214 to 91 over Col. Edmund C. Lynch, W3HWJ.

When the above results are added to those of the "declared elections" previously reported, it is seen that ARRL members have made no changes in their division directors and so far have changed only two alternate directors, with delayed elections yet to be held for two more alternates.

REGISTRATION OF TRANSMITTERS

FCC regulations normally require a proof of the use of either commercial or amateur licenses as a condition to their renewal without reexamination. Because wartime conditions, particularly military service, make it difficult for operators to make such a showing, the Commission has suspended this requirement, a year at a time, the last such order expiring at the beginning of this year. The arrangement still being desirable, FCC in December again took this action, this time by means of its Order No. 77-B, which again waives this requirement until further order, but not beyond January 1, 1944.

Amateur or commercial applicants, when applying for renewal, may therefore continue to ignore the question on the form which inquires for evidence that the old license has actually been used in communication.

RE K6OJI

In our correspondence section some months ago we published a letter, from a K6 amateur, in the course of which K6OJI was accused of unbecoming conduct in that he allegedly broadcast a distorted version of the Pearl Harbor attack while it was in progress, to the det-
When joining the League or renewing your membership, it is important that you show whether you have an amateur license, either station or operator. Please state your call and/or the class of operator license held, that we may verify your classification.

The Apparatus and Personnel Bureaus of Headquarters remain plenty busy. The search continues for factory-built transmitters and communications-type receivers, and your apparatus can put on a uniform right away if you'll register it for sale with our Apparatus Bureau.

Are you licensed?

When joining the League or renewing your membership, it is important that you show whether you have an amateur license, either station or operator. Please state your call and/or the class of operator license held, that we may verify your classification.

riment of amateur radio. K60JI roundly denied the charge, said that his only reference to the happenings there consisted in getting off a simple “OK” message to his father in the States. While QST assumes no responsibility for statements made by correspondents, an amateur's reputation with his fellows is a precious thing and it was at first our resolution to make a thoroughgoing investigation and get at the details of the facts in the matter. This has proved impossible during the war. In the intervening months, however, we have been in considerable correspondence over the affair. While we have not been able to gain access to the official records we desired, we must now say, in fairness to K60JI, that so far we have not turned up any evidence to support the accusation. In consequence we offer him our apologies for its publication.

A.R.R.L. WAR BUREAUS

The Apparatus and Personnel Bureaus of Headquarters remain plenty busy. The search continues for factory-built transmitters and communications-type receivers, and your apparatus can put on a uniform right away if you'll register it for sale with our Apparatus Bureau.

Any occupation in radio rates pretty high as "essential" employment these days. Are you thinking of shifting, or are you interested in a better job, and would you like to have your radio talents, whether operating or technical, utilized in the war effort? Register your availability with the Personnel Bureau and you'll receive some interesting offers. See October QST, page 38.

We seek data on licensed amateurs serving with the armed forces, both for our record of what the amateur is doing in the war and for mention in the current Services department in QST. No restricted information wanted — just name, rank, branch, arm of service and old home-town call. Drop us a line about you and your gang.

IF YOU CHANGE YOUR ADDRESS—

Please give us as much advance direct notice as is possible — also be sure to put both your new and your old address on the letter or card (not the envelope).

What Is It?

BY FRANK E. JUDD*

WHAT is the thing that's in a tube
That people call the mu?
It is a silly-sounding word —
What does the blamed thing do?

Well, listen, child, and you shall hear
How simple such things are,
And you may then astonish
The people near and far.

A grid can make a current flow,
Or stop it, if you please;
It only needs a voltage
To accelerate or cease.

This current flow is to the plate,
And from the tube’s cathode.
’Tis so in multielement
Or simplified diode.

Now, positive potential,
When placed upon a plate,
Can also make a current flow
But at a lesser rate.

Compared with what the grid can do
Its pull is pretty lame.
The grid can make a bigger flow
With current just the same.

Divide the oomph that grid can show
By what the plate can do:
You will derive that magic thing
That people call the mu.

And when you've found out all that stuff,
Without or with assistance,
The next thing that they'll ask you
Is, "What is plate resistance?"

Well, that is just as easy,
Believe it true or not.
When there's a current to the plate
There's voltage on the spot.

And when you’ve done that little thing
At school or in your patio,
You’ll find that volt and current change
Are at a certain ratio.

And when you have determined
That ratio or rate,
Know then that you have found the
Resistance of the plate.

Now, there is still another thing
I mention with reluctance.
It is a sixty-dollar word —
They call it transconductance.

(Continued on page 67)

* 1168 W. Sixth St., Eugene, Ore.
AN ALMOST CONTINUOUS SEQUENCE OF WORKING DAYS UP TO FIFTEEN HOURS LONG PRECLUDES THE POSSIBILITY OF FINDING TIME FOR PREPARATION OF ANY FORMAL COPY THIS MONTH, SO WE'LL JUST RUN THROUGH THE LIST OF NEW ADDRESSES AND A FEW BITS OF INFORMATION THAT HAVE COME TO US IN RECENT WEEKS.

W6OZ/H, (1551 Pennock Rd., Pittsburgh, Pa.) passes along the new address of Sgt. Frank Platner, W8FGV, who was in India when last heard from. You can get V-Mail to Frank as follows: 35280950, A.P.O. 884, c/o Postmaster, New York City.

Fred Bornman, W8QDU, turns up in San Diego, where he is now Lt. E-V (S) at the Naval Radio Station at Challas Heights. He has talked with a number of the hams therabouts, including Frank Grey, W9LLM/6, and W6OZH. The boys are considering cooking up some sort of general reunion. Fred may be addressed at Park Manor, Fifth Ave. at Spruce, San Diego, Calif.

Another Naval lieutenant is R. E. "Steam" Harrison, W1JTB, late of Ware and Wayland, Mass., and Wickford, R. I., now stationed in Chicago. From a home practically in the water of Narragansett Bay, Steam had to go to Chicago to be a sailor! The Harrisons are living at 321 Plymouth Court, Chicago, Ill.

Clarke Paige, W1CGY, who used to be on Five from Athol, Mass., and Cape Cod, was frequently torn between two hobbies, skiing and amateur radio. Having lost the latter for the duration he is going in for the former in a large way. Clarke enlisted in the Mountain Infantry (Ski Troops) in November and is now in training somewhere in Colorado. The address we have is a temporary one so details will have to wait another month.

At least one of our Horsetrader gang is in North Africa. W1KJT, formerly of Middletown, Conn., relates, in a letter forwarded by W1LLL, that the successful landing "sure was lots of fun — you should have been here!" Johnnie hasn't received any mail since the trip to North Africa from England, where he had been stationed for some time, and he's curious to know what the folks back home think of what the boys have done over there. He'd also like to be brought up to date on the doings of his u.h.f. pals in and out of the service. His address: Corporal John Bibisi, A.P.O. No. 1, New York City.

We have several reports of DX on the f.m. and police frequencies, after a lapse of several months since the end of the summer DX season. This is in line with our 50-Mc. experience. Old hands at u.h.f. DX need not be reminded of those times when the old band loosened up and dropped a few surprise sessions into our laps just in time for Christmas.

W3AXU, Trenton, N. J., got a fine signal from W45V, Evansville, Ind., on December 4th, at around 9:45 P.M. This station and W51C, Chicago, were heard on December 18th, from 11:30 to after midnight. John has a new f.m. beam mounted on a Mims Rotator, the latter having been obtained through a bit of horsetrading.

W1HDF, Elmwood, Conn., heard W47NV, Nashville, on the 18th. Between 10 and 11 P.M. the signal was of practically local characteristics, with fading so slight as to have no effect on program quality.

From Gatun, Canal Zone, J. S. Farmer reports reception of KQDH, WQMB, and KQM on October 13th, and WAZO on October 28th. The frequency, 34 Mc., and the time of day, about 4 P.M., indicate that this reception was probably the result of exceptionally good F₁ conditions rather than sporadic-E.

New England motorists have reason to remember December 21, 1942, when the cancellation of all A, B, and C coupons gave us our first real gasless Sunday. Brownie, W1LLL, who lives in the midst of Hartford's heavy-traffic area, fervently hopes that we can have another sometime when there's DX to be worked on Five. This was his first Sunday with no ignition noise — and just in time for the mid-winter openings, too!

We don't hear much from the gang about WERS work; no details, at least, but there are some WERS calls in circulation here and there and Washington is dealing out new ones right along, but slowly. A Christmas card from WB8YF is also signed WJOR-9, so we take it that there's something doing down Allentown, Pa., way. As for us, we're still waiting.

What Is It?

(Continued from page 58)

It is the ratio of the change in current to the plate voltage change back at the grid, they state. Now do not be alarmed by this; just place yourself above it. And if they ask you this in Quiz Why, just think nothing of it!
A General-Purpose Play-Back Amplifier

Applying Negative Feed-Back and Audio Compensation with a Minimum of Parts

BY CLINTON B. DE SOTO,* W4CBD

Amateurs who turn to allied fields, such as recording, for experimental activity during the present enforced hiatus find themselves confronted by the same parts shortages that hamper the building of radio equipment. Basically, of course, similar components are used in all electronic equipment—condensers, resistors, transformers and so on. The fact that the parts required for radio construction or repair are hard to come by these days means also that there are few parts available for building such devices as recording and play-back amplifiers.

To some extent, of course, the amateur who turns to recording can adapt existing equipment to his needs. A low-power modulator, if it has adequate sensitivity and output and a decent frequency characteristic, will do a satisfactory job as a cutting-head amplifier. If necessary it may even be made to do double duty and serve as a play-back amplifier, as well.

For a really satisfactory recording system, however, separate amplifiers should be used for the two jobs. In the first place, the requirements are quite different. The play-back amplifier requires neither as much sensitivity nor as great power output as the one which drives a recording head from a microphone or comparable low-level source. The frequency characteristics required in the two units are more often the converse than they are similar; and that means fussy switching or knob-turning when changing between the two uses. Then, too, a successful recording technique more or less requires a separate play-back amplifier, if something better than "home recording" results are to be achieved.

The amplifier pictured herewith was designed to meet the requirements for a practical play-back amplifier which could be constructed without running afoul of priorities or becoming engulfed in the quicksand of shortages. It has sufficient sensitivity to operate from a low-output high-quality crystal pick-up (or, with suitable modification of the input circuit and a step-up transformer, from a magnetic pick-up). It has adequate power output to give satisfactorily-realistic reproduction for home use. The use of negative feed-back reduces the overall distortion to a satisfactory level for high-fidelity reproduction, and separate frequency-response controls for the bass and treble regions provide compensation for various recording characteristics or to reduce the high-frequency "hiss" when commercial pressings are played.

Circuit Details

As may be seen by the circuit diagram and photographs, four tubes are used. The amplifier is assembled as a unit on a metal chassis, the idea being that this small unit could be conveniently installed wherever desired in a cabinet or at any convenient spot in a complete recording installation. No built-in power supply was included; these days it is often more convenient to make use of an existing unit. Similarly the output transformer was omitted from the chassis, since this part is usually found mounted on whatever loudspeaker can be dug up for the purpose.

---

* Executive Editor, QST.

A general-utility play-back amplifier for reproducing instantaneous recordings and commercial pressings from a crystal pick-up, with a corner of the associated power supply. Output is 5 to 6 watts undistorted. Negative feed-back and audio compensation are incorporated.
The output stage uses a pair of 6F6s, triode-connected, in push-pull. These tubes were selected in preference to such other obvious choices as 2A3s or 6L6s because they are currently more easily obtainable. Push-pull coupling from the single-ended 6SJ7 input stage is accomplished by a 6N7 twin-triode phase inverter, because resistors and condensers are more readily available from the junk-box or sparsely-stocked dealers' shelves than are interstage transformers for coupling "I plate to 2 grids." The same considerations dictated the use of the simple frequency-response compensating circuits shown, in preference to more elaborate systems employing inductances or other special components.

Apart from the compensating and negative feed-back circuits (which will be discussed separately in detail), the design of the amplifier is quite conventional. Somewhat more than the required gain is provided, the total gain at full output being a theoretical 50 db. The reduction in gain caused by degeneration and the losses in the frequency-compensating circuits bring the actual overall gain down to about 30 db., however, and about \( \frac{1}{2} \) volt of signal is required for full output. Even this amount of amplification is more than is required for high-level crystal pickups, but it affords a comfortable margin for low-output high-quality units.

The 6N7 phase-inverter circuit is the self-balancing type originally popularized in England under the name "Floating Paraphase," and which has since seen increasing use in this country. Because half of the load for each triode (\( R_8 \)) is common to both and the grid of the second triode is supplied with its out-of-phase input signal from this junction point, the circuit is automatically self-adjusting to maintain the same output signal level from both plates. It is probably the most nearly fool-proof phase-inverter circuit available, being self-balancing at all input levels and under a wide range of circuit conditions.

**Audio Compensation**

The degree of audio compensation provided is based on the assumption that what is wanted is faithful, pleasing reproduction of the original recording. This assumption is, of course, predicated on the prior one that the record — whether it be an instantaneous cutting or a commercial pressing — will have been properly made to conform with one or another of the standard frequency characteristics.

In other words, no attempt is made to compensate for possible faults in cutting the record. All that is done is provide bass compensation where required for modified constant-velocity pressings and high-frequency cut-off to reduce the apparent "scratch" noise.

The frequency-response curves of Fig. 2 illustrate the results. Curve 1 shows the normal flat response (bass switch closed to left, shorting \( C_2 \) ), suitable for use with any constant-amplitude recording and a reasonably flat pick-up. At the low-frequency end the response curve extends substantially flat down to 30 cycles or so. At the high-frequency end the response curve extends substantially flat down to 5000 cycles or so. At the high-frequency end the response drops 2 db. between 5000 and 10,000 cycles and is down about 5 db. at 15,000. In other words, in the "normal" condition the amplifier meets the strictest standards for high-fidelity reproduction.

---

**Fig. 1** — Circuit diagram of the play-back amplifier.

- \( C_1, C_2 = 0.005\mu f, \) midget mica.
- \( C_3 = 25\mu f, 25\)-volt electrolytic.
- \( C_4 = 0.5\mu f, \) 200-volt paper.
- \( C_5 = 4\mu f, \) 450-volt electrolytic.
- \( C_6 = 50\mu f, \) midget mica.
- \( C_{10}, C_{11}, C_{12} = 0.1\mu f, \) 400-volt paper.
- \( C_p = 0.002\mu f, \) midget mica.
- \( R_5, R_9 = 0.5\) megohm, \( \frac{1}{2} \) watt.
- \( R_5, R_6, R_8 = 50,000 \) ohms, \( \frac{1}{2} \) watt.
- \( R_7 = 1\) megohm variable.
- \( R_8 = 500 \) ohms, \( \frac{1}{2} \) watt.
- \( R_9 = 25,000 \) ohms, \( \frac{1}{2} \) watt.
- \( R_{11} = 1 \) megohm variable.
- \( R_{12} = 1500 \) ohms, \( \frac{1}{2} \) watt.
- \( R_{15}, R_{17}, R_{18} = 0.25\) megohm, \( \frac{1}{2} \) watt.
- \( R_{19} = 750 \) ohms, 10 watts.

---

**Fig. 2** — Audio-response curves. See text for details.
Curve 2 is taken with the bass switch closed to the right, connecting $C_1$ and $C_2$ in parallel (0.01 µfd. in circuit), giving approximately 3 db. per octave compensation. This degree of compensation, coupled with the normally rising low-frequency curve of the average inexpensive crystal pick-up, gives ample bass response for natural-sounding reproduction of modified constant-velocity pressings.

Curve 3 is with the bass switch open (0.005 µfd. in circuit), giving an approximation to the theoretical 6 db. per octave compensation required below the turnover frequency for modified constant-velocity pressings. With the average pick-up this amount of compensation will be found excessive, but it is useful for some types of pick-ups and with certain recordings, and may be used if "bassy" reproduction is desired or where the loudspeaker lacks low-frequency response.

These three positions should give adequate range of control for most conditions that may be encountered. If intermediate variations are desired, however, it is a simple matter to obtain them by a 1-megohm variable resistor connected between $R_3$ and ground.

As is obvious, this simplified bass compensating circuit does not give theoretically-ideal curves. Changing the compensating capacity from 0.01 to 0.005 µfd., for example, not only changes the rate of compensation but also shifts the turnover point. In practice, however, such deviations from a theoretically-perfect characteristic are of little practical importance and the difference in reproduction quality is scarcely apparent.

The treble compensating circuit ($C_7$, $C_8$, $R_9$, $R_{16}$) is definitely not a tone control. It is an elementary 2-section resistance-capacity low-pass filter with constants selected to give fairly sharp cut-off above 5000 cycles, to reduce needle scratch without seriously affecting fidelity of reproduction. The effect is not serious on ordinary pressings, at any rate, and it is with these that scratch is a problem. Wide-range instantaneous recordings with low inherent high-frequency noise level require no scratch filter, anyway.

Those who insist on having a definite tone-control effect, with noticeable high-frequency attenuation, can sharpen the cut-off by adding another 0.002 µfd. fixed condenser between $C_6$-$R_9$ and $R_{11}$. If this is still not enough, increasing the values of the filter capacities from 0.002 µfd. to 0.005 µfd. will certainly satisfy even the most hardened tone-control knob-twister. In that case, however, even the small additional complication of the 2-section filter seems pointless, and an ordinary single-section "brute-force" tone control (0.01-µfd. and 0.5 megohm) should be satisfactory.

Negative Feed-Back

While the advantages of negative feedback in reducing distortion, providing a flatter over-all frequency characteristic and keeping down the residual hum level are now widely recognized, the design complications and danger of instability have tended to discourage its use in resistance-coupled amplifiers.

These complications are critical in proportion to the feed-back factor, the number of stages, the over-all gain and the width of frequency response. This is not the place to engage in lengthy discussion of the theoretical aspects of negative feedback. It should be enough to say that, of the many possible arrangements, the one selected...
gives satisfactory performance without any tendency toward instability despite the fact that it is applied over three stages.

As shown in Fig. 1, the feed-back voltage is taken from the “in-phase” plate of the push-pull output stage and is applied to the screen of the pentode input amplifier. Thus as far as the feed-back voltage is concerned the feed-back is over two stages (the 6SJ7 screen being effectively a plate), with 90° phase shift in each. Yet the control exerted by the feed-back voltage applies substantially to the 6SJ7 stage as well, and therefore the amplifier is degenerative overall.

A conceivable source of trouble with this arrangement lies in the possibility of phase shift in the push-pull output transformer at either very high or very low frequencies. Such phase shift will be reduced if the two sides of the primary are carefully balanced and closely coupled. It seems desirable to use a good-quality output transformer, therefore, although trial of various transformers ranging from the cheaper to the more expensive showed that, with the feed-back factor established by the constants shown, no instability was encountered even with extreme bass compensation. This is probably attributable to the low-frequency discrimination inherent in the cheaper transformers. Any slight tendency toward high-frequency regeneration is completely cured by the small 50 µfd. balancing condenser from the 6SJ7 plate to ground — as is evidenced by the slight droop in the response curve at 10,000 cycles.

The effectiveness of this negative feed-back arrangement is demonstrated by the overall performance. First, there is the ideally-flat normal frequency-response curve; such flat overall response could not ordinarily be achieved without feed-back unless special compensation was employed. Second, there is the absence of hum. The residual output of the amplifier with the gain control wide open but without signal (input circuit open) was below the limits of measurement. Finally, there is the low distortion at maximum power output — 5 to 6 watts undistorted at the speaker voice coil under Class-A conditions. Incidentally, neither power output nor distortion are particularly sensitive to load impedance variations, a 2-to-1 change in load around the rated value (10,000 ohms) reducing the undistorted peak power only about 15 per cent.

**Construction**

The construction of the amplifier is completely simple and straightforward. A 7 x 9 x 2-inch metal chassis gives ample room for the few components, permitting accessible point-to-point wiring. A shielded input connector is used, and the short leads to the compensator circuit and the 6SJ7 grid are also shielded. Standard plug-and-socket connectors are used between the amplifier and the power supply as well as to the speaker with its built-in output transformer.

The loudspeaker used can be anything capable of handling 5 or 6 watts with reasonable fidelity — i.e., from the 8-inch size up. An output transformer with a 10,000-ohm push-pull primary is required — preferably with a primary inductance of not less than 25 to 30 henries, if this value can be determined, and of the type of construction wherein two identical primary coils are wound side-by-side, with the secondary winding common to both, rather than as two concentric windings with the secondary in between.

The power supply used with the amplifier must be capable of delivering 350 volts at about 70 ma. Regulation is not too important, but the supply should have a 2-section filter with adequate output capacity (8-16 µfd.).

---

**Strays**

Details of a new electronic device which signals and measures ice forming on airplanes in flight and automatically operates the plane's de-icers, were made public recently. The ice indicator provides the pilot with information on the thickness and rate of accumulation of ice on exposed plane surfaces, and, for the first time in flying history, permits de-icing equipment to be turned on at the exact moment it becomes most efficient. The indicator itself is composed of three separate units and utilizes electronic principles for its operation. A pick-up plate or sensing element is mounted on the wing or plane surface where ice accretion is to be measured. This plate is very small and is set flush with the plane so as not to disturb the airfoil. It contains parts which actuate the mechanism by noting the accumulation of ice. The disc is connected to an amplifier inside the wing, which, in turn, is connected to a power-supply unit. The latter does the actual work of turning on the de-icers and registering the accumulation on an instrument board motor. The entire equipment weighs less than five pounds. — *Radio Jobber News.*

---

An electronic micrometer accurate to 0.000002 inch is being used to measure the stretch of a bolt which holds together two sections of the crankshaft of an aircraft engine. The bolt is tightened under 1500 foot-pounds tension until it stretches exactly 0.008 inch. — *Ohmite News.*

---

Officer: “What brings you out to the rail in this kind of weather?”

W4EFX (RM1c): “I was impelled by something deep within me, sir.” — *The (N.C.) Arc.*
Radio Courses Offered U. S. Army Men at Reduced Rates

Men in any branch of the U. S. Army are eligible for training in radio and electrical engineering and many other trades and subjects at considerably reduced rates. The Army Institute offers many courses, while additional ones are conducted through the auspices of several well-known universities where college credit may be obtained.

