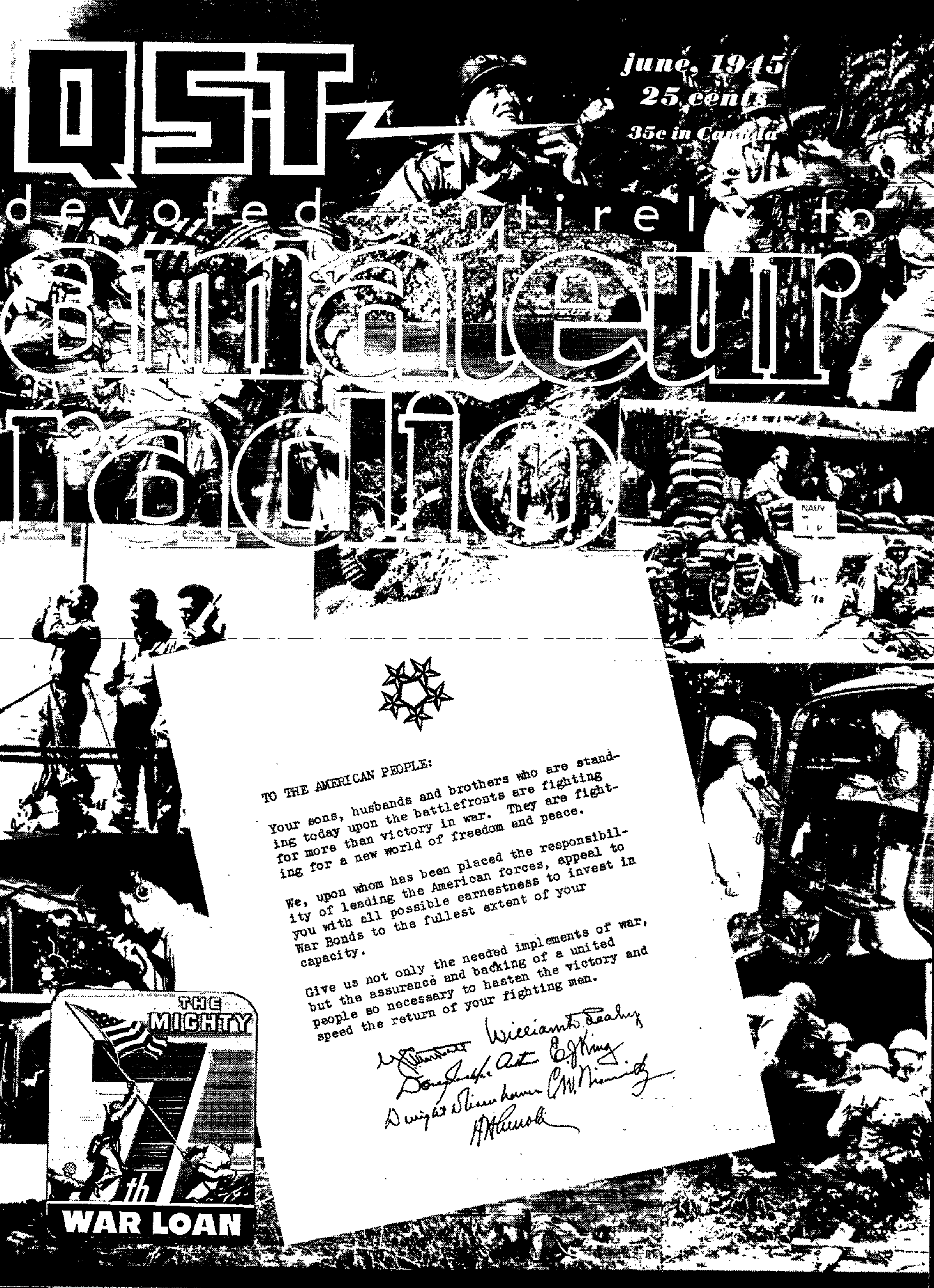
QST

june, 1945
25 cents
35c in Canada

devoted entirely to
amateur radio



TO THE AMERICAN PEOPLE:

Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.

