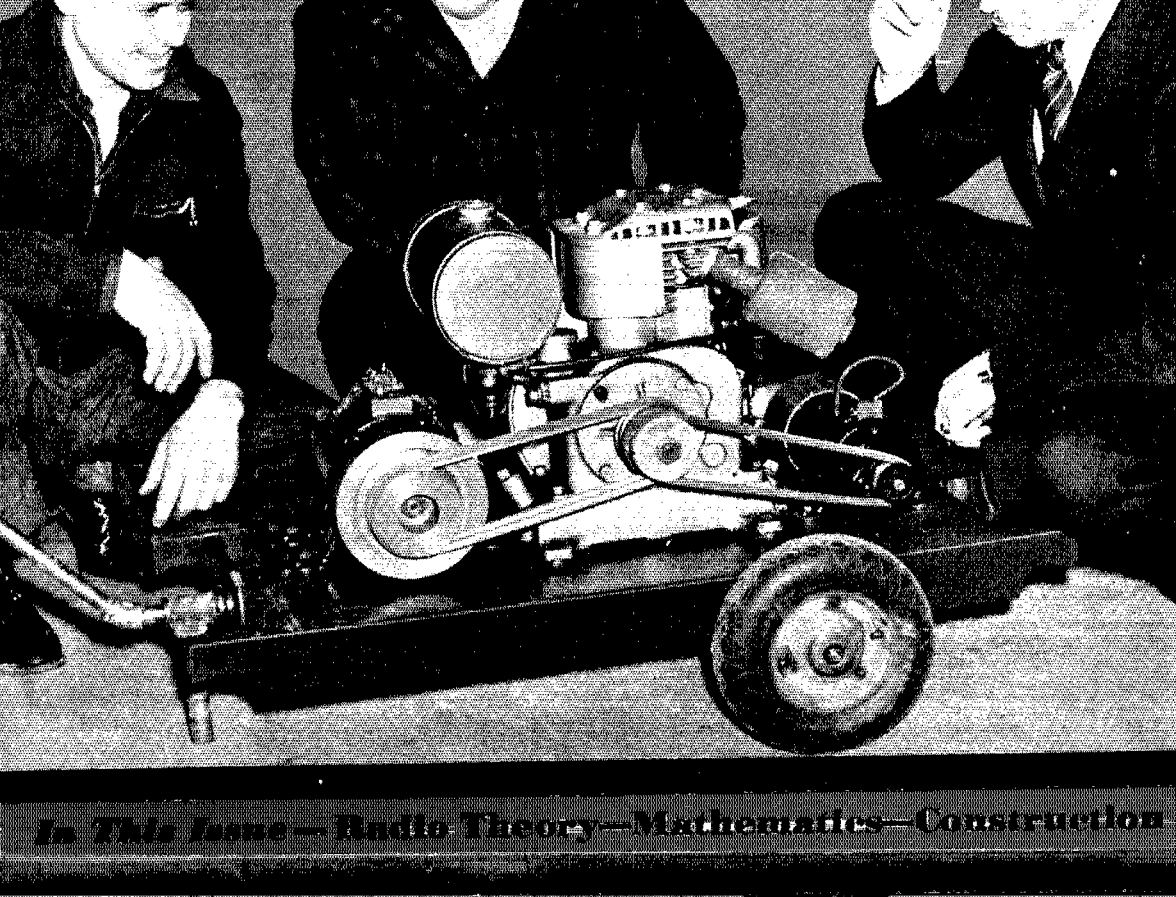
QST

february, 1943
25 cents
35c in Canada

devoted entirely to

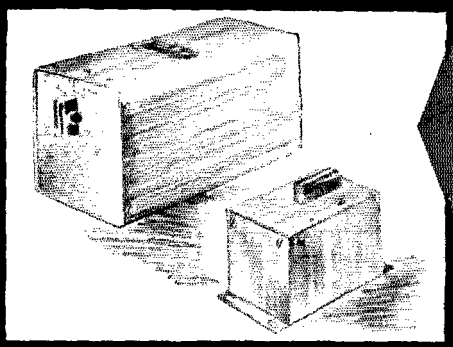
amateur radio



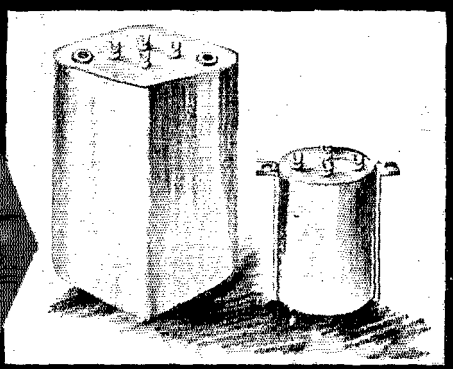
In This Issue—Radio Theory—Mathematics—Construction

Waste *is as damnable as sabotage*

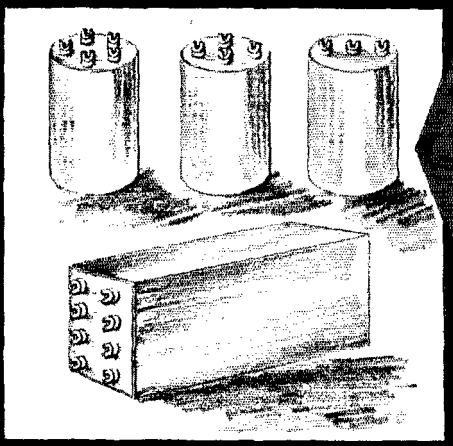
Electrical and mechanical design are the foundation of our military production. Small individual savings, when multiplied in mass production, add up to large savings in critical materials and labor time. Here are some examples from our organization:



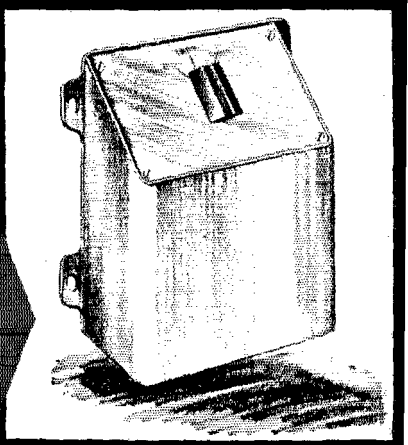
Cumulative electrical and mechanical redesign reduced the quantity of critical materials in this unit 60%, reduced total size and weight in direct proportion.



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 units. By combining the three in one case, we eliminated two aluminum housings, four terminals, two 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.

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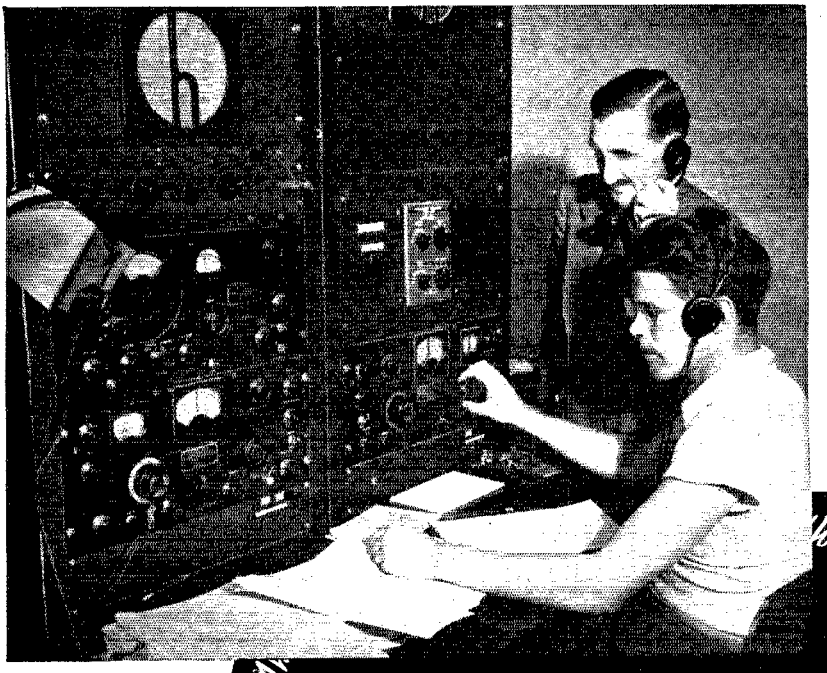

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FEBRUARY 1943

VOLUME XXVII

NUMBER 2

★

★

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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

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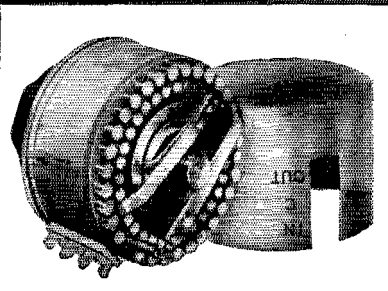
Official U. S. Navy Photograph



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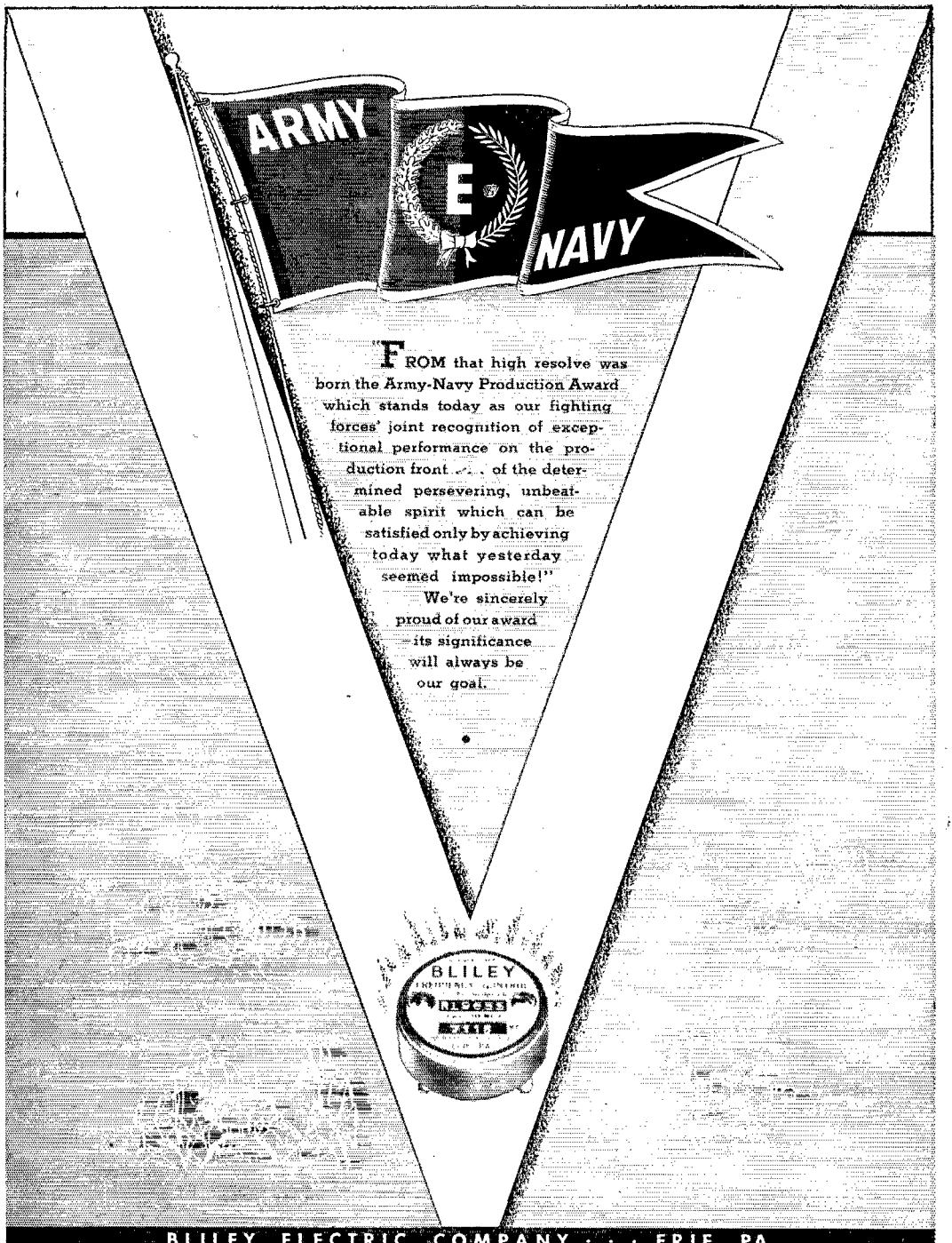
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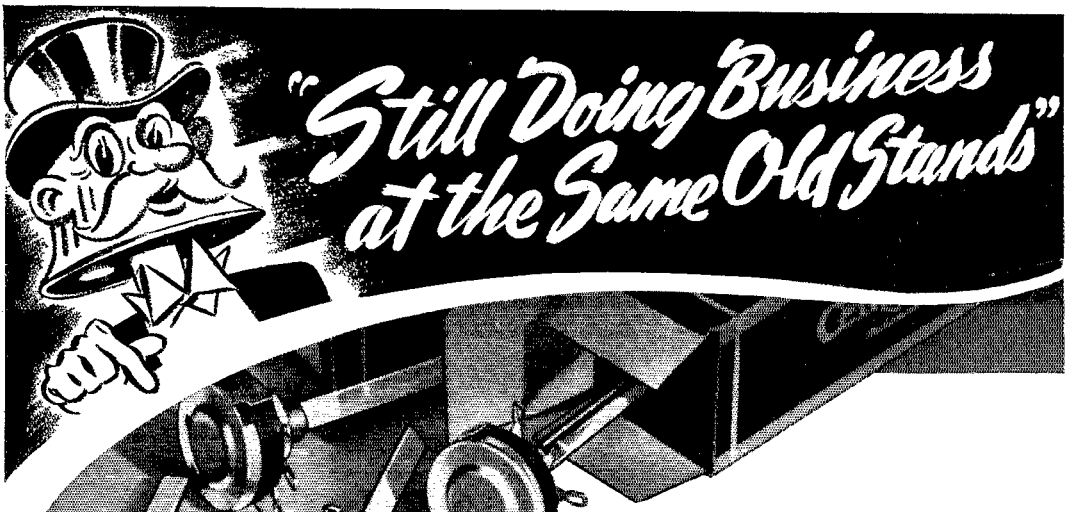

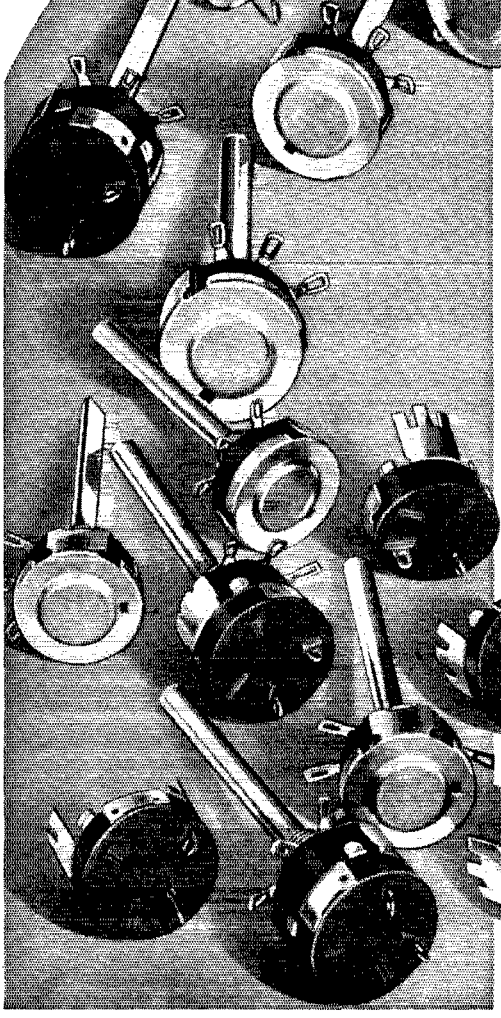

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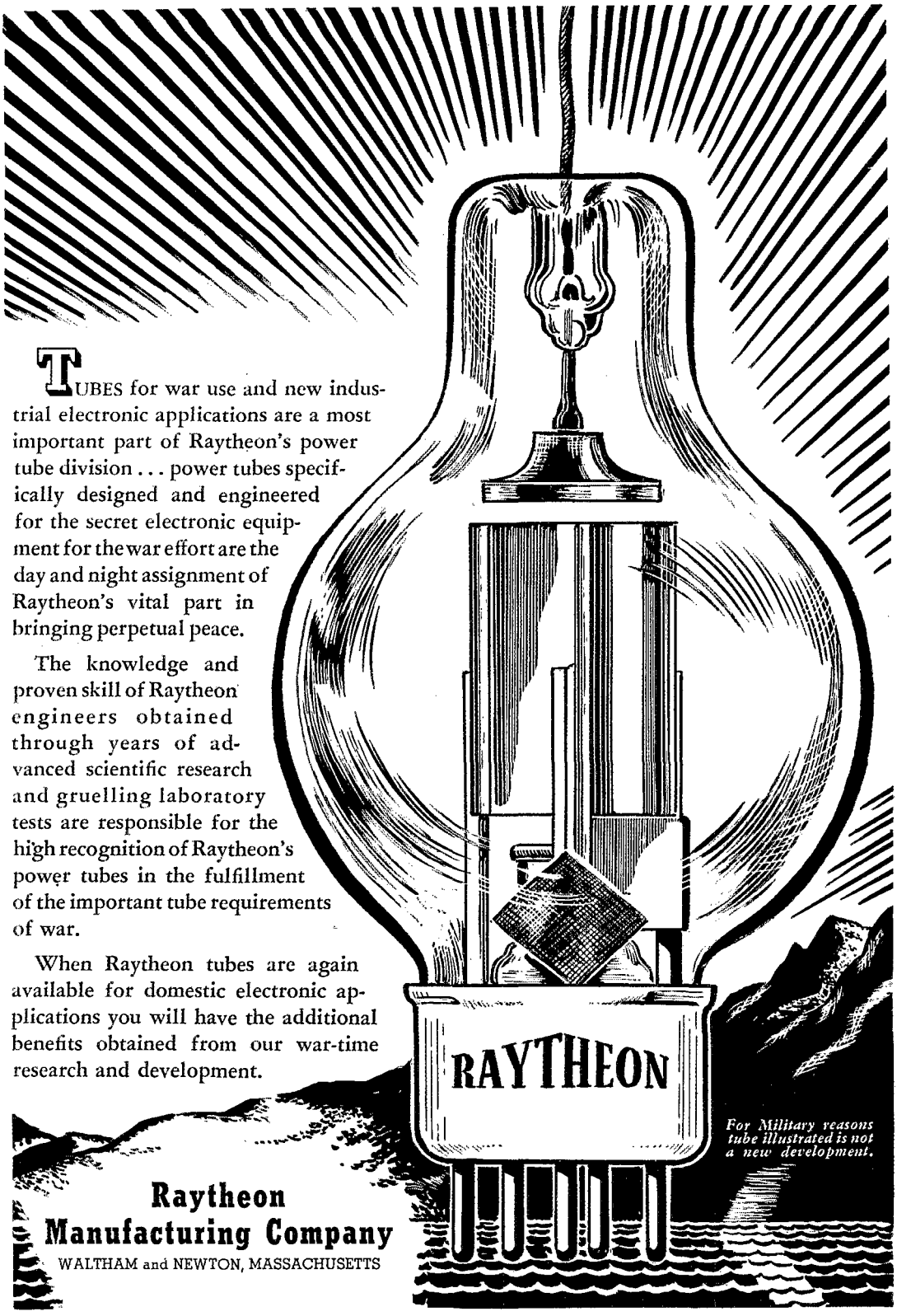

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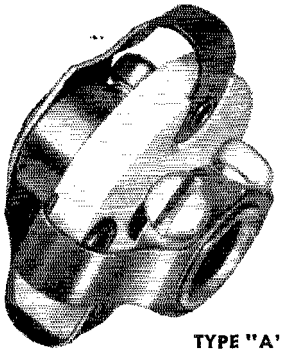

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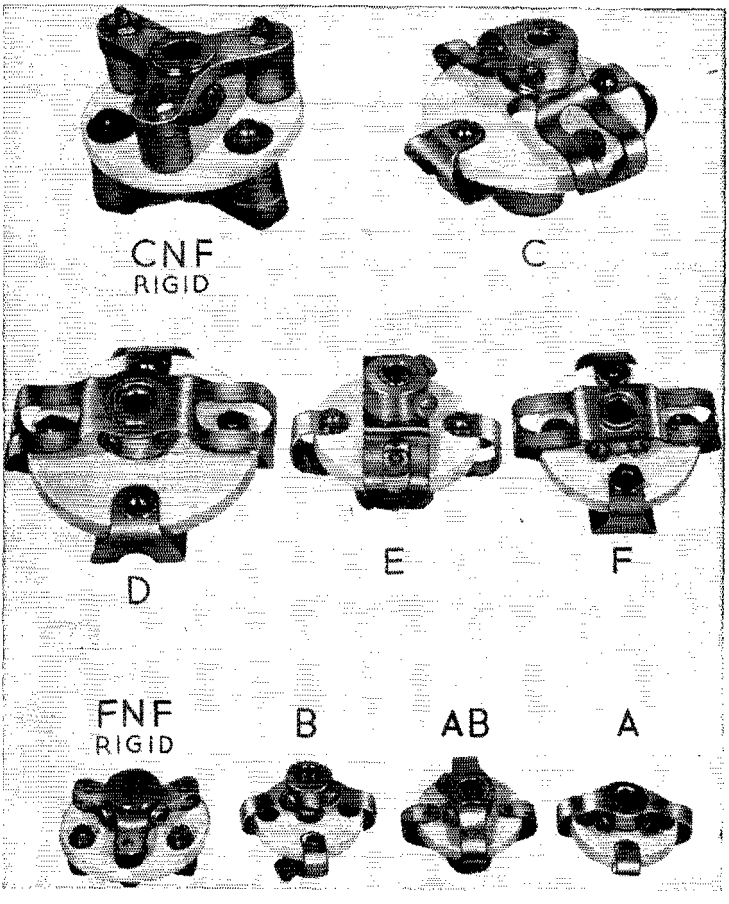

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It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. 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.

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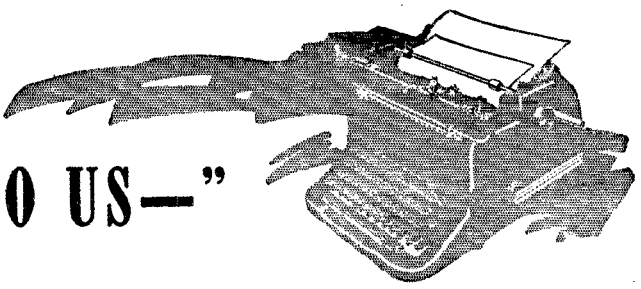


"IT SEEMS TO US—"

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, coöperative 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, W2KHM** (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 coördinator 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.

Right — Entrance to the Atlantic City radio school.

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*

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 waggling 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; it was he 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 24 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. Huddleson, 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.