Courses need not be interrupted for overseas duty. Ask for a copy of the Army Institute Catalog at any Army Library or write to Army Institute, Madison, Wisconsin. These courses are available only to men in the Army.

A method of preventing the jamming of radio messages while still maintaining secrecy has recently been patented by François C. Henroteau of Ottawa, Canada. This is accomplished by use of a key plate which varies the frequency of the wave in an irregular way according to a pattern on the plate. A similar key plate at the receiving end removes the distortion. If the enemy should happen to find out the pattern being used, the key plates can be changed. — Radio Jobber News.

When possible, transmitting tubes, transformers and bleeder resistances should be warmed up periodically while not in use. This prevents filaments from becoming brittle and helps to dry out other equipment. This is especially important when one is located along the coast. — W20MM.

The Associated Amateur Operators' Club of Denver has bought two War Bonds with treasury funds and plans to buy another soon. They have also been collecting old newspapers, copper, aluminum, etc., and putting the money into the treasury for War Bond purchases.

Dr. L. P. Wheeler of Washington, D. C., has been elected president of the Institute of Radio Engineers for 1943. Dr. Wheeler heads the FCC Engineering Department's Information Division and formerly served in the Naval Research Laboratory as superintendent of the Consultant Division.

Mr. F. S. Barton of England, chief of the radio division of the British Air Commission, was elected vice-president. Dr. W. L. Barrow, associate professor of electrical communications at MIT and a former ARRL SCM was elected to the Board of Directors.

Loaded coal cars at the New Piney Fork preparation plant of the Hanna Coal Co., of Ohio, are emptied by being rolled onto a rotary dump, fastened to the rails by a mechanical device and then rolled upside down over a chute. After the car has been righted it moves off the dump by gravity. To prevent the dump from operating again before the empty car has cleared the dumping position, thereby tipping the car off the tracks, G. E. engineers have installed a photoelectric device, operating on the shadow of the car; which automatically prevents operation of the dump until the empty car has completely cleared.

Somebody has suggested that Axis members ought to be called Jids, a combination of the prefix letters J, I and D. This seems especially appropriate since it puts the poor I's in the middle again!

LU Hams on Fire

Argentina has opened up the 5-meter ham band, and in order to create a good supply of radio operators has made the requirements for obtaining amateur licenses much simpler. The Radio Club Argentino is sponsoring a contest that is somewhat similar to the SS contests formerly held in the U.S.A. The enrollment has passed the hundred mark, and those fellows are really going to it with real ham spirit.

On October 31st a small cabin plane (LV-KFA) ascended to an altitude of 3500 meters with radio equipment that consisted of a 5-watt transmitter and a National 1-10 receiver, and proceeded to QSO hams on the ground. Some of the stations that worked the plane are LUs 6DJ, 1AU, 9EE, 6EL, 4BD, 2BG, 8DJF, 6BK, 5CK and 4BB. Although results as far as DX is concerned were not as good as had been expected, preparations are going on for more experimental communication on the 5-meter band from aircraft to ground.

James B. Houlahan

A collection of radio and electrical formulas may be obtained in booklet form from Allied Radio Corp., 833 West Jackson Blvd., Chicago, Ill. A charge of ten cents is made to cover the cost of mailing and preparation. Conversion tables and tables of trigonometric functions are included. The booklet is pocket size and is edited by Nelson M. Cooke, CRE, U. S. Navy.
SHATTER-PROOF INSULATOR FOR CONCENTRIC ANTENNAS

Noticing W8SR’s article on concentric-antenna construction in the Hints and Kinks section of QST for May, I thought I'd pass along a constructional tip.

I used several of these on 2½ portable-mobile before December 7th and, as a rule, I rolled the coaxial up in a blanket and tossed it in the back of the car. After driving to the top of some distant peak, I usually found the ceramic feed-through insulator cracked or broken. At home, the one I had on my fixed antenna 90 feet in the air also frequently broke in windstorms.

A visit to a radio store or electrical repair shop will provide a lot of empty spools which once held magnet wire. By sawing one of these spools in half and boiling in paraffin for about 15 minutes we have two bushings that are well-nigh unbreakable and whose losses do not appear to be excessive. All of the spools appeared to fit snugly into one-inch conduit, but the inner hole varied from ¼-inch to ⅛-inch, with the ¼-inch size predominating. — Clyde Criswell, W8QLZ.

NOISE LIMITER FOR U.H.F. MOBILE INSTALLATIONS

Fig. 1 shows the diagram of a very successful noise-silencing circuit I am now using with my automobile radio receiver which I use in conjunction with a Browning u.h.f. converter. Ignition interference from my own car had been cut considerably by the use of the usual condenser and suppressor precautions, but there was still enough noise left to bother me, especially when no signal was present, as in the case of police-station reception. The ignition interference caused by other cars near by was terrific, becoming nothing less than a bedlam in heavy traffic.

The circuit suggested by W9ZWW in QST for March, 1940, was tried, but since it was designed to be most effective during signal reception, noise was still bad when no signal was present. Knowing that an effective noise silencer is used by Hallicrafters in their S-27 u.h.f. a.m.-f.m. receiver, an adaptation of this circuit was worked out for inclusion in the automobile receiver. Acknowledgement of the suggestions made by W9WNE is made at this time. He suggested keeping the volume control out of the limiter bias circuit and supplied the circuit used for the volume-control isolation.

With the noise-limiter tube in the circuit, no ignition noise is heard from my own car at any time, signal or no signal. Ignition noise will appear under conditions of extreme saturation by...
other unshielded or unsuppressed automobile engines, but, on the whole, this limiter is most satisfactory. It is possible to cruise in the city with the volume at a satisfactory level for signal reception, and yet not have bothersome ignition noise when the signal is off the air. This limiter is preferred to a noise squelch circuit both because of its ease of installation in the receiver and for its better sensitivity to weak signals. No noticeable effect on the quality of either voice or music reception is experienced when the noise limiter is in circuit. — Paul M. Cornell, W3EFW

SIMPLE SCRATCH FILTER FOR PHONO PICK-UP

![Diagram](image)

**Fig. 2** — Combination tone-control and scratch-filter circuit suggested by W9CYL.

C — 0.006 µfd.

R — 50,000-ohm wire-wound control.

L — 250-millihenry choke.

This filter allows enough highs to come through to keep the tone natural, while it seems to let all the frequencies through when set to the high-frequency end. — R. N. Kjerland, W9CYL

SIMPLEST CODE-PRACTICE SIGNAL SOURCE

Justin Barton, of Bethesda, Md., comes along with a bright idea that provides as simple a method of obtaining a signal for code-practice as one could wish for. He points out that almost any antenna strung in the vicinity of power wiring will pick up a hum which may be heard in a pair of headphones connected in series with the antenna and ground. For code-practice work, all that is necessary is to add a key to break the ground connection, as shown in Fig. 3. It certainly is worth trying if you have a pair of headphones and key handy. Certainly nothing could be simpler.

CODE-PRACTICE OSCILLATOR FROM HOWARD RECEIVERS

Here is a kink that might be well worth mentioning in QST for those of the clan that use Howard receivers. On the 160-meter band several harmonics from b.c. stations can be found. They give a nice clean note when the b.f.o. is used. On the back of the receiver is a terminal strip for an external loudspeaker. Two of these terminals, marked V1 and V2, must be short-circuited in order to have the internal speaker work. If a key is inserted between these two terminals in place of the jumper, a clickless note is obtained. These terminals are not "hot," so it is an excellent place to key. — Eugene Wiggins, Lafayette, Ohio

As suggested in a recent issue of QST, I have been using the WWV signal for code practice. I read with interest the article on page 74 of the September issue describing the trouble WSBWK and WSSDU have had with the signal being almost as loud with the key open as closed. I had the same trouble, but found that a lot of it was coming from the pick-up in the lead from the key to the receiver. I have been using the signal perfectly satisfactorily by using a shielded lead from key to receiver, the shield being grounded to the chassis. — Henry Y. Satterlee, W2NDW

In recognition of the evident scarcity of materials and manufacturing facilities, FCC has adopted its Order No. 107, requiring the readjustment of b.c. transmitters in the interest of conservation of equipment. As a result of these readjustments, radiated power is decreased by one decibel. The life of equipment is materially prolonged as a result, while the change should not be noticeable to the listener.

Most new bugs are very stiff in operation because of the excess tension of new springs. Instead of waiting two or three years for the springs to weaken, I use a much faster method. The two adjustment screws on the springs are tightened as far as they will go and left in that condition for a week or so. The difference in operation when the bug is readjusted is surprising. — W3EUV.

A construction company located in Tacoma, Wash., is about to employ forty 9-foot electricians in the construction of an Army barrack. No, the story isn't being stretched a bit — the workmen are being stretched! Each electrician will be equipped with a set of stilts so he can work at the required height without a ladder. It is estimated that the time saved will amount to about one-third of the total job. — Ohmite News.
N.A.B. THANKS HAMS
National Association of Broadcasters
Normandy Building, 1626 K St., N. W.
Washington, D. C.
Editor, QST:
We think the amateurs have been responding very nicely to our appeal for transmitting tubes that you were kind enough to publish on page 39 of the December issue of QST. At the present time, approximately seventy-five lists of available tubes have been received and more are coming in daily. . . . Your interest in this effort and willingness to cooperate are greatly appreciated.

Judging from recent issues of QST, amateur radio is doing more than its part in support of the war effort. However, radio people who were once amateurs and have maintained some contact with this field through the years have known that amateur radio could be counted upon whenever an emergency arose.

— Howard S. Frazier
Director of Engineering

AIR FORCES INSTRUCTORS NEEDED
5156 Cates St., St. Louis, Mo.
Editor, QST:
Please emphasize even more strongly than you have before the need for instructors in the Army Air Forces Technical Training Schools. That's a long name, but an important one right now.

I became acquainted with the AAFTTS through QST in September. I corresponded with Capt. Gilmore in Chicago and here I am now at St. Louis, enrolled in the Air Forces Radio Instructors' School. In ten more weeks I will be teaching radio mechanics in one of the Air Forces schools.

There is no doubt but that these new enlisted men need instruction — and good instruction. In twelve weeks' training (with pay of $135 a month!) the Air Forces hope to turn out enough good instructors to satisfy the demand. However, it is impossible to start from scratch. That is why hams are important. With amateur or other radio background, or a good electrical and mathematical foundation, the student can become a good instructor.

The drawback is that the hams and others are not showing up in sufficient numbers. In fact, they (the Air Forces) have tried to include inexperienced people in their school here in the hope that they could add to the number, but so far it has been an uphill grind.

LIFE ON A SUBCHASER
U.S.S. SC 667, c/o Postmaster,
Morgan Annex (Navy Desk), New York City
Editor, QST:
After reading in November QST about "the sea-going soldier," we thought we would let you know what life on a subchaser is like, and how it differs from an Army transport. We read this article, digested every word of it and thought how lucky this soldier is.

To begin with, we have two operators on this ship — W9UQA, RM1/c, and W6QZY, RM3/c. Our watches are four hours on and four off. In other words, just time enough to turn your hat around and you are on watch again. Beside these watches we are solely responsible for all upkeep of equipment which bears a marked similarity to radio.

Our equipment in the radio shack consists of one receiver, one transmitter, one mill and no room for anything else. Copying press or any fast circuit is strictly taboo, for the simple reason the ship is rolling so fast the mill will not carry from side to side. It is a very common occurrence for this ship to make 45-degree rolls even in fairly smooth sea. In rough sea — well, that is entirely a different story. If the cook can keep chow on the range we strive to keep it in the stomach!

Our stateroom is somewhat different, also. Underway we have an army cot, half in the yeoman's office and half in the radio shack. This makes a much handier set-up and one doesn't get salt spray slapped in his face by going forward to his regular bunk.

As to emptying our ash tray, the 45-degree rolls pretty well take care of that at frequent intervals. We do our own cleaning of the radio shack, which consists of a complete field day every time we are tied up.

Please understand we are not exaggerating any points, only comparing. And if youse guys don't believe this little article, join the Navy and get on a subchaser! . . .

— L. R. Shaw, W9UQA, RM1/c
R. L. Edwards, W6QZY, RM3/c

February 1943
THE "HANDBOOK" AS LITERATURE

Puerto Carreno, Republic de Colombia

Editor, QST:

Here, in a place so far removed from the com­forts of civilization, I am impelled to write a note to Hq. and explain how much pleasure I have received from the Handbook — not as a reference book but as literature.

Like many other hams, I have probably in the past only used the Handbook for reference — to find the value of a resistance or condenser or something of the sort which I did not remember — but without really giving it much serious study. However, in the present instance, in which it is necessary for me to travel fast and light and with very little in the way of entertainment, I find that a great deal of time can be spent interestingly and profitably with a Handbook. In fact, I now class it as a literary gem along with my book of Spanish idiom. And I suggest that, as there are many other hams away from home and with whom space and weight is at a premium, they might do well to pack along a copy of the latest Handbook and do a lot of very interesting reading.

One of the few people with whom I have had any contact here is ex-HK3AB, who has the past two Spanish editions of the Handbook on his desk. Here's wishing continued success for the ARRL and for a happier day when we'll be QSOing again.

— R. M. Jones, W4BTM

FLOWERS FOR GADWA AND ESPY

1764 Palace Ave., St. Paul, Minn.

Editor, QST:

Usually, when I take typewriter in hand and start off a letter to the Editor, it is to register some protest or other. . . This time, however — and it is certainly a rare occasion — I should like to be noted as registering my vote on the other side of the fence.

I have just finished reading and re-reading some of the articles in the December issue. I am forced to rise to the occasion and comment that I think this issue has two of the most excellent and timely articles in it. They are in particular the article on page 17 by Dr. Gadwa and the one on page 52 by Dawkins Espy.

In regard to the first of these, I believe this to be the first presentation of this material that was sufficiently non-mathematical to permit easy understanding by the mass of amateurs and still not simplified to the extent of being an incorrect approximation. For this many others will probably thank you, since I have on untold occasions struggled vainly to impart this picture to hams in the process of "matching up the antenna." To see the job so well done leads me to this letter. I hope you will accept my commendation and pass it along to the author as well.

With respect to the second of these articles, I again see the virtue of your editorial judgment. On altogether too many occasions I have seen hams throw up their hands in horror at the suggestion of looking at the mathematical concepts of their rigs, when truly they are working with a medium which permits of a nicety of mathematical handling with the simplest of math tools, as compared to mechanics or hydraulics for instance. I sincerely hope you will continue to encourage this line of education. It is apparently in line with the desires of less-educated but more learned educators.

— J. L. Hill, W9ZWY

Editor's Note: — To other readers who feel the same way, good news! More Gadwa, and more on mathematics, too, in this issue.

A LETTER FROM AFRICA

Somewhere in West Africa

Editor, QST:

To-day I got my copy of the 1942 ARRL Handbook, and I am so glad to get it that I felt I would like to sit down and write you my thanks for such a grand publication. Out here we are far from civilization as we knew it and amateur radio is only a beautiful dream of days gone by, but we -- the ex-amateurs of the camp -- still spend many happy hours chewing the rag about what we did, what we're going to do and what we should have done. And the contents of the Handbook will supply the material for months of argument. It might interest you to know that I got your book just 11 months and 3 weeks after ordering it from the Church Missionary Society, the only "bookshop" on the coast. Some wait, but worth it! . . .

I wonder if there is anyone who would care to spend an odd moment and write to us and let us know how things are with hams and radio in the States nowadays. We never see any American radio magazines or publications out here, so we know nothing of what goes on with you. (Although the correspondent's address is withheld for reasons of security, correspondence will be forwarded.)

Cheerio! And on behalf of myself and pals, thanks for the book.

— Steve Wade

AND ONE FROM THE BAHAMAS

Nassau, Bahamas

Editor, QST:

. . . During my short stay in New York I was frankly amazed at the wonderful welcome which was given our party by all types of people. We were almost mobbed! Believe me, I can say in few words that the American people are swell! And I
shall take back many happy memories of W. I do hope that before I eventually return home I shall go through America again and end up in ARRL Hq. Even though my stay in New York was of only ten hours' duration I managed to find the nearest ham radio store, but although I was trying to purchase a McElroy straight key my disappointment was great on learning that it was a case of priority only, which shows just how W is "going to it" in the war effort — and from what I have seen elsewhere, she certainly is!

On my arrival in Miami I was delighted to see QST on a newsstand and immediately purchased it. Furthermore, I have obtained it here in Nassau and I am waiting for the next issue for I have bought it for years in London. . . .

... There are two W hams here whom I have met, ex-W5BP (Capt. F. Hagan of Arlington) and W8DUF (Ed Lockwood of Cincinnati). You can guess I was very happy to be able to have a rag-chew with them. . . . I have also met VP7NR, the only ARRL member (I should think). He is an ARRL member and I was very pleased with the QSL card which he gave me.

I mention these things because I now realize more fully than ever the meaning of ham radio, the splendid spirit of it and all that it means. I regret that owing to the brief stay I was unable to meet even a few of the many Ws in New York whom I contacted on 20-meter c.w.

Perhaps you will think there are many bouquets in this letter, but I wish to add one more, and that is that I had the 1937 ARRL Handbook via RSGB and it has been the most useful handbook for hams that it has been my pleasure to come across. It has enlightened me on very many points in the past, and in fact I find that I can still learn from it. QST, too, is a most valuable publication and I have read it with enjoyment, each copy from cover to cover. . . .

Having seen a bit of America I can say I guess I'm proud of America and all she stands for, and proud of ARRL and the war work it is doing, also the greater work of keeping the ham movement going in W which in wartime with hams spread about all over the world is no mean achievement.

Let us hope that soon we shall have struck at Hitler and all he stands for and be back on the air again sending out TEST or CQ!

— A. C. Bruce, G5BR

TO HELL WITH HITLER

Editor, QST:

To Hell with Hitler!

To help back that sentiment I am enclosing the renewal of my own membership in ARRL and adding that of a newly-licensed amateur who is not yet a member. . . .

There could be no more appropriate occasion to send a verbal orchid to all of you workers of the Headquarters Force. Some of you have gone to war service; others have assumed double duties. There have been new departments to organize and more work in the old ones; there have been shortages and restrictions of materials as well as men — greater responsibilities, harder work, more annoyances.

In spite of all these things, I am sure that our "Service Command" at Headquarters is now rendering more service to all radio amateurs than ever before. I am equally certain that you are now publishing the best QST in the history of the League. When I add that you are extending a greater measure of personal service to each member as well as keeping the entire body of amateurs at the alert for either war or peace, it proves that we do not lack able leadership in any department. . . .

— R. E. Olmstead, W9POB

RADIO INSTRUCTION AT BELTON HIGH

Belton, S. C.

Under the heading "U.S.A. Calling" in December QST you have listed on page 30 some schools which are conducting radio courses. [These were schools designated for Signal Corps training. — Ed.]

The Belton High School has been conducting a national-defense radio class continuously since April, 1941. We have graduates scattered throughout the Civil Service and the armed forces. Courses are of 12 weeks' duration, 6 hours each night, 5 nights each week for a total of 360 hours. Certificates are issued covering the following subjects: (1) Radio construction, d.c., a.c. and u.h.f. (2) Use of test equipment, soldering iron, hand tools, tube tester, ohmmeter, signal generator, aligning tools, grid-dip meter, Lecher wires, condenser checker. (3) Schematics. (4) Maintenance and repair of receivers and accessories. (5) Related theory. . . .

From April through September, 1941, there were two radio schools carrying on here, one for whites and one for Negroes . . . . The students have been from farmers and textile workers to bankers. Some had radio experience and some did not know a paper condenser from a firecracker. One, a banker, completed the course and qualified as staff sergeant in the Marines.

We have a nice well-heated and ventilated laboratory, with plenty of locker rooms, cabinets, blackboards, equipment and parts to build all the projects listed. The writer, having dabbled with radio since 1920, cleaned out the junk room, and from old sets that had not seen the light in many years, auto fenders and whatnot, some tough-looking as well as some respectable-looking rigs have been constructed.

— Hugh L. Tollison, Instructor
OCD Booklet. We wish to announce the imminent release of OCD's booklet, "The War Emergency Radio Service," intended as a guide to the establishment of WERS in local communities. The booklet will discuss in detail all phases of WERS organization, including OCD's recommended plan for division of frequencies among the various units of a licensee. Further details on this "Tri-Part Plan" will be found elsewhere in this issue.

WERS Progress. WERS organization is still on the upswing. Last month we reported 53 distribution of WEBS licensees and progress many more licenses have been granted and still more are pending. It is interesting to note the distribution of WERS licensees and progress being made comparatively in different parts of the nation.

Of the 22 states containing municipalities who have licensees, according to our latest information, 17 are in the so-called "coastal" area; 6 are inland. Conversely, of the remaining 26 states in which there are no WERS licensees, 6 are in the coastal area while 19 are inland. This condition, while seemingly indicative of complacency or lack of initiative of civilian defense officials in inland states, is as it should be. WERS licensing of applying municipalities in the coastal area was and is most important, inasmuch as these areas are the most likely to receive the initial attention of enemy bombing missions. This is not to say that applications from inland areas are being pigeonholed; all applications are receiving prompt consideration at FCC regardless of their origin.

Our reports from Emergency Coordinators further reveal that of the 6 states in the coastal area in which no WERS licensees have been granted, 5 started action in this direction. Of the 19 inland states having no WERS licensees, 12 have started action while nothing has been heard from the remaining 7.

It is time for inland areas to become aware of the necessity for setting up precautions to combat enemy action. European experience should have amply demonstrated by this time that enemy forces, whether on land, in the air or in the form of internal saboteurs, strike hard in the least expected places. Communication is one of the first things they strike at. Naturally coastal areas, being more air-raid-conscious than inland areas, have acted first and more swiftly in preparation; but we know that the best and most active amateurs are not confined to coastal areas, and we urge that WERS be introduced into your community at the earliest opportunity.