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ARRL Board Meeting Highlights ● 112-Mc. Coax Antenna ● Automatic Relaying ... Function ● Cathode Followers ● Graphical Bandspread Solution ● New WERS Regs

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The radio amateur has distinguished himself outstandingly in the service of his country in time of war. One of the most interesting and valuable contributions the ham has been able to make is in the ranks of the RID – Radio Intelligence Division of the Federal Communications Commission. RID polices the airways, tracks down illegal radio stations, traps enemy spies. About 70% of the big RID staff are licensed amateur radio operators. Above you see a sketch of a typical ham in the employment of RID taking bearings on a radio signal.

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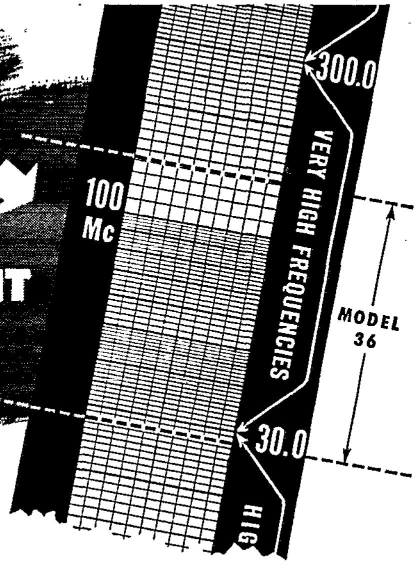

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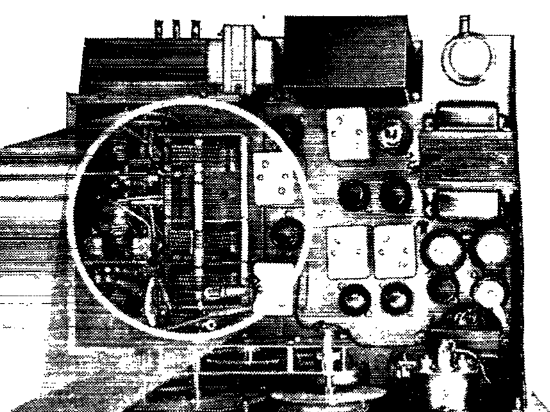
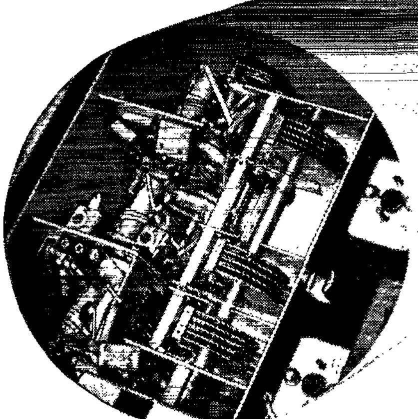
FM-AM-CW

27.8 to 143 Mc.

Covers old and new FM Bands





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JUNE 1945

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QST *devoted entirely to*

AMATEUR RADIO

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CONTENTS

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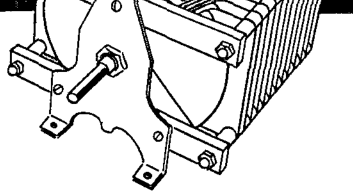

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Denver 7, Colorado

January 9, 1945

Chief Engineer
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Robert F. Six

Robert F. Six
President

RFS/lad

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President
Continental Air Lines

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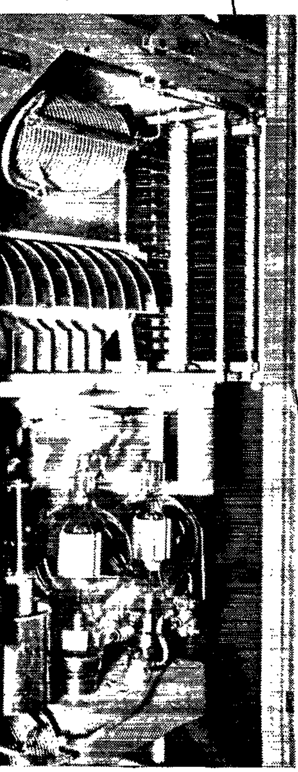

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Section Communications Managers of the A.R.R.L. Communications Department

Reports Invited. All amateurs, especially League members, are invited to report communications activities, training plans, code classes, theory-discussion groups, civilian-defense building or planning each mid-month (16th of the month for the last 30 days) direct to the SCM, the administrative official of ARRL elected by members in each Section whose address is given below. Radio Club reports and Emergency Coördinator reports representing community organized work and plans and progress are especially desired by SCMs for inclusion in *QST*. **ARRL Field Organization appointments,** with the exception of the Emergency Coördinator and Emergency Corps posts, are suspended for the present and no new appointments or cancellations, with the exception named, will be made. This is to permit full efforts of all in Emergency Corps plans.