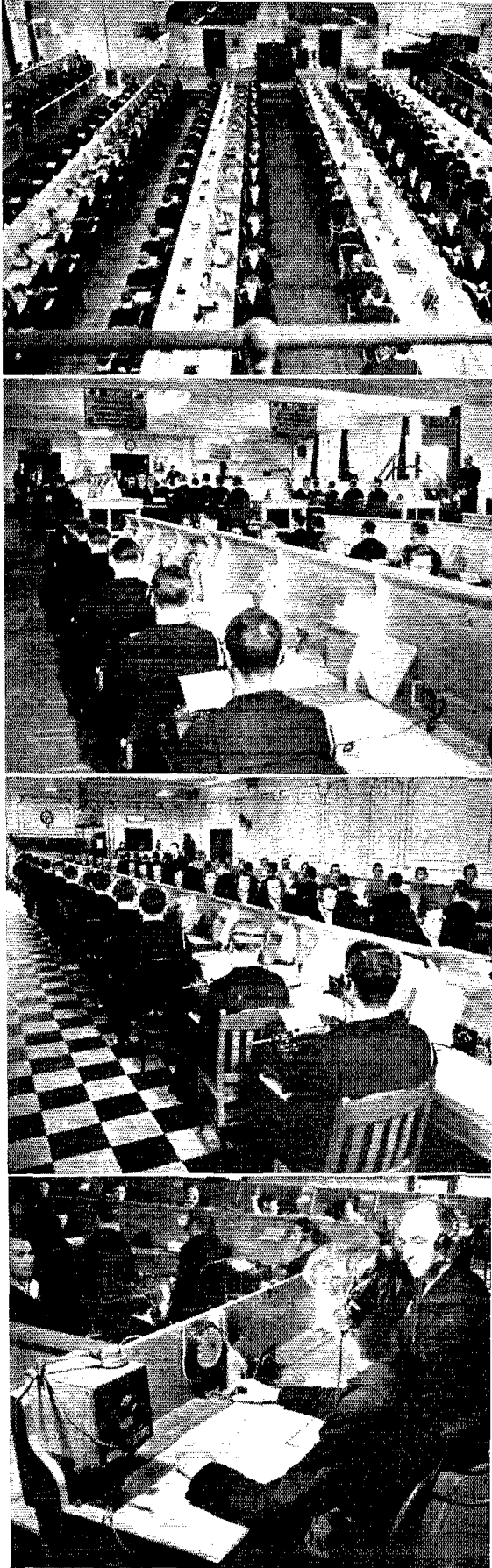
As soon as the student has the alphabet more or less memorized, it is broken down into the old "similar character" combinations. He hears "EISH5" and then "EIS5H" and "EI5SH," etc., over and over, until the fact that these "similar" sounding characters actually are markedly different is indelibly impressed. Then the same with "TMOØ9" 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



Top — The "big code room." Beginners' classes are held in this large two-story room, formerly a chapel. Code and instruction are fed to each position through large switchboard and tone-source panels on dais. On walls are GMT clocks, typewriter keyboard charts and posters reading, "Accurate copies save lives and ships," "Speed requires practice," etc. *Second from top* — This two-level code room on the lower deck is used for intermediate instruction. Experienced instructors — one to every fifteen men — supervise training. *Third from top* — Part of the advanced code training room. Rotary switches at each position simulate eight-channel operation for network, intercommunication and preliminary watch-standing drill. *Bottom* — "Grasp the key firmly but not tightly — fingers well over the knob — hold the hand in a natural position. . . ." Lt. (jg) Davis, officer in charge of code instruction, gives a student pointers on proper manipulation of a hand key at the instructor's dual position.

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

Left — Procedure class. Here the students learn how to handle traffic and carry on contacts the Navy way. *Right* — In the watch-standing room trainees gain experience in off-the-air copying of actual transmissions. Each table has its own receiver array as shown in the foreground, covering all Coast Guard frequencies.

and turns in a passing grade for two consecutive weeks. The night classes give the student 1½ hours daily extra drill.

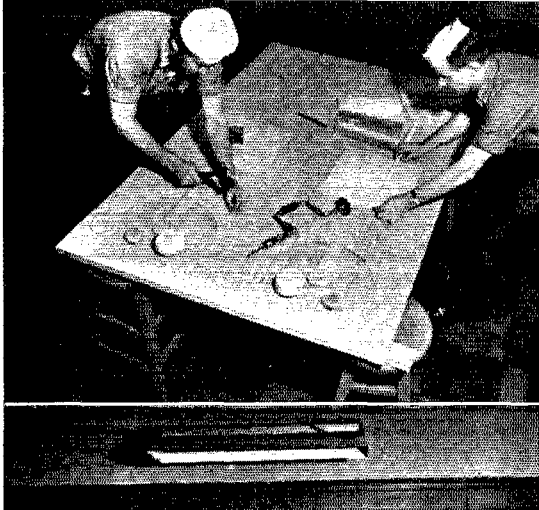
If this standard of absolute accuracy sounds like a utopian ideal, the Coast Guard replies that its radiomen can't afford to make mistakes. As Comdr. Jacobs pointed out, "With the complex code groups now in use, a single error might lose an entire convoy."

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



Below, left — Chalk talks supplement textbooks in the theory lecture room. The instructor uses a microphone and p.a. system so no student will miss a word. *Below, right* — Radio electrician C. O. Charley instructs students in operation of d/f equipment in the matériel lab. *Right* — The stock clerk issues r.f. chokes from a well-filled bin to a student about to build an experimental oscillator. In this room all parts, tubes and test instruments used in lab work are stored, issued only upon proper authorization and receipt. *Center* — Super-scale models of test sets and other equipment facilitate matériel instruction. The instructor explains the significance of a 325-volt d.c. reading on a standard multimeter. *Top* — Constructing an enlarged scale model of a transmitter panel for student instruction. Carpenters cut out plywood panels and scales, turn knobs and other parts. Completed model is painted to make an exact replica of the original unit.

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.

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 coördination — 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 "subnormal" 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 102*)

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[1] (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'

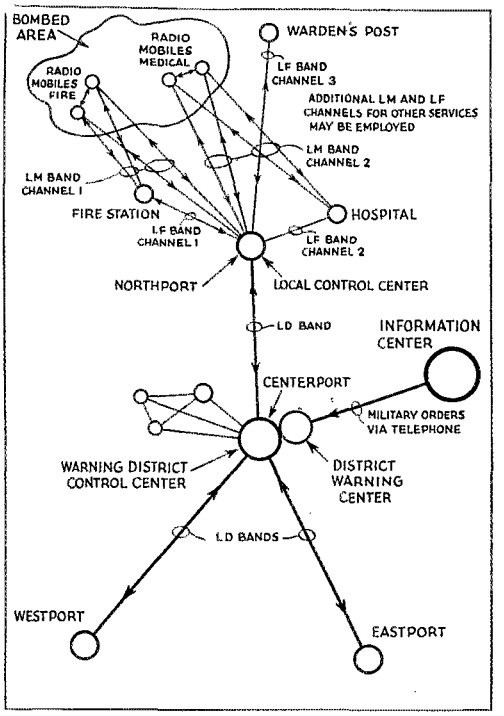


Fig. 1. — **Tri-Part Plan for a district warning area.**

* Acting Communications Manager, ARRL.

[1] It is assumed that local WERS licensing will be by warning areas, but this does not mean that the proposals herein advanced will be useless to individual communities. On the contrary, the plan, while discussed from a warning area standpoint, is just as applicable to independent community licensees.

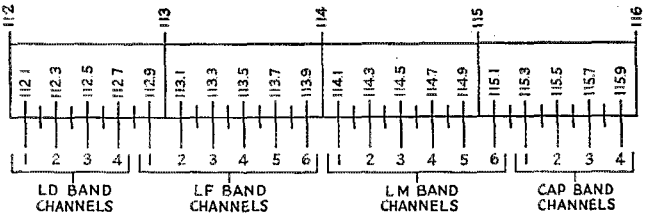


Fig. 2 — Allocation of channels in the 112–116-Mc. band in accordance with recommended plan. *LD Band* — Channels in this band are used for communication between control center and warning district control center. This is the supplemental circuit between a community and an outside point. *LF Band* — Channels in this band are used for communication between control center and local fixed points such as hospitals, fire stations, wardens' posts, etc. The control center coördinates the activities of the various services over these channels in the event of failure of telephone service. *LM Band* — Channels in this band are used for communication between control center and mobile units of the various services at the scene of the incident. An "up-to-the-second" picture of the progress of the incident is maintained at the control center from information received over these channels. This enables the rapid coördination of all activities and prompt dispatch of aid through the use of any band for outgoing orders from the control center. *CAP Band* — By agreement between the United States Citizens' Defense Corps and the Civil Air Patrol, these four channels have been set aside for the use of CAP to eliminate serious interference which might otherwise occur between air and ground stations.

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 coördinates 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 coördinating all activities.

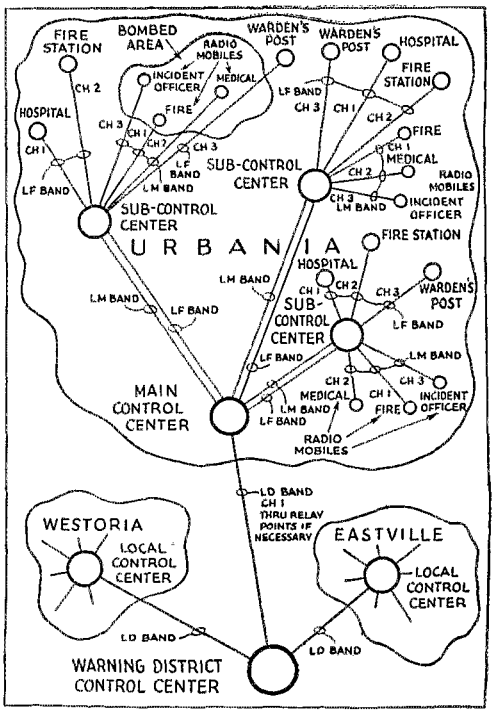


Fig. 3 — The Tri-Part Plan expanded for use in large metropolitan areas where subcontrol centers are used.

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 coördinate 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 coördinating 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:

"Since 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 Coördination 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 Coördination 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 Coördination 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 28-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 Coördination 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. — EDITOR.

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.

ANY 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[1] 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:

$$R_o = 276 \log 2S/D \quad (1)$$

where R_o = characteristic impedance of the line in ohms
S = spacing between conductor centers in any units
D = diameter of conductor in same units

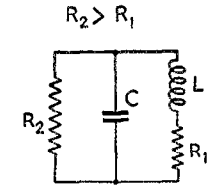


Fig. 1 — Parallel-resonant circuit with equivalent series and parallel resistances.

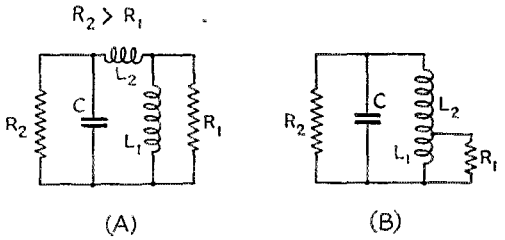


Fig. 2 — An impedance-matching circuit using series or tapped inductances.

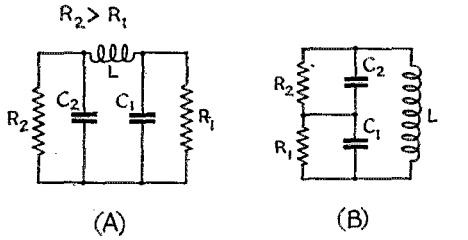


Fig. 3 — The pi-section filter, another type of impedance-matching circuit.

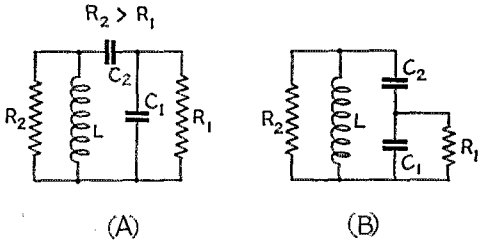


Fig. 4 — These circuits resemble those of Fig. 2 with L and C interchanged.

*214 Hillcrest Rd., Mt. Vernon, N. Y.

[1] Gadwa, "Standing Waves on Transmission Lines," *QST* December, 1942, p. 17.

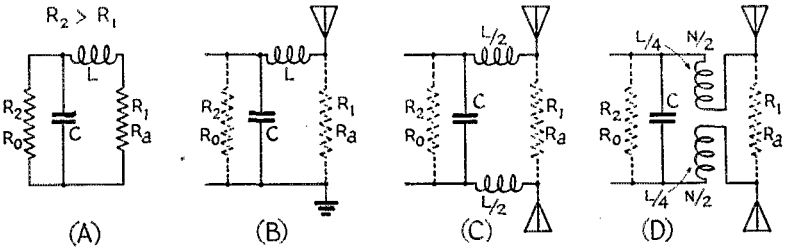


Fig. 5 — These impedance-matching circuits are used when the antenna resistance is lower than the characteristic impedance of the transmission line.

Impedance Transformation

In come 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 [2] 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, [3], [4], [5] are:

$$X_L = \sqrt{R_1 (R_2 - R_1)} = R_1 \sqrt{\frac{R_2}{R_1} - 1} \qquad (2) \text{ and } (2a)$$

$$X_C = R_2 \sqrt{\frac{R_1}{R_2 - R_1}} = \frac{R_2}{\sqrt{\frac{R_2}{R_1} - 1}} \qquad (3) \text{ and } (3a)$$

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
$L = X_L / 2\pi f$ (4)
$C = 1/2\pi f X_C$ (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.

[2] Everitt, Communication Engineering, p. 75.
[3] Andrews, *QST*, October, 1939, p. 39.
[4] Plotts, *QST*, November, 1941, p. 15.
[5] Roberts, *QST*, January, 1928, p. 43.

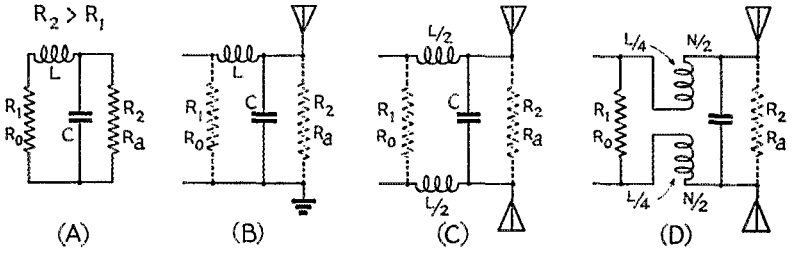


Fig. 6 — Circuits for use when the antenna resistance is higher than the line impedance.

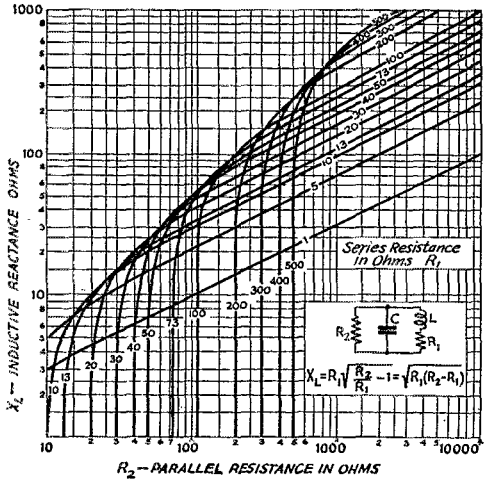


Fig. 7 — Parallel resistance vs. inductive reactance for various values of series resistance.

To aid in the solution of equations (2) and (3) curves are presented in Figs. 7 and 8. From the inductive and capacitive reactances, the inductance and capacitance can be determined from equations (4) and (5). From the inductance, the coil diameter, length of winding and number of turns may be found by the usual formulas or from a *Lightning Calculator*.

A Practical Example

To illustrate the various steps in the calculation, a typical case is solved. It is desired to match the 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).

$$R_o = 276 \log (2 \times 6/0.064) = 276 \log 188 = 276 \times 2.275 = 625 \text{ ohms}$$

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

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

or 1.00 microhenry. Using the *Handbook* formula

$$N = \sqrt{\frac{(3A + 9B)\,L}{0.2A^2}}$$

where N = number of turns

A = diameter of coil in inches (let A = 1. 5 inches)

B = length of coil in inches (let B = 1.5 inches)

L = inductance in microhenrys

$$N = \sqrt{\frac{(3 \times 1.5 + 9 \times 1.5)\ 1.00}{0.2 \times 1.5^2}} = 6.3 \text{ turns}$$

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

$$X_C = 625 / \sqrt{625/13 - 1} = 625/6.86 = 91.1 \text{ ohms.}$$

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 × 1.414 = 610 volts and on 100 per cent modulation the peak is 610 × 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

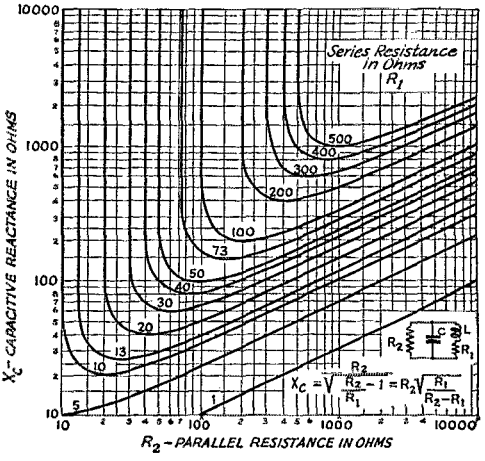


Fig. 8 — Parallel resistance vs. capacitive reactance for various values of series resistance.

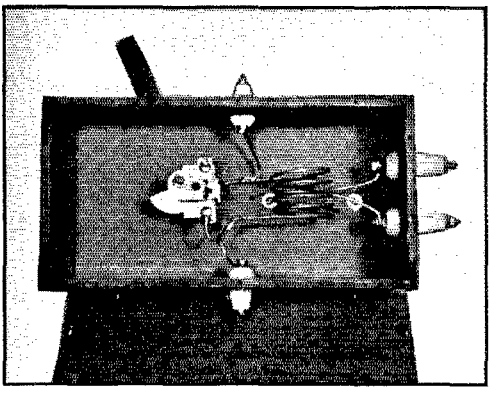
box made of quarter-inch tempered Masonite, with feed-through terminals brought out through the sides for the line and similar terminals at one end for the antenna.

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.



Suggested construction of an impedance-matching transformer for suspension from an antenna. The condenser is controlled by the arm projecting toward the upper left. A pulley could be used for adjustment from the ground.

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,[1] 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.

$$R_2 = \frac{L}{CR_1} \qquad (6)$$

This is true when R_1 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 ¼ 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 ¼ 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.

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

or

$$I_1/I_2 = \sqrt{R_2/R_1} \qquad (7)$$

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

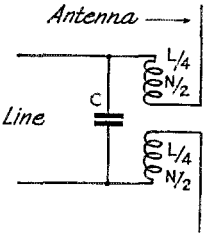


Fig. 9 — This circuit is used for matching a half-wave antenna to a line having an impedance of the order of 500 ohms. Constants for 114 Mc. operation are given in the text.

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:

S = 2 inches spacing
D = 0.064 wire diameter, inches
R_2 = 495 ohms, line impedance
R_1 = 73 ohms, antenna resistance
f = 114×10^6 cycles per second
X_L = 175.8 ohms
L = 0.245μh.
A = 1 inch (coil diameter)
B = 1 inch (coil length)
N = 3.8 turns
$N/2$ = 1.9 turns
X_C = 206 ohms
C = 6.8 $\mu\mu$fd.

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 diheptal 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 1⅜-inch neck and a magnal 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 1⅜-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, W1KVG, Whitinsville, Mass.
E. J. Botimer, W8NZW, Akron, Ohio
Henry Leonard Brock, W5HGE, Tuckerman, Ark.
Ellsworth O. Dumas, W8LE, 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.

U.S.A. CALLING!

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 sergeancies, 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-O 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. Age limits, 20 to 45. Address The Commandant, Headquarters, U. S. Marine Corps, Washington.

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.

YLs 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 PHYSICISTS

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 those 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 still open.

The basic position in this work is Junior Instructor at $2000 a year, with the more experienced instructors selected 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 nonmember, 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 24 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)

Elementary A.C. Mathematics

Part I—Periodic Phenomena

BY GEORGE GRAMMER,* WIDF

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 would 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.[1]

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

* Technical Editor, *QST*.

[1] We intend to deal here with principles rather than details of manipulation. Facility in the use of any kind of mathematics must be acquired by constant practice according to some logical plan. Study along these lines should be carried out with the aid of a good text, one example of which is Cooke's "Mathematics for Electricians and Radiomen," reviewed in April, 1942, *QST*.

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 fearsomely 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

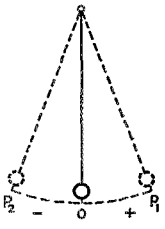


Fig. 1

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 P_1 and P_2. 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 OP_2 along the arc is the same as the distance OP_1. 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.

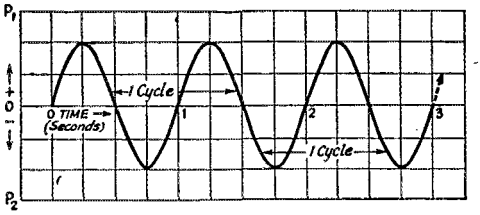


Fig. 2

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 OP_1 or OP_2, 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 OP_1 and OP_2 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 P_1 or P_2, 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 OP_1 or OP_2, 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 OP_1 in Fig. 3 corresponds to OP_1 in Fig. 1, and OP_2 in Fig. 3 to OP_2 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.

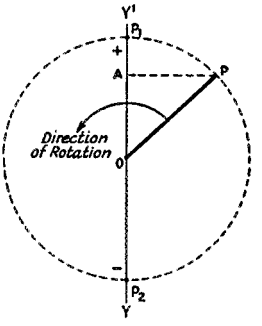


Fig. 3

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

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 *XX'*, in Fig. 4, which extends to the right of *O* to the point *A*.

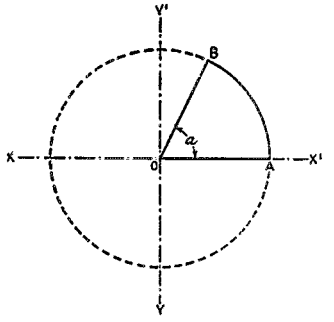


Fig. 4

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 *a* 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 × 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 zero at any 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

$$\text{Length of arc} = \text{Length of radius} \times \text{Angle}$$

where the unit of angle is chosen so that the statement is true; i.e., so that the correct answer will be obtained when specific values are substituted. By simple transposition,

$$\frac{\text{Length of arc}}{\text{Length of radius}} = \text{Angle}$$

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 2π radians in a circle, since the circumference is 2π ($\pi = 3.14159\ldots$) 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 2π 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 projection of the radius (Fig. 3). We shall cover a bit more ground here than we actually need for the present purpose, but it will all be useful later.[2]

In elementary geometry it is proved that the sum of the angles in any triangle is equal to two right angles, or 180 degrees. A *right triangle* is one in which one angle is a right angle. Therefore in a right triangle the remaining two angles must add up to a right angle, or 90 degrees. Thus in Fig. 5, where we have a right triangle with sides A, B, and C, the angles a and b added together equal 90 degrees. It can be shown that in a triangle of this type there is a definite relationship between the angle a (or b, since the value of b is determined once a is given) and the relative lengths of the sides of the triangle. That is, if a is fixed in value, then the ratios of A to C, A to B, B to C, etc.

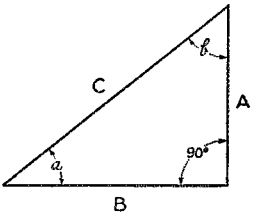


Fig. 5

have constant values no matter how large or small the triangle itself may be. These ratios are the *natural trigonometric functions* of the angle.

The basic functions of an angle are named the *sine*, *tangent* and *secant*. Considering the angle a in Fig. 5, these functions are as follows:

$$\text{sine } a = \frac{A}{C}$$

$$\text{tangent } a = \frac{A}{B}$$

$$\text{secant } a = \frac{C}{B}$$

With respect to the angle a, side A is known as the *opposite* side, B is the *adjacent* side and C is the *hypothenuse* (side opposite the right angle). Thus the sine of the angle is equal to the opposite side divided by the hypothenuse, the tangent is equal to the opposite divided by the adjacent side, and the secant is equal to the hypothenuse divided by the adjacent side. Considering angle b, side B becomes the opposite side and A the adjacent side. Consequently,

$$\text{sine } b = \frac{B}{C}$$

$$\text{tangent } b = \frac{B}{A}$$

$$\text{secant b} = \frac{C}{A}$$

[2] To some extent the following is a duplication of part of the material in W6UBT's article in December *QST*. For those who have no training in trigonometry it will do no harm to go over the ground again, while its omission would constitute an important gap in the development.