Only 8 states are entirely unrepresented by any reports of definite action toward WERS organization, which is most encouraging considering that there may be plans somewhere within these states that have not been reported to us. How about it? ECs in the states of Mississippi, North Dakota, Oklahoma, Arkansas, Wyoming, Idaho, New Mexico and Nevada are requested to report any WERS activity in their communities to make our report of states containing active WERS organizations unanimous. ECs in active WERS areas should keep Headquarters informed of activity either direct or through your SCM.

More ECs needed. Uncle Sam and the war continue to draw on our much-needed field appointees. SCMs in every active section are continually calling for new applicants, not only to fill the shoes of those forced to leave, but to fill additional posts where they become needed. The gradual exodus of our ECs has made the situation critical in many sections. If you are a licensed amateur and a member of the League, if you foresee a need for organization in your community, if you are willing and can take the time, drop your SCM a line explaining the situation. Chances are he will welcome you with open arms. OCD has long recognized ARRL's field organization as the basis for WERS under the supervision of and with the cooperation of local civilian defense officials; but every licensed amateur, League member or not, should hasten to offer his services to his local defense council for assistance in establishing WERS in the community. This is the time to forget petty personal or political animosities. This is war.

Emergency Coordinator duties have been simplified by the war, but at the same time they have been made far more important than they ever were. The one most important duty is assistance in the administration of WERS—but do not be misled; this simple statement of duty covers a lot of territory. It means local organization of all amateurs into a planning committee; it means establishment of training classes for auxiliary operators if any are needed (and they invariably are); it means conducting surveys of available equipment, personnel and facilities for building more equipment and training more personnel; and it means constant alertness to receive and absorb...
Honor Roll

The American Radio Relay League War Training Program

Listing in this column depends on an initial report of the scope of training plans plus submission of reports each mid-month stating progress of the group and the continuance of code and/or theory classes. All Radio Clubs engaged in a program of war radio training are eligible for the Honor Roll. Those groups listed with an asterisk teach both code and theory. Those listed with two asterisks teach theory only. Others conduct only code classes.

*American Women’s Voluntary Services, New York, N. Y.
*Central Oregon Radio Klub, Bend, Ore.
*Delta Radio Club, New Orleans, La.
*Dutchess County Sheriff’s Emergency Radio Corps, Poughkeepsie, N. Y.
*East Texas State Teachers’ College Amateur Radio Club, Commerce, Texas
*Iowa-Illinois Radio Club, Burlington, Iowa

*Knoxville Radio Communications Club, Knoxville, Tenn.
*Orange County Radio Assn., N. Y.
*Saint Petersburg Florida Radio Club, St. Petersburg, Fla.
*South Jersey Radio Assn., Merchantville, N. J.
*Tucson Short Wave Assn., Tucson, Arizona

new developments from FCC and OCD, as relayed through the pages of QST and special bulletins, and consequently to keep local planning up to date. ECs are liaison officers between their local governments and the amateur service. In many cases they are appointed radio aides, thus giving them two jobs that are almost identical in duties, the appointment as radio aide serving to bring ECs even closer to their local governments. Headquarters shortly will have a bulletin available outlining wartime duties of Emergency Coordinators. Copies will be available upon request direct to Headquarters or to your SCM.

What Can I Do? Most of you will remember KBW’s editorial in November QST entitled “What Are You Doing?” This editorial was reprinted and circularized to clubs and radio dealers for display purposes. Now many individuals, most of them not licensed amateurs, are writing us to ask “What can I do?” Usually they are told that if they are interested in communications work they can best serve by enrolling in training classes for WERS, or classes sponsored by clubs aimed at the eventual acquisition of amateur licenses. They are given names and addresses of local amateurs or clubs to contact.

If these people (men and women) aren’t interested in radio and in doing something to help their country, they wouldn’t write to us. They therefore constitute a valuable supplement to our limited WERS personnel, as well as prospective colleagues of ours after the war. Such volunteers are invariably more valuable than those who have to be coaxed to participate, and it seems that there are many in every community if only they knew whom to contact. Why not get some publicity in your local paper? Recruit young men from high schools and men and women not subject to the draft and not engaged in work which would render them unavailable during emergency periods. We should by this time have become resigned to the fact that the remaining local amateurs who have not been called for military duty are too few to supply administrative as well as operating personnel. Establish training classes for WERS, let its existence be known, so that you will have an answer to the question “What can I do?”

ARRL War Training Program. Despite the diminishing size of our monthly Honor Roll of clubs and volunteer groups participating in the ARRL War Training Program, hundreds of such groups are offering free radio training classes. Any club or organized group (affiliated or otherwise) so engaged is eligible for listing in the Honor Roll provided it reports its activity to Headquarters either direct or via the SCM once per month. We want not only to know that a class or classes are being conducted, but to receive a monthly report of progress and developments. Although only clubs or groups conducting code and/or theory classes on a voluntary basis are eligible for Honor Roll listing, we also welcome reports of other classes being conducted for inclusion in our card file; and remember that outlines of code and theory courses, as well as suggestions for textbooks to be used, are still available upon request from headquarters, at no charge. Let’s have more reports of classes being conducted and increase the size of the Honor Roll in future issues of QST!

—G. H.

February 1943
ELECTION NOTICES

To all ARRL Members residing in the Sections listed below:
The list gives the sections, closing date for receipt of nominating petitions for Section Manager, the name of the term incumbent and the date of expiration of his term of office. This notice supersedes previous notices.

In cases where no valid nominating petitions have been received from ARRL members residing in the different Sections in accordance with these notices, the closing dates for receipt of nominating petitions are set aside to the dates given here.

It is hereby requested that the members of a Section, in the absence of nominating petitions from Members of a Section, the incumbent continues to hold his official position and carry on the work of his Section subject, of course, to the passage of proper nominating petitions and the holding of an election by ballot. Petitions may be received on or before noon of the dates specified.

The names of the Missouri and Eastern Florida Sections, nominating petitions are hereby solicited for the office of Communications Manager in these Sections, and the closing date for receipt of nominations by ARRL Headquarters is hereby specified as noon, Monday, February 15, 1943.

Section       Closing Date       Present SCM       Present Term
Alaska        Feb. 1, 1943        James G. Sherry       June 14, 1942
W. Penna.     Feb. 1, 1943        W. S. Goldberg       All
No. N. Y.     Feb. 1, 1943        Edward Gurgalsky       Oct. 15, 1942
West Indies   Feb. 1, 1943        Mario de la Torre       Dec. 18, 1942
Mississippi   Feb. 1, 1943        S. Benton Cain       Feb. 6, 1943
Missouri      Feb. 15, 1943        Robert G. Morewood       ...
E. Fla.       Feb. 15, 1943        Carl G. Bichard       (resigned)
Hawaii        Feb. 15, 1943        Francis T. Hatt       Feb. 28, 1941
Sacramento     Feb. 15, 1943       Vincent N. Feldman       June 16, 1942
Vallej         Feb. 15, 1943        Edward W. Eizum       Nov. 1, 1941
Oregon         Feb. 15, 1943        R. W. Barnier       Dec. 1, 1941
W. N. Y.       Feb. 15, 1943        Fred Chichester       Dec. 6, 1941
N. H.         Feb. 15, 1943        Mrs. Dorothy W. Evans       Sept. 1, 1941
W. N. Y.       Feb. 15, 1943       Henry G. Homberger       Oct. 15, 1941
No. Carolina   Mar. 1, 1943        W. J. Wootman       Mar. 18, 1943
N. Y.         Apr. 1, 1943         Clayton G. Gordon       Apr. 15, 1943
N. Y. C.      Apr. 15, 1943       E. L. Bausch       April 15, 1943

You are hereby notified that an election for an ARRL Section Communications Manager for the next two-year term of office is about to be held in each of these Sections in accordance with the provisions of the By-Laws.

2. The elections will take place in the different Sections immediately after the closing date for receipt of nominating petitions as given opposite the different Sections. The ballots mailed from Headquarters, will list in alphabetical sequence the names of all eligible candidates nominated for the position by ARRL members residing in the Sections. Ballots will be mailed to members as the closing dates specified above, for receipt of nominating petitions.

3. Nominating petitions from the Sections named are hereby solicited. Five or more ARRL members residing in any Section may submit the name of any eligible member of the staff of one of the ARRL's instruction fields, used in conjunction with the Empire Air Training scheme, and the closing date for receipt of nominations by ARRL Headquarters is hereby specified as noon, Monday, February 15, 1943.

4. You are hereby notified that an election for an ARRL Section Communications Manager for the next two-year term of office is about to be held in each of these Sections in accordance with the provisions of the By-Laws.

5. The candidates and five or more signers of each nominating petition shall be members of the ARRL residing in the Sections named and the closing date for receipt of nominating petitions is noon, Monday, February 15, 1943.

6. The elections will take place in the different Sections immediately after the closing date for receipt of nominating petitions as given opposite the different Sections. The ballots mailed from Headquarters, will list in alphabetical sequence the names of all eligible candidates nominated for the position by ARRL members residing in the Sections. Ballots will be mailed to members as the closing dates specified above, for receipt of nominating petitions.

7. Nominating petitions for the positions from the Sections named are hereby solicited. Five or more ARRL members residing in any Section may submit the name of any eligible member of the staff of one of the ARRL's instruction fields, used in conjunction with the Empire Air Training scheme, and the closing date for receipt of nominations by ARRL Headquarters is hereby specified as noon, Monday, February 15, 1943.

ELECTION RESULTS

Valid petitions nominating a single candidate as Section Manager were received in the number of Sections, as provided in our Constitution and By-Laws, electing the following officials, the term of office of the individual holding the office to expire on the date given:

Santa Clara Valley  
East F. Sanderson, W1EIZ  
Oct. 15, 1942
Nebraska  
Roy E. Olmsted, W0FB  
Oct. 15, 1942
Tennessee  
James B. Wirt, W4SP  
Nov. 15, 1942
Oregon  
Jack Austin, W7ON  
Nov. 23, 1942
Georgia  
Ernest L. Morgan, W4PDJ  
Nov. 29, 1942
Southern Texas  
Horace Fiddly, W5M4  
Jan. 15, 1943
Kentucky  
Darrell A. Doward, W5RAU  
Dec. 15, 1942

The Month in Canada

Nova Scotia—VEI

From L. J. Fader, 1FQ:

I have been able to collect a few more notes on some of the gang, so here goes:

1FQ is now located in Halifax. He was formerly at Dominion No. 2 and a familiar figure on the 20-meter 'phone band.

1FW is serving in Malta with the RCAF. He apparently has made quite a name for himself since joining up and proceeding overseas. He is doing war work of a civilian nature somewhere in Ontario. He is connected with the operating staff of one of the airport's instruction fields, used in conjunction with the Empire Air Training scheme. 1E0 is also doing the same type of work somewhere in Ontario.

1GY is in Goose Bay, Labrador, with the Dept. of Transport. He was formerly located in New Brunswick and before becoming a wireless operator with the Dept., was engaged in clerical work in the City Hall at Halifax. Bruce Taylor, formerly a VE1, is now with the RCCS. He was on the staff of CBA at the time of joining up, and previous to going with the CBC was engaged as a service man with the Robt. Simpson Eastern Ltd. at Halifax. 1JA and 1FQ recently called on Merrill Young, 1BG, who is one of the operators at CBA. Merrill looks fit and well, and through QST wished to be remembered to all with whom he used to talk on the old 20-meter band.

I expect to attend a little rag chew tomorrow at the home of 1JA, Archie MacHaffie in Glace Bay. Expect to meet up with some more of the VE1 gang whom I have not seen for a couple of years. Included in this group will be 1DM and 1AB. I had the pleasure of meeting 1EB recently, whom I had not seen for a couple of years.

I regret to mention that, due to ill health, Clip Short, 1AW, has been forced to give up his radio service business, and has moved to the country. We are all very sorry to hear this and on behalf of the other members of the VE1 gang extend to Clip our wishes for a speedy recovery. Clip is one of the older fellows in the gang, and I know that this news will be received with regret by his many friends, both here in the Maritimes and also in the other parts of Canada and the U.S.A.

Len Foster, ex-1EF, has been promoted to the rank of sergeant in the Signal Corps, Reserve Army, at Halifax. Len was a member of the Signal Corps in the U.S. Army in the last war, and was stationed for a time at Fort Monmouth, N. J.

Ontario—VE3

From Len Mitchell, 3AZ:

The only report received this month was from 3LR, who is stationed in Montreal with the CBC. He reports that 3AUX and SAHY who are with the RCAF in England turn out to all the RSGB meetings. Incidentally, they state the RSGB now has the largest membership at any time in its history. Congrats.

3BBP is with the RCAF overseas and is stationed on an island. He says it is lonesome and isolated but a FB location for an amateur station. 3KT is still operating with the Ferry Command—radio, of course. 3V8 is in Hamilton with the RCAF studying for a WAG.

3IB reports that the West Side Radio Club held a recent meeting. Those attending were some of the boys back from overseas as well as those still left behind, including 3A1B, AD, 4A7X, FB, APO and others.

All VE3's join with the other Canadian amateurs in extending to CQM Alex Reid their deepest sympathy in the recent death of his wife.
Tube manufacturers have published a great deal of data on prolonging tube life by such tricks as leaving filament current on during short stand-by periods. Similar care will help prolong the life of other radio parts.

If the plate voltage of a receiver is measured during the warm-up period, you will find that it may reach quite high values. Most rectifiers have directly heated cathodes and reach operating temperature quickly. All or most of the other tubes will have indirectly heated cathodes and will not pass plate current for some time. During this interval there will be relatively little B-supply current drain and a power supply which normally delivers 300 volts under load may reach 400 volts. Even though this condition does not last very long, it may damage parts. This is particularly true of electrolytic condensers which cannot “take it” any too well in any case, and which have even less dielectric strength than normal after they have been standing idle. With repair parts harder to get than a second cup of coffee, our advice is to cut the B-switch until all tubes are warmed up. Preferably, this switch should be located ahead of the power supply filter to save the filter condensers, too.

If you do have to make repairs, be sure you know what is wrong before you fix it. We wish this advice was as superfluous as it sounds, but sometimes it is easy to be fooled. As an example, suppose one of the AVC bypass condensers opens up. The most noticeable effect of this open condenser will be to detune the corresponding grid circuit quite badly. Most likely the receiver will still operate, though poorly.

Making a large adjustment of the trimming condenser to retune the grid will make such a great improvement that many are deceived into thinking that they have repaired the damage. The receiver may seem to work all right, but it does not have its old performance.

Actually, the mere fact that a large adjustment was necessary should show that the real trouble was elsewhere. A good communication receiver will run for years without requiring realignment. When required, trimmer adjustment will be very small.

Once trouble is located, be sure your replacement parts are really interchangeable. For example, a glass tube will not replace a metal tube unless an external tube shield is added. Furthermore, the receiver will most likely have to be realigned, for the interelectrode capacities will be different.

Of course, exact replacements are best from every point of view. These days we have to take what we can get, however, even if we do have to lose a little in performance. After the war is won and factory servicing and realignment become available again, you can have your receiver put back “in the pink.”

**Dick Gentry**

On this page, in the November issue, we asked amateurs to help us build equipment for the War Program. The response has been splendid, with one man promptly coming all the way from Texas. We still need more men, however, and opportunities are still open. If you can come, please write to us. Details are given on Page 77 of November QST.
Avocation Becomes a Vocation
(Continued from page 63)

To-day the old set is giving yeoman service where it will do the most good. Thousands have been shipped abroad, and many of them appear in photos received from our fighting fronts.

The demands of the military have resulted in new designs and innovations. These will be incorporated in the new sets that will find their way into thousands of radio shacks after the war. Some of these late developments are most revolutionary. The panoramic technique alone offers unlimited possibilities for accurate tuning of DX stations. One manufacturer is even now keeping pace with the military sets by incorporating many of the new ideas into experimental sets designed for post-war amateur radio. This foresight should offer much encouragement to those who are wondering how long it will take to return to "normal" when the last shot has been fired.

Hams in the Labs

The typical American radio laboratory staff includes many hams. In times of peace they are charged in designing new equipment for one of the greatest hobbies known. The testing, alignment, and other operations were performed by amateur radio operators in hundreds of laboratories. These men had learned the importance attached to the manufacture of sets for use in peacetimes and it was comparatively easy for them to take over the responsibility of making precision adjustments on sets tagged for Uncle Sam's forces.

A visit to one of these radio plants puts us in contact with many hams that you have talked to on the air. At the Hallicrafters, for example, we find Bill Halligan, W9WZE, one of radio’s old-timers, president of The Hallicrafters. When bombs fell on Pearl Harbor, his company, like many others, possessed a large group of skilled craftsmen engaged in building transmitting and receiving equipment of many types. Among them are Herb Hartley, W9WNG; Cletus Wiot, W9TDF; Donald Wilbur, W8BR; Clarence Zorn, W9TAL; Wallace Burandt, W9PTD; Fred Connor, W9CUK; Jack Cappels, W9EPB; Ray Polkingham, W9AV, and Jack Pekasovich, W9LOL — to mention only a few. All are applying their technical and executive knowledge to the war effort. They realize that the further pursuit of their radio hobby can only be guaranteed by a final and complete Allied victory.

Yes, an avocation has become a vocation to thousands of men and women. They are turning out the finest radio equipment that can be made. Army and Navy inspectors — also including many amateurs — are seeing to it that there will be a steady supply of transmitters, receivers and other special equipment reaching our fighting men wherever they may go. They also know that the future of their hobby depends entirely upon ultimate victory for the Allies. Without that victory, there can never be a return of our avocation.  

Are You Making Good in Your New Radio Job?

New Jobs Create NEW OPPORTUNITIES

There’s no “ceiling” to the better jobs available today. CREI home study courses can give you the practical technical training you need to “make good” now—and to enjoy security in the years to come!

Hundreds of practical radio men have been given responsible jobs throughout the radio industry—government jobs, broadcast jobs, technical manufacturing jobs, aviation radio jobs—jobs which in many instances require a thorough knowledge of practical radio engineering.

If you are a practical radio man who realizes that fortunate circumstances have placed you in a job requiring technical ability of high caliber...

If you are smart enough to know that you will “get by” with your better job only so long as a fully qualified man is unavailable...

If you have the ambition to make good in your new, better job and to rise to even a still better job...

—then a CREI home study course in Practical Radio Engineering will help you to acquire the necessary technical knowledge and ability which is demanded by the better, higher paying positions in technical radio.

WRITE FOR FACTS TODAY about CREI Home Study Courses
If you have had professional or amateur radio experience and want to make more money, let us prove to you that we have something you need to qualify for a better radio job. To help us intelligently answer your inquiry, please state briefly your background of experience, education and present position.

CREI STUDENTS AND GRADUATES
The CREI Placement Bureau is flooded with requests for CREI trained radio men. Employers in all branches of radio want trained men. Your government wants every man to perform his job, or be placed in a job, that will allow him to work at maximum productivity. If you are or will be in need of re-employment write your CREI Placement Bureau at once.

Capitol Radio Engineering Institute
Home Study Courses In Practical Radio Engineering
for Professional Self-Improvement
Dept. Q-2, 3224 16th St. N. W., Washington, D. C.
Contractors to the U. S. Signal Corps and U. S. Coast Guard
Producers of Well-trained Technical radio men for Industry
BUILT TO LAST

A typical example of rugged construction

THROUGH a combination of bolting, stapling, soldering, aging and heat-treating, Hammarlund variable condensers maintain permanent calibration under all sorts of conditions in tanks, airplanes and battleships.

THE HAMMARLUND MANUFACTURING CO., INC.
460 West 34th Street, New York, N. Y.
"D.c. is useful enough in its way. Lots of parts can't live without it. But it's not as readily available as a.c. — you have to get it from things like batteries and generators, you know — and so the kind of power we get to start with is a.c. For those that need it we make d.c. from the a.c."

"Tell us about a.c.," Sleuth commanded.

"A.c. is alternating current. That's the kind I carried. It's electric current direction all the time, at regular intervals. At one instant the current flows in one direction and at another instant in the opposite direction. Of course, when the current changes, the polarity reverses from positive to negative or vice versa. Each complete change of direction — from plus to minus, say, and back again — is called a cycle. The rate at which it changes is known as the frequency of the current. The polarity of the house-lighting current they get from me reverses 120 times each second; that makes its frequency 60 cycles per second."

"And the Signal has to have this kind of current to live?" the Sleuth asked.

"Well, not exactly," Power Cord hedged. "But the set has to be supplied with it to keep the Signal alive."

"However, you claim it was because the current was no longer available that the Signal died," Sleuth persisted.

"I do," Power Cord answered firmly.

The Sleuth pounced. "Well, then, since it was your job to deliver this current and you didn't do it, you're responsible for the Signal's death!"

Power Cord writhed in denial. "Oh, but you don't understand," he wailed. "It wasn't my fault that I couldn't deliver the current. I just couldn't get any. There wasn't any coming from the wall outlet!"

"How do you explain that?" Sleuth probed.

"I can't," Power Cord answered in a defeated tone. "It always was there, as much as was needed. Before this I was always charged up full, ready to conduct whenever A.O. Switch up there closed the circuit."

There was silence for a moment. Then a speculative look came over Volt Meter's face. Suddenly he jumped up. "I think I've got it," he announced. "If Power Cord isn't lying, there's only one reason why he hasn't been getting enough electrons to feed the set. That's because a certain part hasn't been doing his job!"

A few seconds later he returned, dragging a prisoner behind him. It was Power Cord's squat little helper, Power Plug. "Do you know what?" Volt demanded. "This fellow wasn't even in his socket. He was lying on the floor taking a nap!"

"Hmmm!" The Sleuth glared sternly. "Maybe not murder, but certainly manslaughter. What have you got to say for yourself?"

Who Killed the Signal?

(Continued from page 48)
ELMER, Junior, like thousands of other amateurs who are now serving as skilled radio operators and technicians, finds his long association with Hammarlund products unbroken by his enlistment in the Signal Corps.
WHEREVER IT IS — WE CAN FIND IT FOR YOU

That's what we've been doing for manufacturers and laboratories — getting the hard-to-find things they need — and getting them fast.

You'll be surprised at what we can do. Our experience as a large distributor of technical radio equipment for many years has taught us where to go for what. Today we specialize on that service because it is an urgent war need.