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THE AMERICAN RADIO RELAY LEAGUE, INC.,

is a noncommercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is noncommercial 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, although full voting membership is granted only to licensed amateurs.

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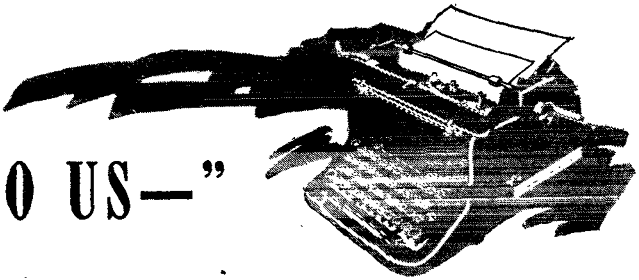
"IT SEEMS TO US—"



**DISASTER RELIEF—
A CALL TO ORGANIZE**

One of the important and traditional duties of amateur radio during peace is to supply communication when emergencies disrupt or overload the normal public facilities. During the war, with amateur stations closed, this contribution by amateurs is nonexistent except as individual amateurs still on the home front give their services to the War Emergency Radio Service. As WERS is our only medium for aiding our communities when wires fail, we want to make the most of it.

Originally conceived solely in terms of civilian-defense communications, the CD type of WERS network (that is, excluding the later additions of State Guard and CAP stations) eventually acquired the right to operate during other types of emergencies endangering public safety or important property — but with this limitation: the authorization and licensing must first exist in terms of a communications plan relating to civilian defense and national security, with the service for the other types of emergency definitely an auxiliary consideration. Over a year ago it became apparent to your League that civilian-defense activities were on the verge of folding as the fear of enemy air raids rapidly decreased. This meant that CD organization would disband in many communities and that therefore the primary requirement for WERS licensing would be undermined, making impossible the continuance of the system on behalf of other kinds of emergencies, particularly those caused by nature's violence. Moreover, there are countless communities that ought to have WERS to deal with potential natural disasters but which never felt themselves impelled to set up a civilian-defense organization and so could never qualify for disaster-relief organization. We therefore went to the Federal Communications Commission in April of 1944 with a proposal to amend the WERS regulations. We asked that CD-WERS be licensed equally for either civilian-defense purposes or for the relief of other types of emergencies endangering public safety. It has taken war-busy Washington a year to study and act in the matter but finally, on April 10th last, the necessary amendments were put into effect. Their text is reported in this issue of *QST* in our department called "Happenings of the Month." It is important that you examine them.

CD-WERS is no longer dependent on the existence of local civilian-defense organization. It may now be organized or reorganized, and its licenses renewed, in terms of plans to cope with public emergencies created by fires, floods, hurricanes, earthquakes, and so on, without regard to whether such situations relate to the national defense or security. New communities may get licenses to implement a disaster-relief plan without ever having had a single air-raid warden. The CDC can fold wherever it wishes and WERS will go on. Additionally, intercity lanes of communication are authorized on behalf of the Weather Bureau's flood and storm warning service.

Opportunity and duty now call us. We've been thinking it over at Hq. and it seems to us to stack up about this way:

1) In communities already licensed for CD-WERS and having an active CDC organization which presumably also concerns itself with disaster relief, no changes are indicated except an exploration of the possibilities of setting up some intercity communication at the request of the Weather Bureau. Radio aides should give thought, though, to the eventual conversion of the system to emergency relief only, when CD dies.