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 *cofunctions* of a, or

$$\text{cosine } a = \frac{B}{C} = \text{sine } (90° - a)$$

$$\text{cotangent } a = \frac{B}{A} = \text{tangent } (90° - a)$$

$$\text{cosecant } a = \frac{C}{A} = \text{secant } (90° - a)$$

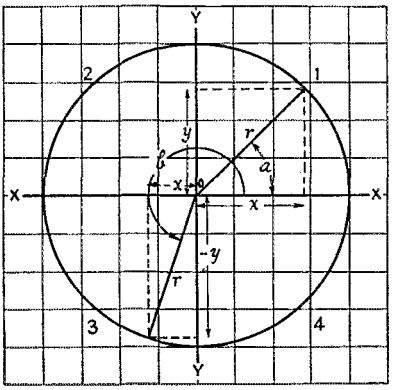


Fig. 6

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 hypothenuse. The perpendicular line has the length y, the projection of the radius on the y axis. Then

$$\sin a = \frac{y}{r}$$

$$\cos a = \frac{x}{r}$$

$$\tan a = \frac{y}{x}$$

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

$$\sin b = \frac{-y}{r}$$

$$\cos b = \frac{-x}{r}$$

$$\tan b = \frac{-y}{-x}$$

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:

	sin	cos	tan
1st quadrant	+	+	+
2nd quadrant	+	−	−
3rd quadrant	−	−	+
4th quadrant	−	+	−

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 become 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 π). 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: $a = 180° - b$
3rd quadrant: $a = b - 180°$
4th quadrant: $a = 360° - b$

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.[3] 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:

$$\frac{\sin a}{a}$$

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 a 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.

[3] A condensed table is given in December *QST* in the article "How's Your Math?" by Dawkins Espy.

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

$$\frac{\sin a}{a} = \frac{1}{\frac{\pi}{2}} = \frac{2}{\pi} = 0.636$$

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 $(15° + 30°)$ equals sin 45°. 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 a^2 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

(Continued on page 78)

The Fifth Regional WERS

Planning the War Emergency Radio Service Organization for Indiana, Kentucky, Ohio and West Virginia

BY PHILIP GIBBS*

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.

*Office of Civilian Defense, 630 Huntington Bank Bldg., Columbus, Ohio.

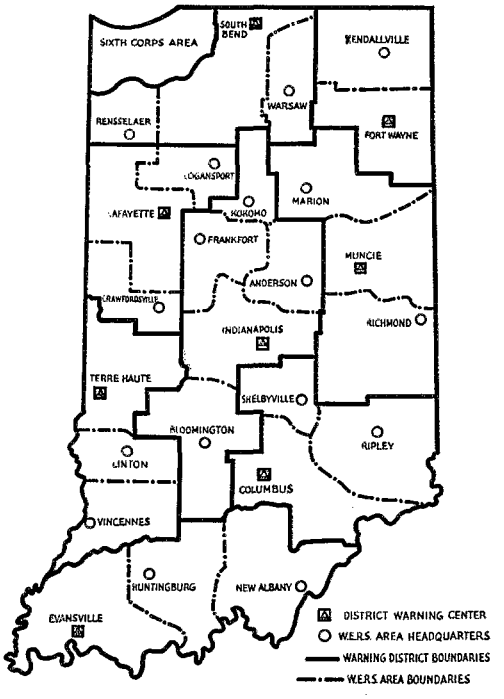


Fig. 1 — Map of WERS areas in Indiana.

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 coöperation 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 Coördinator 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 coördinators 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.

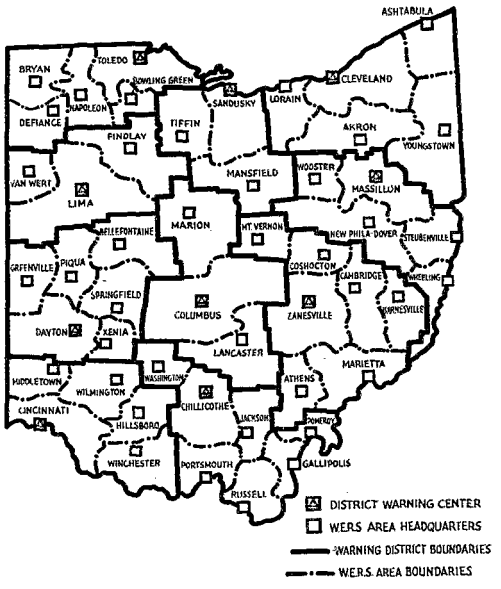


Fig. 3 — WERS areas in Ohio.

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*)

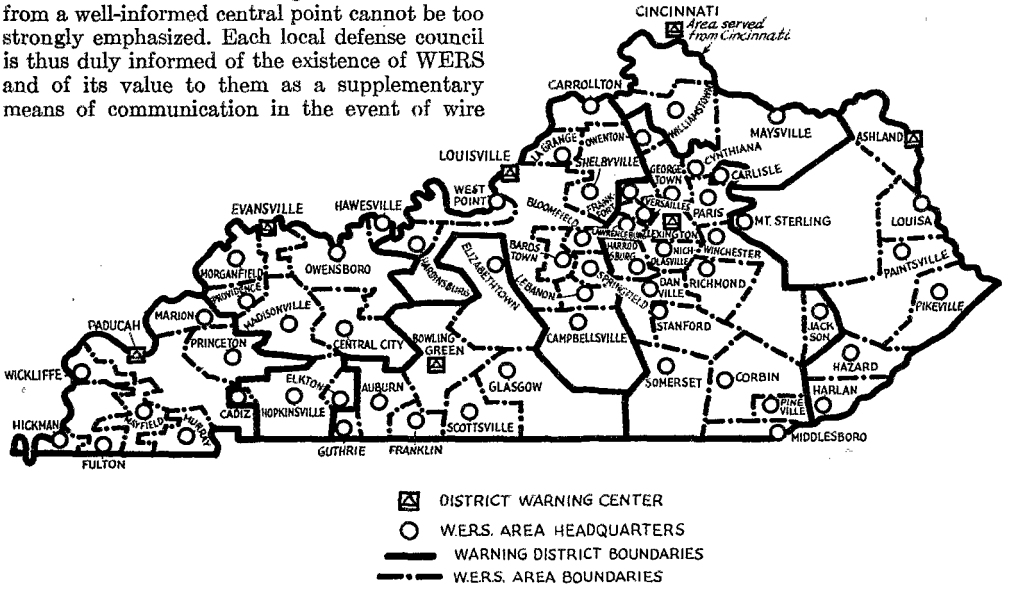


Fig. 2 — WERS areas in Kentucky. As indicated, Cincinnati, Ohio, is d.w.c. for the extreme northern region.

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.

*333 Campus Drive, Bluffton, Ohio.

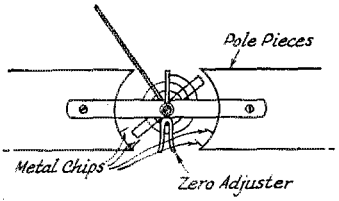


Fig. 1 — Iron or steel chips clinging to the magnet will prevent free movement of the coil assembly and cause the pointer to stick.

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 ½ 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.

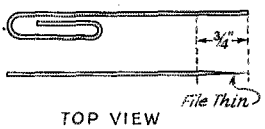


Fig. 2 — Converting a paper clip into a tool for removing chips.

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

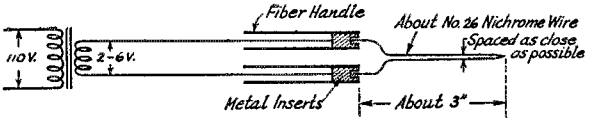


Fig. 3 — A heating device for burning lint in close quarters.

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

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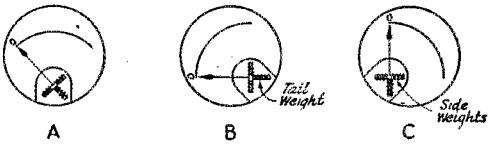


Fig. 4 — The three steps in balancing a meter. (A) Set pointer on zero by means of zero adjustment screw while holding meter with plane of dial in horizontal position. (B) Adjust tail weight until pointer is on zero while holding meter with plane of dial in vertical position. (C) Adjust side weight until pointer is on zero while holding meter with plane of dial in vertical position.

IN THE SERVICES

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, Kilocycle 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.

Pvt. Edmund J. Billingsley, W5DFY of Little Rock, Ark., was the No. 1 man scholastically in the first class to graduate from the Sioux Falls Army Air Forces Technical Training Command School on November 10th. Can you see the smile on his face as he receives his diploma? *Official U. S. Army Air Forces Photo.*

1FYH, Walsh, address unknown.
1HOV, Boulay, address unknown.
1IJL, Manitsas, 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.
2GSG, 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.
2LFI, Petrucci, Cpl., Ft. Monmouth, N. J.
2LXO, Jacke, Cpl., Ft. Monmouth, N. J.
2MHP, Albrecht, Pvt., Camp Crowder, Mo.
2MOR, Kovacs, Cpl., Ft. Monmouth, N. J.
2MRL, Kolen, Pvt., Camp Lee, Va.
2QC, Charles, Lt. Col., Ft. Dix, N. J.
3FXM, Santomos, Sgt., address unknown.
3IKA, Friend, Pvt., Scott Field, Ill.
4FKA, O'Neal, Lt., Drew Field, Fla.
4GKZ, Costopoulos, Cpl., Camp Crowder, Mo.
4HJT, Jacobs, Lt., Camp Carson, Colo.
4HVU, Blencoe, Major, Memphis, Tenn.
5CNO, Serur, Sgt., foreign duty.
5EWZ, Bowers, Lt., Ft. Monmouth, N. J.
5GKB, Forgy, Pvt., Camp Crowder, Mo.
5HDM, Davis, Sgt., Hensley Field, Texas.
5ISA, Hibdon, Sgt., foreign duty.
5JL, Dunten, Lt., Ft. Monmouth, N. J.
6ANM, Elser, Major, foreign duty.
6BAM, Trotter, Tech. 5th, Camp Crowder, Mo.
6CLV, Broderson, Presidio of San Francisco, Calif.
6RUB, 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.
8LGQ, Ludwig, Pfc., Camp Carrabelle, Fla.
8LPE, Kleiber, Pvt., Camp Breckinridge, Ky.
8RJR, Weiller, Pvt., Camp Carson, Colo.
8TKW, Timmerman, Pfc., Camp Bowie, Texas.
8UBN, Hazelton, Capt., St. Augustine, Fla.
8UEY, Crumrine, Tech. Sgt., Ft. Wayne, Mich.
8VID, Puhak, Pvt., address unknown.
9AID, Midgley, Pvt., Athens, Ga.
9BFO, Gabardy, Lt., Ft. Monmouth, N. J.

9BLV, Starkey, Cpl., Camp Crowder, Mo.
9CTA, Thursdale, foreign duty.
9CYS, Jackson, Chicago, Ill.
9GEQ, Bryan, 2nd Lt., Ft. Monmouth, N. J.
9HVJ, Kruvand, Sgt., Hunter Field, Ga.
9IZB, Barker, 2nd Lt., Sarasota, Fla.
9KDH, Yunck, Lt., foreign duty.
9TKJ, Ankner, Tech. 5th, Camp Murphy, Fla.
9UKW, Forti, Pvt., Port Arthur, Texas.

Operator's license only:
Hearle, Pvt., Camp Crowder, Mo.
Underberger, address unknown.

COAST GUARD

GLENN MUNRO, W8GLS, 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, RT1c, 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.
5IQI, Robinson, RM3c, Miami, Fla.
ex-K7EBR, Smith, RM2c, address unknown.
7GKS, Killeen, RT2c, Seattle, Wash.
8GLS, 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.
Field, RT1c, New York, N. Y.
Forsberg, RT2c, New Bedford, Mass.

NAVY—GENERAL

AN INCIDENT: E. J. Drozdick, W1NBM, 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.

Here's background! Major W. M. Duckwitz, W8CJT, an amateur for 17 odd years in Michigan, he volunteered in the Signal Corps in August, 1940. Assigned to Fort Knox until May of 1942, when he was ordered to Egypt as observer on communications in the desert, he is now back at Knox as chief of the communication officers division.

1MBS, Brigham, A/C, address unknown.
1ZV, Packard, Lt., address unknown.
2HRH, Siegler, Lt., Washington, D. C.
2ICN, Lee, Lt. (jg), San Diego, Calif.
2IOF, Lathrop, Lt. (jg), address unknown.
2KC, Solotar, Lt., New Orleans, La.
2NBV, Makahon, ACRM, Kansas City, Mo.
3BEN, Green, Lt., New York, N. Y.
3FSO, Ritchey, Lt., Washington, D. C.
3HRB, Stott, Jacksonville, Fla.
4DOT, Smith, Ens., San Diego, Calif.
4GJW, Woods, Lt. (jg), Robertson, Mo.
4IFH, Lanier, RM2c, Key West, Fla.
5AAC, Milam, New Orleans, La.
5EMA, Reynolds, Alameda, Calif.
ex-5JAX, Nelson, Ens., Tucson, Ariz.
6BSC, Gulick, Ens., San Francisco, Calif.
6EID, O'Brien, Lt. (jg), address unknown.
6JAQ, Berlier, RM2c, San Diego, Calif.
6KVP, Anderson, EM3c, address unknown.
6LJA, del Castillo, EM2c, San Diego, Calif.
6MFZ, Harris, RT, address unknown.
6OLI, Stevens, Ens., Hatboro, Pa.
6RYO, Quigley, MM2c, San Diego, Calif.
7AAU, McAllister, RT2c, Bremerton, Wash.
8GYB, Bossler, RM1c, address unknown.
8LCN, Leiner, RT2c, Norfolk, Va.
8OLB, Andrews, Lt., Washington, D. C.
8ORM, Henderson, Chicago, Ill.
8PKS, Harry, Lt., Cambridge, Mass.

8QQE, Kreilick, Ens., Cambridge, Mass.
8VTL, Holland, address unknown.
8WPM, Niedermier, Seaic, Great Lakes, Ill.
9CTK, Beach, RM2c, Great Lakes, Ill.
9GMQ, Smith, Lt., Chicago, Ill.
9HLR, Deal, Lt. (jg), Corpus Christi, Texas.
9HYX, Oberg, address unknown.
9JYW, Wessell, address unknown.
9LPU, Andrew, Sea2c, Miami, Fla.
9PUB, Gilea, RM2c, Chicago, Ill.
9QCC, Fritz, Ens., Hanover, N. H.
9QLR, Lewis, RM3c, Robertson, Mo.
9TRD, Stimpson, Lt., Chicago, Ill.
9YEJ, Knochel, Lt. (jg), Miami, Fla.

ARMY—AIR FORCES

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

1GVT, McNassor, Pvt., Scott Field, Ill.
1ILU, Parker, Capt., Washington, D. C.
1JXE, Rice, Lt., Maxton, N. C.
2BGV, Hellmuth, Lt., foreign duty.
ex-2EIS, Haines, Major, Washington, D. C.
2FEJ, Nestor, A/C, Scott Field, Ill.
2FKF, Meeker, Lt., Bradley Field, Conn.
2HF, Brown, Capt., Bolling Field, D. C.
2HUB, DeGraff, Dale Mabry Field, Fla.
2JBO, Samuels, Pvt., Madison, Wis.
2KIV, Rasmussen, Pvt., Scott Field, Ill.
2MSY, Andrews, Major, Washington, D. C.
2MUX, Greenebaum, A/C, San Antonio, Texas.
2MVL, Threlkeld, Capt., Washington, D. C.
2NEO, Morris, Pvt., Truax Field, Wis.
2NGR, Walsh, Scott Field, Ill.
3CUC, Heller, Pvt., Harlingen, Texas.
3ESP, Dunphy, A/C, Scott Field, Ill.
3FVJ, Whitlock, A/C, Scott Field, Ill.
3GFG, Wenke, Sgt., Scott Field, Ill.
3GJZ, Fowler, Lt., foreign duty.
3ILN, Magowan, Pvt., Chicago, Ill.
3WA, Johnson, Lt., Washington, D. C.
4EFG, Andrew, Capt., Morrison Field, Fla.
4FGJ, Helms, Lt., Knobnoster, Mo.
4KV, Spratlin, Lt., foreign duty.
ex-4MM, Retzbach, Capt., Washington, D. C.
ex-5AH, Peck, Lt., Washington, D. C.
5AMJ, Fisher, Pvt., San Antonio, Texas.
5AQO, Swearington, Capt., Washington, D. C.
5BGP, Guzick, Perrin Field, Texas.
5EWB, Blake, Moody Field, Ga.
5GIN, Fisher, Pvt., Dalhart, Texas.
5GQI, Beeler, Lt., Washington, D. C.
5HZC, Faust, A/C, Scott Field, Ill.
5IAB, Logue, Lt., Scott Field, Ill.
5TP, Hunt, Major, Great Falls, Mont.
6ETR, Gee, Pvt., La Junta, Colo.
6PBY, Stanton, A/C, Scott Field, Ill.
6PFK, Eichenberg, La Junta, Colo.
6PMU, Bridges, Pvt., Merced, Calif.
ex-6RM, McRae, Lt. Col., Washington, D. C.
6SZU, Sosnov, Lt., Los Angeles, Calif.
6TFW, Gasperoni, A/C, East St. Louis, Ill.
6UOW, Cramer, Tech. Sgt., Muroc, Calif.
7HZL, Halphide, Pvt., Kelly Field, Texas.
7KD, Gleason, Major, foreign duty.
8AVY, Francis, address unknown.
8LJF, Fearman, Pvt., Boca Raton Field, Fla.
8NGY, Foley, Pvt., Fresno, Calif.
8PND, Deigert, Major, Washington, D. C.
8PVN, Broughton, Staff Sgt., Lubbock, Texas.
8SKE, Miklas, Pvt., Eglin Field, Fla.
8SWC, Nielsen, Pvt., Salt Lake City, Utah.
8UYT, Donahue, Cpl., MacDill Field, Fla.
9ACJ, Pyrz, Cpl., foreign duty.
9ALV, Kaplan, A/C, Scott Field, Ill.
9DBB, Lounsbery, Lt., Washington, D. C.
ex-9ECB, Quigley, Capt., Washington, D. C.
9HMD, Makela, Pvt., Coffeyville, Kansas.
9HQC, Fish, A/C, Scott Field, Ill.
9INY, Roszhart, Pvt., Pueblo, Colo.
9PUE, Schmidt, Capt., Scott Field, Ill.
9QJH, Walker, Pvt., Ft. Bragg, N. C.
9QZB, Kelley, Cpl., foreign duty.
9TCP, Dale, Lt., foreign duty.
9VTP, Leary, A/C, Scott Field, Ill.
9WYH, Besch, Pvt., Ft. Benning, Ga.
9YIF, Pyrz, Pvt., Homestead, Fla.

NAVY—SPECIAL DUTY

A RECENT graduate of a radio matériel school, Floyd R. Clarke, W9RUJ, 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!

1BBX, Miller, RE, Algiers, La.
1LPC, Boutwell, RT2c, Anacostia, D. C.
2AXI, Wohlafka, RT2c, Corpus Christi, Texas.
ex-2BAO, Eclestein, RT2c, Anacostia, D. C.
2GWI, Kocsis, ARM2c, Anacostia, D. C.
2HAE, Fort, ARM2c, Jacksonville, Fla.
2OZL, Bayer, RT1c, Chicago, Ill.
3BVB, Leslie, RT2c, Chicago, Ill.
3HBW, Thompson, RT3c, Grove City, Pa.
3HJM, Woodward, ARM1c, Anacostia, D. C.
3HWE, Boyer, ACRM, Anacostia, D. C.
3IRW, Willson, ACRM, Anacostia, D. C.
3ISQ, MacPeek, Seaic, Grove City, Pa.
3IXD, Schnaithman, RT3c, Grove City, Pa.
3JBH, Stoudenmire, RT2c, Norfolk, Va.
4BJL, Clapper, RT2c, Treasure Island, Calif.
5FCI, Fay, RT2c, College Station, Texas.
5JIK, Proctor, RT1c, Chicago, Ill.
5KKR, Milam, Treasure Island, Calif.
6FMY, Bank, Treasure Island, Calif.
6HXY, Smith, RT3c, Treasure Island, Calif.
6TAK, Gilleran, RT2c, Treasure Island, Calif.
6TLI, Lee, RT2c, San Deigo, Calif.
7FHY, Dailey, RT2c, Bremerton, Wash.
8FRR, Orzech, RM2c, Grove City, Pa.

8JHK, Baumgardner, 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.
8VBZ, Perry, RM2c, Corpus Christi, Texas.
8VNA, Searl, ARM1c, Anacostia, D. C.
9ATG, Corderman, Sea1c, Chicago, Ill.
9CUS, Dykes, EM3c, Anacostia, D. C.
9GKW, Schorn, ARM2c, Anacostia, D. C.
9JRN, Shearer, RT2c, Treasure Island, Calif.
9UAS, Foster, RT2c, Chicago, Ill.
9WJM, Pechulis, RT2c, Chicago, Ill.
9WXD, Whitcomb, 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.
1MGT, 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.
3IXJ, Collins, Staff Sgt., Quantico, Va.
4FIJ, Fincher, Staff Sgt., New River, N. C.
4GTB, McCoy, address unknown.
4GVJ, Jenkins, New River, N. C.
4HHI, Heuer, address unknown.
4HWI, Jordan, New River, N. C.
4IHI, Battle, New River, N. C.
5CT, Barclay, Lt., Cambridge, Mass.
5HQG, Garrett, Pvt., foreign duty.
6FHQ, Harris, Staff Sgt., San Diego, Calif.
6TYT, Van Kol, HA1c, Camp Pendleton, Calif.
KC6USC, Buchanan, foreign duty.
7GRQ, Padden, Staff Sgt., Corpus Christi, Texas.
8NDR, Mason, Pvt., address unknown.
8RBG, Kennedy, New River, N. C.
8RNG, Bowman, Staff Sgt., address unknown.
8ROD, McJury, New River, N. C.
8RTK, White; Sgt., foreign duty.
8TDI, Hull, New River, N. C.
ex-9DPK, Storm, New River, N. C.
9FWP, Brendiar, New River, N. C.
9JYA, Milnor, Staff Sgt., Corpus Christi, Texas.
9OFI, 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 it to say the following have been assigned foreign or sea duty of some kind:

2AOS, Biele, Lt. Comdr.; 2IXF, Coker, CRM; 2JED, Kane, RM2c; 4ADP, Hoselton, Lt.; 5FAJ, Calhoun, RM2c; 6OMG, Estes, CRM; 6OSU, Reimer, RT2c; 6PLX, Bramkamp, Dr.; 6PTN, Elkerton; 6UOT, Hickingbottom, RM3c; 7CT, Crouter, Lt.; 7SWL, Clayton, RM3c; 8AYH, Gastgeb, CRM; 8NCJ, Rosenberg; 9CCW, Ackermann, RM2c; 9UQA, Shaw, RM1c; and 9ZZU, Rosing, RM.

Henry Wastradowski, W7JAS, active on 10 meters until December 7th, has taken on new responsibilities. Last September he started working as husband for Mrs. W7JAS and now he is working as RT2c for the Navy at the Treasure Island Radio School, San Francisco. *Congratulations all the way 'round!*

HAM HOSPITALITY

THE New South Wales Division of the Wireless Institute of Australia extends an invitation to amateurs of the United Nations in service to attend its general meetings held at YMCA Buildings, Pitt Street, Sidney, on the third Thursday of each month. 'Phone Chairman Priddle, VK2RA, at BW6006, or Secretary Ryan, VK2TI, at FX3305.

The Experimental Radio Society of Egypt welcomes hams on active service. Write Frank Pettit, Catholic Club, Mustapha Barracks, Sidi Gaber, Egypt; or 'phone Alexandria 27315 (SUISG) or Ramleh 498 (SU1RD).

Who Killed the Signal?