And you'll be surprised, too, at the wide range of equipment and parts and supplies we have right on the shelf.

Elementary A.C. Mathematics
(Continued from page 37)

radius. Thus at any particular angle \( a \), the equation which gives the instantaneous value of the periodic function is

\[ i = A \sin a \]

where \( i \) represents the instantaneous value and \( A \) is the amplitude (or, as it is frequently called, the maximum amplitude), represented by the length of the radius when a graph is drawn to scale. Our remaining problem is to determine the angle \( a \) at the particular time at which we wish to know the instantaneous value of the function.

Frequency and Angular Velocity

The unit of time commonly used in physical measurements is the second. If the rotating radius in Fig. 4 makes one complete revolution in one second, it will have generated a total angle of \( 2\pi \) radians in one second. Since the radius is rotating at constant speed, the angle which it makes with the reference or zero line at any instant will be proportional to the time elapsed since it was last in the reference position. If the period of the rotation is one second, then at one-half second it will have generated an angle of \( \pi /2 \), or \( \pi \) radians; at one-fourth second it will have generated an angle of \( \pi /4 \), or \( \pi /2 \) radians, and so on. In other words, we can very easily change any instant of time into a corresponding angle. Of course if the period of the rotation differs from one second, this difference in speed must be taken into account. For example, if the radius makes two revolutions per second, at the end of one-half second it will have made one
SPRAGUE
HERMETICALLY SEALED METAL ENCASED PAPER TUBULARS
TYPES PX-24, -24A, and -24B

BUILT TO DO MICA CAPACITOR JOBS
...and do them well!

Small — light in weight — hermetically sealed, and outstandingly sturdy, these Sprague Metal-Encased Paper Tubular Capacitors have proved eminently satisfactory for numerous blocking and by-pass applications previously assigned exclusively to molded mica units. Not only is this true as regards less critical “mica jobs,” but also on more exacting applications where characteristics such as temperature-insulation resistance, voltage-capacitance, or temperature-capacitance are important considerations.

There remain, of course, certain applications where mica capacitors should still be used, and Sprague regularly produces large quantities of transmitting mica capacitors in a complete range of types and sizes.

Deliveries of both types are obviously dependent on prevailing priorities. Production facilities—especially on the Metal-Encased Paper units—are being steadily expanded, and Sprague engineers will gladly cooperate in determining the adaptability of these Capacitors to your requirements.

SPRAGUE SPECIALTIES COMPANY

MANUFACTURERS OF A COMPLETE LINE OF RADIO INDUSTRIAL CAPACITORS AND KOLOHM RESISTORS
The impelling necessity for war production will truly be reflected in the post war period by vastly improved communication systems, both in radio and television equipment. In the future people will enjoy the luxury of these ultra modern communications through Harvey-Wells experience gained in war production... the instrument will be more compact... homes will enjoy them... all cars will have them... factories will use them... boats, planes and trains will demand them...

However, at the present time we pledge ourselves to see that our war jobs are delivered on time and to the best of our individual efforts.

* HARVEY-WELLS COMMUNICATIONS Are Helping to Win, this War *

HARVEY-WELLS Communications inc. *
HEADQUARTERS
For Specialized Radio Communications Equipment
SOUTHBRIDGE, MASS.

(Continued from page 78)

complete revolution and thus generated an angle of $2\pi$ radians, as compared to $\pi$ radians in the same time when the period was one second. The faster the rotation the shorter the period.

Since the rotating radius generates $2\pi$ radians in each period, the total number of radians generated in any number of periods is equal to $2\pi$ multiplied by the number of periods. Hence the number of radians generated in one second will be equal to $2\pi$ multiplied by the number of periods in one second. The number of periods or cycles in a second is called the frequency of the phenomenon. The greater the frequency the larger the angle generated in one second; in other words, the more rapid the rotation of the radius. Thus frequency determines the speed at which the phenomenon takes place. The rate at which the angle is generated, in radians per second, is called the angular velocity, and has a special symbol, $\omega$. From the above it is apparent that

$$\omega = 2\pi f$$

$f$ being the frequency in cycles per second.

Measuring Time

The reader to whom the foregoing ideas are new probably will be thinking, by this time, that quite a lot is involved in arriving at a mathematical expression which will describe an alternating current. It is necessary to examine a number of ideas, including those we more or less take for granted, with some care so we can be sure we know what they really mean. In the beginning we said that our mathematical description of an alternating current must tell us the amount and direction of current flowing at any instant. "Instant" implies measurement of time. We now have an angular method of measuring time, but have not yet brought it into correspondence with a particular instant.

What do we mean, for example, when we say that the time is 8:05 A.M.? Actually, we mean that 8 hours and 5 minutes have passed since an event which we call "midnight" took place. "Midnight" or "zero time," our reference point in the system by which we measure off the time of day, is identified by reference to the positions of certain stars. When dealing with a periodic phenomenon, it is convenient to take the beginning of a cycle as a reference point and call the time "zero" when the motion passes through that point. Then any subsequent instant can be identified by measuring the time which has elapsed since zero time. The beginning of a cycle is commonly taken as the point when the motion is passing through zero and starting to increase in the positive direction.

When the rotating radius passes through the zero position (as given by OA in Fig. 4 or OX in Fig. 6) we can call the time zero. Then the angle $\alpha$ in Fig. 4 gives the position of the radius at a certain instant of time later than zero time. Let us call the time $t_1$ when the radius reaches the position $OB$ and $t_0$ when it was in the reference position $OA$. Then the elapsed time is $t_1 - t_0$. The
Mugs, jugs and goblets were about the only ceramics actively participating in past wars. Spirits were enlivened and convictions reaffirmed by mugs and plates bearing appropriate sentiments. Gay commemorative jugs, fashioned by earlier American ceramists, helped perpetuate the memory of men famed in war and peace.

But today ceramics play an active and vital role in war. Complex electrical mechanisms depend upon AlSiMao steatite ceramic insulation for unfailing performance. It was a proud day for American Lava Corporation when it was the first in the land to produce electrical insulators meeting Navy "G" specifications. Since that time AlSiMao insulators complying with the toughest specifications of Army and Navy have gone out of this plant in an ever-increasing flood.

The men who make AlSiMao have only one regret. The all-out efforts of the past two years have forced them to lose touch, for the time being, with many peacetime friends and customers. Every consideration beyond the war effort was proudly and gladly thrust aside. But when peace comes, you will find that the stresses and strains of war have resulted in new and better AlSiMao products, backed by the same alert organization ready to serve you in the same old spirit of friendly helpfulness.
It takes tough equipment to keep dishing out a perfect job for our Navy in all climates, all weather, and under all conditions. Cinaudagraph Speakers' engineers are building these tough babies — they're special jobs, and production gets the emergency "green light.'

This is experience you'll have behind your Cinaudagraph Speakers when you can buy them again!

The "WAVES" & "SPARS" are looking for YL ops!

JOIN NOW

3911 S. Michigan Ave., Chicago

It takes tough equipment to keep dishing out a perfect job for our Navy in all climates, all weather, and under all conditions. Cinaudagraph Speakers’ engineers are building these tough babies — they’re special jobs, and production gets the emergency "green light."

It is this experience you’ll have behind your Cinaudagraph Speakers when you can buy them again!

The "WAVES" & "SPARS" are looking for YL ops!

JOIN NOW

Cinaudagraph Speakers, Inc.

3911 S. Michigan Ave., Chicago

"At Finer Speakers Made in all the World"

(Continued from page 78)

angle \(a\) generated in this time obviously will depend upon the speed of rotation.

Now if we have an automobile traveling 30 miles per hour and want to know how far it will go in any given period of time, we multiply the speed by the elapsed time to find the distance. For example, in one-half hour the car would travel \(30 \times \frac{1}{2}\), or 15 miles. Similarly, to find the angle generated in a given time we multiply the angular velocity by the elapsed time, or

\[
a = \omega (t_1 - t_0)
\]

This gives us the position of the rotating radius at the given instant \(t_1\). In practice, the expression \(t_1 - t_0\) is usually simplified to the single letter \(t\), it being understood that \(t\) means the time which has elapsed between the reference time and the particular instant under consideration. Thus,

\[
a = \omega t
\]

As explained before, the angle \(a\) may be considerably larger than a circle or \(2\pi\) radians, in which case it must be reduced to an equivalent angle plus a number of whole cycles.

We have here chosen the beginning of the cycle to identify the reference or zero time because it is a convenient point. It is not necessary to choose it; in fact, cases arise in practice where it is not possible to pick the beginning of a cycle as the reference. Suppose, for example, that we are for some reason forced to take the position \(OB\) in Fig. 4 as a reference, calling the time at which the radius is in that position \(t_0\). Then at the later time \(t_1\) the angle between the rotating radius and the reference \(OA\) line will be given by the formula above plus the angle \(a\). In other words, the radius had a head start when we chose our reference time and consequently has reached a greater angle than it would had it started from the zero position. We can indicate this mathematically by writing

\[
b = \omega t + a
\]

where we now use the letter \(b\) to indicate the angle between the radius and the zero position \(OA\) after the elapsed time \(t\). If we had picked our reference time when the radius was below the zero position by the angle \(a\), the radius is "handicapped" by the angle \(a\). Since the speed is constant the radius will travel the same distance in the given time, but the position it will reach in such a case with respect to the zero position represents a smaller angle. In this case the angle \(a\) would be subtracted from \(\omega t\) instead of being added.

In either case the time required for the radius to travel through the angle \(a\) would be smaller as the angular velocity is larger. That is, the time required to travel a given distance is inversely proportional to the angular velocity, in the same way that the time required for a car to travel a given distance is inversely proportional to its speed. Consequently the time represented by the angle \(a\) is equal to \(a/\omega\). This time is called the phase of the phenomenon. It is important when we have to consider two similar phenomena operating simultaneously, since at any given
Meissner is honored by an award.

Army E Navy

Meissner employees are justifiably proud of their "E" emblem...the symbol of a job well done.

Meissner is deeply grateful for this honor. Meissner is built upon our employees, made possible by their sincere cooperation and unswerving loyalty to duty.

This Army-Navy "E" award will be an inspiration to the entire Meissner organization to put forth increased efforts to win the battle of production.

Meissner.

"Precision-Built Products."

81
instant the two phenomena may be in different parts of their cycles even though the cycles themselves are identical. Phase tells us just how far apart, in time, the two phenomena begin and end their cycles.

We can now put together the final expression which gives a mathematical description of simple harmonic motion, whether it be the swing of a pendulum or the variation of a simple alternating current. We found previously that the instantaneous value was

\[ i = A \sin a \]

where \( a \) is the angle at the instant under consideration, corresponding to \( b \) in the formula \( b = \omega t + a \). We now substitute the value of the angle given by the second formula for \( a \), obtaining

\[ i = A \sin (\omega t + a) \]

When dealing with alternating currents, the amplitude of the current is usually indicated by the capital letter \( I \) or the expression \( I_{\text{max}} \), while the small \( i \) indicates the instantaneous value of the current. The expression then becomes

\[ i = I_{\text{max}} \sin (\omega t + a) \]

If the phase is zero, the phase angle \( a \) can be dropped out, leaving

\[ i = I_{\text{max}} \sin \omega t \]

(This is Part I of the article. Part II will appear in an early issue of QST.—Editor.)

Australian Amateurs

(Continued from page 81)

will be manned entirely by hams. After many years of untiring effort, the Wireless Institute of Australia has at last convincingly demonstrated the value of the experimenter to the community.

"Applications from experimenters interested are now being received by this division and very soon the network should be in operation."

And a further report from the September issue:

"Considerable progress has been made with the preliminary organization of the above network. Nearly one hundred and fifty applications for enrollment were received by the Technical Committee and unfortunately, at this juncture, all offers to assist could not be availed of; nevertheless, the men whose services cannot be used for the present have been placed on the reserve of officers. Letters of appreciation of the work done by the Institute continue to pour in from all quarters, particularly from those chaps on service, and many offers of the use of equipment are gratefully acknowledged.

"For the time being, the operations of the network will be confined to Sydney and suburbs, but eventually it is anticipated that every large town will have its installation until such time as the network becomes state-wide. Just how long this
There is a basic difference in Ohmite rheostat design that becomes more and more apparent in actual service ... a difference in smoothness of action, in long life, in trouble-free performance that means permanently smooth, close, electrical control. Every design feature has been time-proved under the most critical conditions, in every climate, on land, at sea and in the air. This soundness of design, plus the wide range of types and sizes, has made Ohmite Rheostats readily applicable to today's vital needs in war and industry. It also makes them ready to serve in the design of new devices to defeat the enemy and build for tomorrow's peace.

SEND FOR THESE HANDY AIDS

Free Quick-Reference Catalog 18 — Gives helpful information on Ohmite stock resistors, rheostats, chokes and tap switches for all types of applications.

Ohmite Ohm's Law Calculator — Helps you figure ohms, watts, volts, amperes—quickly, easily. Solves any Ohm's Law problem with one setting of the slide. All values are direct reading. Available for only 10c. (Also available in quantities.)

OHMITE MANUFACTURING CO., 4864 FLOURNOY ST., CHICAGO, U.S.A.
NOW—a really high-powered R A D I O ENGINEERING LIBRARY

The Library comprises a selection of books called from leading McGraw-Hill publications in the radio field.

especially selected by radio specialists of McGraw-Hill publications
to give most complete, dependable coverage of facts needed by all whose fields are grounded on radio fundamentals
available at a special price and terms

THESE books cover circuit phenomena, tube theory, networks, measurements, and other subjects—give specialized treatments of all fields of practical design and application. They are books of recognized position in the literature—books you will refer to and be referred to often. If you are a practical designer, researcher or engineer in any field based on radio, you want these books for the help they give in hundreds of problems throughout the whole field of radio engineering.

5 volumes, 3559 pages, 2558 Illustrations
Eastman's FUNDAMENTALS OF VACUUM TUBES, 2nd edition
Terman's RADIO ENGINEERING, 2nd edition
Everitt's COMMUNICATION ENGINEERING, 2nd edition
Hund's HIGH FREQUENCY MEASUREMENTS
Henney's RADIO ENGINEERING HANDBOOK, 3rd edition

10 DAYS' FREE EXAMINATION SPECIAL LOW PRICE EASY TERMS

Special price under this offer less than books bought separately. Add these standard works to your library now; pay small monthly installments, while you use the books.

SEND THIS EXAMINATION COUPON

McGraw-Hill Book Co., 330 W. 42 St., N. Y., Send me Radio Engineering Library for 10 days' examination on approval. In 10 days I will send $3.00 plus few cents postage, and $3.00 monthly till $24.00 is paid, or return books postpaid. (We pay postage on orders accompanied by remittance of first installment.)

Name
Address
City and State
Position
Company

(Continued from page 41)

Rejuvenating Old Meters

(Continued from page 41)

will take is difficult to say. The State War Effort Coordination Committee state where a station is to be installed, and it depends entirely on that body just how soon the scheme expands.

"The original intention of the Technical Committee, who by the way consists of R. A. Priddle, VK2RA, A. V. Bennett, VK2VA, P. Dickson, VK2AFB, W. G. Ryan, VK2TI, and W. McElrea, VK2UV, was to make use of existing equipment in order to get the network in operation quickly, and then eventually substitute for this equipment a standardized station. It was found, however, that nearly every member would have to rebuild, so it was decided that each station would be equipped with standard tx, rx and power supplies from the inception. The transmitter will consist of 4 stages crystal-controlled, using an 807 in p.a., cathode-modulated. The receiver will be a super-regen. with a stage of r.f. and there will be two power supplies, one of which will be independent of the a.c. mains.

"At the present time the members of the Technical Committee are visiting the various localities where stations are to be installed and meeting the amateurs who are interested, and putting before them full details of the scheme and obtaining details of the gear that will have to be released from seal.

"Those applicants whose services are accepted will be investigated by Security Service, and if satisfactory will be enrolled as members of State Coordination, attested, issued with police passes, armbands and, where necessary, stickers for the windscreen of cars, and a certificate to be issued by the Institute, stating that they are members of the Emergency Communication Network.

"A word of warning. Do not touch any seals until such time as you receive permission from the PMG to do so and do not make any direct applications to the Senior Radio Inspector. The Institute will take care of all applications and they will go through in toto.

"Once permission has been received to build r.f. equipment and units are completed, exercises will be held each week until such time as proficiency is gained in procedure and the quick handling of messages. These exercises will be made realistic and will be part of State Coordination trials that are held from time to time."

(red pencil marks for the points or paste on a new paper dial and mark off a complete scale. When making pencil marks, be sure not to touch the pointer since it may bend and thus upset the meter balance.

It is well to note that the reading of a d.c. meter will decrease when the instrument is mounted in a steel panel. The amount of decrease depends upon the particular meter and the thickness of the panel. If the meter is to be used in a steel panel,
Proving ground for the future of electronics

On the battlefields, electronics is meeting its extreme test. Failure here means death to men, defeat to armies. Conversely, experience here means vastly broadened knowledge, improved techniques, and progress so rapid as to be impossible of description.

The collective brains of Eimac engineers are concentrated full tilt on the new knowledge which is coming out of this holocaust. And are consequently still setting the pace in vacuum tube developments. The fruits of their efforts are going directly to Uncle Sam and our Allies to play a vital role in the war.

When the fighting stops you'll find Eimac still the pre-eminent choice of engineers throughout the world.

*Army-Navy "E" awarded for high achievement in production for war.*
YEARLY BINDERS

Are We Right?
You should have at least two of them—one for your complete 1942 file of copies, and one for each 1943 issue as published.

With each Binder is furnished a sheet of gold and black gummed labels for years 1925 through 1944. The proper one can be cut from the sheet and pasted in the space provided for it on the back of the binder.

Price $1.50 postpaid
Available only in United States and Possessions

THE AMERICAN RADIO RELAY LEAGUE
West Hartford, Conn.

(Continued from page 84)

it would be well to check the accuracy in the same panel. A.c. meters are not affected appreciably by steel panels.

Repairing A.C. Meters
The same procedure should be followed and similar adjustments made in the case of a.c. moving iron type meters. A few additional words are in order, however.

Usually there will be no metal chips in an a.c. meter because there is no magnet to hold them there.

Most a.c. meters employ a fan swinging in a closely fitted chamber to obtain damping. Dirt or fuzz in this chamber will cause stickiness or excessive friction.

It is important not to bend the soft iron vane (either movable or stationary) since the meter accuracy is dependent upon the proper placing of these vanes. The same holds true to an extent for the pointer on a.c. meters. Also, changing the position of the coil around the vanes will affect the accuracy.

Extending Meter Ranges
The formulas for extending the ranges of d.c. voltmeters and milliammeters are given in The Radio Amateur’s Handbook. These apply to a.c. meters as well, if the resistors are non-inductive and the value of meter resistance used is the a.c. resistance. Since the resistors may or may not be non-inductive, and the a.c. resistance of the meter may or may not be close to the d.c. value, it will probably be advisable to check the calibration.

Best accuracy is of course obtained with precision wire-wound resistors. Lacking these, carbon resistors will have to suffice. Probably this type will not be obtainable in the correct resistance values, so the advice is, use what you have and mark the dial accordingly.

Strays

The use of radio music in barns during milking hours has increased production of milk 30 gallons daily from 180 cows, according to one Southern California farmer. This is one way of meeting the goal of 125 billion pounds of milk for 1942.


R.I.: “Do you have license?”
Ham: “Yes, sir.”
R.I.: “Where?”
Ham: “All over me!” — D.V.R.A. News.

Black crackle finish which has become filled with dust may be made to look like new by wiping with a clean rag soaked in any light oil. The oil should be allowed to remain on the surface for an hour and then be thoroughly wiped off. — WSERV.
Smoothly ... accurately ... rapidly ... McELROY is producing precision-built, urgently needed telegraph apparatus.

Designed by the world's champion telegraphist and outstanding wireless operator of all time, our equipment is rendering unfaltering service under all the intense wartime traffic ... including the task of training thousands of new wireless operators in the shortest possible time.