2) In licensed communities where CDC activity has ceased and the danger of enemy action or sabotage is believed entirely past, we urge radio aides to set about the revision of their networks, in consultation with the municipal authorities, in terms of the relief of other kinds of emergencies. The municipality is still the license holder and all WERS activities are for the aid of the municipality. The April amendment states that the communication authorized under this new form of organization must relate "directly to governmental activities to alleviate or prevent any emergency which jeopardizes or may jeopardize public safety." The governmental activities here referred to will generally be those of the municipal government, meaning the municipal safety services, chiefly the police and fire departments. These agencies of town or city government will go into action in any local emergency, will bear the brunt of its relief. They will need supplementary communication during the emergency. There may be other agencies that are part of the municipal government, such as mayors' relief-direction committees, Red Cross facilities, hospital organization,

harbor activities, and so on, which are properly included. Any community has a "most likely" type of emergency. We suggest that the radio aides report the new authorization to their city fathers and promote a reorganization of community planning so that WERS can be regrouped and relocated in a way best calculated to aid the local government's relief agencies if disaster strikes. Mutual-aid arrangements with near-by communities are eminently a part of such planning, as are also intercity links for the Weather Bureau in vulnerable regions.

3) Communities never before possessing WERS now have their chance. Until amateur radio resumes and is able to take over, this is the only agency whereby private citizens can supply communication assistance to the relief agencies of their locality. No city is immune to nature's wrath; preparedness is the answer. We urge interested amateurs of v.h.f. experience in such communities to bring the possibilities of WERS organization to the knowledge of municipal and local Red Cross officials, and to endeavor to help in the creation of an emergency communication plan tailored to the area's needs and probable problems. There are about 300 WERS licenses. There ought to be 25,000. *Your* community needs it, because you never can tell when disaster will strike and WERS is the only supplementary form of communication available during the war. The League has a booklet, "A Manual for the War Emergency Radio Service," which, although written early last year in terms of civilian defense, should prove decidedly helpful to those participating in the planning of a new local system. If you engage in such work in your community, ask us for a free copy.

WERS offers no DX thrills, no rag-chews beyond those incident to testing. But it does hold out the enjoyment that flows from radio operating and association with other amateurs, and particularly in the licking of its technical problems, which are plenty. Apparatus can be made and tested, fixed and portable and mobile, and there is a very great deal to occupy the energies and skill of those with technical leanings. Participants in WERS have perhaps a bit of a jump on other amateurs in preparation for postwar resumption on v.h.f.; at least they are keeping their hands in. The purpose of the system of course is not to provide fun for its operators, although some of that is inevitable, however incidental. Its job is to be ready to help in emergencies. Emergencies are bound to occur and no city should be without WERS through the lethargy of its amateurs. How about jumping on this problem, gang, and capitalizing on CD-WERS's new usefulness under its liberalized regulations?

K. B. W.

★ SPLATTER ★

OUR COVER

WITH victory in Europe the war is half won — but only half, for there are numerous treacherous Japs still to be beaten. The surest way that we can help finish the job is to buy War Bonds — and keep buying them. It is in this cause that the five-star generals of our Army and admirals of the Navy have addressed to the American people the appeal reproduced on the cover this month. Won't *you* help put the "Mighty Seventh" War Loan Drive over the top, so our fighting men can raise the American flag in the heart of the enemy's domain?

FOOTNOTES

THE first of this month's crop of new contributors is **Lt. Velio S. Buccicone, SC, W9IIL (p. 42)**, formerly of Gary, Ind., but now receiving mail via a Seattle APO. Starting in amateur radio in 1937, Velio progressed to Class A and radiotelephone first class tickets. He reports being a c.w. hound with 40 meters his favorite band. Yea, brother! W9IIL holds a code proficiency award (35). He also worked 'phone on the lower bands. While attending Purdue University, W9IIL served as an engineer at the Lafayette, Ind., b.c. station, WASK. Graduating in 1942, Velio entered the Army and was assigned to the Signal Corps, where he found a bit of spare time to work out the dope in the article on solving bandspread problems through graphical methods. . . .

Usually the authors of Hams in Combat stories are not included in Footnotes, but we make an exception this month for **Jean Hudson, W3BAK** (p. 36). Jean, who has been a licensed amateur since she was eight years old, explains where she fits into the picture of Lt. Hyland's life: "I first met Joe when I was eleven. My father brought me to New York to see Mr. Carson, W2ISO (the man mentioned as having taken his amateur examination at the same time Joe did), regarding the possibility of my becoming a camper at Rose Hill, the camp I described in my article in *QST* for May, 1942. Joe, who was fifteen at the time, was present at the interview. Later, at camp, our mutual interest in radio brought us together frequently and I came to know him very well. In New York during the past four years, Rosemary (Joe's fiancée), Joe and I often have been together — so often that I have come to look upon Joe as an older brother, and I am sure he regarded me as his 'little sister,' for he often alluded to me as such. Joe was a wonderful fellow, a 'regular' guy if there ever was one. He was a credit to his college, his profession and the radio amateur group to which he belonged. . . ."