A Radio Mystery Serial

BY CLINTON B. DE SOTO,* W1CBD

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.*

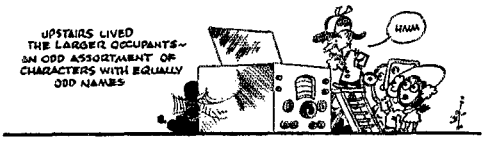
But radio isn't really any more mysterious or complex than many a detective story — at least not after you've read the last page and know "whodunit." The difference lies in the method of presentation. There may be some utility, then, in the idea of presenting radio fundamentals in the manner of detective 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 — well, 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

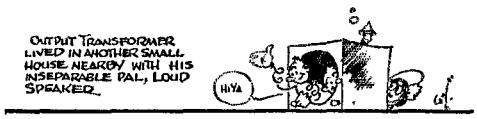


cover, and a spider spun suspension cables for his web between its louvres and the wall. The receiver did not much care; indeed, it had no way of knowing. For the heart had gone out of it. The Signal was dead.

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,



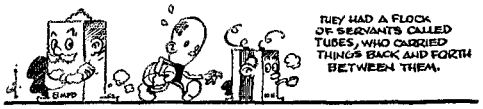
he lifted the lid and peered inside. It was of two-story construction. Upstairs, on top of the metal floor called the chassis, lived the larger occupants — an odd assortment of characters with equally odd names. These characters belonged neither to the animal nor vegetable kingdoms, but to a special classification of fauna called "parts."

Most of these parts seemed to be members either of 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.

* Executive Editor, *QST*.

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."

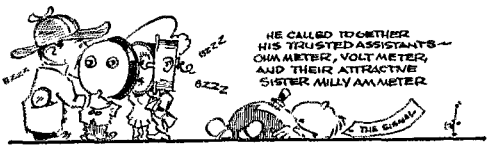
Leaving the rest of the parts to wonder what was happening, they went over to the rear of the chassis.

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

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 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."

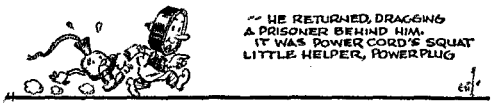
"I'll explain it this way. You know that when two permanent magnets are placed together with the north and south poles facing they exert a mutual attraction. In the same way, a positively-charged nucleus attracts negatively-charged electrons. In many substances the attraction is so great that the electrons 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 these 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?

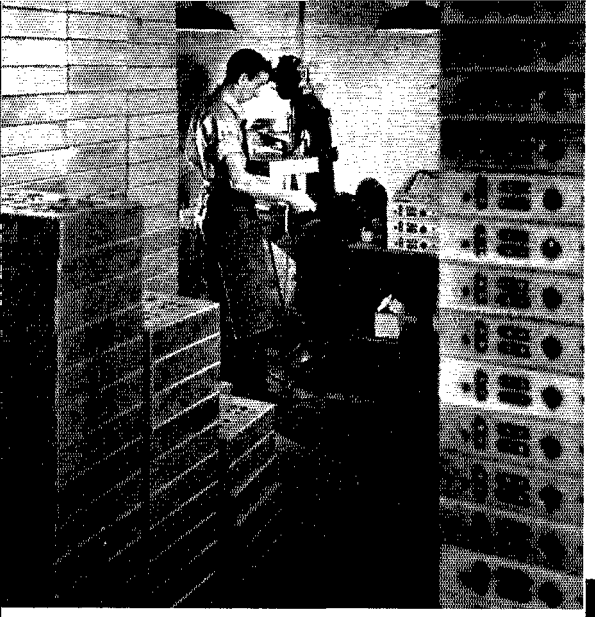
The combination of manufacturers and home-builders has been of tremendous importance in the job of turning out military equipment to "get the message through." If it were not for the fact that American radio manufacturers had been producing transmitters and receivers for amateur radio operators throughout 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.

Transmitters by mass production. On the assembly line at the left individual units are carefully tested for continuity of wiring and correct cabling by skilled girl operators. After testing, all necessary adjustments are completed before the chassis units are mounted in the transmitter cabinets. At the right is a row of complete transmitters, fully assembled, tested and ready for shipment to our armed forces. Note the final inspection tags attached to the front panel.

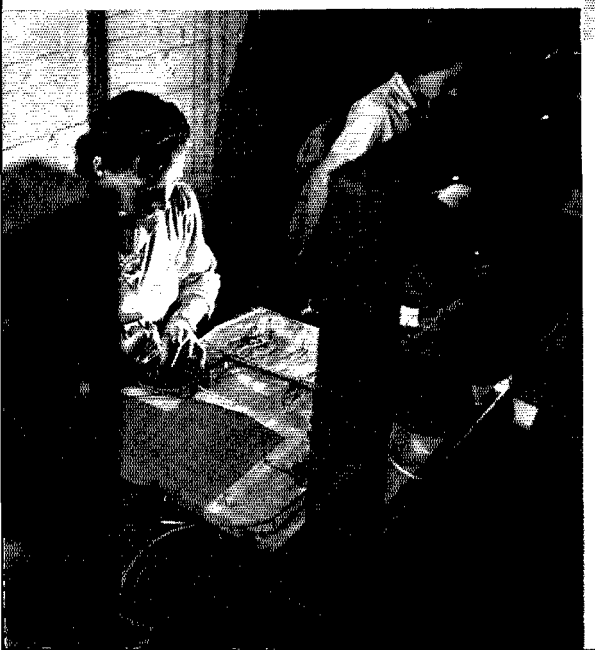


From raw material to finished parts.

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!



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.

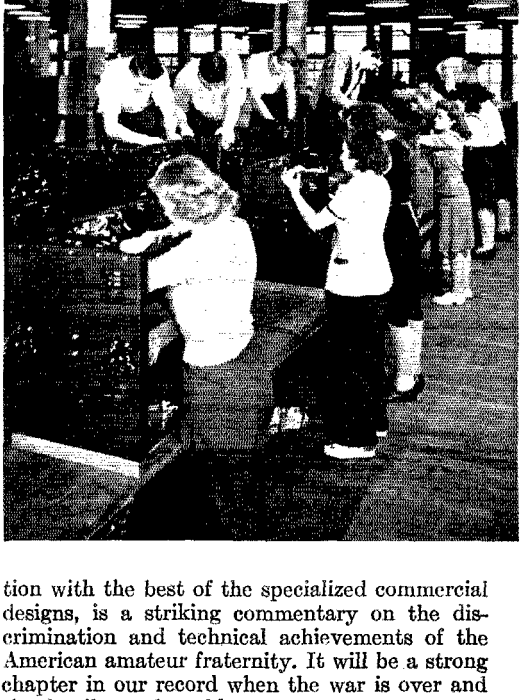
That is why Uncle Sam has placed so much confidence in American radio manufacturers. They are doing an outstanding job.

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

— 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 competi-



From component parts to complete transmitters.

Above — Heavy transmitter chassis are held at a convenient angle for wiring on special wood frames. Each operator is responsible for completing a designated series of connections in a prescribed order. This steps up production and prevents mistakes due to complicated circuits.

Left — Transmitters being assembled on one of the many assembly lines. Heavy tables support the tremendous weight of the units. Girls as well as men play an important rôle in production. Many of them will be among tomorrow's hams.

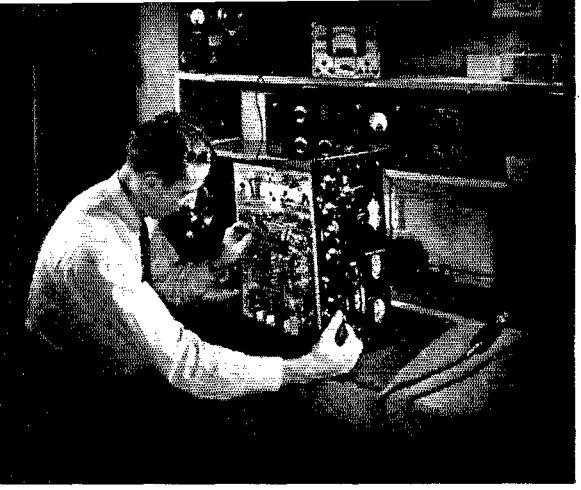
Below — Transmitters are placed on dollies to facilitate being moved along the assembly lines. The YL in the foreground is inserting transmitting tubes in a completed unit. After continuity tests are made it will be sent along to the inspectors and testers.

tion 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



A familiar model is this receiver, here seen undergoing a series of tests in the Hallicrafters laboratory. Military sets of similar design successfully withstand terrific punishment when used on our battlefronts.

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 breadboard style for the 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 the new equipment at their stations.

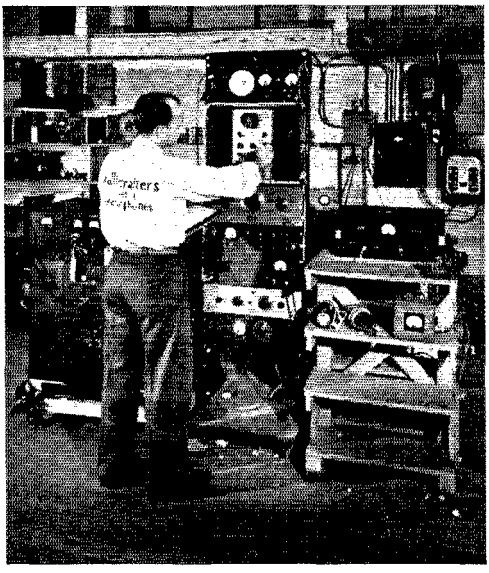
Many hams have in the past been a bit careless in constructing their own rigs. The American manufacturer has been responsible in many ways for changing the entire technique in assembly, layout and wiring of units. Bad habits have been corrected. Building a large transmitter, for example, is done by following 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.

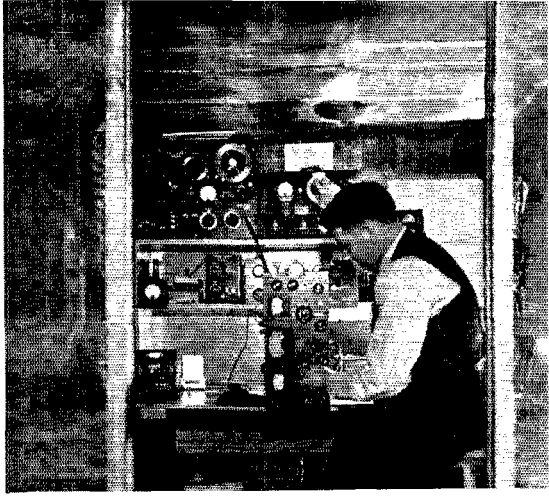
In making these large transmitters each assembly line is charged with the responsibility for turning out individual sections. A portion of one of these lines is shown in one of the photos. These units, after receiving final tests and inspections, will later be placed into their steel cabinets.

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



Each transmitter receives its "baptism of fire" before being packed for shipping. Precision equipment is used for these important tests and actual testing must be executed by skilled radiomen. Many are licensed amateurs.



Shielded test booths are an important part of a modern radio plant. Outside QRN cannot be tolerated while critical adjustments are being made. Grounded copper screen completely encloses each test room.

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 QRM 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 72)

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, W8ZQ — 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 Eldridge, 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-supply units of reasonable output. Gene Copp tied this fact and the *QST* article together in his mind — and things began to happen.

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 W8ZQ. W8ZQ, 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 1¾ hp. but capable of 2½ 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.

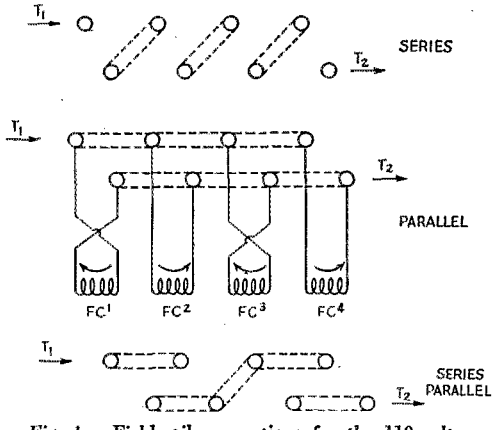


Fig. 1 — Field-coil connections for the 110-volt rewound a.c. generator. Coil leads are brought to terminals on a panel mounted on top of the generator housing and connected in series, parallel or series-parallel.

HAPPENINGS OF THE MONTH

QRT METERS

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:

Lt. Dosland	596
Lee R. Kemberling, W8ESN	342
Harold M. Baker, W9MDJ	294

"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 reëlected over Dr. Lawrence J. Dunn, W2CLA, by 495 votes to 347.

W2LV, having removed from the division, was not a candidate for reëlection as alternate director. This election was between George Rulffs, Jr., W2CJY, and Leslie J. Fitz Gibbon, W2BWC, 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

THE facts that you sent in your application for registration of your transmitters some time ago and you have not yet heard from the FCC should not disturb you. The task of assigning numbers and making out stickers is a tremendous one and, because of the shortage of clerical help in Washington, this work has been postponed for more important duties. Sooner or later you will receive your certificates to stick on your transmitters.

PROOF-OF-USE WAIVED

FCC REGULATIONS normally require a proof of the use of either commercial or amateur licenses as a condition to their renewal without reëxamination. 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-

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. K6OJI 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 K6OJI, 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 57*)

* 1168 W. Sixth St., Eugene, Ore.

ON THE ULTRAHIGHS

CONDUCTED BY E. P. TILTON,* W1HDQ

An almost continuous succession 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.

W6PCB/8 (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 thereabouts, 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.

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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 56-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 F_2 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!

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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 W3BYF 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.

*329 Central St., Springfield, Mass.

What Is It?

(*Continued from page 56*)

It is the ratio of the change
In current to the plate
Divided by the 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. DESOTO,* W1CBD

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.

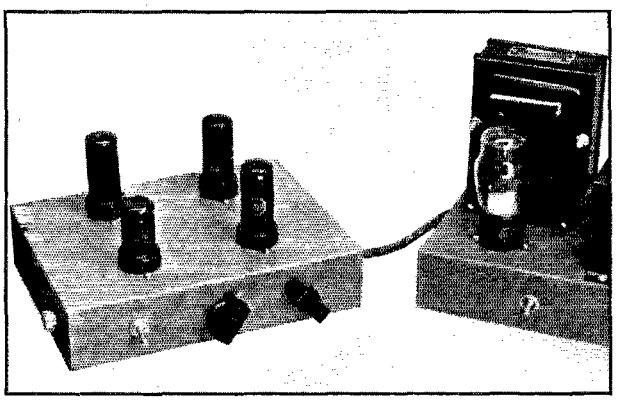
For a really satisfactory recording system, however, separate amplifiers should be used for the two jobs. In the first place, the requirements are quite different. The play-back amplifier requires neither as much sensitivity nor as great power output as the one which drives a recording head from a microphone 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 "1 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 ½ volt of signal is required for full output. Even this amount of amplification is more than is required for high-level crystal pick-ups, 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_{18}) 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.

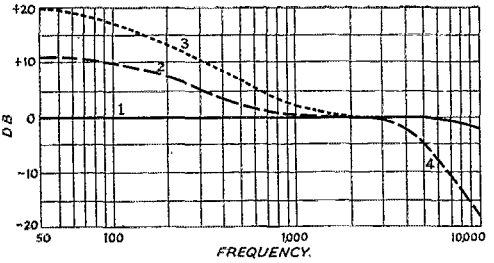


Fig. 2 — Audio-response curves. See text for details.

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 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.

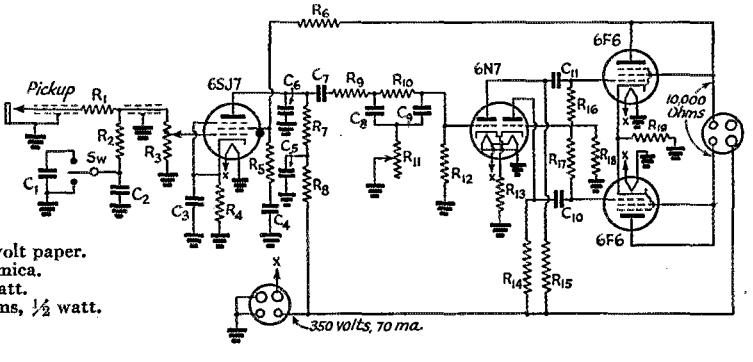
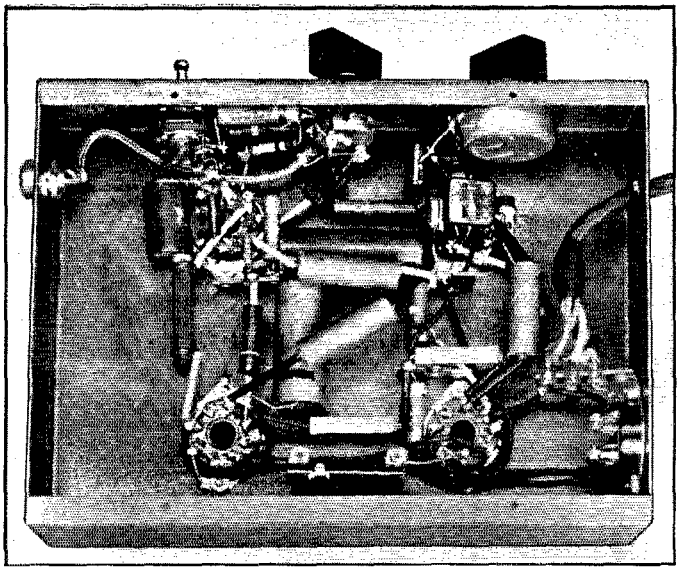


Fig. 1 — Circuit diagram of the play-back amplifier.
C_1, C_2 — 0.005-μfd. midget mica.
C_3 — 25-μfd., 25-volt electrolytic.
C_4 — 0.5 μfd., 200-volt paper.
C_5 — 4-μfd., 450-volt electrolytic.
C_6 — 50-μμfd. midget mica.
C_7, C_{10}, C_{11} — 0.1 μfd., 400-volt paper.
C_8, C_9 — 0.002-μfd., midget mica.
R_1, R_{12} — 0.5 megohm, ½ watt.
R_2, R_8, R_9, R_{10} — 50,000 ohms, ½ watt.
R_3 — 1-megohm variable.
R_4 — 500 ohms, ½ watt.
R_5 — 25,000 ohms, ½ watt.
R_6 — 1 megohm, ½ watt.
R_7, R_{17}, R_{15} — 0.1 megohm, ½ watt.
R_{11} — 0.5 megohm variable.
R_{13} — 1500 ohms, ½ watt.
R_{16}, R_{17}, R_{18} — 0.25 megohm, ½ watt.
R_{19} — 750 ohms, 10 watts.



Beneath the chassis of the playback amplifier. The input connector is at the left, output (speaker) socket and power cable at right. Controls along the top are, l. to r., bass-compensating switch, gain control and treble compensating control. The 6SJ7 input amplifier is at upper left and the 6N7 phase inverter at upper right, with push-pull 6F6s below.

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_2 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_{10}) 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 feed-back 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 feed-back. 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 $\mu\mu$fd. 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 × 9 × 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.*

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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.*

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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.*

STRAYS

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.

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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.*

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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. — *W2OMM.*

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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.

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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.

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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!

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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, 8DJE, 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 E. Houlahan*

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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.

HINTS AND KINKS FOR THE EXPERIMENTER

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 ⅜-inch, with the ¼-inch size predominating. — *Clyde Criswell, W6QLZ.*

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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

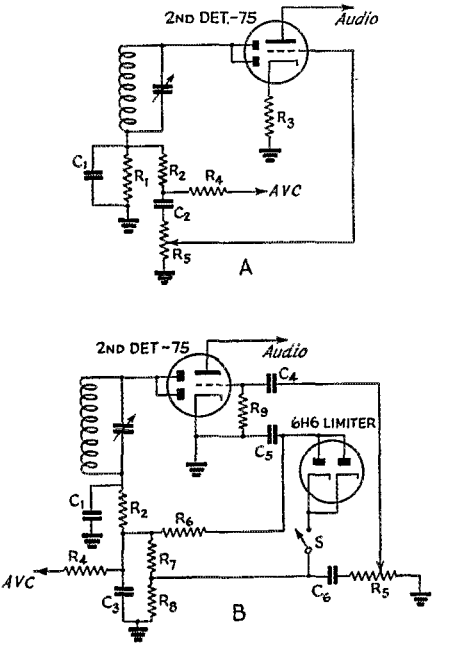

Fig. 1 — W8EFW's noise-limiter circuit for mobile receivers using u.h.f. converters. (A) shows original connections in the b.c. receiver, while the alterations are shown in (B.)

C_1 — 50 μμfd.
C_2 — 0.01 μfd.
C_3 — 50 μμfd.
C_4 — 0.005 μfd.
C_5 — 0.05 μfd.
C_6 — 0.005 μfd.
R_1 — 250,000 ohms.
R_2 — 50,000 ohms.
R_3 — 250 ohms.
R_4 — 1 megohm.
R_5 — 500,000-ohm potentiometer.
R_6 — 1 megohm.
R_7 — 40,000 ohms.
R_8 — 150,000 ohms.
R_9 — 10 megohms.

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, W8EFW*

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SIMPLE SCRATCH FILTER FOR PHONO PICK-UP

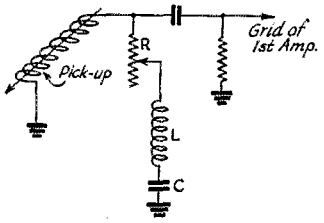

Fig. 2 — Combination tone-control and scratch-filter circuit suggested by W9CYL.
C — 0.006 μfd.
R — 50,000-ohm wire-wound control.
L — 250-millihenry choke.

FIG. 2 shows a simple combination tone control and scratch filter which I have used for a number of years. I find it very useful, especially when playing old records. It happened that I used a wire-wound resistor. The low side of the tone control 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*

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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.

Fig. 3

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 V_1 and V_2, 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 W8BWK and W8SDU 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*

Strays

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. — *W8ERV*.

—···—

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 that of the total job. — *Ohmite News*.

CORRESPONDENCE FROM MEMBERS

The Publishers of *QST* assume no responsibility for statements made herein by correspondents.

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 coöperate 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 what 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.

The training here will equip radio enthusiasts like myself who have never had the opportunity to use actual equipment with the practical knowledge and experience necessary for instruction.

As I said before, please emphasize this need again. It is *so* great, and the supply is dwindling. . . .

— *Robert G. Salsbury*

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 also 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

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 32 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, W9ZWW*

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. — EDITOR.)

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 ragchew with them. . . . I have also met VP7NR, the only amateur here (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, G5BB*

TO HELL WITH HITLER

Milford, Nebr.

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.

Editor, *QST:*

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*

OPERATING NEWS

GEORGE HART, W1NJM
Acting Communications Manager

CAROL A. KEATING, W9WWP
Assistant Communications Manager

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 licensees, with more pending. Since that time 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 Coördinators further reveal that of the 6 states in the coastal area in which no WERS licenses 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 roll call 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 coöperation 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 Coördinator 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.

*Albany (N. Y.) Amateur Radio Assn.
*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.
*M.I.T. Radio Society, Cambridge, Mass.
*Orange County Radio Assn., N. Y.
Saint Joseph High School Radio Club, St. Joseph, Mich.
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 Coördinators. 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.*

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 present 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 response to our previous notices, the closing dates for receipt of nominating petitions are set ahead to the dates given herewith. 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 the Section subject, of course, to the filing of proper nominating petitions and the holding of an election by ballot or as may be necessary. Petitions must be in West Hartford on or before noon of the dates specified.

Due to resignations in the Missouri and Eastern Florida Sections, nominating petitions are hereby solicited for the office of Section Communications Manager in these Sections, and the closing date for receipt of nominations at ARRL Headquarters is herewith specified as noon, Monday, February 15, 1943.