Illustration: Model XTR-442 Tape Transmitter, operates accurately at controlled speeds ranging from 5 to 250 words per minute.
AMATEUR ACTIVITIES

ATLANTIC DIVISION

MARYLAND-DELAFORCE-DISTRICT OF COLUMBIA—SCM, H. C. Halverson, WABB—There were approximately 70 hams present at the hamfest in October at home of W3FPQ. AC4JS gave a talk and showed movies of his activities in the West, including his ham activities. There were lots of games, dancing, prizes and a sand with you left foot, or QLF, contest. Over half those present were out-of-towners who are temporarily in Washington. Among those present were SFCD, 8KW, 3AKB, 6OGZ, AFJ (ex-W2BB), D2AL, J2SH (ex-M2Y), and 8WFP. E8 gave a talk at a recent Club meeting on the carrier system, and it would be fitting for the hams to drop a line to the SCM at frequent intervals so that some check on what the other fellow is doing could be found in this write-up. Code and theory classes have been taught by many of the gang, which demonstrated the need for further organization and preparedness. Subsequent Sunday operation showed that a great many wrinkles had been ironed out successfully. On December 8th, Fort Wayne held a surprise blackout. Hams in advance and in a very successful operation was conducted. In one case, the telephone communication system was unable for half an hour to maintain contact between control center and one district control center. The WERS station in that district had complete control of its responsibilities within three minutes was handling all the traffic on that circuit. This very forcefully demonstrated the need and practicality of WERS in an actual emergency. On December 18th it was reported complete and data from the joint operating agreement for Branchburg and Hillsborough Twp's: in Somerset County. The plans have been drawn up so as to facilitate operation with New Brunswick, N. J., whether his twp. is licensed separately or to work out of New Brunswick, N. J., which is their District Warning Center in the ARP set-up. ACC and ABS are cooperating as radio sides for their respective twps. of Branchburg and Hillsborough, planning to operate as one unit. JAG is employed in the repair department of Hurley-Tobin Co., Trenton. DCQ is attending radio school for position of civilian radio inspector for the Army. H2Z has been promoted to seaman at Fort Monmouth Radio School. It was reported here that GFS had reported for duty in Unk Sam's forces. Steve has been deferred for the present. FXM is now Sgt. Joe Santonos, doing radio work. His address is Box 231, Hightstown. J2ZK assisted in old equipment at the October meeting, with the club receiving 8% of the proceeds. Three new members were welcomed into the ranks of the JSRA recently; Ernie Foux, of Pine Hall, N. J.; Julius Gadd, of Collingswood, N. J.; and Ralph Pierce, of Hadfield, N. J. Newly licenced hams in the South Jersey vicinity are Ray Hibbe, Hank Bennett, and Bill Wescoff, of Collingswood, N. J., and Bob Haworth, of Oaklyn, N. J. Please give us the calls, if any. The American Emergency Net and the Westmont, N. J. Net held their annual banquet on Sept. 8, 1942, held in Berlin (N. J.) Park; among those present were IAS, AEJ, HLY, HND, EET, JOP, I2ZP, Bob Beelke, Hank Bennett, Miss Jean MacMullan, and all the VLA, XYLs, and GWS. The VLA, XYLs and Gws were played between teams managed by Mrs. ICO and Miss MacMullan. The DVRA, at their November meeting, elected other members to take over the unexpired terms of the members who lost their commission to the Services. Those selected were: acting president, JO1; acting vice-pres., EED; assistant sec., Chas. Moore; Sgt.-at-arms, JAG. The members decided to reduce the DVRA dues to twenty-five cents per month until further notice. The officers have been surprised at the volume of communication over the 120 Electric Lines. G3T was a recent visitor over the week end. No WERS calls issued for this section up to the present writing. APY heads WERS activities in Montco. On Perry Nightman in Prince Georges Co. Jean Hudson is with the WERS in NYC and operates a walkie-talkie rig. Thank you all for the holiday greeting cards. 73 to all. SOUTHERN NEW JERSEY — Acting SCM, W. Ray Tomlinson, WSGCU—Asst. SCM, Z1; Regional EC in charge of Emergency Coordination, BAQ; Emergency Coordinators: Atlantic City, EF7M; Camden, KW; North Plainfield, G8IT; Vineland, GMY; Somerville, EGC; Regional Coordinator, Ted Forrest, decided to reduce the DVRA dues to twenty-five cents per month until further notice. The officers have been surprised at the volume of communication over the 120 Electric Lines. G3T was a recent visitor over the week end. No WERS calls issued for this section up to the present writing. APY heads WERS activities in Montco. On Perry Nightman in Prince Georges Co. Jean Hudson is with the WERS in NYC and operates a walkie-talkie rig. Thank you all for the holiday greeting cards. 73 to all.

CENTRAL DIVISION

INDIANA—SCM, R. E. Kroll, W9KGO—Acting SCM in charge of Coordination, VYU. Any communications regarding EC work should be directed for the duration to VYU for prompt attention. The majority of radio meetings have been called because of the reduced hours of gasoline and transportation facilities, and it would be fitting for the hams to drop a line to the SCM at frequent intervals so that some check on what the other fellow is doing could be found in this write-up. Code and theory classes are being taught by many of the gang. Let us hear from you as to the progress of the classes. Remem-
TOMORROW’S RIG WILL BE A HONEY—
AND YOU’VE GOT IT COMING TO YOU!

WHEN THE WAR is won, and the bands are returned to the amateur, your apparatus will be like nothing ham radio has known. For this war has compressed years of research into months. Already—in the minds of technicians, in the labs of radio science, and in the field of battle—Tomorrow’s rig is in the making, and you’ve got it coming to you.

Not every amateur radio operator can serve with the Armed Forces. But there is war work for all. And just as Isolantite Inc. is busy around the clock on vital production-for-war, stay-at-home hams are helping in the war effort wherever they can. Some are serving as civilian instructors in the schools of the Army Air Forces, or in technical and high schools where pre-induction courses are speeding the training of desperately needed operators and technicians.

Still other amateurs are manning the nation’s War Emergency Radio Service System. Help is urgently needed everywhere, and it is help that only the experienced ham, with his rig and his talents, can give. The gang away in service may be proud of the way he is pitching in in this greatest of all national emergencies.

If we stick to our guns, you'll be back on the air some day ... with a better rig. And you will enjoy it more for having served your country during this period of closed stations.

Isolantite*, too, will be back, with its unique combination of properties—high strength, dimensional precision, electrical efficiency and non-absorption of moisture—helping you to make the most of all the wartime developments in amateur radio.

*Registered trade-name for the products of Isolantite Inc.
towert. SAG operates at WBAA in addition to taking a full
senior EC course and acting as EC for the West Lafayette
area. Art reports his chief difficulty is in obtaining equip-
ment for WERS. BFF got that well-known notice recently.
EET now has Class A ticket. Officers elected by the Indiana
apolis Radio Club for the coming year are: YMV, pres.; JIC,
vice-pres.; JHC, secy.; DSC, treas.; VPF, chief op.; and
DNQ and JYP, directors. 9UY7 is sig, in Signal Corps, Co.
State Defense Council has been inactivated in that above
call to WERS in Indiana and is urging local defense councils to take
advantage of the facilities offered for WERS. Through Lieut.
Mount, state Communications coordinator and Mr.
Yeleski, state assistant, and local defense councils are be-
ning to see that they have the equipment and personnel on hand to
keep their WERS organization. I have been consulted fre-
frequently
for names of ECs or interested hams in almost every Indiana
county. In quite a few instances, I have been compelled
to admit that there was no EC in the town under considera-
tion. If you have an EC in your locality, register in the ABC
with him if you are not already registered; make your own
availability known. If you have no EC, please volunteer for the job,
or recommend a fellow ham if appointed is not qualified. A postcard to me will bring you information
on WERS in your city. 73, Roy.

MICHIGAN — SCM, Harold C. Bird, WSDPE — DYR reports that the code and theory classes are about to
finish, as the junior class is making steady progress. Cow
writes us a nice card saying he received the QM bulletin
while convalescing from an operation. PLQ is teaching
radio to a class of five members with the assistance of MFQ at YMOCA and DRE at SCS. As a member of the YMOCA
radio club, he is teaching radio theory and code at Saginaw.
High three nights a week. UKR reports renewing his QST membership, also that he has vibrapack for 122 Mc. ECS is very busy at an
old jobs when not on radio and is looking for a new call.
SAG operates at WBAA in addition to taking a full
senior-mobile. Equipment ready. Deputy Radio Aide TOZ
said it was kind of cool, but he is still doing some woodcraft work. LSF
finally broke down and sent us a card from the Middle West.
Shays he has not forgotten anyone, but has been so QRL he has
not had time to write. However, he says he thinks of the old gang but is plenty QRL. PLQ
gave us a surprise the other night by dropping in for a rag
chew. 8VKJ ex-9UPG is studying for C.G. commission at New
London, Conn., after spending many months on active
duty in So. Pacific. Oakland County Radio Club is still working with the OOD in their preparation work for WERS.
They hope to be licensed soon. Well, fellows, when you read
this you will probably also read that your SCM has been re-
nominated. If you fellows are that well satisfied, will not
complain. You did fairly well this last month in reporting,
but come on with some more. I know you fellows are doing
wonderful work and are making progress, but there is an e.o.o. if there is anything to be learned. How about you? Hope
that you all had a pleasant Christmas. 73 — Hal.

OHIO — SCM, D. C. McCoy, WSCBI — Emergency
Coordinators are needed for a number of points in the State
of Ohio. This, according to our organization, is the new OHIO WERS plan. The following towns are not
covered by Emergency Coordinators and your SCM would like to have recommendations from clubs or individuals regarding suitable amateurs to be appointed as Emergency
Coordinators for the following WERS areas in Ohio: Bryan,
Napoleon, Defiance, Bowling Green, Van Wert, Xenia, Wil-
ington, Hillaboro, Winchester, Sandusky, Tiffin, Lorain,
Ashland, Mansfield, Westerville, Marion, Washington Court
House, Jackson, Gallipolis, Pomeroy, New Philadelphia, Steub-
enville, Cambridge and Barnesville. Springfield: EQN reports that NPZ and GDX are now at Patterson Field with the Air
Service Command and that OG is now doing work in Clevem-
dale Court House, Belpolm: Charles De Long was
appointed Emergency Coordinator for Bellefontaine WERS
area as of September 25th, upon recommendation of Dr.
Weisber, who resigned to go into the Navy. Dayton: The
WERS license for Dayton has been received; call letters
WJTW. All Assistant Emergency Coordinators have been
appointed radio aides and definite assignments given to them
in connection with the Dayton WERS operation. DMN is
deputy radio aide in charge of education, and has started
teaching classes for operators for third class permits,
asisted by LCO, RHH and AGR as a committee, assisted by a number of others acting as instructors and assistance.

A few of the students who were trained last spring are also
acting as assistant instructors. Construction of equipment
for main control station is now well under way. Deputy
Radio Aide H. O. Jones (no call) is in charge of this project,
with RHH furnishing frequency measuring equipment, LCO
and OVL receives, AZH auxiliary emergency power supply,
CBI the transmitter and NSS the antennas. TQC has re-
signed as deputy radio aide due to lack of time occasioned by
long working hours. Deputy Radio Aide OVL has been
placed in charge of portable-mobile equipment ready. Deputy
Radio Aide TOZ is personnel officer and is busy fingerprinting the gang who have applied for operator's permits and getting their papers ready to go to FCC; a serious problem in getting the
necessary equipment for this activity. A few jobs are now
ready for service. The lack of 2-volt vibrator power supplies
is the most serious problem. APT, DDG and DEQ are
applying for in the name of the city to cover the city and
county have purchased a number of Abbott TR-4 units,
and a number of composite units are built and ready for action.
Frequency measuring equipment is under construction. Op-
erators, mostly recruited from local broadcasting groups
are being augmented by students from a school for third
class permits. The training program contemplates 6 people
available for each station in the system. The license has been
applied for in the name of the city to cover the city and

90
When the war ends, there will be a phenomenal expansion in the peace-time use of electronics. Today—while the war absorbs the tube output—try to fix in your mind this unique source for tubes which you will seek tomorrow:

Its name: UNITED. Its organization: a group of eminent engineers and technicians, uniting their highly specialized skills. Its product: power tubes, unsurpassed in precision, for every electronic requirement including radio communication, physiotherapy and industrial control. Its standard: power tubes that consistently attain the highest record in every test of performance. Remember the name “United.”

UNITED ELECTRONICS COMPANY
NEWARK, NEW JERSEY
county, with county approval. Several radio-equipped planes are also under consideration. QM9 would like to see more interest from the local amateurs in the WERS program.

Canton: MRL is communications and intelligence officer for Civilian Air Patrol. ADQ has been appointed radio aide for Canton, and is struggling with organizing his WERS training program. A training course for radio operators is planned, due to large losses of amateurs to the armed forces. Fortunately, the Canton group are reported to have had considerable experience with 112-Mc. operation prior to the shut-down. Newark: EMH has resigned as EC for Licking County, and is now in the Navy training at Bliss Electrical School, Washington, D. C., Mt. Vernon: OUF has been appointed EC for the Mt. Vernon WERS area, and has also been appointed radio aide by the Richland County Council for Defense. Medina: KNP's appointment as EC has been renewed. He reports that he and EMY, HFD and DXB will apply for WERS operator's permits, and station license will be applied for by the city for communication with the Akron Warning Center. KNP says he has sold all of his meters to the League for the Army. Reports GMI in the Navy at RM2o on sea duty. The tire and gas shortage has forced the Medina County Radio Club to cut down its meetings to quarterly, and will probably force suspension of operations completely for the duration. Zanesville: TGU reports that no radio aide has yet been appointed for WERS operations in Muskingum County, as all the rest of the gang are afraid to turn State Trooper. RIA is a physician for help in handling it. How about some of you fellows stepping up and helping Hal out? Of course the job of radio aide is a lot of work and worry, but so is dodging bombs and bullets at the front. RIA has sold his car right after Pearl Harbor, and is now a stenographer at Wright Field. Athens: LKI's appointment as EC for the Athens WERS area has been renewed, after his letter had spent several months in the mail trying to find the man. SCW, W9FUZ, is a 2nd lt. in Signal Corps. He has been enjoying operating with the Merchant Marine. PTU is now an Air Corps captain, at WDC, as is RIA present address. Just endorsed EC certificate for ERO. Am wondering if any other ECs wish to have their certificates endorsed? If so send them in to me here at Glenwood. With the sessions greetings and especially may the New Year bring cheer and good news. Luck on 73.—Army.

DELTA DIVISION

ARKANSAS—SCM, Ed Beck, W6GEC—It would be a swell thing to make a New Year's resolution to get in a report each month hereafter and then stick to it. How's about it, gang? Let's have quite a few more reports next month. ICI is captain in the school, and writes to let us know all's well and that he is fast away and not bothered with the heat. EVD is a captain with the Civil Air Patrol. IIE get's home on a short leave once in a while and always reports. PS is our idea of a W6X, doing almost double duty in addition to holding a technical-sergeant rating in the CAP. FPU is also plenty busy, but managed to get home briefly for Christmas. JB is making a survey of the area and trying to get the "clean-up." The gang are all up-to-date report from him for next issue. Fiqua: WKN reports WERS activity is excellent. A number of tests for coverage have been made and signals from the control station are excellent all over town. Two special drills have been held in addition to the regular Sunday night test periods, and a class of men and women are in training for third class phone tickets to qualify for WERS permits. The armed services have made further inroads on WRR's personnel. NAC is now in the Navy, DEI is in the Coast Guard, and all the rest of the gang are in training.幅. TEF is assistant officer at Camp Crowder, Mo. KOB begins training for the Signal Corps at Ft. Leavenworth, Mo., Jan. 4th. SZX was last heard from in Washington, D. C. 6ULS (ex-WDL) is in San Diego working for an airplane company. MKNW is now an NDT, and is in training at Minneapolis for radio work. He is in the reserve and will be called soon as he completes training. TNQ sold and gave all his equipment to the Signal Corps. Seasons greetings to you.

DIA DIVISION

SOUTH DAKOTA—SCM, P. H. Schultz, W9QVY—DUD left South Dakota State College in March 1945 to work as a radio engineer aide for the Naval Reserves. SCM, Millard L. Bender, W9NYQ—Nearly all the men are in service, mostly the Navy. DEI is Lieut. (jg) instructing engineering at Dartmouth College, Hanover, N. H. ZAD is 1st Lt, Co. 123b, Chicago, Ill. RIA's niece got married right after Pearl Harbor, and is now a stenographer at Wright Field. Athens: LKI's appointment as EC for the Athens WERS area has been renewed, after his letter had spent several months in the mail trying to find the man. SCW, W9FUZ, is a 2nd lt. in Signal Corps. He has been enjoying operating with the Merchant Marine. PTU is now an Air Corps captain, at WDC, as is RIA present address. Just endorsed EC certificate for ERO. Am wondering if any other ECs wish to have their certificates endorsed? If so send them in to me here at Glenwood. With the sessions greetings and especially may the New Year bring cheer and good news. Luck on 73.—Army.
The high regard in which IRC Resistors are held by Engineers and Executives of America's leading electronic industries is clearly attested by the voluntary remarks quoted at the right. These are taken from among returns to a nation-wide marketing study recently made by a wholly independent research organization. This survey was completely unbiased, with no company name or product disclosed.

PREFERRED for PERFORMANCE

INTERNATIONAL RESISTORS

INTERNATIONAL RESISTANCE COMPANY

401 NORTH BROAD STREET
PHILADELPHIA, PA.
cantly married. FOJ, BTS, CDB, DPO, FCU, LLA and GNR have joined the Emergency Corps from Kingsport Area. Welcome, gang. Let's have more reports.

HUDSON DIVISION

EASTERN NEW YORK—SCM, Robert E. Haight, W2LU—MCV reports he and MGO are pounding brass for the Army in Africa and says the old bandido is still bothering them. They send 73 to the 100-100 meter gang, especially around Schenectady and Amsterdam, and would appreciate your letters. Address is Hq. Co. 67th A.R., AFO, Postmaster, New York City, U. S. Army. LII reports the Orange County Radio Area, is still going strong with the boys building 2½-meter antennas at the fire house and other points from which to set up fixed stations. The WERS application has been acknowledged by P.C.O. to hear from them soon. Code and theory classes still in operation. Dick Gould passed his amateur exam. All the equipment and the men to handle WERS are set and ready to go, waiting for license. 1943 officers for S.A.R.A. are: pres. BRS; vice-pres. NIV; secy. MSX; tresa., LWQ; directors: HJG, CVZ, NIV.

HZL reports the WERS radio stations are being set up. HZL is radio able to the Schenectady War Council. AZH and BRS talked home with the door prizes as usual. When you SCM's address. It may change soon. 73. —W2LU.

MIDWEST DIVISION

IOWA—SCM, Arthur E. Rydberg, W9AED—WFD, C.O. of the Burlington Squadron, CAP, was aloft on Dec. 15 and left the blackouts unfinished. The Corps school in Chicago and is now attending radio school in Philadelphia. WNL is Tech. Corp. in Signal Corps and is in radio school at Camp Murphy. QM. QWD is at the Q. M. Army Post School, and Francis E. Warren, WYO, QGQ is attending a Civil Service school at Iowa City, HIM attending the same type school at Rolla, Missouri. The Iowa-Illinois Amateur Radio Club is renewing QST free of charge for all its members who are in uniform. QVA reports their code and theory classes continue each week. YGA is at the Des Moines Post. J.W. school. FDL is now a senior instructor at Lafayette School, Lexington, Ky. ACC is in a Signal Battalion at Fort Lewis, Wash. FRH is in the Corps Radio Office at Goodfellow Field, Texas. QGQ has been made a Warrant Officer. Equipment for Des Moines WERS control center has been completed and donated by UOP. COE looks at his transmitter occasionally.

KANSAS—SCM, Alvin B. Unruh, W9AWP—ZVP is working 18 hours a day. He is EC for Sumner and Cowley counties. KWA completes high school in January, and has class A, radiotelephone first, and radiotelegraph second class licenses. FSS was home on furlough. WFF is in Signal Corps school in Ga. FER is experimenting with portable emergency receivers. HJM is in military service. MAE, EC for Wyandotte County, reports SSL wants to be heard. He has completed his examinations in Chautauqua and Elk counties; he reports that CD officials prefer land line to radio communications. John holds rating of 2nd Lt. with the Army and stationed at Goodfellow Field, Texas. QM. QWD is now a senior instructor at the Air Corps School in Goodfellow Field, Texas. COE's office in Kansas City to take a position with the electronics company. CDX is in military service. HGB has left the Army and stationed at Goodfellow Field, Texas. OCG has been made a Warrant Officer. Equipment for Des Moines WERS control center has been completed and donated by UOP. COE looks at his transmitter occasionally.

CONNECTIONS—SCM, Edmund R. Fraser, W1KQY—20CC (ex-1XFN) recently paid a visit to "GB" and brought his xryi who can copy 13 w.p.m. and hopes to have a ticket shortly. 1XFN, now in the Signal Corps, is located in Bridgeport and says he would like to meet the local hams and attend BARA. APA please take notice. Norwich warning district has now received WERS license and expects to be on the air shortly. ARI, reporting for the Stamford warning district writes that successful tests have been held to date with public officials commenting highly on the performances. The New Haven warning district is nearly operating and is being taught by P. WY. QGQ is at Bridgeport until further notice. All other training centers are in the same urgent need. Write me. Send in a prompt report for yourself and all the men in the Service.

NEW ENGLAND DIVISION
Saves Time in Solving Resonant Frequency, Capacitive Reactance, Inductive Reactance, Coil "Q" and Dissipation Factor Problems

Here's how it works

<table>
<thead>
<tr>
<th>FRONT</th>
<th>EQUATION</th>
<th>SOLVES</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonant Frequency problems</td>
<td>$\omega^2 L C = 1$</td>
<td>1. Resonant Frequency if L and C are known 2. Various L and C values for desired resonant frequency</td>
<td>Frequency 5 cycles to 300 megacycles  Capacity .001 mmf. to 1,000 mmf.  Inductance .0001 mh. to 10,000 henrys</td>
</tr>
<tr>
<td>Reactance problems</td>
<td>$X_L = 2 \pi f L$  $X_C = \frac{1}{2 \pi f C}$  $Q = \frac{2 \pi f L}{R}$  $D = 2 \pi f CR$</td>
<td>Any single unknown variable, providing remaining variables are known in equations for Inductive Reactance, Capacitive Reactance, Coil &quot;Q&quot;, Dissipation Factor</td>
<td>Frequency 0.1 cycle to 10,000 megacycles  Capacity 1 mmf. to 100 mmf.  Inductance .001 mh. to 100 henrys</td>
</tr>
</tbody>
</table>

Shure Brothers, designers and manufacturers of Microphones and Acoustic Devices, are supplying our Armed Forces and our Allies with rugged military microphones for duty on land, on the sea, and in the air. However, you can still obtain our standard line of microphones for vital civilian needs. See your local radio parts distributor—or write for catalog 154Q.
EASTERN MASSACHUSETTS—SCM, Frank L. Baker, Jr., W1ALP—BLR is now EC for Reading. AAR is now radio technician in the Coast Guard. MPT writes from Baltimore that he is 3rd op on a United Fruit Co. boat, KXU, CWV and IDU are at Fort Monmouth. ILL is leaving for the service soon. K16W is also going on a bomber. CKB is mine-sweeping. A9H is working at the Naval Yard. NBQ is a chief radio op on a new Liberty ship; he met MKL over in England. CTR has a new jr. alp, ALW, ICO, I0E, IIM and AII have been working on their hook-up. Whether W1AG is also dropping on the hook-up, IIM is married. Thanks for all the Christmas cards, fellow-s, and let's have a letter from you, wherever you are.

NEW HAMPSHIRE—SCM, Mrs. Dorothy W. Evans, W10MM—In addition, they are graduating nine operators in the section holding amateur licenses who soon may serve in the armed forces, and one or two oldsters who may likely remain in your area! It will help you to more fully enjoy amateur radio when restored and you may help the war effort at the same time. Let's remember that whatever W1AG is also dropping on the hook-up, we have only a few more radio operators available. A few who are here have already left, and 15% are not replaceable. After deducting those amateur licenses that could be available or considered better, no system can be better than the operators make it. Think it over. If we don't have the personnel, how can we successfully carry out any particular arrangement? We have never intended to do things by halves and you will agree it is no time to start doing so now. In the meantime, start the "future hams," help them if you can, and buy war savings stamps and bonds to realize that new equipment which you will want in the future.