Next on our list is **Neal H. McCoy, W1FMN**

(Continued on page 98)

Cathode-Follower Circuits

Their Principles of Operation and Application

BY LT. HULEN M. GREENWOOD,* AC

Although the cathode-follower stage provides less than unity amplification, and therefore introduces a loss instead of a gain, it has many useful applications. Following a discussion of the principles of operation, the author reviews some of the more recent circuits in which the cathode follower is employed.

In considering cathode-follower circuits, the first question which naturally arises is, why use such a circuit anyway? It involves a loss instead of a gain and apparently wastes a tube, socket, two resistors and a condenser. Well, now, does a tube always have to *amplify?* Detectors don't amplify ordinarily, and frequency discriminators, rectifiers and reactance tubes in f.m. receivers provide no amplification. However, the cathode follower does some jobs better than anything else devised. It can be a transformer good to any old frequency, or a volume control, a "clipper" stage or an isolation device. Let us say you are building a nice, wide-band, high-gain amplifier for a "super" oscilloscope. You put the first tube in, and you have to provide a volume control in the input circuit. By the time the tube, volume control and terminals are wired in, there is a capacity of 20 to 100 $\mu\mu$fd. across the input and, right off the bat, the circuit is ruined, because this high capacitance will load down any r.f. or video stage or circuit. What to do? That's easy. Just use a cathode follower for the input circuit.

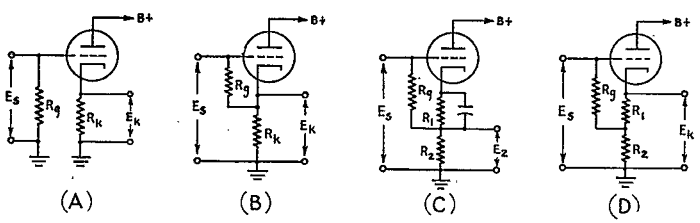


Fig. 1 — Four basic cathode-follower circuits.

Circuits

There are four circuits generally used for frequencies outside the r.f. range. These are shown in Fig. 1. What we want to know, of course, is the relationship between E_s and E_k. E_k always is less than E_s, for the circuit is 100-per-cent degenerative. For the circuits in Fig. 1-A and 1-B we may write

$$\text{Voltage amplification } (VA) = \mu \frac{R_k}{R_k\ (\mu + 1) + r_p}$$

This fraction shows that R_k must be as large as possible in respect to r_p if the gain is to approach unity. As an example, if a 6J5, which has a μ of 20, is used in either circuit with 20,000 ohms for R_k and 7700 ohms for r_p,

$$VA = (20)\frac{20{,}000}{[(20{,}000)\ (21)] + 7700} = 0.935$$

We have not yet shown the cathode follower hooked up to anything. Suppose we use the circuit of Fig. 1-A. Fig. 2 shows the circuit of Fig. 1-A connected through a blocking condenser, C_c, to a volume control, R_L. R_L is quite large in respect to R_k and C_c is so large that its reactance is negligible. Hence, the tube thinks it sees only R_k in the cathode circuit, and we have the circuit of Fig. 2-B. We may draw the equivalent circuit as Fig. 2-C. S is a fictitious signal generator putting out a voltage equal to the original input signal, E_s, times 20/21, or 0.954 E_s, across a resistance equal to 7700/21 = 366 ohms and an output load resistance of 20,000 ohms. Looking back in the direction of the arrow, from the circuit which is to be hooked across R_k, what impedance do we see? We see 366 ohms in parallel with 20,000 ohms, which is practically 366 ohms. From this a general rule may be formed. If R_k is considerably larger than r_p, the output impedance of the cathode follower is $r_p/\ (\mu + 1)$.