Section	*Closing Date*	*Present SCM*	*Present Term of Office Ends*
Alaska	Feb. 1, 1943	James G. Sherry	June 14, 1942
So. Minn.	Feb. 1, 1943	Millard L. Bender	Aug. 22, 1942
W. Penna.	Feb. 1, 1943	Elmer Krall	Sept. 20, 1942
No. N. J.	Feb. 1, 1943	Edward Gursky, Jr.	Oct. 15, 1942
West Indies	Feb. 1, 1943	Mario de la Torre	Dec. 16, 1942
Mississippi	Feb. 1, 1943	S. Benton Cain	Feb. 15, 1943
Missouri	Feb. 15, 1943	Robert C. Morwood (resigned)	.....
E. Fla.	Feb. 15, 1943	Carl G. Schaal (resigned)	.....
Hawaii	Feb. 15, 1943	Francis T. Blatt	Feb. 28, 1941
Sacramento Valley	Feb. 15, 1943	Vincent N. Feldhausen	June 15, 1941
Nevada	Feb. 15, 1943	Edward W. Heim	Nov. 1, 1941
Oklahoma	Feb. 15, 1943	R. W. Battern	Nov. 1, 1942
W. N. Y.	Feb. 15, 1943	Fred Chichester	Dec. 6, 1941
N. H.	Feb. 15, 1943	Mrs. Dorothy W. Evans	Sept. 1, 1941
Utah-Wyo.	Feb. 15, 1943	Henry L. Schroeder	Oct. 1, 1942
No. Carolina	Mar. 1, 1943	W. J. Wortman	Mar. 18, 1943
R. I.	Apr. 1, 1943	Clayton C. Gordon	Apr. 15, 1943
N. Y. C. and L. I.	Apr. 15, 1943	E. L. Baunach	Apr. 22, 1943

1. 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 concerned. Ballots will be mailed to members as of 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 have the privilege of nominating any member of the League as candidate for Section Manager. The following form for nomination is suggested:

(Place and date)

Communications Manager, ARRL
38 La Salle Road, West Hartford, Conn.

We, the undersigned members of the ARRL residing in the.....Section of the.....Division hereby nominate.....as candidate for Section Communications Manager for this Section for the next two-year term of office.

(Five or more signatures of ARRL members are required.)

The candidates and five or more signers *must* be League members in good standing or the petition will be thrown out as invalid. *Each candidate must have been a licensed amateur operator for at least two years and similarly, a member of the League for at least one continuous year, immediately prior to his nomination or the petition will likewise be invalidated.* The complete name, address, and station call of the candidate should be included. All such petitions must be filed at the headquarters office of the League in West Hartford, Conn., by noon of the closing date given for receipt of nominating petitions. There is no limit to the number of petitions that may be filed, but no member shall sign more than one.

4. Members are urged to take initiative immediately, filing petitions for the officials of each Section listed above. This is your opportunity to put the man of your choice in office to carry on the work of the organization in your Section.

— *George Hart, Acting Communications Manager*

ELECTION RESULTS

Valid petitions nominating a single candidate as Section Manager were filed in a number of Sections, as provided in our Constitution and By-Laws, electing the following officials, the term of office starting on the date given.

Santa Clara Valley	Earl F. Sanderson, W6IUZ	Oct. 15, 1942
Nebraska	Roy E. Olmsted, W9POB	Oct. 15, 1942
Tennessee	James B. Witt, W4SP	Nov. 15, 1942
Oregon	Carl Austin, W7GNJ	Nov. 22, 1942
Georgia	Ernest L. Morgan, W4FDJ	Nov. 29, 1942
Southern Texas	Horace Biddy, W5MN	Dec. 15, 1942
Kentucky	Darrell A. Downard, W9ARU	Dec. 15, 1942

The Month in Canada

NOVA SCOTIA—VE1

From L. J. Fader, 1FQ:

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

1FG 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. 1HO 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. 1ED 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, 1GH, 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 MacPhail 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, Cliff 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 Cliff our wishes for a speedy recovery. Cliff 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 3AHX and 3AHV 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!

3BBF 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. 3VS is in Hamilton with the RCAF studying for a WAG.

3HB 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 3AIB, AD, AWX, FB, APO and others.

All VE3s join with the other Canadian amateurs in extending to CGM Alex Reid their deepest sympathy in the recent death of his wife.

—•••—

W1MOK went to New York for a week-end and, while standing in Penn Station waiting for his friend, whistled CQ. From out of the dim-out appeared not only his friend, W2HKH, but several other hams as well. They all had quite a chat, and it wound up looking like a hamfest of the good old days.

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 53)

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.

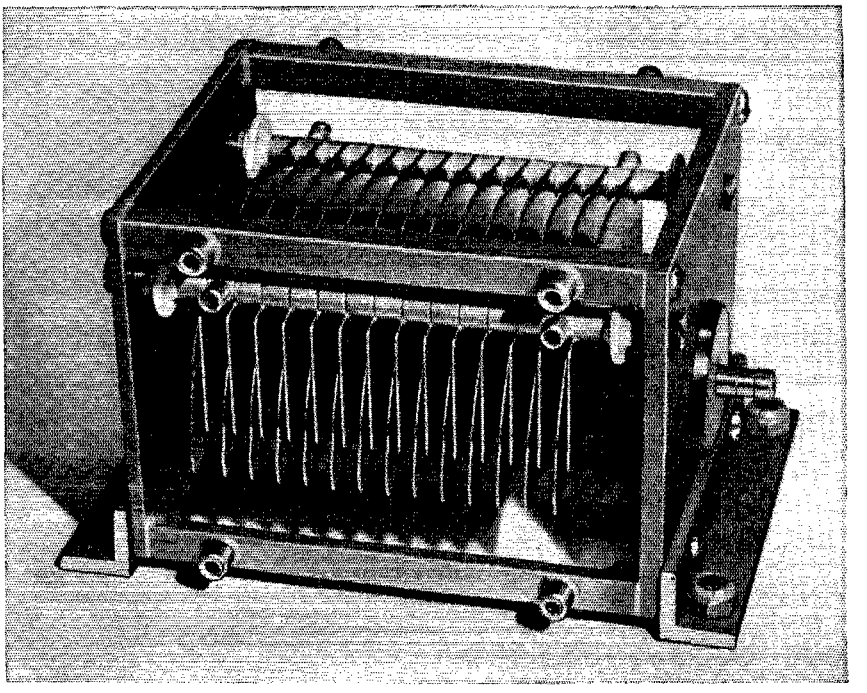
Hams in the Labs

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 peace-times 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, W9BRT; Clarence Zorn, W9TAL; Wallace Burandt, W9PTD; Fred Connor, W9CUK; Jack Cappels, W9EPB; Ray Polkingham, W9IAV, 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.

BUILT TO LAST



A typical example of rugged construction

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

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Who Killed the Signal?

(Continued from page 48)

"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. In it electrons change 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 direction 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!" he charged.

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.C. 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?"

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.

PRECISION PRODUCTS FOR BETTER RADIO

HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 WEST 34TH ST., NEW YORK, N. Y.

(*Continued from page 74*)

"P-please, mister, it's not my fault," Power Plug whimpered pleadingly. "The Signal was already dead when I left my receptacle. Honest — I would never have left otherwise."

The Sleuth looked at him keenly. "Well, there's one way to find out. Go down there and plug yourself in, Plug, and we'll see. Volt, you'd better go with him."

A few moments later Power Cord seemed to come to life again. "The current — there's the current!" he shouted. "Hey, up there — you A.C. Switch. Close yourself and let's get going!"

Twenty seconds later his face fell again. "It's no use," he said. "The set still doesn't work. See — Dial Light is the only one doing a blessed thing."

When he returned, Volt's steps were dragging. "Nothing happened, eh? I thought so, when I didn't hear any noise. Guess this fellow was telling the truth at that." Volt was thoroughly dejected.

But Sleuth wasn't discouraged. "A thing like that can happen in the best of circuits," he said kindly. "We'll just have to look a little further."

(*To be Continued.*)

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 2π 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 $2\pi/2$, or π radians; at one-fourth second it will have generated an angle of $2\pi/4$, 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

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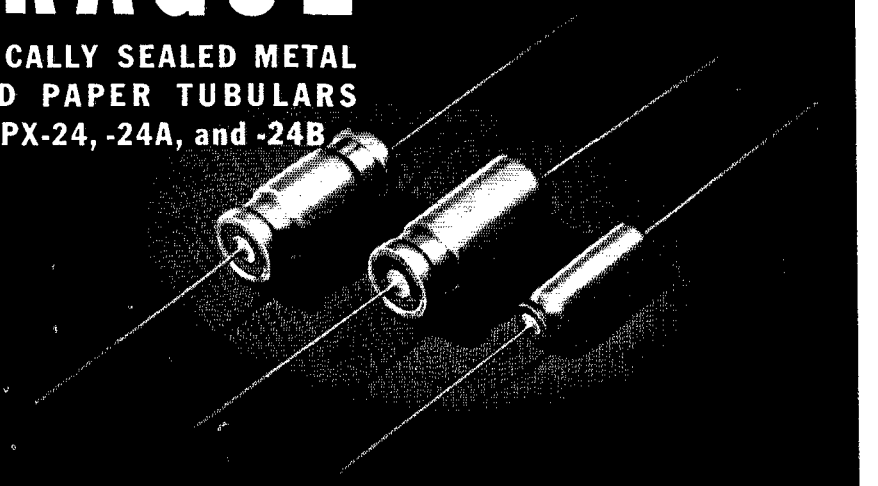

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There remain, of course, certain applications where mica capacitors should still be used, and Sprague regularly produces large quantities of transmitting mica capacitors in a complete range of types and sizes.

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.

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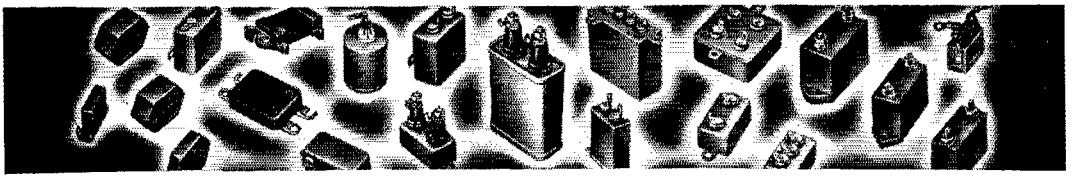

MANUFACTURERS OF A COMPLETE LINE OF RADIO INDUSTRIAL CAPACITORS AND KOOLOHM RESISTORS

(*Continued from page 76*)

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

Since the rotating radius generates 2π radians in each period, the total number of radians generated in any number of periods is equal to 2π multiplied by the number of periods. Hence the number of radians generated in one second will be equal to 2π 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, ω. 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 a 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

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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 ALSIMAG 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 ALSIMAG 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 ALSIMAG 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 ALSIMAG products, backed by the same alert organization ready to serve you in the same old spirit of friendly helpfulness.

ARMY E NAVY

AWARDED JULY 27, 1942

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(*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 2π 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 ωt 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/ω. 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


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(*Continued from page 80*)

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_{max}, while the small i indicates the instantaneous value of the current. The expression then becomes

$$i = I_{max} \sin (\omega t + a)$$

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

$$i = I_{max} \sin \omega t$$

(*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

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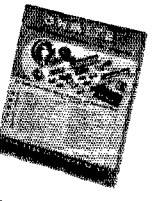

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BE RIGHT WITH OHMITE RHEOSTATS • RESISTORS • TAP SWITCHES

(*Continued from page 82*)

will take is difficult to say. The State War Effort Coördination 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 Coördination, 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 Coördination trials that are held from time to time."

Rejuvenating Old Meters

(*Continued from page 41*)

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.

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(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.

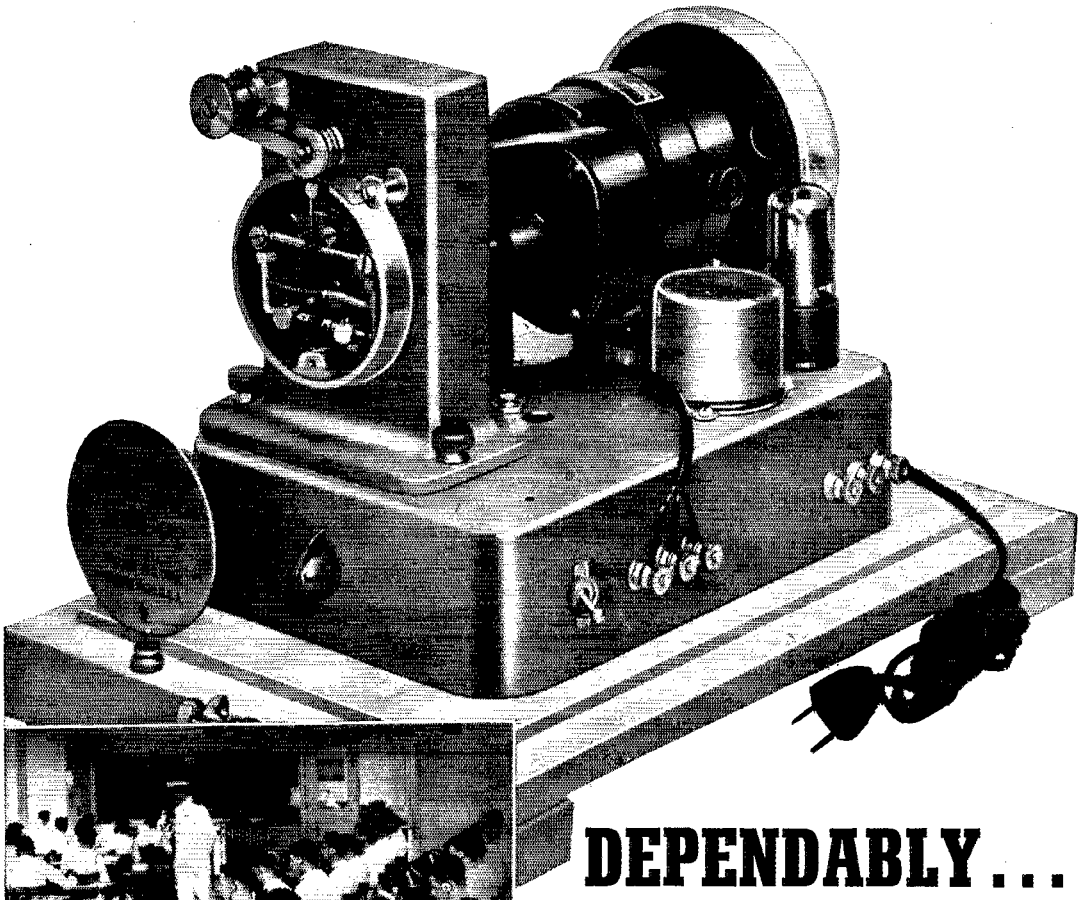
— *Radio Jobber News.*

—•••—

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. — *W8ERV.*



RADIO NEWS PHOTO

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AMATEUR ACTIVITIES

ATLANTIC DIVISION

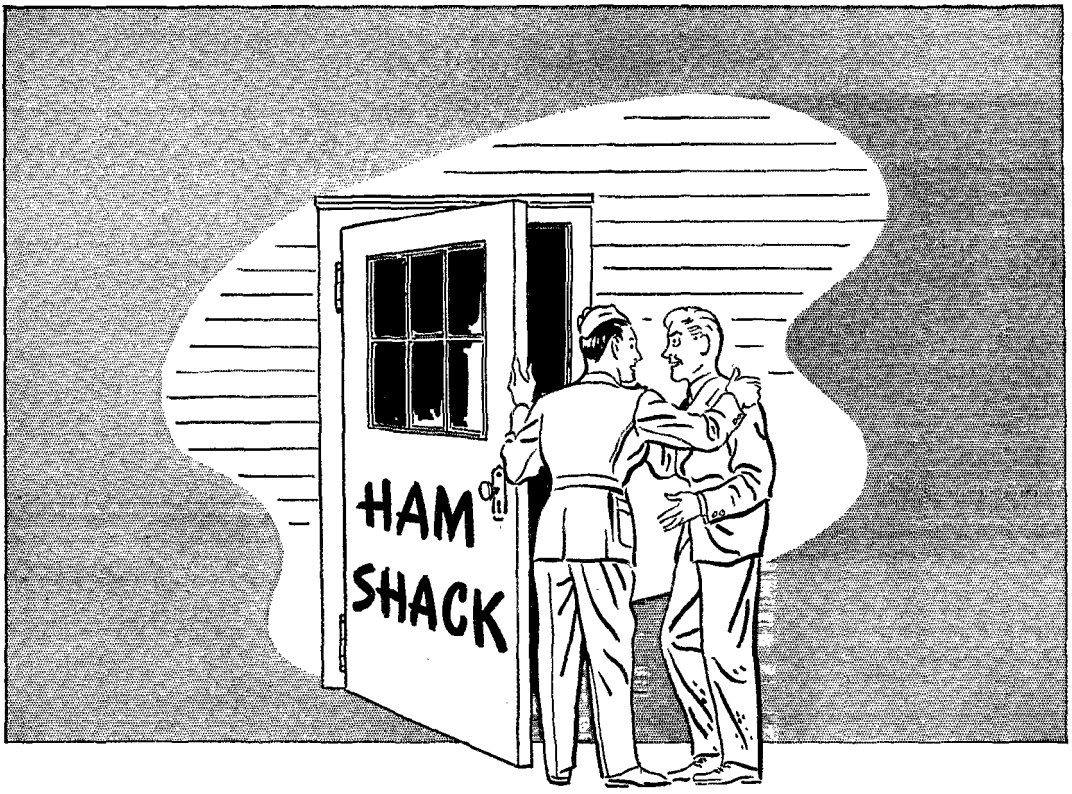
MARYLAND-DELAWARE-DISTRICT OF COLUMBIA — SCM, Hermann E. Hobbs, W3CIZ — There were approximately 70 hams present at the hamfest in October at home of W3FPQ. AC4JS gave a talk and showed movies of his activities in Tibet, including his ham activities. There were lots of games, dancing, prizes and a send with your left foot, or QLF, contest. Over half those present were out-of-towners who are temporarily in Washington. Among those present were 5FCD, 8KWA, 3AKB, 6OGZ, 3JPK (ex-9WSR), 3DAL, 3JSH (ex-2MIY), and 9WWP. EIS gave a talk at a recent Club meeting on the carrier system of communication over the 120 Electric Lines. CJT was a recent visitor over the week end. No WERS calls issued for this section up to the present writing. AFY heads WERS activities in Montgy. Co. and Perry Wightman 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, W3GCU — Asst. SCM, ZI; Regional EC in charge of Emergency Coördination, BAQ; Emergency Coordinators: Altantic City, EFM; Camden, KW; North Plainfield, CGU; Vineland, GMY; Somerville, EBC. Regional Coördinator Ted Torretti is again "on the go" in pursuance of his duties as civilian engineer for Signal Corps Labs, destination unknown. Asst. SCM ZI has resigned his position as radio engineer in field division, Signal Corps Labs, and has accepted the position of radio technician with the New Jersey State Police Radio Communications System. He is now located at Troop "C," N. J. State Police, West Trenton, N. J. Ed has charge of eleven "fixed" FM stations, and sixty-five patrol cars assigned to this area. Former SCM Les Allen, CCO, is now located in Arkansas. Mail will reach him addressed to Lt. Lester H. Allen, AC, AAF-BFS, Tuckerman, Arkansas. ITU's address is U. S. Army, Co. C, 29 Sig. Trng. Bureau, Camp Crowder, Mo. Address ARN, Anthony S. Rura, AS, Bks 428, Co. 24, U.S.N.T.S., Bainbridge, Md. JOL resigned position at Palmer Labs to accept position as "leader" in radio equipment installation at Eastern Aircraft. Quite a number of local hams have taken employment at Eastern Aircraft including HW, IDY, IIN, BWF, IUQ and CFB. Since the close-down of amateur transmission, CFB and his brother, 8LFM, who maintained regular weekly skeds for over seven years, have turned to photography as an outlet for their energies. ABS reports his fall session of the Hillsborough Township Radio School started on December 3rd, with 37 students studying both amateur and 3rd class 'phone. Stan has, as radio aide for his territory, drawn up complete operating plans and data for a joint operating agreement for Branchburg and Hillsborough Twps: 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 coöperating as radio aides 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. HAZ has been promoted to sargeant at Fort Monmouth Radio School. It was erroneously reported here that GPS had reported for duty in Unk Sam's forces. Steve has been deferred for the present. FXM is now Sgt. Jos Santomos, doing radio work. His address is Box 232, Highlands, N. J. HZM enlisted in Naval Reserve as radio technician 2nd class, and is stationed at Phila. Navy Yard. It is reported that GEV has enlisted as electrical engineer in the Service. The South Jersey Radio Assn. is progressing nicely with radio classes under the capable tutorship of FDF. There was an auction of old equipment at the October meeting, with the club receiving 5% of the proceeds. Three new members were welcomed into the ranks of the SJRA recently: Ernie Foxx, of Pine Hall, N. J.; Julius Krivos, of Collingswood, N. J.; and Ralph Pierce, of Haddonfield, N. J. Newly licensed hams in the South Jersey vicinity are Ray Hibbs, Hank Bennett, and Bill Wescott, 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 enjoyed their annual picnic on Sept. 6, 1942, held in Berlin (N. J.) Park; among those present were IAS, AEJ, HLY, HND, EET, JOF, IIC, IZP, Bob Boehme, Hank Bennett, Miss Jean MacMullan, and all the YLs, XYLs, and OWs. The afternoon baseball game was played between teams managed by Mrs. IIC and Miss MacMullan. The DVRA, at their November meeting, elected other members to take over the unexpired terms of the members who have been called to the Services. Those selected were: acting president, JOL; acting vice-pres., EED; assistant secy., Chas. Moore; sgt.-at-arms, JAG. The members decided to reduce the DVRA dues to twenty-five cents per month until further notice. To the boys in the Service to whom W3GCU owes a letter, an apology is due. Sorry to be so tardy in writing, fellows, but will surely drop you fellows a line soon. Please don't let this deter you from sending in your dope for this column. Please fellows, let's hear from some of the other parts of the Section. We need them just as much now as before. Thanks again to those who are helping, and, until next time, 73.

WESTERN PENNSYLVANIA — SCM, E. A. Krall, W8CKO — Acting Assistant SCM in charge of Emergency Coördination, 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 off because of lack 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. Remember, many of the fellows who are in the armed forces read this write-up and would be delighted to know what is going on in the old home town. So, what say? 73.

CENTRAL DIVISION

INDIANA — SCM, LeRoy T. Waggoner, W9YMV — War Emergency Radio Service is now an actuality in Indiana. WERS station WJGV, issued to the City of Fort Wayne, operated on the 112-Mc. band for the first time during the November 22nd practice period. Five stations participated in this drill, 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 WERS were of course notified in advance and 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 control center reported to the control center and 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 13th it was arranged to have the control transmitter broadcast a tone modulated signal for the first half hour of the practice periods to enable net stations to align receiving equipment on the net frequency. Biggest difficulty encountered was interference from SWL receivers radiating. The Fort Wayne hams are to be commended and congratulated for their excellent performance in WERS. The City of Anderson, with ICY as communications coördinator and SUR as radio aide, has been issued a WERS license with the call letters WJWH. No operation has as yet been reported. Richmond has likewise been licensed for WERS with assigned call letters WJXY. NVA reports that they have encountered tough going in the matter of equipment and adequate personnel to man the transmitters but will "be in position to deliver the goods and uphold ham tradition." MEY has changed QTH to East Chicago and is looking for hams in WERS. MJW reports that Mount Vernon is completing its application for WERS license. FOS recently graduated from the officers' training school at Fort Monmouth and is awaiting assignment to active duty. RCV is radio operating for American Airlines. SNF works at Army Air Force school in Chicago as well as being EC for Highland. UZW is on very active duty with the Marines. RSP is a radio officer in the Merchant Marine. EGQ says that Gary's WERS application was held up on a technicality, but that now all is under control. DGA is a tech. sgt. at Fort Custer. KYQ made three tons of scrap out of a 132-ft. steel



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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.