NORTHERN DIVISION

MONTANA—SCM, Rex Roberts, W7CPY—BCE is in radio signal school of the Air Corps at Sacramento, FL still located in Seattle. AST with Alaskan Communications at Seattle, EN in Traveler's Rest, SCM with CAA at Mammoth. GFT is holding down a berth with Western Air at Great Falls. CFP is senior instructor in Signal Corps school in Kentucky, and says the hours are as long as they were during a DX period. Great Falls has been unable to get a W6FJF in CAA's base application for the 15-meter band. The mobile cars will have "War Emergency Radio" stickers on the windshield, with a unit number, EN, our EC for Hopper, reports a radio school started a month ago, with both men and women students, and they are following QST suggestions in code and theory. Ken says the class make him study to keep ahead of them. Being a "key" man, BS will not be able to join the Navy, so now he is looking for another kind of a job. He met a friend in Phila. during the holidays, and let's have a letter from you, wherever you are.

OREGON—SCM, Carl Austin, W7GNJ—EC, JN, GNJ has been re-elected SCM for another two years. ARZ, radio aide, city of Bend, reports receiving the W5R license, and plans to complete a course in the near future. The Bend city council bought 2 units, and two were donated. INT is now warrant officer in the Navy, located somewhere on the West Coast. Jean Petit, formerly of East Providence Police Radio, is now with WEAN. Jean was formerly a member of P.I.A. Thanks, everybody, for the improved cooperation on the West Coast.

VERMONT—SCM, Clifton G. Parker, W1KGJ—JVB is now engaged in his new duties as instructor at the Brown Vocational School, Wilmington, Delaware. K16M is reporting in the ranks of the "key" men. HMP recently was in Boston and secured his second-class license. KXU and NCD, formerly of East Providence Police Radio, are now in the Mobile Corps. WB3 recent was in Boston and secured his second-class license and is now engaged as flight radio operator with Northeast Airlines. KWB and family are now radio technician in the club rooms. The mobile cars will have "War Emergency Radio" stickers on the windshield, with a unit number, EN, our EC for Hopper, reports a radio school started a month ago, with both men and women students, and they are following QST suggestions in code and theory. Ken says the class make him study to keep ahead of them. Being a "key" man, BS will not be able to join the Navy, so now he is looking for another kind of a job. He met a friend in Phila. during the holidays, and let's have a letter from you, wherever you are.

PACIFIC DIVISION

EAST BAY—SCM, Horace R. Greer, W6TIT—EC: QBE, EC u.h.i.; PKQ, Asst. EC u.h., G7T, OO u.h.7: ZM. The second meeting, problem session, Personnel Committee. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities. All New England states were represented, and the conference was very helpful. In examining the Vermont Section it becomes apparent that while WERS operations present problems, many are not immediate, and personnel problems immediately. Any arrangement must necessarily depend on having operators available. A few who are here have allowed their licenses to lapse. The schools now being carried on in Bellows Falls, Burlington, Montpelier and Morrisville will undoubtedly have W1AG and called activities.
... and they are real seagoing reproducers! ... because each one has been specially constructed and meticulously engineered for perfect performance under the most severe operating conditions.

Jensen
RADIO MANUFACTURING CO.
6601 SO. LARAMIE AVENUE, CHICAGO
The death of HOW of the Army Ferry Command was a shock to his many friends. AEX is on a much needed diet, as you can't Oscilate at 275 pounds. OZA has returned from Africa for the Pan-American Airways and will now be working for them. He reported that all the Districts were represented where he was stationed. Here is looking for a bright 1943. 73. — "TI." 

ROANOKE DIVISION

WEST VIRGINIA — SCM, Kenneth M. Zinn, W8JRL — BobCraig of Wheeling, ex-AUJ, has joined the Army. LCN is at the Naval Operating Base, District Communications Office, Norfolk, Va. AZD is RMM USNR At least three new DXers from West Virginia. Among Craftsmen, Building 198, N.O.B., Norfolk, Va., and likes it very much. DFA, ex-Fireman of Wheeling Fire Co., joined the Coast Guard as chief specialist. BTY is now located at naval receiving station at Lock Haven, Pa. VGH finished Signal Corps school at Montgomery, Va., and is awaiting an assignment. JLZ has also finished Signal Corps school at Baltimore. Charles Handy, Secretary of MARA, has recovered from a recent illness and is back on the job and doing fine. Our column this month is pretty short. Pep it up, boys. 73. — Ken.

ROCKY MOUNTAIN DIVISION

COLORADO — SCM, Stephen L. Fitzpatrick, W9CNL — Several radio operators of Denver have just purchased their fourth War Bond, and they say that the fifth will be forthcoming in the near future. 2nd Lt. EHC is the officer-in-charge at the RCA Signal Corps Training School at Philadelphia, Pa. UFT is now with the Douglas Aircraft Co. as a jr. radio repair electrician. He says it's nice working with 5JFV and 5JGV. KHQ has a bunch of worn-out radio tubes for Uncle Sam's metal scrap drive. He advises that QLG has moved from U.S. to Riffy. The AARD is desirous of organizing an orchestra of four or five pieces. Those interested please contact TFF or WYX for details. BQO, GAA, TRR and YXU will start new classes in code and theory in January at C. A. Johnson Building. Thia enjoyable get-together chat makes one long for the short waves again. Harrison Goff has been transferred to Dayton, Ohio. 73. — Franklin.

SOUTHEASTERN DIVISION

EASTERN FLORIDA — Acting SCM, Frank C. Fasett, W4BYR. IP is at Dinner Key with Pan Am. CN2 is in Miami working toward RT2nd with PAA. Jim Exline, of online with his "Order Of The" Many hams from the Miami area attending PAA radio class. Supposed KK is busy with WERS. ACZ reminds us all of the anniversary of the death of AFC at Pearl Harbor on last December 7th. AGM is with PAA by way of the Navy. The gang works long and hard for speedy recovery of GQJ, who is confined to his bed at Palm Beach. FSS is holding down Daytona Beach by himself these days. ETQ now in Jax with St. Johns River Shipbuilding and also active in Jax CAP. FWX reports much FDF activity in Jax area. 1st Signal Co. has been formed in order that Georgia may cooperate with them through this column. It also served to have Georgia in the news every issue. 

GEORGIA — SCM, Ernest L. Morgan, W4FDJ — Your new SCM asks all members who live in communities where there are two or more amateurs to communicate with him with respect to appointments as Emergency Coordinator. Order that they may cooperate with the Civilian Defense to the fullest. All amateurs, ARRL members or otherwise, are asked to drop a card giving the dope on themselves or neighbors for inclusion in this monthly column. It also serves to have Georgia in the news every issue. QWG is now a major. FOO is Lt. A.A.C. ERS AMM 1/6 at Jax. FFI FDE EEE all at Jax. JFF at Tampa. GRP at Berwyn, Ill. CBR at Charleston, S. C. FWQ doing a big job at Aladdin. "Dow" Pepper got another at Savannah if he's there yet. 73. — "Pop."

SOUTHWESTERN DIVISION

ARIZONA — SCM, Douglas Atkinson, W6RWR — The list of Arizona hams, known to be in some branch of current war activities now totals 29. There must be others whom I've missed. If you know of any, kindly let me know, so that we may let the fellows know of them through this column. Here is the list of those known to be in service: FZQ, HBR, IUG, IDQ, IYQ, JHV, KOL, LSK, MSP, NKG, OVE, PQQ, QLZ, QWG, RFE, RGF, RFE, RSN, RJD, SGO, SOG, TRG, TWU, TYU, TWD, UGW, UKY. The gang runs long and hard for speedy recovery of GQJ, who is confined to his bed at Palm Beach. FSS is holding down Daytona Beach by himself these days. ETQ now in Jax with St. Johns River Shipbuilding and also active in Jax CAP. FWX reports much FDF activity in Jax area. 1st Signal Co. has been formed in order that Georgia may cooperate with them through this column. It also served to have Georgia in the news every issue. QWG is now a major. FOO is Lt. A.A.C. ERS AMM 1/6 at Jax. FFI FDE EEE all at Jax. JFF at Tampa. GRP at Berwyn, Ill. CBR at Charleston, S. C. FWQ doing a big job at Aladdin. "Dow" Pepper got another at Savannah if he's there yet. 73. — "Pop."

W9MYR reports that his ARRL code-proficiency certificate was accepted by the government as ample proof of his code ability at 25 w.p.m., in connection with an exam he took recently.

Clearwater, Pinellas County, has first WERS license in Florida! Call is WJIL. WJIL 1 and 2, actually took part and furnished valuable assistance in recent blackout exercise covering that area. It is hoped that Hillsboro will come thru before next report. DUJ is now tech. sgt. with OAF, holding down operations at Sarasota as field installation controller.

WESTERN FLORIDA — SCM, Oscar Cederstrom, W4AXP — MS renewed his EC certificate. GWU reported missing in action. He was a member of the lost squadron in the Pacific battle area. Also, in the course of recognizing one of his family. REJ, RGF, RFS, RJN, RIZO N-A, SOM, Douglas Aitken, W6RWW — The list of Arizona hams, known to be in some branch of current war activities now totals 29. There must be others whom I've missed. If you know of any, kindly let me know, so that we may let the fellows know of them through this column. Here is the list of those known to be in service: FZQ, HBR, IUG, IDQ, IYQ, JHV, KOL, LSK, MSP, NKG, OVE, PQQ, QLZ, QWG, RFE, RGF, RFE, RSN, RJD, SGO, SOG, TRG, TWU, TYU, TWD, UGW, UKY. The gang runs long and hard for speedy recovery of GQJ, who is confined to his bed at Palm Beach. FSS is holding down Daytona Beach by himself these days. ETQ now in Jax with St. Johns River Shipbuilding and also active in Jax CAP. FWX reports much FDF activity in Jax area. 1st Signal Co. has been formed in order that Georgia may cooperate with them through this column. It also served to have Georgia in the news every issue. QWG is now a major. FOO is Lt. A.A.C. ERS AMM 1/6 at Jax. FFI FDE EEE all at Jax. JFF at Tampa. GRP at Berwyn, Ill. CBR at Charleston, S. C. FWQ doing a big job at Aladdin. "Dow" Pepper got another at Savannah if he's there yet. 73. — "Pop."

SOUTHWESTERN DIVISION

ARIZONA — SCM, Douglas Atkinson, W6RWR — The list of Arizona hams, known to be in some branch of current war activities now totals 29. There must be others whom I've missed. If you know of any, kindly let me know, so that we may let the fellows know of them through this column. Here is the list of those known to be in service: FZQ, HBR, IUG, IDQ, IYQ, JHV, KOL, LSK, MSP, NKG, OVE, PQQ, QLZ, QWG, RFE, RGF, RFE, RSN, RJD, SGO, SOG, TRG, TWU, TYU, TWD, UGW, UKY. The gang runs long and hard for speedy recovery of GQJ, who is confined to his bed at Palm Beach. FSS is holding down Daytona Beach by himself these days. ETQ now in Jax with St. Johns River Shipbuilding and also active in Jax CAP. FWX reports much FDF activity in Jax area. 1st Signal Co. has been formed in order that Georgia may cooperate with them through this column. It also served to have Georgia in the news every issue. QWG is now a major. FOO is Lt. A.A.C. ERS AMM 1/6 at Jax. FFI FDE EEE all at Jax. JFF at Tampa. GRP at Berwyn, Ill. CBR at Charleston, S. C. FWQ doing a big job at Aladdin. "Dow" Pepper got another at Savannah if he's there yet. 73. — "Pop."

W9MYR reports that his ARRL code-proficiency certificate was accepted by the government as ample proof of his code ability at 25 w.p.m., in connection with an exam he took recently.
PIONEERS...in war and peace

THE FIRST TANTALUM TUBE WAS A GAMMATRON

Gammatron engineers, in their constant quest for more rugged and efficient electronic tubes, were first to appreciate the remarkable advantages of tantalum as a plate and grid material.

This unique element has the lowest gas content of any metal. It readily endures high temperatures, and will radiate tremendous amounts of power. Moreover, tantalum has the very desirable characteristic of acting as a sponge with respect to gases; once it is de-gassed by the Heintz and Kaufman process, it eagerly absorbs and retains any gases later released.

Thus tantalum construction and Gammatron design result in electronic tubes which have longer life, and the ability to withstand heavy overloads without freeing destructive gas.

Gammatrons in dozens of types, with ratings from 50 to 5000 watts, are now serving the American cause on the r.f. and u.h. frequencies...just as many new types will serve in the peacetime age of electronics.

GAMMATRONS...OF COURSE!

HK-257 BEAM PENTODE
OPERATING DATA
RF Power Amplifier, Class "C" Unmodulated

<table>
<thead>
<tr>
<th>Rating</th>
<th>Operation</th>
<th>Maximum</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Output</td>
<td>335 Watts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving Power</td>
<td>0 Watts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Plate Volts</td>
<td>4000</td>
<td>3000 Volts</td>
<td></td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>150</td>
<td>100 M.A.</td>
<td></td>
</tr>
<tr>
<td>DC Suppressor Voltage</td>
<td>60 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Suppressor Current</td>
<td>3 M.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Screen Voltage</td>
<td>750</td>
<td>750 Volts</td>
<td></td>
</tr>
<tr>
<td>DC Screen Current</td>
<td>30</td>
<td>8 M.A.</td>
<td></td>
</tr>
<tr>
<td>DC Control Grid Voltage</td>
<td>-500</td>
<td>-200 Volts</td>
<td></td>
</tr>
<tr>
<td>DC Control Grid Current</td>
<td>25</td>
<td>0 M.A.</td>
<td></td>
</tr>
<tr>
<td>Peak RF Control Voltage</td>
<td>170 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>75</td>
<td>65 Watts</td>
<td></td>
</tr>
</tbody>
</table>
"84" Aerovox paper tubulars. 400 v. D.C.W. .01 to 1.0 mf., 600 v. .001 to .5 mf., 1000 v. .001 to 1.0 mf., and 1600 v. .004 to .05 mf.

- Non-inductive paper section in extra-generously-waxed tubing with wax-sealed ends.
- Tinned-copper pigtail leads that won't pull out or loosen.
- New colorful varnished label jacket.

Better PAPER CONDENSERS

Yes, better, because these Aerovox paper tubulars are super-sealed. Beneath the colorful yellow-black-red label jacket you'll find an extra-generously-waxed cartridge to match the wax-sealed ends. A better job—at no extra cost.

Ask Our Jobber...

Ask him for Aerovox paper tubulars to serve most purposes where dependable paper condensers are required. Ask for new "Victory" catalog.

The Fifth Regional WERS

(Continued from page 89)

Coordinators in many key cities throughout Ohio. These men are generally the leaders selected by the local amateur organizations. They have a technical knowledge of radio equipment which is essential in establishing a WERS network. Therefore, it is our suggestion that this individual be contacted and his services obtained as radio aide or his suggestion secured as to who would be suitable for handling this assignment.¹

Section Communications Managers of the various states are also kept informed by the state defense council of all information being disseminated, so that he may inform each Emergency Coordinator whom to contact to offer the facilities and personnel of the local amateur organization. In Ohio, Dan McCoy, WSCBI, Section Communications Manager of the ARRL for Ohio, has been appointed State Radio Aide in charge of WERS for the Ohio State Council of Defense. This will give considerable stimulus to our Ohio program and has already proved advantageous.

Radio Communications Committee

WERS is a specific service in itself, but its usefulness and success is dependent to a great extent upon its coördination and cooperation with existing radio communications facilities. It was, therefore, requested that each state set up a radio communications committee consisting of representatives of all radio services in the community. This committee includes (1) the chief of the state police radio division, (2) outstanding municipal signal man representing municipal radio stations throughout the state, (3) the ARRL section communications manager and (4) a representative of the commercial broadcaster's association.

This committee is charged with the responsibility of preparing plans for the utilization of existing state, municipal and commercial radio facilities and the tying of such existing facilities in with WERS networks to function as a unit under emergency conditions. Such committees already have been formed in the states of Ohio and Indiana and are shortly to be appointed for the states of Kentucky and West Virginia.

Results

Considering that the Fifth Region of OCD is composed entirely of inland states, the organization provided for and planned as well as the results achieved have been extraordinarily comprehensive. The latest information on licenses granted by FCC (through Dec. 17, 1942) shows that six Ohio points have had licenses granted (Akron, Piqua, Athens, Columbus, Cuyahoga County and Dayton). Several other key Ohio cities have filed their license applications. In the State of Indiana the cities of Anderson, Fort Wayne and Richmond, in the State of West Virginia the County of Kanawha and in the State of

¹ From a memorandum to local Ohio Defense Council officials written by D. E. Park, Communications Coordinator of the Ohio State Council of Defense.
Minus Sound Effects

If you were receiving radio messages from men in the midst of ear-splitting battle noises, you'd hear crisp speech undistorted by background sound effects.

Electro-Voice Microphones, in military service, are helping to make it possible. Similar microphones, designed to achieve such results, will be available for specific commercial applications . . . after our wartime job is done.

Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., INC. 1239 SOUTH BEND AVE., SOUTH BEND, INDIANA
Kentucky the city of Ashland have been granted licenses. Many other applications for points in the Fifth Region are now pending action in Washington. It is significant that an Ohio municipality (Akron) was the first WERS licensee in the United States, and that that license will shortly be extended to cover several other adjacent communities.

Due credit should be given to the following state defense council communications coordinators for their efforts in furthering WERS in their respective states: Mr. D. E. Park, Ohio; Mr. A. A. Sharp, Kentucky; and Lt. Walter Mentzer, Indiana. It is to be expected that, in view of the centralized organization in the Fifth Region of OCD, the states of Ohio, Indiana, Kentucky and West Virginia will continue to play leading roles in WERS organization and operation.

QST Visits the Coast Guard

(Continued from page 18)
New Low Temperature Electrolyte

War requirements are providing the incentive for new developments that might have been delayed for years under peace-time conditions. Military radio equipment must be dependable in tanks operating under the blistering heat of the Sahara Desert sun. The equipment must operate, too, in the icy sub-zero temperature of the stratosphere, where giant bomber planes carry their messages of destruction to the enemy. Ambient temperature ranges of -56° C. to +85° C. present problems never previously encountered.

Certain inherent characteristics of dry electrolytic capacitors make them invaluable for military use—they are compact, light in weight and require a minimum of critical materials. Formerly, however, there were certain characteristics in electrolytic capacitors which demanded improvement—and the graph shows how well these demands have been met. The improvement results from a special new electrolyte obtainable up to 300 volt rating and developed in the Laboratory of P. R. Mallory & Co., Inc.

To interpret the graph, remember that with decreasing temperature the capacity of an electrolytic condenser tends to drop, while the series resistance tends to increase. Both of these changes increase the total impedance of a capacitor. Since the performance of a capacitor in either by-passing or filter service is dependent upon its total impedance, the impedance value is a more comprehensive measure of capacitor merit than either series-resistance or capacity values, considered separately.

Curve 1 (at left)
shows the characteristics of a typical electrolytic capacitor of the type formerly manufactured for domestic use. At -40° C., the impedance has increased 3 times over the room temperature value, and in a filter circuit the hum output would increase proportionately.

Curve 2 (at left below)
shows the impedance characteristics of a typical condenser employing the new Mallory electrolyte which has been developed especially for low temperature applications. The graph illustrates that at -40° C., the filtering or by-passing action is 100% better than equivalent condensers of the older construction.

For voltages over 300, these units may be series connected and still have less weight and size than equivalent paper capacitors.

This advertisement is No. 2 of a series to acquaint you with the practical application of radio products.

P. R. MALLORY & CO., Inc.
INDIANAPOLIS, INDIANA
Cable Address—PEU2MALL0
Under impetus of war, autos have developed into sturdy jeeps and mighty tanks, transport planes into slugging bombers—and peacetime B. & W. Inductor Coils into rugged warriors of the ether waves.

In many instances, standard B. & W. Coils have turned the trick. In others, such as the one illustrated above, it was only necessary to add extra "armor" to standard coils to meet the rough and tumble action of the fighting service. In still others it has, of course, been necessary to design special units for ultra special requirements.

Whatever the need, B. & W. Inductor Coil engineering still leads the way!
Every time a manufacturer produces a transmitting tube, he is making a definite contribution toward winning the war. At times the personal welfare of hundreds of millions of people throughout the entire United Nations may depend on just one single vital transmission—perhaps on just the function of a single tube.

The great responsibility of all tube builders is shared and carefully guarded by Taylor Tubes. Every manufacturing facility, together with the productive efforts of the entire personnel of skilled Taylor craftsmen is pledged to Victory.

_Millions Depend on Taylor Tube Quality_

- ✓ TRANSMITTING
- ✓ ELECTRONIC
- ✓ RECTIFIER
- ✓ INDUSTRIAL

"More Watts Per Dollar"

Taylor HEAVY CUSTOM BUILT DUTY Tubes

TAYLOR TUBES, INC., 2341 WABANSIA AVE., CHICAGO, ILLINOIS
Get my big free catalog and order rigs and parts you need now. Catalog fully illustrated, contains largest stock of parts and supplies on hand. Stock won't last... so get catalog today and pick out what you'll want. Lowest prices, best terms in the country.

WRITE TO LEO W9GFQ

WHOLESALE RADIO LABORATORIES
746 West Broadway
Council Bluffs, Iowa

Best Selling Radio and Inter-Com. PILOT LIGHT ASSEMBLIES
Gothard No. 300 line are standard models (require a 7/16 inch diameter hole for mounting). You can have IMMEDIATE DELIVERIES FROM GOTHARD... if you want special models send us your specifications—you will receive a prompt reply.

There is a New Gothard Catalog available—
write for your copy today.

Gothard MANUFACTURING COMPANY
1316 North Ninth Street, Springfield, Illinois

A great deal of the training emphasis at the Coast Guard school is placed on the watch-standing class, therefore. To the watch-standing room up on the fourth deck the students come at the end of their 13th week for hours of practice in on-the-air listening to actual marine communications. Each table in this room is provided with a relay rack on which are installed two receivers, giving coverage on the low, intermediate and high frequencies.