Analysis of Circuit Fig. 1-A

Suppose now that we use the circuit. We shall have to employ the tube characteristic curves shown in Fig. 3. Suppose E_{bb} is fixed at 300 volts and R_k at 20,000 ohms. First, the load line for 20,000 ohms is drawn. Now we can prepare a tabulation as shown in Table I. To start, let us assume that the grid-cathode voltage, E_c, = 0. Using Fig. 3, we find that the plate current is 10.2 ma. at point P_1. If the current is 10.2 ma., then the cathode voltage, E_k, must be (20,000) (0.0102) =

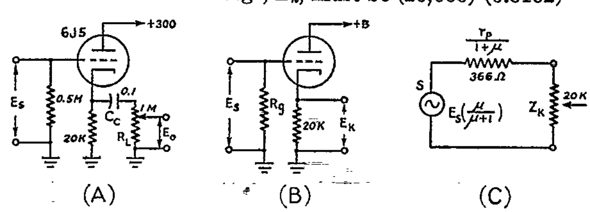


Fig. 2 — Development and equivalent circuit of Fig. 1-A.

*Sqdn. H, Officers Mail Room, Boca Raton Field, Fla.

TABLE I

E_c	I_b	E_k	E_s
− 0	10.20	204	204
− 2	8.70	174	172
− 4	7.25	145	141
− 6	5.75	115	109
− 8	4.40	88	80
− 10	3.20	64	54
− 12	2.10	42	30
− 14	1.30	26	12
− 15.3	0.77	15.3	0
− 16	0.70	14	− 2
− 18	0000	0	− 18

204 volts positive in respect to ground. Since E_s is the voltage from grid to ground, and since the grid-cathode voltage is zero, making the grid 204 volts positive also in respect to ground, then it follows that the signal voltage must be 204 volts positive. Now we can fill in the first line of Table I.

Now let the grid-cathode voltage be − 2 volts. The load-line intersection with the − 2-volt curve shows that the current is 8.7 ma. at point P_2. If the current is 8.7 ma., the cathode-ground voltage will be (20,000) (0.0087) = 174 volts positive in respect to ground. If this is true, the grid-cathode voltage will have to be 172 volts positive in respect to ground in order to have the grid-cathode voltage be the required − 2 volts. Therefore, the signal voltage will have to be 172 volts. In this way Table I can be filled in step by step.

When we come to the − 16-volt curve, we must watch out. Here the current is 0.7 ma., and E_k is 14 volts positive in respect to ground, making the grid-cathode voltage − 14 volts. But the required voltage is − 16, so the signal must supply the other 2 volts, making the signal voltage − 14 + (− 2) = − 16 volts.

Now that we have the data, they may be used to plot a curve showing the relation between the input voltage, E_s, and the output voltage, E_k. This has been done in Fig. 4. Notice that the input signal may swing up to + 204 volts but down only to − 18 volts.

What would happen if a sine wave with a maximum value of 50 volts were applied, for example? The positive half would appear undistorted across R_k, except for the slightly smaller amplitude (50 × 0.935). However, when the signal reached a value of − 18 volts, the plate current would be

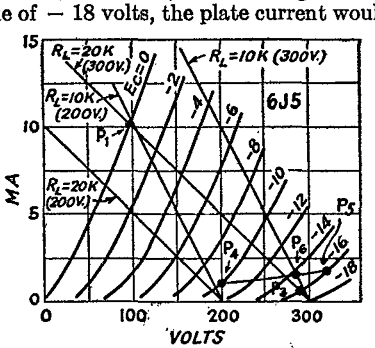


Fig. 3 — **Load lines for two load resistances and two voltages plotted on 6J5 characteristic curves.**

cut off. The wave would appear as in Fig. 5. Part of the negative peak is cut off. Cathode followers often are used in just this way, providing coupling from one circuit to another and clipping off an undesired portion of the wave at the same time.

What happens if R_k is decreased to 10,000 ohms? The zero grid-signal plate current then is 16.4 ma., and the maximum positive signal voltage which can be used drops to (10,000) (0.0164) = 164 volts.