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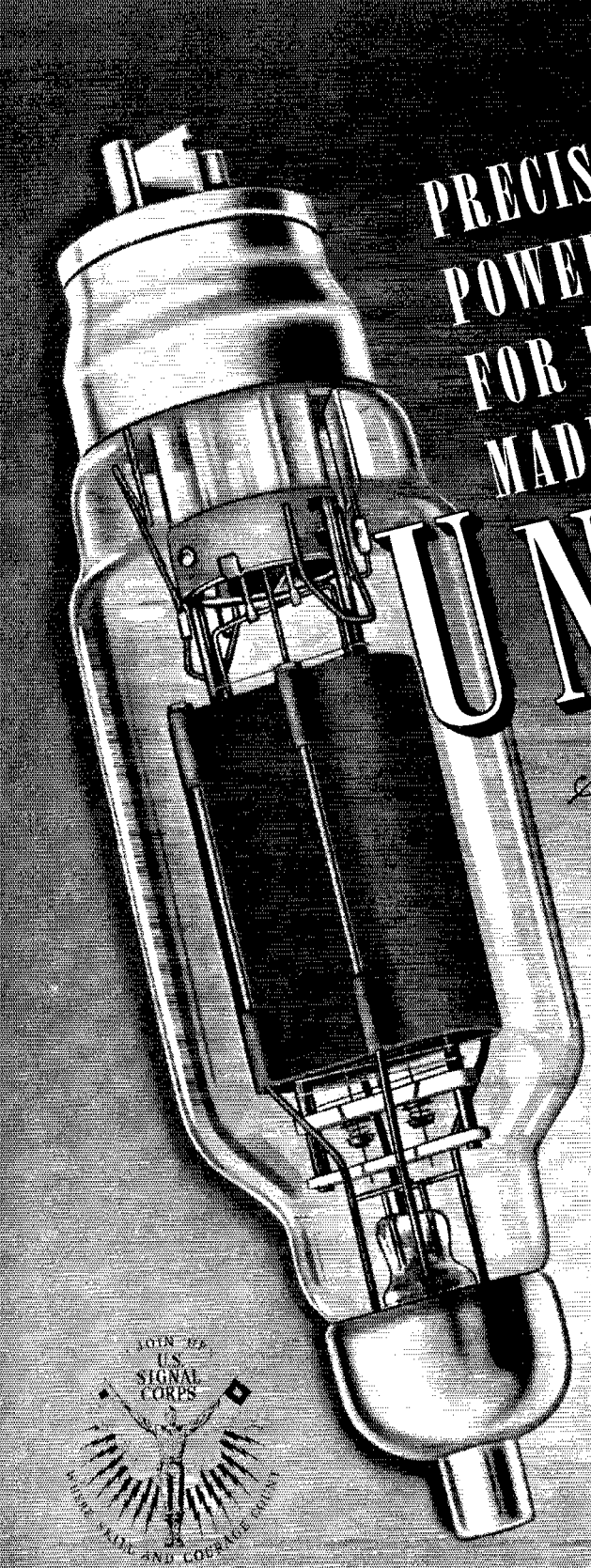
tower. SAG operates at WBAA in addition to taking a full senior EE course and acting as EC for the West LaFayette area. Art reports his chief difficulty is in obtaining equipment for WERS. BQF got that well-known notice recently. EHT now has Class A ticket. Officers elected by the Indianapolis Radio Club for the coming year are: YMV, pres.; JJC, vice-pres.; BHC, secy.; DSC, treas.; VPN, chief op.; and DNQ and JYP, directors. 9UUY is sgt. in Signal Corps, Co. B-803 S.S. Reg., at Fort Monmouth, N. J. The Indiana State Defense Council has been very actively interested in WERS in Indiana and is urging local defense councils to take advantage of the facilities offered for WERS. Through Lieut. Mentzer, state Communications coördinator and Mr. Zellon Audritsh, his assistant, aid is given to applicants for licenses in perfecting their applications to the FCC. Personal trips are planned for January to points throughout the state to further organize WERS work. Complete coöperation of all the hams of Indiana is needed if we are to achieve success in WERS organization. I have been consulted frequently for names of ECs or interested hams in almost every Indiana community. In quite a few instances, I have been compelled to admit that there was no EC in the town under consideration. If you have an EC in your locality, register in the AEC with him if you are not already registered; make known your availability. If you have no EC, please volunteer for the job, or recommend a fellow ham to me for appointment for this important task. A postcard to me will bring you information on WERS in your city. 73, Roy.

MICHIGAN — SCM, Harold C. Bird, W8DPE — DYH reports that the code and theory classes are about to graduate and they are making arrangements for a new class. COW writes us a nice card saying he received the QMN bulletin while convalescing from an operation. PLQ is teaching code with the assistance of MPQ at YMCA and Elks, handling his CPT cadet class five nights a week. QQS is teaching radio theory and code at Saginaw High three nights a week. UKV reports renewing his *QST* membership, also that he has vibrapack for 112 Mc. SCS is very busy at an Indiana school teaching radio mechanics. DSQ says it's kind of cool, but he is still doing some woodcraft work. LSF finally broke down and sent us a card from the Middle West. Says he has not forgotten anyone, but has been so QRL he has not had time to report. He is receiving some schooling. SAY says he thinks of the old gang but is plenty QRL. PLC 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 OCD 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 renominated. 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 something. Your SCM is playing around with an e.c.o. to see 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, W8CBI — Emergency Coördinators are needed for a number of points in the State of Ohio to round out our organization, in accordance with the new Ohio WERS plan. The following towns are not covered by Emergency Coördinators and your SCM would like to have recommendations from clubs or individuals regarding suitable amateurs to be appointed as Emergency Coördinators for the following WERS areas in Ohio: Bryan, Napoleon, Defiance, Bowling Green, Van Wert, Xenia, Wilmington, Hillsboro, Winchester, Sandusky, Tiffin, Lorain, Ashtabula, Lancaster, Marion, Washington Court House, Jackson, Gallipolis, Pomeroy, New Philadelphia, Steubenville, 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 teaching radio to U. S. Naval Reserves. Bellefontaine: Charles De Long was appointed Emergency Coördinator for Bellefontaine WERS area as of September 25th, upon recommendation of Dr. Webster, who resigned to go into the Navy. Dayton: The WERS license for Dayton has been received; call letters WJTW. All Assistant Emergency Coördinators have been appointed deputy radio aides and definite assignments given them in connection with the Dayton WERS operation. DMN is deputy radio aide in charge of education, and has started training classes for operators for third class permits, assisted by LCO, RHH and AGR as a committee, assisted by a number of others acting as instructors and assistants. 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, LJ and OVL receivers, AZH auxiliary emergency power supply, CBI the transmitter and NSS the antennas. TQC has resigned 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 program. Considerable difficulty is being experienced in getting the necessary equipment for this activity. A few jobs are now ready for service. The lack of 6-volt vibrator power supplies is the most serious problem. TDY was the first to have his 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 at Washington. An alerting system has been worked out for the radio division of the Dayton Council for Defense, and several practice tests have already been held, resulting in improvements to the original system. Changes in working hours for many of the boys creates a serious problem in keeping this system properly organized. Because of the lack of u.h.f. activity, especially on 112 Mc. in Dayton, it is expected that a big job will have to be done to check the coverage in the city and county, due to the irregular character of the terrain. Deputy Radio Aide LJ is secretary of the supervisory group, and Deputy Aide NSS is technical advisor. IX was home on leave the week of November 2nd, has been promoted to lt. (jg) in the Navy and has left for sea duty. MFV was reported at Scott Field. This is an error and we have received a letter from Duke from the A.A.F. Technical School at Sioux Falls, S. D., where he is in training for radio operator. He expects to graduate soon. SVI is at officers' training school at Ft. Monmouth, N. J. RHH is still teaching radio theory at the local YMCA and is also deputy radio aide. CED is supervising code training for Army glider pilots at YMCA college. GCG and IBQ are assisting him. DEL is now first lieut. in the Air Corps, doing radio engineering work. QDI graduated from Purdue Dec. 19th as an aeronautical engineer, was married the 21st, and will move to the East to take a job with one of the large airplane factories. Steubenville: SZV has enlisted in the Navy and is now in active service in the Pacific. A new EC is needed for Steubenville. Elyria: ELC has resigned as EC and enlisted in the Air Corps as radio man. Coshocton: TGA says that local amateurs are busy setting up their WERS facilities. They are also getting ready for operator training classes at the local high school to fill in their depleted ranks. Toledo: RRZ reports he is active in civilian defense, is communications officer for the local Civil Air Patrol and chairman of Lucas County Amateur Club. He reports much activity among the older amateurs toward getting their WERS facilities organized, and that their license application is about ready to go to FCC. Cincinnati: MFP reports 20 members of the old reliable Queen City Emergency Net are forming the backbone for the Hamilton County WERS operations. BFB, though not a net member, is pitching in and helping. The Greater Cincinnati Amateur Radio Association has suspended operations for the duration. MFP would like to see more of the many amateurs in the Cincinnati area join the WERS program. Parts to construct WERS gear are scarce. Frequency-measuring equipment is under construction, and the county council has made available funds to purchase a number of Abbott TR-4's, but these will not be sufficient for their whole equipment program. 5JCV (ex-ORV of Cincinnati) is now in Cleveland, working as a radio operator for Penn Central Air Lines and writes that ex-ORX of Cincinnati is now sailing out of a southern port as a ship operator. MFN is now a lieut. in the Signal Corps, stationed in England. SUO is also there, but his rank is not known. RSP is third class petty officer at the naval armory in Chicago, and UNV is a corporal at the Savannah air base. Columbus: QMN has been appointed Regional EC for Columbus warning center. A personal visit by the SCM on November 12th found that Columbus is well along in their WERS plans. 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. Operators, mostly recruited from local broadcasting stations, 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



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county, with county approval. Several radio-equipped planes are also under consideration. QMN would like to see more interest from the local amateurs in the WERS program. Canton: MWL is communications and intelligence officer for Civilian Air Patrol. ADQ has been appointed radio aide for Canton, and is struggling with organizing his WERS set-up. A training program for third class 'phone 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: HMH has resigned as EC for Licking County, and is now in the Navy in training at Bliss Electrical School, Washington, D. C. Mt. Vernon: OUZ has been appointed EC for the Mt. Vernon WERS area, and has also been appointed radio aide by the local defense council. Mansfield: JJM has been appointed EC for the Mansfield WERS area, and has also been appointed radio aide by the Richland County Council for Defense. Medina: KNF's appointment as EC has been renewed. He reports that he and EMV, HPD 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. KNF says he has sold all of his meters to the League for the Army. Reports GMI in the Navy as RM2c on sea duty. The tire and gas situation 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 tackle the job. It is a physical impossibility for him to handle 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. Hal's 17-year-old niece got her license right after Pearl Harbor, and is now a stenographer at Wright Field. Athens: LKU'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 new SCM. We expect an up-to-date report from him for next issue. Piqua: 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 WKN's personnel. NAC is now in the Air Corps. JEI is now at St. Petersburg, Fla., and THJ is slated to enter the Lexington, Ky., training school for radio service men. Greenville: AWR has been appointed Emergency Coördinator for the Greenville WERS area.

DAKOTA DIVISION

SOUTH DAKOTA — SCM, P. H. Schultz, W9QVY — DUC left South Dakota State College in March 1942 to work as a radio engineering aide for the Naval Research Laboratory in Washington, D. C. He now has Class A, radiotelephone commercial first, and radiotelegraph second licenses. Besides that he has an xyl (in June). He would like to hear from the South Dakota gang. His present address is Ensign C. W. Reedy, U.S.N.R., 1326 Ridge Place S. E., Washington, D. C. He will report to New York, December 28th, for active duty. ZRA is communications officer for the 147th Field Artillery somewhere in Australia. He is doing a good job as such according to a report I received from the lt. col. who is executive officer for the 147th Field Artillery. GLK, LBU, GZU, WLP, SEB and QVY, also the Pierre Amateur Radio Club, sold their receivers to the Third Airways communication detachment. The Club and its members are now without receivers and we think it will be necessary to concentrate solely on WERS for our future work. One receiver was furnished by an outsider, so the eight receivers required were furnished entirely from this city. "Our hobby has gone to war," hi! LMY is in officer's training school at Shattuck Military School in Faribault, Minnesota. He expects to get into Navy radio work. He would like to hear from the old gang at Mitchell and Huron, also from the rest of the South Dakota gang. BZI has finished his course at Chicago and is now in aviation radio school at Ward Island, Corpus Christi, Texas. BJV is somewhere in Northern Ireland. I can still use more reports for *QST* news. It is necessary that the report leave Pierre on the 16th so you must have your dope to me before the 15th or it must wait until the next month. Remember, *QST* news is censored, so don't delay your report.

NORTHERN MINNESOTA — SCM, Armond D. Brattland, W9FUZ — This is about the time of year one thinks of giving something to someone and especially to those in the armed services. What more enjoyable gift than a subscription to *QST*? It solves the ever present question: "What can you really give to a man in service that does not further add to his burdens?" Along with this thought, what are you few remaining at home doing about keeping up the local radio club's affiliation with ARRL so that those who are not so fortunate as to have thoughtful friends and relatives keeping up their memberships may continue on club rate basis? Why not interest the classes you are teaching in forming or continuing affiliated clubs? TEF is seaman 2nd class in Coast Guard. ICU has received promotion at Monmouth, but anticipates induction into service soon. GFR is now instructing at Signal Corps school (U. of No. Dak.) as reservist in U. S. Signal Corps. UKW is corporal in Army Signal Corps. BFO is 2nd lt. in Signal Corps. HMD is specialist in Signal Corps. HYX has been in Navy for about a year. CTA is "across." DPP is operator at WMFG. GDT is in the reserve in college at Hibbing. A card from KET indicates he has been enjoying operating with the Merchant Marine. PTU is now an Air Corps captain in Australia or thereabouts. Just endorsed EC certificate for EHO. Am wondering if any other ECs wish to have their certificates endorsed? If so send them in to me here at Glenwood. With the seasons greetings and especially may the New Year bring cheer and good news. Luck es 73. — *Army*.

SOUTHERN MINNESOTA — SCM, Millard L. Bender, W9YNQ — Nearly all the men are in service, mostly the Navy. DEI is Lieut. (jg), instructing engineering at Dartmouth College, Hanover, N. H. ZAD is RT1c, Co. 122B, Chicago, Ill. KUI is Warrant Officer, assistant communications officer at Camp Crowder, Mo. KOB begins training for the Signal Corps at St. Louis, Mo., Jan. 4th. ZSX was last heard from in Washington, D. C. 6UUS (ex-WDL) is in San Diego working for an airplane company. Kyle McClary, unlicensed, is in training at Minneapolis for radio work. He is in the reserves and will be called soon as he completes training. YNQ sold and gave all his equipment to the Signal Corps. Seasons greetings to you.

DELTA DIVISION

ARKANSAS — SCM, Ed Beck, W5GED — 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. ICJ is captain in the signal intelligence service, and writes to let us know all's well and that he is far away and not bothered with the heat. EVD is a captain with the Civil Air Patrol. IUE gets home on a short leave once in a while and always reports. PX is our idea of a busy man, 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. BM is making a survey of the employment situation, regarding future adjustment. EKD is also tech.-sgt. in Civil Air Patrol and takes care of brass pounding instruction. FXO is busy finding something to do at all times. May the richest blessings attend everyone in the section for the coming year in every respect and may the reports come fast and furious. 73 and all the best to each. — Ed.

LOUISIANA — SCM, W. J. Wilkinson, Jr., W5DWW — DXL has completed basic flight training. JET now in Naval Medical Dept. KHH working on carrier current equipment. KGR in Radio and Sound Branch of Navy. HEJ and HEK are at Camp Forrest, Tenn. FYS now in San Diego, Calif. Delta Radio Club of New Orleans has WERS net coming along nicely. About 10 rigs ready to go on 2½. Code and theory classes are being conducted. Officers of club now are: ECO, pres.; ST, vice-pres.; HUT, secy.; JFZ, treas.; JNY, E.C.; CXQ, activities mgr.; and UK, custodian of equipment. CMQ is RM2c in Navy.

TENNESSEE — SCM, James B. Witt, W4SP — The Knoxville Radio Communications Club has graduated its second code class since Pearl Harbor. The last class consisted mostly of aviation cadets. Mr. Chas. Harrill has been recommended by the Knoxville Club for WERS radio aide appointment. The gang there is working on 2½-meter gear. HQ is trying to get in radio work with War Dept. under Civil Service. BXG has been transferred to Chicago. DHI is in Baltimore. GQI is with American Airlines. CHI re-

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cently married. PGJ, HTS, CDB, DFO, 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 MGG are pounding brass for the Army in Africa and says the old ham itch is bothering them. They send 73 to the ole 160-meter gang, especially around Schenectady and Amsterdam, and would appreciate your letters. Address is Hq. Co. 67th A.R., APO 252, c/o Postmaster, New York City, U. S. Army. LH reports the Orange County Radio Assn. 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 F.C.C. and they are hoping 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., NHY; secy., MSX; treas., LWQ; directors: KUG, CVZ, NIV. HZL reports the WERS radio stations are being set up. HZL is radio aide to the Schenectady War Council. AZH and BRS walked home with the door prizes as usual. Watch your 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. 14th, observing the blackout. ALC has finished Signal 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, Fla. GWD is at the Q.M. T. R. C. at Fort Francis E. Warren, Wyo. QOQ 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. YEA is at Des Moines J.R.T. 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 Air Corps Radio 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. CCE 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. IBZ was home on furlough. VWP is teaching 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 help with WERS. RAT resigned as EC for Montgomery, Chautauqua and Elk counties; he reports that CD officials prefer land line to radio communications. John holds rating of 2nd lt. with CAP, teaching radio laws, code and theory classes. EFE is plumber at naval base in Idaho. PSE/VWT is teaching code and ground subjects to CPT students. MWM of KGGF/KGZP is RM2c. QQI is with Boeing in Wichita. QZT is aircraft radio op in Australia. LTO is going to radio school in Illinois. TKF is RM2c in Navy, flew home for short leave. FVR is teaching ESMWT class, "Fundamentals of Radio I" at W.U. A new class in "Fundamentals of Radio II" has been organized with night lectures and shop work at Wichita H.S. East. Let us know when you enter the military services or accept a new job or organize a new class — the rest of the gang are interested! 73. — *Abie.*

MISSOURI — Acting SCM, Letha E. Allendorf, W9OUD — A great deal of water has passed under a number of bridges since the report of December, 1941. Some of it was directly beneath NCD, who joined the Merchant Marine last summer as op, and wrote this account in a letter to OUD: "I left my last ship 950 miles out in the Atlantic and came part way home by lifeboat — six days of it — and was then picked up by a foreign ship, landed at a foreign port and returned to the States by troop transport. Received a couple of small burns, but consider myself fortunate, as not all the fellows got back. I didn't know the ship was on fire until the transmitters went dead. When I stepped back from the operating position and saw the flames, I made tracks. Believe I broke every known speed record." He even failed to rescue his late copies of *QST* which his XYL had brought to him, at Baltimore, before he went to sea. He is now on his way to the Pacific Coast to join another ship. WAP has just received his telegraph second and has signed on with the Merchant Marine out of New York City. KSB is in the Army and stationed at Camp Atterbury, Ind. UYD is stationed at Fresno, Calif. FMI is a sergeant in the Home Guard at Crystal City. UAM has a service shop in that town. UUB has learned to use a mill, and SCB is class A amateur studying for second class telephone. VMI, UUB and SCB are conducting code classes at SCB's home for interested boys. Hope to include some of the Home Guard members later. PAA is in the Army, and CJR is operating for the State Highway Patrol. QMD is back in the States, in Florida, after his sojourn in West Africa. He is still pounding brass. HGB has left the RI's office in Kansas City to take a position with a marine engine manufacturing company. KJC says all ham activity has ceased in Lawrence County; he himself is very busy at his dental profession. OWQ's letter to a ham in Holland was returned by the censors, recently. BMS finally landed his telephone first. He also took a bunch of the Joplin NYA radio students to K.C. for their exams. OUD has those home fires pretty well under control by now, but that is about all she can say. Send in more please — lots of it, and let's see how it looks in print. And now, to each one of you from all of the rest of us, 73 and a very successful 1943.

NEBRASKA — SCM, Roy E. Olmsted, W9POB — Your SCM and YOD are teaching radio at the Signal Corps school at Milford; TQD is a new student, coming here from WAR. UHT is teaching dentistry at U. of Iowa. LTL doing radio work on bombers in Texas and expecting advancement. KPA is awaiting his call for Alaskan service with Pan American. OHU is operator for CAA at Pueblo, Colo. UDH is at home, but donating his gear to war service. GXO now master sergeant, Signal Corps, at Washington, D. C. HYR doing trick at KFAB and two war jobs for relaxation. DXY head-over-heels in work at Selective Service Office. GTG still with CAA at Grand Island. YOP doing maintenance work with CAA at Hutchinson, Kansas. MLB is EC at Gothenburg and has WERS set-up completed in that area. YDZ is RMlc with the Navy on the East Coast. PCL is radioman on a sky-tank and expects to travel soon. ZFC in Air Corps and now studying at technical school in N.Y.C. GFI now asst. engineer at WJAG. ZPW soon leaves for Denver. QWU is teaching in Chicago. ZUT with Signal Corps overseas. ZPW teaching code to aviation students. JBK sends in a swell report of Norfolk activities. HQQ getting AEC organized in Lincoln. Present ECs are located at Lincoln, Omaha, Ceresco, Gothenburg and Potter. We need others at such key points as Grand Island, Hastings, Alliance, O'Neil, Norfolk, Fremont, Beatrice, McCook, Chadron and Nebraska City. Look up the dope in past issues of *QST* and get busy at these points. If you have idle radio gear, either your own station equipment or old receivers, donate the stuff or sell it to a radio training school. We need a lot more than we can find here at Milford, and 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

CONNECTICUT — SCM, Edmund R. Fraser, W1KQY — 2OCC (ex-1KFN) recently paid a visit to "GB" bringing his xyl who can copy 13 w.p.m. and hopes to have a ticket shortly. 3IZT, 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. CTI 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 100 percent after ironing out the bugs. KQY, assisted by AGT, recently examined 48 candidates for restricted radio-telephone permits in West Haven; 44 were successful in passing. KAT examined 25 candidates in Guilford. Results unknown at present. Hamden, East Haven, and New Haven expect to hold examinations very shortly. Candidates are now filling out proper forms, etc. Anyone having HY-75 and HY-615 tubes they would like to sell, write BHM New Haven. Let's start the New Year off with a bang with reports from QV APA VB BCG CJD KSJ KYQ KKS MGC JXP LVQ UE BDI JFT TS EFW BPU and others.