Part of the time they listen to the coastal transmissions in the very low-frequency region. A point of interest in this connection is that the LF receivers in use while we were there didn't tune down that low. New ones were on the way, but in the meantime all the receivers were being fed from a converter which translated the low-frequency transmissions to a higher frequency within the receiver range. This arrangement still permitted the student operators to get practice in receiver tuning and adjustment.

For a total of ten weeks the student listens to these transmissions, practicing intercepting traffic from the air, keeping the log and the other details of actual operation.

His performance in the watch-standing class is the final criterion of a student's ability to graduate. At the end of it he should be qualified to step aboard a transport and take over a watch as well as a veteran—or almost as well, at least.

Training Schedule

These three divisions of the training—code, procedure and watch-standing—occupy roughly three-quarters of the entire training time. The remaining quarter is applied in the theory and matériel divisions.

At the start the new student receives code and typing training for two of the four 1 3/4-hour class periods of the day, the third and fourth being occupied with procedure and theory lectures.

After the first week or so, a typical day's code and typing work of 3 1/2 hours is subdivided about as follows: 2 hours transcription of aural copy on the typewriter, 45 minutes of straight typing practice, 30 minutes of sending and 15 minutes of code listening (no copying) all broken down into alternate 15-minute periods. After the 13th week the student begins in the watch-standing room.

Meanwhile the theory classes have been completed, and with the 14th week they move from the lecture rooms to the labs for 10 weeks of practical matériel work.

The weekly schedule calls for regular practice, lecture and lab periods for five days in each week—Monday through Friday. Code tests are given in the several classes on Friday, while on Saturday mornings written exams are given in theory and procedure. In each case the tests are designed to provide useful review practice as well as an inventory of progress.

Theory and Matériel

We were particularly interested in learning how much radio theory and matériel knowledge a
WANTED IMMEDIATELY
FOR WAR EMERGENCY

METERS

of the following description ONLY:

301 type Weston, and equivalent General Electric or Westinghouse types—round or square cases, for mounting in 2¾ inch hole, DC MILLIAMMETERS with scale ranges from 0–100 ma to 0–600 ma. AC VOLTMETERS, range, 0–6 v. A.C. to 0–10 v. A.C.

Seven dollars each will be paid you for each meter accepted, (enough to assure your replacement with a new meter after the war). All meters must be in good operating condition. We reserve the right to reject and return (prepaid) any meters which we find unsuitable. Your cooperation will be deeply appreciated—and will constitute a definite contribution to the war effort. Please send your meters to

THE HALLICRAFTERS CO.
2611 Indiana Avenue  Chicago, Illinois

Please mark plainly on the outside of each package, your name, address and the words "METERS—RUSH"
Coast Guard radio operator is expected to have. The answer is — plenty!

Of the 24 weeks, the first 14 are devoted to theory, the following 10 to matériel. The distinction is principally in that the first division represents a lecture course while the second is lab work. (At the outset the lecture and lab sessions were alternated; while this is still conceded to be the best system, the practical mechanics of instruction have dictated that the two divisions now be given in sequence rather than in parallel.) The scope of this training can best be appreciated by summarizing the lesson topics.

As the courses are now organized, a week is devoted to each topic. Here is the list, by weeks:

**Theory:**
(1) arithmetic and mensuration (general review of mathematics, including algebra and geometry); (2) electronics (basic theory of electricity, the electron, etc.); (3) d.c. and a.c.; (4, 5) Ohm's Law for d.c. and a.c. circuits, (6) primary and secondary cells (storage batteries are important items in shipboard installations); (7) magnetism and alternators; (8) d.c. motors and generators; (9) measuring instruments; (10) inductance and capacity; (11) a.c. circuits; resonance; (12) vacuum tubes; (13) receivers, direction finders; (14) transmitters, antennas.

**Matériel:**
(15) shop practice (wiring, use and care of tools, etc.); (16) conductors, insulators, soldering; (17) Ohm's Law (color codes, use of ohmmeter, etc.); (18) batteries (charging and care), symbols, diagrams; (19, 20) oscillators (building up breadboard layouts from experimental kits), transmitters, frequency checking; (23) radio direction finders (use and troubleshooting); (24) transmitters and transceivers (adjustment, troubleshooting and analysis).

The theory and basic matériel classes are under the supervision of Lt. (jg) A. P. Winkler. Warrant Officer C. C. Charley is assigned as chief of the matériel instructors, and Warrant Officer G. Williams is assigned as chief of the theory instructors.

The theory section of the course is based on a text prepared by the Capitol Radio Engineering Institute. Slide films and scientific equipment are used to augment theory instruction. In addition, the students are supplied with copies of the ARRL Handbook for reference — and how well-thumbed and dog-eared these become!

The matériel classes are divided into sections of about 25 men each. The instructor assigned to each section remains with it throughout the term of the class. The emphasis is entirely on practical work and every man takes a hand — soldering, assembling standard breadboard layouts, running tube characteristic curves, trouble-shooting on obsolete Coast Guard receivers and transmitters in which commonly-encountered troubles have previously been introduced, witnessing demonstrations illustrated by an RCA "dynamic demonstrator" and Gulliverian models of the standard test sets and equipment. In this theory and matériel training the instructors constantly bear
Listen and above the clatter and crash of war you can hear the murmuring of a coming peace — whisperings from industry preparing for a new future. And there are strange new sounds — the names of new products and of new things to be accomplished. From the field of electronics come the greatest promises of all.

Tomorrow is to be the day of electronics. In industry, in transportation, in communications and in the office and the home, new efficiency, new conveniences and new pleasures will spring from the achievements that electronics have wrought in war.

To the companies that will produce the electronic devices of the future, TUNG-SOL has an important message. We will be ready. When this tomorrow dawns, you will find at TUNG-SOL not only a dependable source of electronic tubes for transmitting, receiving and amplifying, but an engineering laboratory service to help you with your plans of tomorrow.
Continued from page 108

In mind that their students are going out as third-class radiomen, not as engineers. Yet they know, too, that some of the men may see their first duty on tenders or other Coast Guard vessels which carry only an operator or two, with no technicians, and that if anything goes wrong the operator himself must be able to fix it — and without delay. They make certain that when the time comes their graduates won’t be found wanting.

Of course, some of the men who show special aptitude for it may later specialize in matériel. These may be sent to the New London school for advanced training.

**Low Average Age**

One outstanding thing about the student body at Atlantic City is the low average age. A typical class will predominate in 19- and 20-year-olds. Rarely do you see a man of more than 25. “A man over 25 has a tough row to hoe,” we were told. The younger a student is the better are his chances of coming through near the top of the class.

Only a few of the trainees assigned to Atlantic City have had some radio background to begin with. Some were hams; others have been servicemen or helpers around a repair shop. The majority are high-school graduates who have requested radio training.

Some, in fact, get transferred to the school from active duty as ordinary seamen — after having hung around the radio shack aboard ship enough to draw attention to themselves by being constantly under foot. A few may have served as strikers in the radio room, picking up a little code and a smattering of technical terms much the way many a budding ham got his start — by haunting another ham’s shack.

Having established their interest and aptitude, these men were selected by their commanders when a quota for radio trainees was given their district. The remainder of the quota will have been filled by men assigned directly from the basic training camps on the basis of experience or special aptitude.

All of the men so selected normally are interviewed by a board. First, of course, they are asked if they want to undertake the training. Then they are given an objective “IQ” test and their experience records checked. The top rankers are then lifted off until the required quota is filled — and the Atlantic City school has another of its monthly classes.

When his training period is completed each man is sent back to his own Coast Guard district, and there he is assigned to active duty. This may be any job in the service that happens to need a radio man, whether afloat or ashore — anything except flying duty, for which additional preliminary training is required.

**School Started in June**

The Atlantic City school is a new school, but its roots are deep-laid. It was only the end of last June when the Coast Guard took over the old Elk’s Hall and the Morton Hotel on famed
FREEZE 'EM OR FRY 'EM

Global war means airplanes in the Arctic. It means tanks in the tropics. For fighting machines of all kinds, combat conditions call for freezing or frying — and sometimes both!

Solar is building capacitors which meet these extreme conditions. If "freezing or frying" is part of your capacitor problems—call on Solar's "temperature-engineering" services.

Facts and more facts. Complete capacitor data describing and illustrating the entire Solar line is now available to design engineers on request.

Solar Capacitor Sales Corp.
Bayonne, N. J.

II CAPACITORS II

Makers of Capacitors: Electrolytic • Mica • Paper • Trimmer • Transmitting
LET'S ALL HELP WIN THIS WAR!

You can help win this war by contacting us if you are willing to convert your equipment into cash.

After the war, you can buy new and better apparatus with what we will pay you now.

Write, telephone or telegraph us description of communications receivers, transmitters and parts, you will be paid cash immediately without bother or red tape.

We also have a store at 2335 Westwood Blvd., West Los Angeles, Calif.

COMPLETE STOCKS

★ We still have large stocks of receivers, 2½ meter equipment, meters, tubes, transformers, resistors, condensers, panels, chasis, and radio parts of all sorts. We sell and rent code teaching equipment. Your orders and inquiries invited.

HENRY RADIO SHOP

BUTLER, MISSOURI

"World's Largest Distributor of Communications Receivers"

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

RADIO OPERATORS’ LICENSE MANUAL

1942 EDITION

Complete and authentic question and answer manual on commercial radio operator license examinations. 1397 questions and answers, 230 pages of vital information for radio operator license candidates.

$3.00 Postpaid or write for descriptive circular.

WAYNE MILLER

The Engineering Building

Chicago

RADIO

PRE-MILITARY TRAINING

for MEN of MILITARY AGE

CIVILIAN TRAINING

for MEN and WOMEN seeking Careers in Radio

Complete Course up to 8 Months

Write, Phone or Call 9 a.m. - 9:30 p.m.

METROPOLITAN TECHNICAL SCHOOL

RADIO DIVISION, Dept. S

7 CENTRAL PARK WEST, N.Y.

Circle 7-2515 Licensed by State of N.Y.

Training at the Elks’ Hall

Equally effective and utilitarian is the carefully-planned arrangement of the training school at the Old Elks’ Building. The layout is so logically arranged it might almost seem the building had been designed for the purpose.
The Triplett Combat Line

New Answers to specialized needs of War Production Speed-up and Standardization; Performance under the Stress and Vibrations of Combat Service. Model 437 JP—A rectangular line of meters to meet dimensions shown (see diagram). Wide-open scale for maximum readability. Complete coverage AC-DC Voltmeters, Ammeters and Wattmeters. Magnetic or static shielding provided on order. Molded Plastic Case for maximum protection in high voltage circuits. Pivots, Jewels and other component parts designed to meet severe vibration requirements.

Model 372—Frequency Meter—"All-American make" Vibrating Reed Frequency Meter. Maximum readability by grouping of Reeds. Range-Frequency-Voltage to meet specific requirements. Protected against excessive panel vibration. In standard 3 inch mounting or on special order in any cataloged Triplett Case.

A WORD ABOUT DELIVERIES

Naturally deliveries are subject to necessary priority regulations. We urge prompt filing of orders for delivery as may be consistent with America's War effort.

THE TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, O.
The big code room where the preliminary classes are held is probably one of the largest single code classrooms in the world. Originally the Lodge Room, the high ceiling of the spacious room rises a full two stories. Well-spaced code tables provide positions for a large group of men. Around the walls are GMT clocks, typewriter keyboard charts and other teaching aids. The clocks accustom students from the beginning to think in terms of universal Greenwich time, as they will have to do on shipboard.

Not the least feature of this big code room is the pipe organ, a relic of its original function. The organ works, too.

The advanced code class meets on the second floor — the main deck. The tables in this classroom are arranged to accommodate students in groups of eight, each position being provided with an 8-circuit switch box. By this switch operation on different frequencies can be simulated, giving the student preliminary practice in watchstanding and intercommunication on the equivalent of eight different channels.

The procedure class also meets in a large classroom on the top deck. Theory lectures are heard at the rear of the second deck.

Two other smaller code classrooms are found on the lower deck, along with the materiel lab, transmitter room, stockroom and a carpenter shop. One of these code rooms is the double-level room shown in one of the photographs — formerly the Elks' kitchen and grill room.

The transmitter room, by the way, was once the bar. Now it houses a dozen or more standard Coast Guard transmitters, types currently in use for both shipboard and shore installations, together with motor-generator sets, storage batteries and charging panels, and completely-wired operating positions. On these the students learn operation, tuning, trouble-shooting, adjustment.

In the carpenter shop members of the permanent detail do needed repair work, build tables and other equipment and construct demonstration models for the materiel lab. This is one illustration of the way the station makes itself self-sustaining. Another is the typewriter shop.

It takes a lot of typewriters to teach code and typing to such a large group of men. As may be seen in the photographs, portables are used — not because they are necessarily better, but because they were available. Maintenance of these machines is not because they are necessarily better, but because they were available. Maintenance of these machines is carried on with characteristic Coast Guard thoroughness. Each typewriter is kept covered and locked when not actually in use — and the instructors keep the keys. The station maintains its own typewriter repair shop, with five typewriter repairmen who apply their full attention to cleaning, adjusting and repairing the machines.

Incidentally, it takes a lot of headphones and keys to supply such a class, too. At the outset headphones were the critical shortage item and many a tired pair of ancient cans was resurrected to supply the early classes. Now that situation is well under control and the present scarcity is in

"Three-Way" Transmitter- Receivers for CD and Military Use
Write for Circular CD

Radio Remote Control Equipment for Models and Industry

RADIO CONTROL HEADQUARTERS, INC.
P. O. Box 214
Deal, New Jersey

SICKLES COILS
ALL TYPES OF RF AND IF WINDINGS
Manufactured by
F. W. SICKLES COMPANY
P. O. Box 920
Springfield, Mass.
Let Hytron Break that Bottleneck!

Hytron

War-Production Shipments Up 700%

In spite of this big increase, Hytron has available:

IMMEDIATELY — large capacity for certain types of radio and electronic tubes.

IN SECOND QUARTER — still larger capacity for almost all types which Hytron is tooled to make.

IN THIRD AND FOURTH QUARTERS — capacity almost unlimited for all types suited to Hytron’s production lines.

If you place your orders now, Hytron’s fast-rising productive capacity can smash those bottlenecks caused by tube shortages.

Hytron Corp., Salem and Newburyport, Mass.

Manufacturers of Radio Tubes Since 1921...
IT PAYS 2 WAYS
WHEN YOU
BUY WAR BONDS

1. Victory Sooner!
2. Interest for You!

Of course it’s patriotic to buy War Bonds, it’s also a common sense investment, and it pays the best interest you can get anywhere. lend your money to Uncle Sam today. Full information at your bank or post office.

Your War Bond Interest Can Actually Pay for Your Amateur Radio Equipment Purchased!

OIL FILLED and Impregnated FILTER CONDENSERS

Real Quality at Prewar Prices! Guaranteed at Rated Voltage.

Now as low as 59¢

<table>
<thead>
<tr>
<th>Volts</th>
<th>Mfd.</th>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>DC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.000</td>
<td>5 x 1 1/4 x 1 1/4</td>
<td>6.90</td>
<td></td>
</tr>
<tr>
<td>2.000</td>
<td>5 x 1 1/4 x 1 1/4</td>
<td>2.75</td>
<td></td>
</tr>
<tr>
<td>3.000</td>
<td>5 x 1 1/4 x 1 1/4</td>
<td>3.75</td>
<td></td>
</tr>
</tbody>
</table>

ORDER TODAY DIRECT FROM NEWARK OR WRITE FOR FREE BARGAIN CATALOG

LEARN CODE the way you’ll be using it by SOUND

The best way to learn to read code is by listening to code. The best way to learn to send code is by hearing your own sending repeated back to you. With the new ALL ELECTRIC MASTER TELEPLEX Code Teaching Machine, you learn code the natural, easy, fascinating way. Only instrument ever produced which records your sending in visible dots and dashes — then SENDS BACK your own key work at any speed you desire. There are NO PERFORATIONS — NO INK. A marvel of simplicity. That’s why practically every school teaching code uses TELEPLEX. We furnish complete courses, including the All Electric Master Teleplex, give you personal instruction with a MONEY BACK GUARANTEE — all at a surprisingly low cost. Write today for FREE catalog Q. 2. NO obligation.

HAM SPECIAL

TELEPLEX CO. 107 Hudson St. Jersey City, N. J.

(Continued from page 114)

hand keys. These are hoarded and allocated almost as rigidly as rubber tires — but somehow enough are found to go around.

Student Environment

Getting back to the station, it’s hard to realize that only a few months before this clean, efficient building was a dirty, decrepit structure that had lain idle for a decade or more. Now shining with spit and polish, fitted with trim wallboard bulkheads, equipped with bright new code and lab tables, it’s the attractive, work-worthy kind of place that just naturally inspires a student to do his very best.

In all other ways, too, the prospective Coast Guard operators are given every incentive to do the best work of which they are capable. There’s none of the dull drudgery of policing or duty companies or mess detail, for example. A permanent company of regular sailors takes care of all the upkeep, cleaning, guard duty and allied work around the school. And in the quarters the original hotel staff has not only been retained but augmented. Mess, as was suggested before, is handled entirely by the hotel; the station itself has no commissary problem.

All the students have to do is learn radio — but that they must do, thoroughly and proficiently. To do so requires a full-time schedule that explains why no other duties are imposed.

It is a 12-hour-plus daily schedule. Reveille is sounded at 6:00 A.M. The morning meal comes at 6:45 and the first class begins an hour later. Two 1½-hour class sessions follow, with a 15-minute rest period in between. At 12:05 P.M. they march out in formation of the noon meal, drifting back in groups as they finish. Classes commence again at 1:00 P.M., with another pair of sessions and a rest interval.

From 4:30 to 5:30 selected groups are given infantry drill or other exercise on the “drill ground” — a larger converted parking lot across the street from the hotel. Evening meal is from 5:30 to 6:30. Then follows a free period, with those taking required additional instructions leaving for the night classes at 8:00 P.M. The remainder are free to read or study or play, as they please.

Taps sound for all at 10:30. The students must stay on the station except for Wednesday night, however. That’s “free night”; from 4:30 P.M. until 2:00 A.M. they may roam the long streets of Atlantic City and taste the varied attractions it affords its servicemen at will. Saturday afternoon from 1:00 P.M. and all day Sunday are free as well.

At all other times the students must remain on the station. By a generous stretch of official interpretation, however, the station includes the waterfront at the head of Virginia Avenue, and during the summertime mostly the students to a man are to be found swimming in the blue Atlantic or on the white beach charming the local feminine population.

The Atlantic City YLs, too, have found that, at work or at play, the Coast Guard’s motto is Semper Paratus — Always Ready.
For All Methods of Quartz Cutting

Whether you use fast through cutting or the more precise down feed Rimlocks can speed up your operations! These Di-Met Diamond Abrasive Wheels need no coaxing on quartz, Steatite, or other hard, brittle materials because they’re designed for speed. The exclusive Rimlock bonding method anchors the diamonds solidly—yet without additional fracturing, and points the diamonds radially so that their sharpest cutting edges do the work. Graded diamonds and high operating speeds produce excellent, smooth surfaces.

Rimlocks are long lived cutters, too—over 700 quartz wafers, averaging 4 sq. inches of surface area each, have been cut with a single blade.

Let Rimlocks prove their superiority in your own quartz cutting operations. Available in many sizes and in two bonds—steel and copper. Write for our new bulletin.

Felker Manufacturing Company
Box 208-A, Torrance, California
MANUFACTURERS OF DIAMOND ABRASIVE WHEELS
The students will also receive general instruction in the organization of the Navy, Marine Corps and Coast Guard. At the end of the first 8 months of training the Navy will give an achievement examination. The results of these examinations will be determinative in making further assignments.

Upon satisfactory completion of their college training, all students will be assigned to additional specialized training in the Navy, Marine Corps or Coast Guard. If found qualified at the completion of this latter training period they will be commissioned as officers in the appropriate Reserve.

The Navy Department has now in operation four programs for the training of male officers: V-1, V-5, V-7 and the Naval Reserve Officers Training Corps.

Under the new program, all reservists in V-1, V-5 and V-7 may continue in college following their present studies until a date to be determined, when they will be placed on active duty as apprentice seamen with full pay, subsistence and uniform. In that status they will complete their college training, which will be accelerated in the case of all students except those who, by July 1, 1943, will enter the senior college class, and engineering students.

The Naval Officer Reserve Training Corps will be continued as an integral part of the new program. NROTC will be selected at the end of the first two semesters from students inducted under the Navy College Training Program. All NROTC students in the Naval Reserve will be called to active duty.

On a date to be announced, students holding probationary commissions in the Naval Reserve, and on active duty in a deferred status, will be permitted to resign and accept assignment to the college training program as apprentice seamen on active duty. On satisfactory completion of their prescribed professional education they will again be commissioned in the Naval Reserve.

Note: So far as we can see, all college students not included in the above plan either by reason of age limitations or enlisted status can volunteer for induction into the Navy and if accepted be placed on the same status as those students already covered by the provisions of the plan.

U.S.A. Calling

(Continued from page 50)

The students will also receive general instruction in the organization of the Navy, Marine Corps and Coast Guard. At the end of the first 8 months of training the Navy will give an achievement examination. The results of these examinations will be determinative in making further assignments.

Upon satisfactory completion of their college training, all students will be assigned to additional specialized training in the Navy, Marine Corps or Coast Guard. If found qualified at the completion of this latter training period they will be commissioned as officers in the appropriate Reserve.

The Navy Department has now in operation four programs for the training of male officers: V-1, V-5, V-7 and the Naval Reserve Officers Training Corps.

Under the new program, all reservists in V-1, V-5 and V-7 may continue in college following their present studies until a date to be determined, when they will be placed on active duty as apprentice seamen with full pay, subsistence and uniform. In that status they will complete their college training, which will be accelerated in the case of all students except those who, by July 1, 1943, will enter the senior college class, and engineering students.