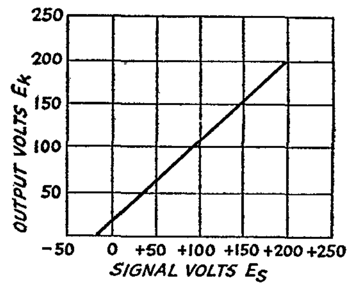


Fig. 4 — **Graph showing relation between output and input voltages for the circuit of Fig. 1-A.**

The zero-signal plate current may be determined in the following manner. Referring to Fig. 3, two grid voltages are selected at random, the corresponding plate currents to develop these voltages across the cathode resistor are calculated. These current values then are plotted as points on the grid-voltage curves and joined with a straight line. The intersection of this line with the load line serves to indicate the static plate current. In Fig. 3, grid voltages of − 10 and − 16 have been selected. The corresponding plate currents are 10/10,000 = 1 ma. and 16/10,000 = 1.6 ma. Thus the positions of P_4 and P_5 are located and the line P_4P_5 is drawn. This line intersects

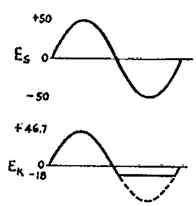


Fig. 5 — **Output wave form for the circuit of Fig. 1-A, showing "clipping" of negative part of wave.**

the 10,000-ohm load line at P_6 where the plate current is approximately 1.4 ma. and the bias about − 14.3 volts. This is a neat little trick for finding the grid bias developed across any particular size of resistor in the cathode circuit of a tube.

What happens when the plate voltage is decreased? Let us say that we retain the 10,000-ohm load resistor and drop E_{bb} to 200 volts. In Fig. 3, another load line may be drawn for the new plate voltage. Once more the zero grid-voltage current is about 10.2 ma. and the maximum positive signal voltage is 204 volts as before. But this time the plate currents are different as we travel down the load line and another tabulation would have to be made to find out just what happens.

Let us increase the value of the cathode resistor to 20,000 ohms. Now the zero-grid-voltage current is about 6.5 ma. and the maximum input signal voltage is (20,000) (0.0065) = 130 volts.

Circuit Fig. 1-B

The first circuit, as we saw, can take a very large positive voltage at the grid and pass it along with practically no distortion. What if we wish to handle a large negative voltage without distortion? The circuit of Fig. 1-B may be used. Once again, we turn to Fig. 3 and the 20,000-ohm line with E_{bb} at 300 volts. With the grid connected in this manner the grid-cathode voltage "wants" to stay at zero. The quiescent current is 10.2 ma. and the zero-signal voltage across R_k again is 204 volts. If the grid-cathode voltage is zero, the grid also must be 204 volts positive in respect to ground. This does not mean, however, that E_s, the signal voltage, is 204 volts positive, for the grid is at this voltage with *no* signal present. The problem will have to be solved, then, by considering *changes* in grid potential from the quiescent value of 204 volts. To simplify the problem, use is made of the gain factor, *VA*, calculated earlier. This was found to be 0.935 for for the 6J5.

With the grid now at − 2 volts, I_b becomes 8.7 ma. and E_k goes to (20,000) (0.0087) = 174 volts.

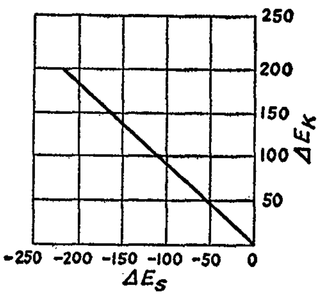


Fig. 6 — **Graph showing relation between input and output voltages for the circuit of Fig. 1-B.**

This is a change in E_k, which may be labelled ΔE_k, of 204 − 174 = 30 volts. This is a *negative* change in E_k, for E_k has *decreased*. The amplification of the stage is 0.935, hence a change in E_k of 30 volts must have been caused by a change in grid voltage of 30/0.935 = 32 volts.

This value of ΔE_s can be obtained in another way. If E_k becomes less by 30 volts, then E_s must become less by 30 volts also. But then, the grid-cathode voltage still will be zero and it was stated that the change came about as a result of setting the grid at − 2 volts in respect to the cathode. Therefore, it is necessary to have 2 volts across R_g supplied by the signal in addition to the 30-volt change. Hence the signal voltage is − (30 + 2) = − 32 volts. In short, $\Delta E_s = \Delta E_k + E_c$. In this manner Table II may be completed. Fig 6 shows the relation between E_s and E_k.

The preceding calculations for Fig. 1-B are not quite accurate. It was assumed that all of the input voltage appears across R_g. Actually part of it appears across R_k. Then, too, the gain of the cathode follower is not a constant; it starts out at 0.935 but becomes 0.920 at very-low values of plate current. This is because the transconductance changes at low plate-current values. These inaccuracies, however, are not important and the results obtained in practice will not differ appreciably from the theoretical values.