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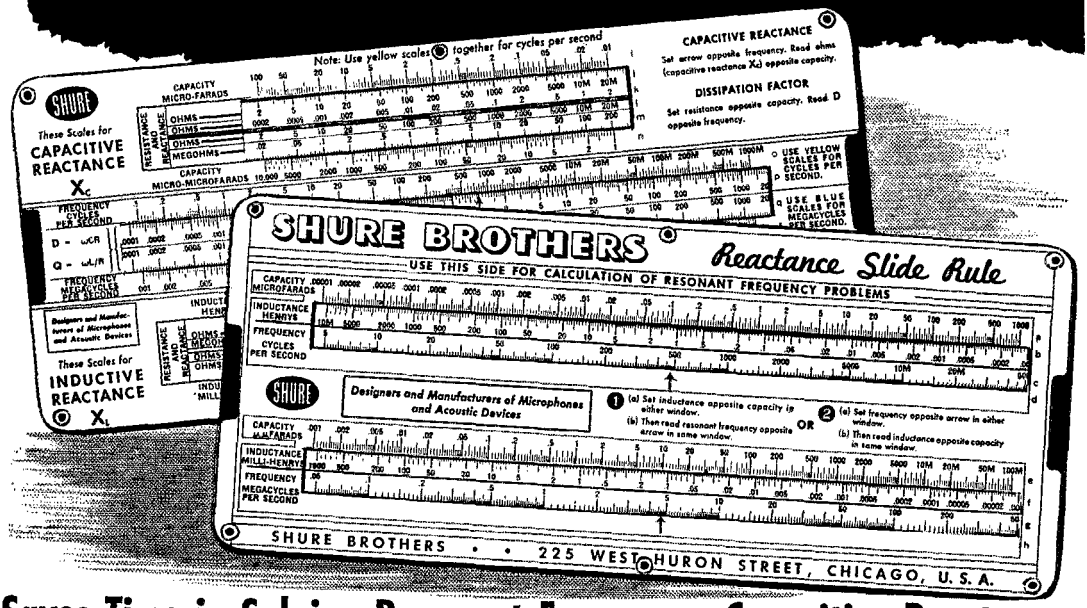

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Resonant Frequency problems	$\omega^2 LC = 1$	1. Resonant Frequency if L and C are known 2. Various L and C values for desired resonant frequency	**Frequency** 5 cycles to 500 megacycles **Capacitance** .001 mmf. to 1,000 mf. **Inductance** .00001 mh. to 10,000 henrys
BACK Reactance problems	$X_L = 2\pi fL$ $X_C = \frac{1}{2\pi fC}$ $Q = \frac{2\pi fL}{R}$ $D = 2\pi fCR$	Any single unknown variable, providing remaining variables are known in equations for Inductive Reactance, Capacitive Reactance, Coil "Q", Dissipation Factor	**Frequency** 0.1 cycle to 10,000 megacycles **Capacitance** 1 mmf. to 100 mf. **Inductance** .001 mh. to 100 henrys

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EASTERN MASSACHUSETTS — SCM, Frank L. Baker, Jr., W1ALP — BLR is new 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. KNZ is overseas as radio op on a bomber. KCP is mine-sweeping. AQH is working at the Navy Yard. NBQ is a chief radio op on a new Liberty ship; he met MKL over in England. CTR has a new jr. op. ALP, LLW, ICO, IDE, IIM and AAH have been working in Maine; 2IK, who is now a captain, also dropped in. IIM is married. Thanks for all the Christmas cards, fellows, and let's have a letter from you, wherever you are.

NEW HAMPSHIRE — SCM, Mrs. Dorothy W. Evans, W1FTJ — Your SCM is still around, ready and willing to report any activities in *QST*. How about it? We are especially anxious to hear from you men in the services. 73. — *Dot.*

RHODE ISLAND — SCM, Clayton C. Gordon, W1HRC — LIV (formerly of Jamestown, R. I.), whose present address is James H. Bowen, RM2c, USN, 237-B Baker St., Benmoreell, Norfolk, Va., inquires the whereabouts of W1AKA, of AQ, and LJO, and hopes that you chaps will see this in *QST* and drop him a line. Private John C. Fulton, 3rd Sig. Service Co. Det., Ft. Devens, Mass., is a former member of the Providence Police Mobile Radio Patrol. He holds a ham ticket issued since the ban on operating, thus no call letters, but would like to hear from the gang back home. Heard MEK is in the Army now, but can't give his address. A more recent letter from MOK says he has finished the course at R.C.A. in Philadelphia and is now at the Philco Training School. He ran into INN down there, but doesn't see too much of him as they are in opposite classes. MOK went to New York for a week-end, and while standing in the Penn. Station waiting for his friend, whistled a "CQ" and got two answers immediately — one from his friend and another from W2HKH. He sends 73 to all the P.R.A. gang. East Greenwich WERS had a test of their 5 units on Dec. 6th. Assisting in the tryout were Earle Fish, Roy Fuller, Howard D. Allen, Calvin Smith and Howard Rice. In addition, they are graduating a class of 15 from their radio school, and shortly expect to have at least 18 well-trained and licensed operators to operate their network. Radio Aide and EC W1MAE of Bradford, R. I., is in charge of the WERS in Westerly, R. I., and they have 4 units there. Their control station is in the club rooms. The town bought 2 units, and two were donated. INT is now working at WEAN. Al McGinn, formerly of WEAN, 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.R.A. Thanks, everybody, for the improved coöperation on getting the news in.

VERMONT — SCM, Clifton G. Parker, W1KJG — JVS is now engaged in his new duties as instructor at the Brown Vocational School, Wilmington, Delaware. MKM is reported as included in the ranks of Vermont amateurs who have turned over their rigs for governmental purposes. CBW recently was in Boston and secured his second-class radiotelegraph ticket. KJR has also taken element three for his second-class 'phone license and is now engaged as flight radio operator with Northeast Airlines. KWB and family now at Portsmouth, N. H. JRU and family recently visited in Vermont. KJG has just returned from a trip to Boston in connection with WERS and allied 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 of many kinds, our immediate, and increasing, problem is personnel. 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 provide some operators but will probably not replace our losses. After deducting those amateur licensees who hold licenses but who are not generally available for emergency communications work, those who are physically incapacitated, and a few who may be available in a prolonged emergency period but ordinarily are traveling or away from home during the week, we find there are forty-nine operators in the section holding amateur licenses who are generally available for emergency operation upon short notice. These 49 operators, unfortunately, are not evenly distributed around the section, and many areas have little or no possible coverage. Be sure, if you have not already done so, to look up that ticket and apply for renewal promptly, if it is about to expire. The FCC is attending to renewals and applications promptly. While we cannot enjoy our usual contacts by air, why not include in your efforts to build up an operator reserve some of these young men 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 whether WERS, as now provided for, is practicable in our rural area or not, or whether some other plan is made 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.

NORTHWESTERN 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. BMX is in Traverse, Mich. EWD with CAA at Missoula. GFT holding down a berth with Western Air at Great Falls. CNP is senior instructor in Signal Corps school in Kentucky, and says the hours are as long as they were during a DX contest. Great Falls has been unable to get a WERS license application completed to date.

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 WERS licenses, and plans extensive preparation and test at once. The mobile cars will have "War Emergency Radio" stickers on the windshields, with a unit number. EDU, our EC for Heppner, 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 receiver. FNS, now an Army It., is very busy with war work in Kentucky, but has the itch to work ham radio again. FU back in Portland. HKI has been ill, but is now able to monitor again. A card from BGM says he likes the work at GE. It is direct war work, also there are lots of hams there. HU and family passed through Bend on way to Idaho Falls. He will be chief at KID, with 5-kw. xmtr. SD in Salt Lake City, with Army engineers. Letter from AOY says he is on inter-call and fire-control wiring at Kaiser's Oregon shipyards. HMP is there also, and OM is foreman. GLF is at Sitka, Alaska, with ACS, and says they made him learn typing immediately. He met IM who has been there some time. IEJ is at Honolulu. HVX, secy. of CORK, reports that the club has purchased a perforating Teleplex from a ham in Riverside, Calif. William VanAllen and Phyllis Coe passed 15 w.p.m. code test, and were given club certificates. New classes are started the first Monday of each month, with the current class totaling about 30 persons. 7FZK is with the FCC at Santa Ana, Calif., temporarily. He is also the new proud papa of a baby girl. 73.

PACIFIC DIVISION

EAST BAY — SCM, Horace R. Greer, W6TI — EC: QDE. EC u.h.f.: FKQ. Asst. EC u.h.f.: OJU. OO u.h.f.: ZM. The regular East Bay Section meeting of the ARRL was held on December 16, 1942, at the Hotel Leamington, Oakland, Calif. The guest speaker was Elbert J. Dodge, NZG, and he gave a splendid talk on "Walkie Talkies for 2½-Meter WERS." EE, the WERS radio aide, gave a report on the progress Oakland has made to date. They still need more rigs and personnel, so let's all sign up as soon as possible. The following were present: NJJ, EY, QAZ, INV, EE, KTI, FKQ, NZO, HGM, ex-AYZ, LGW, QDE, ZM, PLB, OAO, BFZ, PSY, QPM, OZA, TI, AEX, NZG, SFT, JEE, G. Campbell, R. Baker and J. Mitchell. East Bay Section ARRL meetings for 1943 will be held as often as practicable. We have always met the third Wednesday of each for the past few years, but due to war conditions it might be necessary to hold meetings now every other month or so, or when an interesting meeting can be arranged. In the future there will be no meeting unless you receive a card.


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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 oscillate at 275 pounds. OZA has returned from Africa for the Pan-American Airways and will now be stationed on the West Coast. He reported that all U. S. 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 — Bob Craig of Wheeling, ex-AUL, has joined the Army. LCN is at the Naval Operating Base, District Communications Office, Norfolk, Va. AZD is RM1c USNR Atlantic Fleet, Amphibious Force, Landing Craft Group, Building 138, N.O.B., Norfolk, Va., and likes it very much. DFA, ex-fireman of Wheeling Fire Co., joined the Coast Guard as chief specialist. BTV is now located at naval recruiting sub-station at Lock Haven, Pa. VGV finished Signal Corps school at Montgomery, W. Va., and is awaiting an assignment. JLZ has also finished Signal Corps school at Montgomery. 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 — The Associated Amateur 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. UPT is now with the Douglas Air Base as jr. airc. 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 GLG has moved from Uravan to Rifle. The AAROD is desirous of organizing an orchestra of four or five pieces. Those interested please contact TFP or WYX for details. BQO, CAA, TRR and YXU will start new classes in code and theory in January at C. A. Johnson Building, Colorado University Extension. IDB and family have been transferred to Pueblo, Colo. The Radio Widow's Club of Denver, Colo., had a very nice Christmas party on December 17, 1942. The Bell Radio Club held a banquet-meeting December 19, 1942; the guest speaker was L. H. Hinckley. ZNN visited CNL at the Denver Municipal Building. This enjoyable get-together chat makes one long for the short waves again. Harrison Goff has been transferred to Dayton, Ohio. 73. — *Stephen.*

SOUTHEASTERN DIVISION

EASTERN FLORIDA — Acting SCM, Frank C. Fassett, W4BYR. IP is at Dinner Key with Pan Am. CNZ is in Miami working toward RT2nd with PAA. Jim Exline, of ole WOE, is in New Orleans with RCA. Many hams in Miami area attending PAA radio class. Suppose 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 Pan Am. AGR is with Navy. All the gang wish for speedy recovery of GJI, who is confined to his bed at Palm Beach. FSS is holding down Daytona Beach by himself these days. HYQ now in Jax with St. Johns River Shipbuilding and also active in Jax CAP. FWZ reports much FDF activity in Jax area. 1st Signal Co. there is progressing in membership drive. FWZ is CO and office boy and invites inquiries. ATM, DU, EBE, HWA, FWZ, HRB and KM are Jax members in 1st Signal Co. Carr and Suttles are op members. ELT, GIP, PI, GEJ and AIJ are some of the old Jax gang now in the armed services in various capacities. AKA is building 112-Mc. lines job, and will work into Clearwater WERS from WSUN. Xmas card received from FYI-RT2/C indicates that he is now in Somerville, Mass. GEE is still at MacDill, but in uniform now. DES still on move with latest word from Macon, Ga. Word has been received from HAD, who is in Alaska. CTS is with SC at Long Branch, N. J., and sez he saw TZ recently. AKV is at Blanding and is chief op at WVAE SC station there. CUZ is announcing at WDAE. HXM is Corp. in SC and is taking advanced training at Midland School, K. C., Mo. EYI of St. Pete sez DWU is still with NAL in Jax. IGQ has new job with Pen. Tel. FRE is now in Navy as RM2/c. Bing Crosby is new ham in St. Pete. GFE now working with EPW at WTSP. FZW somewhere in Pacific. St. Pete gang running code classes every night at airport main hangar. Clearwater, Pinellas County, has first WERS license in Florida! Call is WJIL. WJIL, 1 and 2, actually took part and furnished valued assistance in recent blackout exercise covering that area. It is hoped that Hillsboro will come thru before next report. DUI is now tech. sgt. with CAP, holding down operating shift at Sarasota air base control station.

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. ASG, a Marine sgt. on Wake Island, is said to be a prisoner of war in Japan. AGS has been missing for nearly a year. He was a radio op on a tanker. EQZ of Opp, Ala., is a visitor in Pensacola. Tom is now a tech. sgt. in the Army and stationed at Tampa. 1BJW is now in the radio dept. of the Naval Air Station here at Pensacola. PE is keeping the radio school perking. Duprce, an ex-W6, of Naval Air Station is back from school and made lt. jg. He is now stationed at Barin Field. DAO sold his Signal Shifter. ECM visited Pensacola. BOW is now a full fledged instructor at Naval Air Station at Jacksonville. FXF of Atlanta is also at Jax as an instructor. BOW has made second class radiotelephone. He also took ham exam class B & A. QN of Orlando, former AARS member, is now a chief petty officer in the Navy. Penton, ex-FRQ, made a short visit to Panama City. BJF, GTJ, and EGO are keeping things in order in the home defense radio layout. HJA and ECT-FJR QSO via a buzzer key hook up. They have apartments above one another. The jr. op. at ECT-FJR is growing rapidly. AXP is accumulating a fine radio library with a book at a time. AXP ran into EQZ at a local radio store recently. 73 and luck for this New Year.

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 Coördinator in order that Georgia may coöperate with Civilian Defense to the fullest. All amateurs, ARRL members or otherwise, are asked to drop a card giving the dope on themselves or neighbor hams for inclusion in this monthly column. It is hoped to have Georgia in the news every issue. FCW is now a major. FOO is lt. A.A.C. ERS AMM 1/c at Jax. FFI FDE EEZ all at Jax. GFF at Tampa. GRP at Berwyn, Ill. CBR at Charleston, S. C. FWD doing a big job at Atlanta. "Doc" Pepper got another at Savannah if he's there yet. 73. — "Pop."

SOUTHWESTERN DIVISION

ARIZONA — SCM, 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, IIG, IUQ, IYZ, JHV, KOL, LSK, MSP, NKG, OVK, PQQ, QLZ, QWG, REJ, RFE, RGF, RFS, RJN, ROD, SGF, SLO, SOG, TRG, TUW, TVU, TYD, UG and UKB. The gang is mighty proud of all of you. UAF is now chief engineer at KGLU. PMJ is helping Uncle Sam by digging copper. RGF is lt. in Air Corps at Mather Field, in charge of Navigation School. QNC helps after working hours with the CPT program. RQX has a new YL member of his family. REO went deer hunting, but still gets all his meat from the butcher shop! UAL and USC were over on the coast recently, visiting USB and taking in the sights. The Phoenix gang is still wrestling with FCC red tape, trying to get WERS going, and are patiently awaiting the results of their third application. QWG has gone back to the briny deep as radio op in the Merchant Marine. NRI has been transferred to California. RFS is also in California, having recently received a promotion in the CAA. The Tucson Short Wave Assn. is still going in high gear, with their code and theory classes and turning out some real ops. After their last meeting they had the pleasure of inspecting one of those compact plane radio outfits. GS teaches code in an Air Base. RFE was married recently. I hope all had a happy holiday season, even though Santa wasn't bringing shiny ham gear. 73. — *Doug.*

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.

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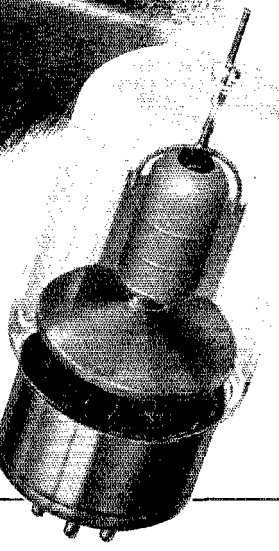

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DC Plate Volts	4000	3000 Volts
DC Plate Current	150	100 M.A.
DC Suppressor Voltage	—	60 Volts
DC Suppressor Current	—	3 M.A.
DC Screen Voltage	750	750 Volts
DC Screen Current	30	8 M.A.
DC Control Grid Voltage	−500	−200 Volts
DC Control Grid Current	25	0 M.A.
Peak RF Control Voltage	—	170 Volts
Plate Dissipation	75	65 Watts

HEINTZ AND KAUFMAN
SOUTH SAN FRANCISCO LTD CALIFORNIA U.S.A.

The Fifth Regional WERS

(*Continued from page 39*)

Coördinators 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, W8CBI, 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 coöperation 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 Coördinator of the Ohio State Council of Defense.

U. S. NAVY OFFICIAL PHOTO

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

(Continued from page 100)

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 coördinators 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 rôles in WERS organization and operation.

QST Visits the Coast Guard

(Continued from page 18)

they don't know. Age is a vital factor, they feel; the younger a student is the better his chances. A man over 25 is at an initial disadvantage compared with his fellows of 19 or 20.

But beyond that they do not care to go. Athletic skill or a native musical bent seem to have little relation to code ability — contrary to opinions expressed by some authorities. A sense of rhythm is useful, all right, but they point out a skilled pianist as one of their outstanding failures. He was too nervous; the temperamental types in general are not so good, according to their experience.

Nor do they see much relationship in athletic ability. In fact, they consider some forms of physical exercise a definite disadvantage to the radio operator. For this reason the physical education drill given the students at Atlantic City is carefully controlled — no exercises are given that might tighten up the muscles, interfering with typing or sending.

Sending Is Stressed

The Coast Guard has the quaint notion (quaint judging from the product of some of the other schools, at least) that good sending is an important qualification of a radio operator. At Atlantic City, therefore, this phase of the training is begun early and pursued intensively.

First the student is given careful instruction in character formation. He is shown how to hold a hand key for maximum control and minimum fatigue — Lt. Cmdr. Griffith confesses that he is somewhat of a "nut" on this subject. The basic rhythm of the code and the fundamental spatial relations between dots and dashes and spaces are thoroughly instilled.

Then one side of the student's split headphones is connected to his own key and the other to the output of an automatic transmitter. The machine sends a character and the student tries to duplicate it. After learning to send all characters cor-

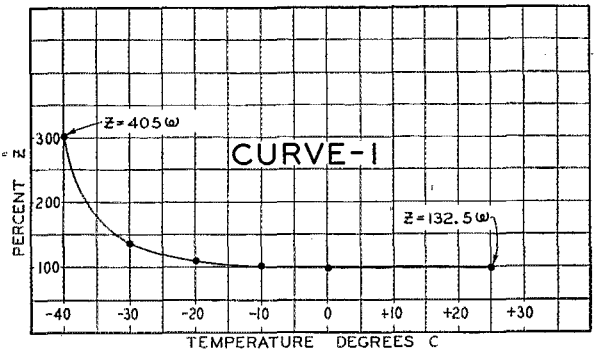
MALLORY TECHNICAL DATA SHEET

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.

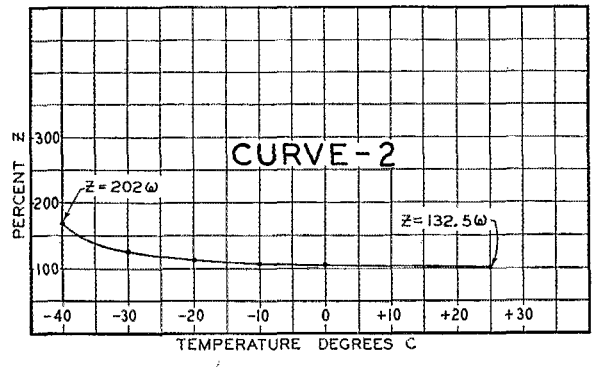
Certain inherent characteristics of dry electrolytic capacitors make them invaluable for military use—they are compact, light in weight and require a minimum of critical materials. Formerly, however, there were certain characteristics in electrolytic capacitors which demanded improvement—and the graph 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.

(*Continued from page 102*)

rectly he then sends in synchronism with the machine from a transcript of the text before him. This practice continues until he progresses to about 15 w.p.m. Then complete words are sent, with corresponding intervals in which the student duplicates the tape transmission.

So effective is this method the instructors swear that toward the end it's impossible to distinguish between any student's sending and that of the tape.

"Listen to one and you listen to them all," according to Lt. Cmdr. Griffith.

Another phase of code instruction on which the Coast Guard has a different slant than many schools is in the use of simulated interference on practice transmissions. They don't do it — at least not in the way the other services do. All practice transmissions are delivered to the student just as they come from the tape heads, with no inserted QRM.

"We believe that it's best to teach the code itself under as nearly ideal conditions as possible," Lt. Davis said. "The best conditions are none too good for proper training."

The point is made that learning the code and operating are in essence quite different functions. Simulated interference merely distracts the student and hampers his code learning, we are told. As for operating training, that is accomplished directly from the air, anyway, giving a maximum of realism where it is most needed.

Procedure Class

So much for the code training at Atlantic City. Let's look now at some of the other divisions.

Once he has the basic fundamentals of code and typing in hand, the student begins procedure class for one period a day. Here under the supervision of Lt. (jg) John Morgan he listens to a daily blackboard-illustrated lecture on operating practice, naval procedure, message form, calling and signing, carrying on a contact and the numberless details of finished operating technique.

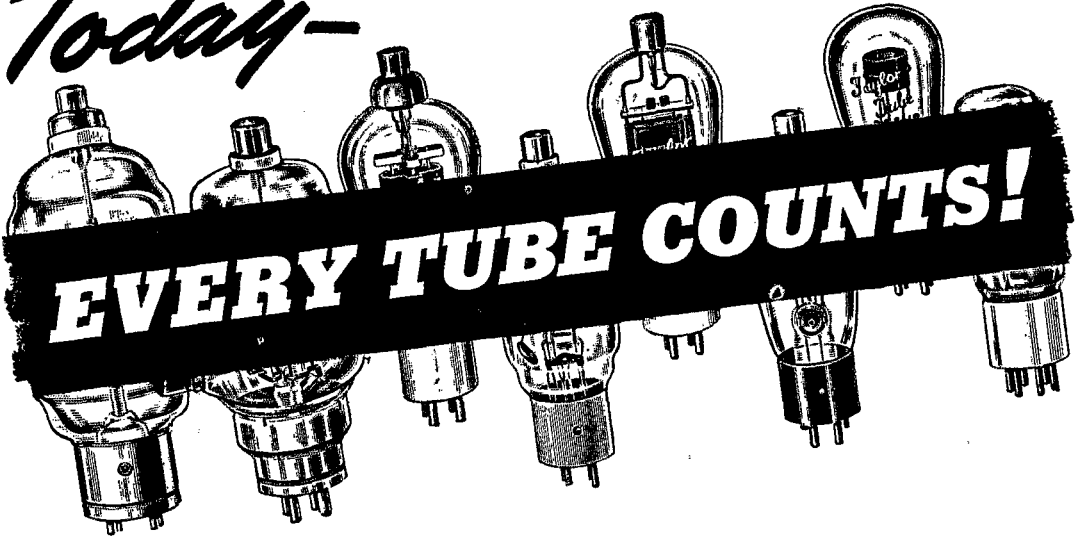
For this course he is equipped with a bulky gray-covered text on procedure and a large notebook which will be well filled with detailed notes when he has completed it. The restricted text contains complete Coast Guard operating instructions. These he must learn to use automatically and correctly. In addition he finds out about the international Berne lists of stations, the use and operation of radio aids to navigation, the making of d/f bearings, and something concerning the adjustment and operation of receivers. The lecture sessions are supplemented with practical drills on standard communications and d/f equipment, and actual procedure drills on message handling and general station operation.

Watch-Standing Class

The next training phase is the watch-standing class under Lt. (jg) James T. Neubauer.

The slogan of a sea-going radio operator in time of war is, "It is more blessed to receive than to send — and a damned sight safer."

Today—



EVERY TUBE COUNTS!

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 personel 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

(Continued from page 104)

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 l.f. 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 1¾-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 3½ 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

(*Continued from page 108*)

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 trouble-shooting); (24) transmitters and transceivers (adjustment, trouble-shooting and analysis).