The Naval Officer Reserve Training Corps will be continued as an integral part of the new program. NROTC will be selected at the end of the first two semesters from students inducted under the Navy College Training Program. All NROTC students in the Naval Reserve will be called to active duty.

On a date to be announced, students holding probationary commissions in the Naval Reserve, and on active duty in a deferred status, will be permitted to resign and accept assignment to the college training program as apprentice seamen on active duty. On satisfactory completion of their prescribed professional education they will again be commissioned in the Naval Reserve.

Note: So far as we can see, all college students not included in the above plan either by reason of age limitations or enlisted status can volunteer for induction into the Navy and if accepted be placed on the same status as those students already covered by the provisions of the plan.

IF YOUR COPY OF QST IS LATE—

Bear with us and the nation’s transportation systems. We are both doing our best—QST is being printed one to three days earlier each month to help keep deliveries up to schedule—but unavoidable wartime delays sometimes do occur. So if QST is late, just be patient—it’s on the way.
KENYON COMES THRU Every Time

WHERE SPECIFICATIONS ARE TOUGH

Navy specifications involving the apparently impossible [censored] have been successfully met by Kenyon's new triumph the [censored].


... Well, after the war you'll hear all about it. Until then, just remember, where specifications are toughest you'll find a Kenyon Transformer.

KENYON TRANSFORMER CO., Inc.
840 BARRY STREET
NEW YORK, N. Y.

ABBOTT INSTRUMENTS
Are Carrying the Messages THROUGH!

In modern warfare coordination plays a major role. When strategy must be relayed to each branch of the fighting forces, there can be NO slip-up ... or the entire plan may go wrong. Abbott Instruments are playing their part in the vital communications necessary to the successful prosecution of the war.

ABBOTT INSTRUMENT INC., • 8 WEST 18th STREET • NEW YORK, N. Y.
THE RADIO AMATEUR'S HANDBOOK

"the all-purpose volume on radio"

Text,* data book, operating manual—it is all these and more. As a text it is probably more used in radio schools and colleges than any other single volume. As a practical constructional handbook, it stands in a class alone. As an operating manual, it provides information available from no comparable source.

Available in two editions. Please be sure to specify which edition when ordering.

STANDARD EDITION

Geared to war needs, the latest Edition of THE RADIO AMATEUR'S HANDBOOK is the largest ever published. In addition to the established features it includes a comprehensive 50-page chapter dealing with the vitally-important War Emergency Radio Service plus other new material—all added without sacrificing the essential information in previous editions which made the HANDBOOK the world's most valuable and widely-used radio book. Retained is the highly successful treatment of fundamentals which was an innovation of the 1942 edition. Stripped to essentials, the theory and design sections cover every subject encountered in practical radio communication, sectionalized by topics with abundant cross-referencing and fully indexed. An ideal reference work, the 1943 Edition also contains all the constructional information on tested and proved gear which has always been the outstanding feature of the HANDBOOK.

$1 IN CONTINENTAL U.S.A., $1.50 ELSEWHERE

SPECIAL DEFENSE EDITION

This edition of the HANDBOOK is designed especially for use in radio training courses. It eliminates those portions of the regular edition which are not useful for instruction purposes and has added chapters on mathematics, measuring equipment and code instruction. The first chapter covers the elementary mathematics necessary for the solution of all formulas and interpretation of graphs appearing throughout the text. A four-place log table is included in the Appendix.

$1 POSTPAID ANYWHERE

* The book "A Course In Radio Fundamentals" is based on the text of either of the above mentioned editions of the HANDBOOK — PRICE 30c

AMERICAN RADIO RELAY LEAGUE, INC.

West Hartford, Connecticut, U. S. A.
OFF and ON!

★ In the sending of radio communications ... orders or messages of any kind ... Astatic’s GDN Series Dynamic Microphones provide greater speed and convenience of operation by grip control. This control, built into the desk stand upon which the microphone is mounted, embodies a relay operating OFF-ON switch for remote control of transmitters and amplifiers, placing instant action at the finger tips of the operator. Available in high and low impedance models, of 50 to 50,000 ohms, Astatic GDN Series Microphones are ideally suited to the requirements of air base and marine ground stations, on ships and for similar uses. Proper priority ratings make these microphones available at Radio Parts Jobbers.

The ASTATIC Corporation
YOUNGSTOWN, OHIO
In Canada: Canadian Astatic Ltd.
Toronto, Ontario

DEDICATED TO Victory

BRACH Antennas and other radio and electrical products are now enlisted for the duration—serving, as in the First World War, to hasten the day of Victory. Their high peacetime standards, today applied to the needs of war, reflect our 36 years’ experience in “QUANTITY-plus-QUALITY” manufacture.

L. S. BRACH MFG. CORP. 55-65 DICKERSON ST
NEWARK, N. J.

World’s Oldest and Largest Manufacturers of Radio Aerial Systems
"ON QUIET DAYS LIKE THIS MY ECHOPHONE EC-1 GIVES ME A LOT OF COMFORT!"

H A M - A D S

(1) Advertising shall pertain to radio and shall be of nature of interest to radio amateurs or experimenters of the type of (2) the ad content. Any character will be accepted, except any special typeface or arrangement, such as all or part capital letters, unless such would tend to make the ad stand out from the others.

(3) If the advertiser will accompany the ad, use a paragraph below. The ad will be printed at 1/16 per word, except as noted in paragraph (6) below.

(4) A special rate of 7¢ per word will apply to advertising which, in our judgment, is obviously non-commercial. This rate is in nature and is placed and signed by a member of the American Radio Relay League, who states that the surplus equipment owned, and for sale by an individual, or a group of persons, the price of advertising is not advanced for special equipment. If by a member of the American Radio Relay League the rate is 7¢. An attempt to deal in apparatus is the custom, and all advertising is by the rate. Provisions of paragraphs (1), (2), (4) and (6) apply to all advertising in this column regardless of which rate may apply.

Having made no investigation of the advertiser, the classified columns, the publishers of QST are unable to vouch for their integrity or for the grade or character of the products advertised.

*****

Gear is short. You can sell your old and extra gear through Ham-Ads.

*****

QUARTZ — direct importers from Brazil of best quality pure quartz suitable for making piezo-electric crystals. The Diamond Drill Carbon Co., 719 World Bldg., New York City. WANTED: Radio operators for merchant marine; must have practical ideas. Write today, Victor J. Evans & Co., 777-B 18th St., N.W., Washington, D. C.

COMMERCIAL radio operators examination questions and list with prices to John Hart, 1123 Broadway, New York, N. Y.


FOR SALE — 2.5 meter mobile station, page 15, May 1940 QST. Best offer. W9TRZ, 906 Taylor Ave., Highland Park, Ill.

SEw: HQ-120X receiver with speaker, excellent condition. $120. W9TRZ, 906 Taylor Ave., Highland Park, Ill.

LEARN radio code easily with KolorKarda, complete short-cut memorizing, practice system — $1.00. KolorKarda, (QT243), Bluffton, Ohio.

SELL: 2.5 meter mobile station, page 15, May 1940 QST. Beat offer. New 801, $3; used 802, $2; 800, $2. Lawrence, 31 Avondale, Haddonfield, N. J.

WANTED: late model Garrard record changer with high fidelity pickup. Perfect condition. Will pay any reasonable price. J. David Marks, 95 Hutonger St., New Haven, Conn.

WANTED, for cash, Dual Speed Portable Recorder, Presto — Bruno — Wilcox Gay. W6RLC, Jerome, Ariz.

FOR SALE — 1 Model 7300 Pioneer Gen-E-Motor 6 v. to 300 v. — 100 ma. J. D. Larkin, 1124 Lexington Ave., Buffalo, N. Y.


RADIO TECHNOLOGY

RCA Institute offers an intensive two-year course of high standard embracing all phases of Radio and Television reception, Practical training with modern equipment. Also shorter specialized courses in Commercial Radio Operating, Radio and Television Servicing, and Aviation Communications. For Free Catalog write Dept. ST-43

RCA INSTITUTES, INC.

A Radio Corporation of America Service

75 Varick Street

New York City

GOOD JOBS in RADIO for young men age 17 to 20


THE DODGE TELEGRAPH & RADIO INSTITUTE

408-1 Monroe St., Valparaiso, Indiana

Pre-Induction RADIO COURSES

for Civilians and those entering Military Service

New classes now starting

- Radio Operating - Code - Radio Servicing

NEW YORK YMCA SCHOOLS

4 West 63rd Street, New York City

MASTER COURSE in RADIO COMMUNICATION

fits you for a job, advancement or license examination. Course by A. R. Nilson for home study covers same scope as resident school course. Every Nilson graduate to date has commercial license, on a good radio job.

F R E E circular 3-Q gives full information. Write today.

NILSON RADIO SCHOOL

51 East 92nd St., New York

LEARN RADIO • TELEVISION


M A S S. RADIO SCHOOL

18 Boylston Street

Boston, Massachusetts
Your Nearby Dealer Is Your Best Friend

Your nearby dealer is entitled to your patronage. He is equipped with a knowledge and understanding of amateur radio. He is your logical source of advice and counsel on what equipment you should buy. His stock is complete. He can supply your needs without delay. His prices are fair and consistent with the high quality of the goods he carries. He is responsible to you and interested in you.

One of these dealers is probably in your city—Patronize him!

<table>
<thead>
<tr>
<th>BALTIMORE, MARYLAND</th>
<th>HOUSTON, TEXAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Electric Service Co.</td>
<td>R. C. &amp; L. F. Hall</td>
</tr>
<tr>
<td>3 N. Howard St.</td>
<td>1021 Caroline Street</td>
</tr>
<tr>
<td>Everything for the Amateur</td>
<td>Equipment for sale to students and civilians interested in radio</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BUFFALO, NEW YORK</th>
<th>KANSAS CITY, MISSOURI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Equipment Corp.</td>
<td>Burstein-Applebee Company</td>
</tr>
<tr>
<td>326 Elm Street</td>
<td>1012-14 McGee Street</td>
</tr>
<tr>
<td>WBPMC and WBNEL — Ham service and sound equipment</td>
<td>“Specialists” in supplies for the Amateur and Serviceman</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BUFFALO, NEW YORK</th>
<th>KANSAS CITY, MISSOURI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dymac, Inc.</td>
<td>Radiolab</td>
</tr>
<tr>
<td>1531 Main Street — Cor. Ferry — GA. 0252</td>
<td>1515 Grand Avenue</td>
</tr>
<tr>
<td>One of the Largest Ham Supply Houses in Western New York</td>
<td>Amateur Headquarters in Kansas City</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHICAGO, ILLINOIS</th>
<th>MILWAUKEE, WISCONSIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allied Radio Corporation</td>
<td>Radio Parts Company, Inc.</td>
</tr>
<tr>
<td>833 West Jackson Blvd.</td>
<td>538 West State Street</td>
</tr>
<tr>
<td>Varied Stocks—Dependable Service. Amateurs in Radio War Training Work—Our Educational Division Will Assist You Without Obligation</td>
<td>Complete stock Nationally Known products</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHICAGO, ILLINOIS</th>
<th>NEW YORK, N. Y.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago Radio Apparatus Company</td>
<td>Harrison Radio Company</td>
</tr>
<tr>
<td>415 South Dearborn Street (Est. 1921)</td>
<td>12 West Broadway</td>
</tr>
<tr>
<td>Electronic supplies of all Kinds</td>
<td>Harrison Has (s) Phone WOrth 2-6276 for information or rush service</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DETROIT, MICHIGAN</th>
<th>OAKLAND, CALIFORNIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Specialties Company</td>
<td>W. D. Brill Company</td>
</tr>
<tr>
<td>325 E. Jefferson Avenue</td>
<td>198 10th Street</td>
</tr>
<tr>
<td>Ham Supplies — National &amp; Hammarfund Sets and Parts</td>
<td>W6KLO — The House of Parts — W6FJX</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HARTFORD, CONNECTICUT</th>
<th>PHILADELPHIA, PENNSYLVANIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. G. Sceli</td>
<td>Eugene G. Wile</td>
</tr>
<tr>
<td>227 Asylum Street</td>
<td>10 S. Tenth Street</td>
</tr>
<tr>
<td>Radio Electronic Equipment</td>
<td>Complete Stock of Quality Merchandise</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST. LOUIS, MISSOURI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Sickle Radio Company</td>
<td></td>
</tr>
<tr>
<td>1113 Pine Street</td>
<td>Owned and Operated by Amateurs</td>
</tr>
</tbody>
</table>
We're Working for UNCLE SAM
These Days, but—

WE'RE AT YOUR SERVICE, TOO!

Uncle Sam, W9GFQ and W9IFI are shoulder to shoulder today doing a job of war manufacture.

We're proud that there's a place for us in the business of making items for wartime radio. When this big job is done, we'll be at your service all the time. Then, if it's important, precision work you need... we're fitted to handle it on order.

SCIENTIFIC RADIO PRODUCTS COMPANY
738 W. Bdwy. Council Bluffs, Iowa
MANUFACTURERS OF PIEZO ELECTRIC CRYSTALS AND ASSOCIATED EQUIPMENT

Have You a Copy?

"A COURSE IN RADIO FUNDAMENTALS" By GEORGE GRAMMER

In Book Form

THE MATERIAL in this volume was prepared in response to the demand for a course of study emphasizing the fundamentals upon which practical radio communication is built. It originally appeared serially in QST and so great was the enthusiasm with which it was received that it is now published under one cover. The course is equally as valuable for those studying at home as for the teaching profession, many members of which have found themselves in the (to them) new field of radio technician training without the benefit of a planned course, nor the time to put in to thorough preparation.

It has been said by the planners of military and pre-service training for radio technicians and mechanics that their objective is to provide, as nearly as possible, the practical experience possessed by the radio amateur with a background of basic fundamentals. The objective in preparing this course, therefore, was to accent those principles most frequently applied in actual radio communication. "A Course In Radio Fundamentals" is a study guide, examination book and laboratory manual. Its text is based on the "Radio Amateur's Handbook" of 1942 or subsequent editions. Either the special edition for war training purposes or the Standard Edition may be used. References contained in the "Course" are identical in both editions.

The material is divided into thirty-six study assignments. With each assignment there is a series of questions designed to bring out the most significant points in the text. When problems of a mathematical nature are included, the answers are given at the end of the book. In cases where more than routine methods are required, the complete solution is given. Where feasible, experiments accompany each assignment to best illustrate the principles being studied. Anyone undertaking the course may be assured that, if he follows its precepts literally and exactly, performs the experiments and examines himself honestly with the test questions, he cannot fail to learn the principles of radio and will be well equipped to undertake specialized and advanced training in any branch of radio communications or electronics. Instructors using this material may be confident that their students will receive thorough training in the essential fundamentals of radio.

PRICE 50 CENTS POSTPAID (No Stamps, Please)

AMERICAN RADIO RELAY LEAGUE, WEST HARTFORD, CONNECTICUT
THE 37222 POSTS AND 37202 PLATES

Such details as: (1) the square shoulder on the mounting stud of the post which seats in the slot in the plate so as to prevent annoying loosening of the posts when operating the clamping head; (2) the telescoping boss and socket so as to permit the plates to grip tightly the thinnest chassis as well as the thickest panels without necessity of grinding or filing; (3) the availability of the plates in Steatite Mic, filled natural bakelite, as well as standard black phenolic are but three of the "Designed for Application" features that make this terminal set more desirable to use than others.

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MAIDEN, MASSACHUSETTS

Index to Advertisers

Abbott Instrument, Inc. .................................. 119
Acrosonic Corporation .................................. 110
American Lava Corporation .................................. 79
American Radio Institute .................................. 108
Artistic Corporation, The .................................. 110
Ayers Automatic Code Machines .............................. 110
Barker & Williamson .................................. 104
Biller Electric Company .................................. 110
Brach Mfg. Corp., L. S. .................................. 121
Candler System Company .................................. 103
Capitol Radio Engineering Institute ......................... 72
Cardwell Mfg. Corp., Allen D. .......................... 121
Centralab .................................. 6
Cinaudagraph Speakers, Inc. .................................. 80
Claronet Mfg. Co., Inc. .............................. 110
Daven Company, The .................................. 4
Dodge Tele. & Radio Institute, The ......................... 123
Echophone Radio Company .................................. 122
Eitel-McCullough, Inc. .................................. 101
Electro-Voice Mfg. Company, Inc .......................... 102
Felker Mfg. Company .................................. 117
Garner Company, Fred E. .................................. 102
Gotthard Manufacturing Company ...................... 106
Hallicrafters Company, The .............................. 1, 2, 107
Hammahm Mfg. Company, Inc. ......................... 18
Harrison Radio Corp. ................................ 121
Harvey Radio Company .................................. 76
Harvey Radio Laboratories, Inc. ......................... 117
Harvey-Wells Communications, Inc. ...................... 78
Heintz & Kammer, Ltd. .................................. 112
Henry Radio Shop .................................. 115
Hytronic Laboratories .................................. 118
Instructograph Company .................................. 118
International Resistance Company ..................... 113
Isolantite, Inc .................................. 90
Jensen Radio Mfg. Company .................................. 97
Kato Engineering Company .................................. 108
Keystone Transformer Company, Inc. ...................... 119
Mallory & Company, Inc., P. R. ............................ 103
Massachusetts Radio School .................................. 133
McIlroy Mfg. Corporation .................................. 87
McGraw-Hill Book Company, Inc. ........................ 84, 100
Messer Mfg. Company .................................. 91
Melville Aeronautical Radio School, Inc. ............. 92
Metropolitan Technical School .............................. 112
Miller, Wayne .................................. 112
National Company, Inc. .................................. Cov. III, 71
New York YMCA Schools, Inc. ............................ 118
Newark Electric Company .................................. 114
Nilson Radio School .................................. 114
Ohmite Mfg. Company .................................. 83
Petersen Radio Company .................................. 104
Port Arthur College .................................. 104
RCA Institutes, Inc. .................................. 123
RCA Manufacturing Company, Inc. ..................... 123
RCA Institute, Inc. .................................. Cov. IV
Radio Control Headquarters, Inc. ...................... 118
Radio Shack Corp. .................................. 121
Raytheon Mfg. Co. .................................. 7
Scientific Radio Products Company ..................... 135
Shure Brothers .................................. 91
Solar Capacity Sales Corp. .................................. 111
Sprague Specialties Company ............................... 77
Sun Radio Company .................................. 114
Taylor Tubes, Inc. .................................. 105
Telephone Company .................................. 107
Terminal Radio Corp. .................................. 73
Thordarson Electric Mfg. Company ...................... 116
Triplite Elec. Instr. Co., The. .......................... 113
Tung-Sol Lamp Works, Inc. .............................. 109
United Electronics Company ............................... 91
United Transformer Company .................................. Cov. II
Vibroplex Company, Inc., The ............................ 108
Wholesale Radio Laboratories .................................. 106
Yaxley .................................. 105
All of our facilities — each minute of the day — every day of the year — are devoted only in bringing the vital stuff that brings VICTORY to a fighting Yank on any front. Only in victory will it be possible to serve you again.

The RADIO SHACK
167 WASHINGTON ST., BOSTON, MASS., U.S.A.
If You Lack Transformer Space ... You Need a Thordarson Incher

Thordarson Tru-Fidelity Incher Series Audio Transformers are specially designed for use where weight and size are as important as quality. There are many types with frequency response performance within −1.5 db from 30 to 15,000 c. p. s. Single plate to grid types for dc in primary are available for voice frequencies.

Thordarson Incher Transformers are protected against moisture by vacuum impregnation of the coils and by hermetically sealing the core and coil assemblies in moisture-proof compound.

For 48 years Thordarson engineers have been designing and building better transformers ... no matter how complicated your transformer requirements may be, send your specifications to Thordarson.

**INCHER CASE DIMENSIONS**
- Diameter 15/16 in.
- Height (incl. lugs) 1 1/4 in.
- Height (Case alone) 1 1/8 in.
- Weight 1 1/4 oz.
- Mounting Centers 23/32 in.

Many other types illustrated and described in Catalog No. 500
National Radio Equipment, designed for peacetime use, is proving out in the hardest tests of war. Receivers and parts that look familiar to any Ham are coming off our lines in steadily increasing quantities to serve in combat communications. National takes especial pride that war brought no sudden redesign of our products.

Just as in peacetime, our equipment was tailored to serve the amateur, so now the same basic designs have been modified to meet the specialized needs of United Nations fighting men. As in peacetime, National designs are being steadily improved, but under the pressure of war, years of research and development are being telescoped into months.

There are many technical developments that we wish we could tell you about now. When the war is won, you will be able to see them in the finest equipment National has ever built.

NATIONAL COMPANY, INC., MALDEN, MASS.
Pert. I

Peak Inverse Voltage, 10,000 volts, max.

Peak Plate Current, 5 amperes, max.

Average Plate Current, 1.25 amperes, max.

For condensed-mercury temperature of 20-60° C.

Designed for

LONGER LIFE — HIGHER PEAK EMISSION

WITH CORRESPONDINGLY LOWER TUBE DROP

While you've been busy making hard-to-replace transmitting tubes last longer on the job, RCA engineers have been losing no time in building longer potential life into the tubes that are produced. The RCA 872-A/872 Half-Wave Mercury-Vapor Rectifier offers a good example of achievements scored in this direction:

Adoption of a special alloy for the cathode base has yielded materially increased emission with correspondingly low tube drop which, in turn, has resulted in greatly improved shelf and operating life. Thermal efficiency has been greatly increased, and, therefore, the tube will withstand higher surge currents without sputtering of the cathode coating—an important factor in increasing life.

In brief, the RCA 872-A/872 of today is a stronger, sturdier tube than ever before—just as numerous other RCA Transmitting Tube types are delivering longer life and better performance as the result of progressive RCA engineering developments.

TIPS ON MAKING YOUR TRANSMITTING TUBES LAST LONGER

Many valuable operation hints on making Transmitting Tubes last longer that were incorporated in previous RCA advertising have now been compiled into a handy booklet. A copy will gladly be sent upon request to RCA Mfg. Co., Commercial Engineering Section, Harrison, N. J.

RCA TRANSMITTING TUBES

PROVED IN COMMUNICATION'S MOST EXACTING APPLICATIONS