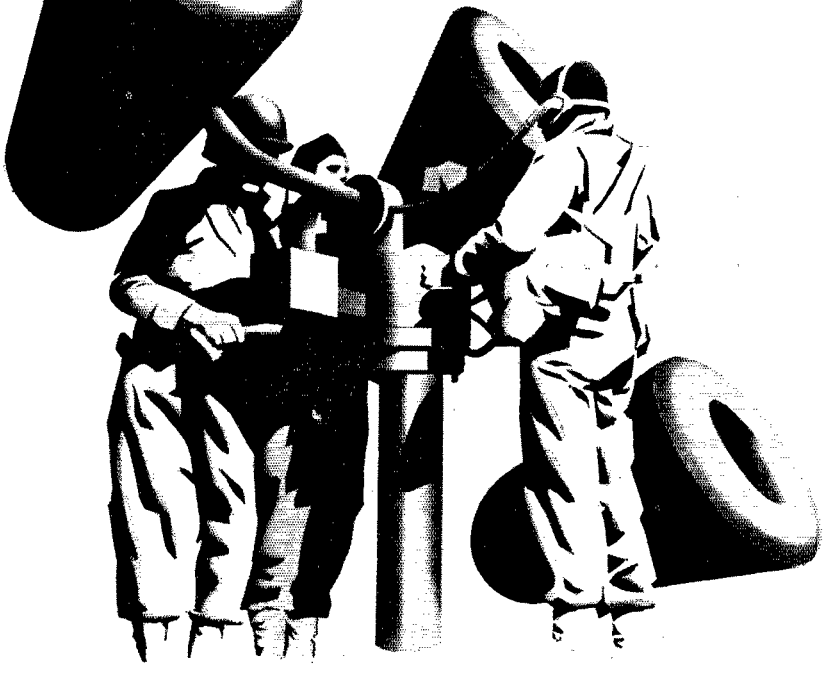
The theory and basic matériel classes are under the supervision of Lt. (jg) A. P. Winkler. Warrant Officer C. C. Charley is assigned as chief of the matériel instructors, and Warrant Officer G. Williams is assigned as chief of the theory instructors.

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!

TOMORROW IS COMING . .



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.

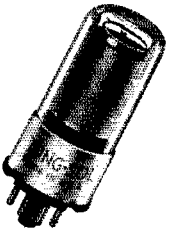
Tomorrow is to be the day of electronics. In industry, in transportation, in communications and in the office and the home, new efficiency, new conveniences and new pleasures will spring from the achievements that electronics have wrought in war.

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.

TUNG-SOL

vibration-tested

RADIO TUBES



TUNG-SOL LAMP WORKS INC., NEWARK, N. J., *Sales Offices:* ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK

ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS, ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERRUPTORS

(*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 of 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

SOLAR CAPACITOR SALES CORP. BAYONNE, N. J.

CAPACITORS

MAKERS OF CAPACITORS: ELECTROLYTIC • MICA • PAPER • TRIMMER • TRANSMITTING

(Continued from page 110)

Virginia Avenue, near where it touches the sea at the point where the renowned Steel Pier ("six shows for the price of one; continuous performances") faces the Boardwalk.

To the school came two nuclei of Coast Guard training — one unit from the New London station and another from the Coast Guard yard at Curtis Bay. An advance guard of staff members and students arrived on the 27th. More came in the next day, and on the 29th classes began. By July 1st these trainees were joined by another group fresh from the boot camps. From then on the student body grew rapidly.

The physical layout of the station is characteristically efficient and straightforward. All training functions are centered in the B.P.O.E. building, while the men are billeted at the Morton.

Let's take a quick look at the quarters first. Turned over in its entirety to the Coast Guard, the Morton still more nearly resembles a hotel than a large building converted into a military camp. The trainees occupy the original guest rooms. They eat in the main dining room. They even eat hotel-style food, served as individual courses instead of on multi-compartment trays.

There is one difference, though — the tempo and efficiency of the service have been stepped up to accommodate the greatly enlarged volume of diners. Notable in the mechanism by which this was accomplished is the dual conveyor-belt system between dining room and kitchen.

Lt.-Comdr. Thomas Husselton, executive officer on the station, took great satisfaction in displaying the workings of the system. Here's the way it works:

When the trainees enter the mess hall in formation following the half-block march from the school, they find places laid complete with bread and butter, a cup of coffee and a glass of water, and a full bowl of steaming soup at each table.

The men file past the outbound conveyor belt, each collecting a laden plate bearing the main course. It takes just 1.8 seconds for a filled plate to leave the chef's hands and reach the trainee's. The soup and the contents of these plates swiftly disappear, the waitresses meanwhile circulating among the tables replenishing supplies of bread, butter and beverage. When the plates are empty these waitresses serve the dessert.

At the end of the meal the students again file past the conveyor system and deposit their emptied dishes on the continuously-running canvas belt, on their way out. Other trainees meanwhile fill the emptied chairs and repeat the process. It's amazing how rapidly the cycle is completed, particularly considering the ample servings — more and better food than most of us are accustomed to having for our daily meals, we'd say.

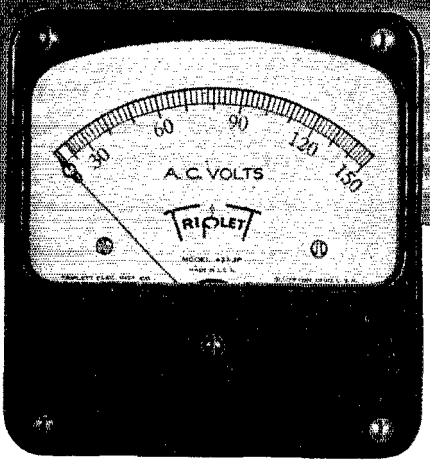
Training at the Elks' Hall

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.

TRIPLETT

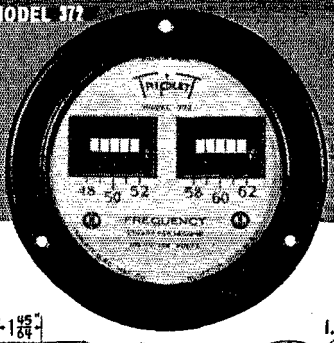
NEW *Combat Line* INSTRUMENTS

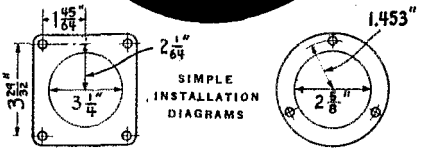
THESE PHOTOGRAPHIC REPRODUCTIONS ARE HALF SIZE



MODEL 437-JP

MODEL 372



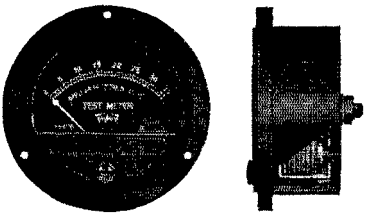


Model 437-JP

Model 372

Maximum Service in Minimum Space

TRIPLETT *Thin Line* INSTRUMENTS



Precision performance by new *thin* instrument with *standard* Triplett movement housed in either metal or molded case. No projecting base; wider shroud to strengthen face; simplified zero adjustment; balanced bridge support; metal bridges at both ends; doubly supported core. For "Precision in limited space" write for Triplett Thin Line Bulletin.

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 J P—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.

TRIPLETT

THE TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, O.

(Continued from page 112)

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 matériel 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.

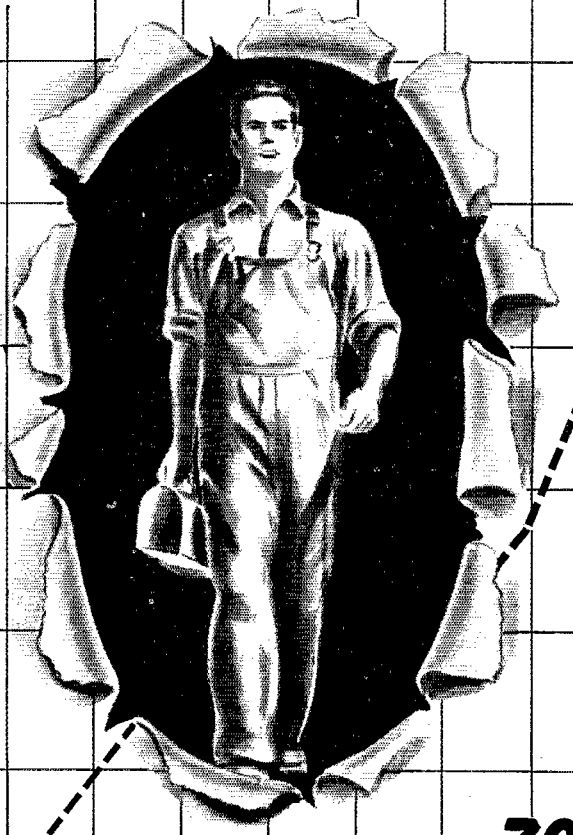
The transmitter room, by the way, was once the bar. Now it houses a dozen or more standard Coast Guard transmitters, types currently in use for both shipboard and shore installations, together with motor-generator sets, storage batteries and charging panels, and completely-wired operating positions. 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 matériel 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 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 time 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

Let Hytron Break that Bottleneck!



900%
800%
700%
600%
500%
400%
300%
200%
100%
JANUARY 1942 EQUALS 100%
JAN FEB MAR APR MAY JUNE JUL AUG SEPT OCT NOV DEC

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 . . .

HYTRON RADIO TUBES

(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 1¾-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.

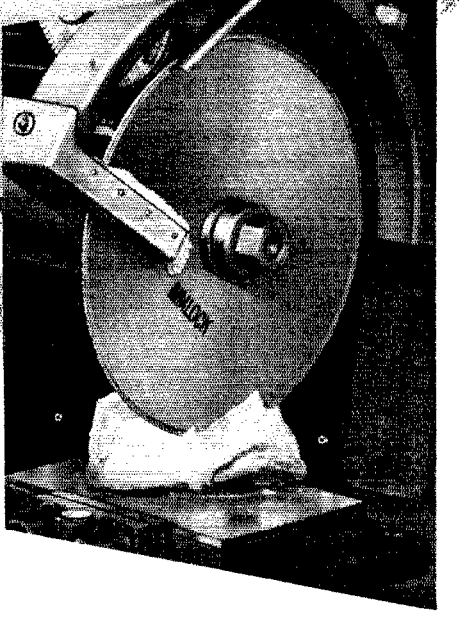
Taps sound for all at 10:30. The students must stay on the station except for Wednesday night, however. That's "free night"; from 4:30 P.M. until 2:00 A.M. they may roam the long streets of Atlantic City and taste the varied attractions it affords its servicemen at will. Saturday afternoon from 1:00 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.

ZIP IN EVERY BLADE

FELKER DI-MET
TRADE MARK REG. U.S. PAT. OFF.
RIMLOCK



DI-MET Rimlocks

More Speed • More Life • More Production

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

FELKER DI-MET

MANUFACTURERS OF DIAMOND ABRASIVE WHEELS

U.S.A. Calling

(Continued from page 30)

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.

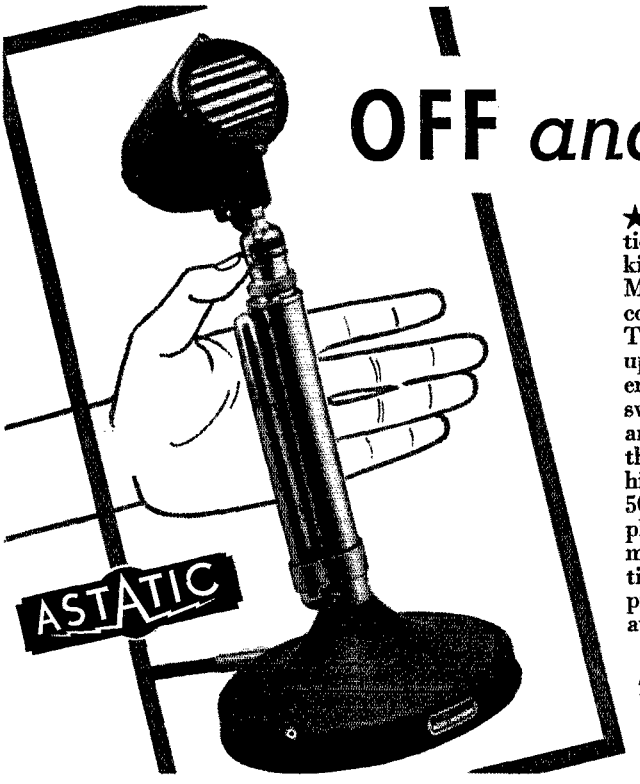
The Naval Officer Reserve Training Corps will be continued as an integral part of the new program. NROTC will be selected at the end of the first two semesters from students inducted under the Navy College Training Program. All NROTC students in the Naval Reserve will be called to active duty.

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.



OFF *and* ON!

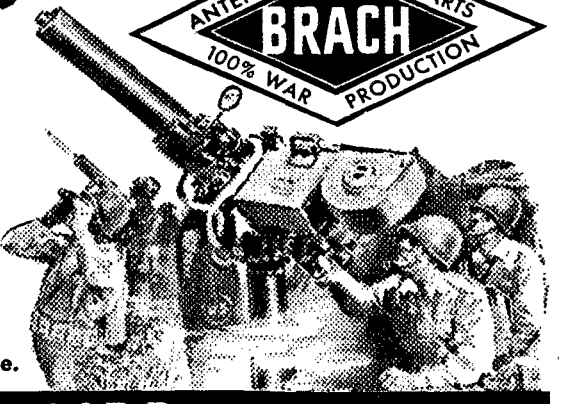
★ In the sending of radio communications . . . orders or messages of any kind . . . Astatic's GDN Series Dynamic Microphones provide greater speed and convenience of operation by grip control. This control, built into the desk stand upon which the microphone is mounted, embodies a relay operating OFF-ON 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*

ANTENNAS & RADIO PARTS
BRACH
100% WAR PRODUCTION

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

Echophone Model EC-1 6 tubes, 3 bands. Tunes from 550 kc. to 30 mc. Beat frequency oscillator. Bandspread logging scale. Self-contained speaker. Electrical bandspread on all bands. AC/DC. 115-125 volts. ECHOPHONE RADIO CO., 201 EAST 26TH ST., CHICAGO, ILLINOIS

HAM-ADS

(1) Advertising shall pertain to radio and shall be of nature of interest to radio amateurs or experimenters in their pursuit of the art.
(2) No display of any character will be accepted, nor can any special typographical arrangement, such as all or part capital letters be used which would tend to make one advertisement stand out from the others.
(3) The Ham-Ad rate is 15¢ per word, except as noted in paragraph (6) below.
(4) Remittance in full must accompany copy. No cash or contract discount or agency commission will be allowed.
(5) Closing date for Ham-Ads is the 25th of the second month preceding publication date.
(6) A special rate of 7¢ per word will apply to advertising which, in our judgment, is obviously non-commercial in nature and is placed and signed by a member of the American Radio Relay League. Thus, advertising of bona fide surplus equipment owned, used and for sale by an individual or apparatus offered for exchange or advertising inquiring for special equipment, if by a member of the American Radio Relay League takes the 7¢ rate. An attempt to deal in apparatus in quantity for profit, even if by an individual, is commercial and all advertising by him takes the 15¢ rate. Provisions of paragraphs (1), (2), (4) and (5) apply to all advertising in this column regardless of which rate may apply.

Having made no investigation of the advertisers in 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. *Diamond Drill Carbon Co., 719 World Bldg., New York City.*

COMMERCIAL radio operators examination questions and answers. One dollar per element. G. C. Waller, W5ATV, 6540 Washington Blvd., Tulsa, Okla.

TELEPLEXES, Instructographs bought, sold. Ryan's, Hannibal, Mo.

OLD QSTs. Buy 1915/23. Sell 1915/41. Singles or files. W6SN.

OSCILLOSCOPE and other radio parts wanted for cash. Send list with prices to John Hart, 1123 Broadway, New York, N. Y.

USED equipment wanted. We pay highest cash prices for communications receivers, transmitters, equipment. Bob Henry, W9ARA, gives you the best deal whether you buy or want to sell. Write, telephone, telegraph description. Cash paid immediately. Henry Radio Shop, Butler, Mo.

WE still have large stocks of communications receivers, transmitters, tubes, mica condensers, meters, transformers, code machines, Vibroplexes, radio supplies of all sorts. Your inquiries and orders invited. Henry Radio Shop, Butler, Mo., and 2335 Westwood Blvd., West Los Angeles, Calif.

IN stock for immediate shipment Mac No. 200 keys, $2.25; Mac deluxe Signatone code practice oscillators, $11.85; Henry Radio Shop, Butler, Mo.

PATENT and sell your idea. Some radio manufacturer may want your practical idea to improve his peacetime product. Complete patent procedures now so you may negotiate with manufacturers when industrial production is again our primary aim. Send for free 48-page, illustrated book about patents, sale of inventions and other valuable information for men with practical ideas. Write today. Victor J. Evans & Co., 777-B Merlin Bldg., Washington, D. C.

WANTED: Radio operators for merchant marine; must have commercial license; wages $300 to $350 monthly. Radio Officers Union, 265 West 14th St., New York, N. Y.

WHY not turn your unused equipment into ready cash which may be applied towards new and better equipment after the war? Leo, W9GFQ, offers you the best cash prices for communications receivers and test equipment. Write today for large illustrated catalog. Wholesale Radio Laboratories, 744 W. Broadway, Council Bluffs, Iowa.

SELL RME-70 slightly used, ham crystals, tubes 250TH, 100TH, RK20, 203Z, 807, 802, 866A, etc., parts, etc. W5HFU, Lt. Ivan Miller, 7th Signal Co., Camp San Luis Obispo, Calif.

SELL — Hallicrafter SX-17 good condition, RCP Co. VTVM. H.A.B., 303–815 S. Hill, Los Angeles.

CRYSTALS: *1700 to 7000 kilocycles, furnished under priority* and M146 Certification. Nebel Laboratory, 1104 Lincoln Place, Brooklyn, N. Y.

SELL: HQ-120X receiver with speaker, excellent condition, $120. W9TRZ, 906 Taylor Ave., Highland Park, Ill.

LEARN radio code easily with KolorKards, complete short-cut memorizing, practice system — $1.00. KolorKards, (QT243), Bluffton, Ohio.

SELL: 2.5 meter mobile station, page 15, May 1940 QST. Best 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 Hubinger 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, III, 124 Lexington Ave., Buffalo, N. Y.

SWL'S? — W8DED, Holland, Mich.

WANTED: 1802–P4 5" kinescope and 1852 tube. Jack Schmermund, West Milton, Ohio.

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!

BALTIMORE, MARYLAND
Radio Electric Service Co.
3 N. Howard St.
Everything for the Amateur

BUFFALO, NEW YORK
Radio Equipment Corp.
326 Elm Street
W8PMC and W8NEL — Ham service and sound equipment

BUFFALO, NEW YORK
Dymac, Inc.
1531 Main Street — Cor. Ferry — GA. 0252
One of the Largest Ham Supply Houses in Western New York

CHICAGO, ILLINOIS
Allied Radio Corporation
833 West Jackson Blvd.
Varied Stocks—Dependable Service. Amateurs in Radio War Training Work—Our Educational Division Will Assist You Without Obligation

CHICAGO, ILLINOIS
Chicago Radio Apparatus Company
415 South Dearborn Street (Est. 1921)
Electronic supplies of all Kinds

DETROIT, MICHIGAN
Radio Specialties Company
325 E. Jefferson Avenue
Ham Supplies — National & Hammarlund Sets and Parts

HARTFORD, CONNECTICUT
R. G. Sceli
227 Asylum Street
Radio Electronic Equipment

HOUSTON, TEXAS
R. C. & L. F. Hall
1021 Caroline Street
Equipment for sale to students and civilians interested in radio

KANSAS CITY, MISSOURI
Burstein-Applebee Company
1012-14 McGee Street
"Specialists" in supplies for the Amateur and Serviceman

KANSAS CITY, MISSOURI
Radiolab
1515 Grand Avenue
Amateur Headquarters in Kansas City

MILWAUKEE, WISCONSIN
Radio Parts Company, Inc.
538 West State Street
Complete stock Nationally Known products

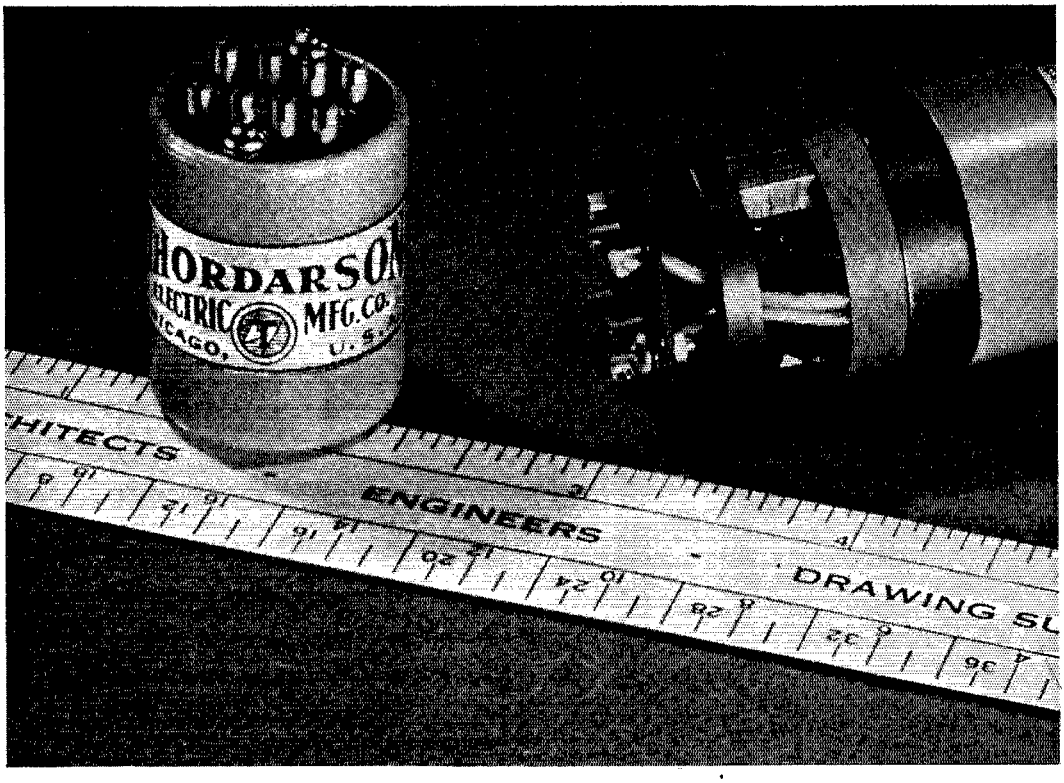
NEW YORK, N. Y.
Harrison Radio Company
12 West Broadway
Harrison Has It! Phone WOrth 2-6276 for information or rush service

OAKLAND, CALIFORNIA
W. D. Brill Company
198 10th Street
W6KLO — The House of Parts — W6FJX

PHILADELPHIA, PENNSYLVANIA
Eugene G. Wile
10 S. Tenth Street
Complete Stock of Quality Merchandise

ST. LOUIS, MISSOURI
Van Sickle Radio Company
1113 Pine Street
Owned and Operated by Amateurs

Index to Advertisers



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.

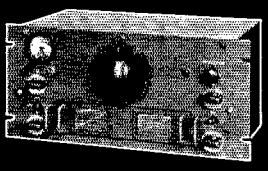
Many other types illustrated and described in Catalog No. 500

THORDARSON
500 W. HURON ST., CHICAGO, ILL.

TRANSFORMER SPECIALISTS SINCE 1895

PRINTED IN U. S. A.
RUMFORD PRESS
CONCORD, N. H.

PROVEN UNDER FIRE



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.

OFFICIAL U. S. NAVY PHOTOGRAPH

RCA

872-A/872

HALF-WAVE MERCURY-VAPOR

RECTIFIER

Price $7.50

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.

RATINGS

Filament Voltage, 5 volts

Filament Current, 7.5 amperes

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.

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