One feature of this connection is extremely valuable. The input capacitance is reduced to a very-low value. Calling the input capacitance C_{in} and obtaining other values from the *Handbook,*

$$C_{in} = (C_{gk} + C_{gp})\,(1 - A)$$
$$= (3.4 + 3.4)\,(1 - 0.935) = 0.442\ \mu\mu\text{fd.}$$

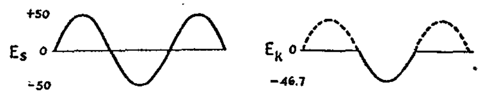


Fig. 7 — **Curves showing input and output waveforms for the circuit of Fig. 1-B, with positive portions of output wave "clipped" as indicated by the dotted lines.**

A characteristic perhaps even more valuable is the increase in input resistance. In Fig. 1-A the input resistance is simply R_g, but in Fig. 1-B it is

$$R_{in} = \frac{0.5}{1 - A} = \frac{0.5}{0.065} = 7.7 \text{ megohms.}$$

We won't load an input circuit much by hanging 7.7 megohms across it, will we?

An unfortunate characteristic, perhaps, is the fact that only negative input voltages may be used. Of course, if we wish to clip off the positive half of the incoming signal, the circuit of Fig. 1-B is perfect for the purpose. The result might be as shown in Fig. 7.

Circuit of Fig. 1-C

May we not realize all of the advantages of the cathode follower without clipping things right and left — or up and down? Let us investigate the circuit of Fig. 1-C. Because its analysis is a bit more complicated than those previously discussed, the circuit is redrawn in Fig. 8 and all voltages labelled. Under no-signal conditions, the bias is developed across R_1. It is assumed that C_k is large enough to hold E_1 constant during a change in input voltage; in other words, the biasing resistor truly is by-passed for all practical purposes. (One of the fundamental concepts of electrical theory is that the voltage across a condenser cannot be changed instantly.) Therefore, if C_k is around 50

TABLE II

E_c	I_b	E_k	ΔE_k	ΔE_s
0	10.2	204	000	000
− 2	8.7	174	− 30	− 32
− 4	7.25	145	− 59	− 63
− 6	5.75	115	− 89	− 95
− 8	4.40	88	− 116	− 124
− 10	3.2	64	− 140	− 150
− 12	2.1	42	− 162	− 174
− 14	1.3	26	− 178	− 192
− 16	0.7	14	− 190	− 206
− 18	00	00	− 204	− 222

μfd., E_1 will stay at − 7.4 volts even if the plate current is reduced momentarily to zero.

Graphical solutions, crude though they may be, are, however, very close to what one observes on an oscilloscope. The first step is to draw a load

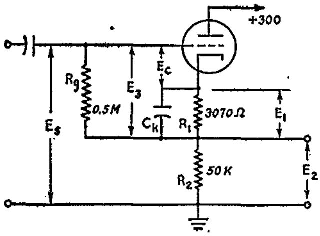


Fig. 8 — **Typical values assigned to the circuit of Fig. 1-C. C_k keeps the drop across R_1 constant.**

line as A in Fig. 9. In this circuit R_1 provides the bias, so the load resistor, R_2, may be made as large as desired, bearing in mind that, in general the higher its resistance, the better. Now it is desirable that the output voltage have a more or less symmetrical swing about the zero-signal value. The maximum possible value of output voltage is 300 — E_{co}, where E_{co} is the no-signal grid voltage. This is true because when the plate current is cut off there still will be a drop across R_1 from the action of C_k. The minimum output voltage will be somewhere near 50 volts, where the load line crosses the line for E_s = 0. So a point along the base line is chosen about half-way between 50 volts and 300 volts, or approximately 175 volts. The 175-volt ordinate intersects the load line at about − 7.4 volts and the zero-signal current is about 2.42 ma. If 7.4 volts are required and the current is 2.42 ma., the resistance required for R_1 is 7.4/0.0024 = 3050 ohms. So the load line *should* have been drawn for 50,000 + 3050 = 53050 ohms. We redraw the load line at B. This changes the zero-signal current a bit, making it 2.41 ma. But with 2.41 ma. instead of 2.42 ma., we need 3070 ohms at R_1 to get 7.4 volts. We really should draw a new load line, but the change is so small that we know we don't have to.

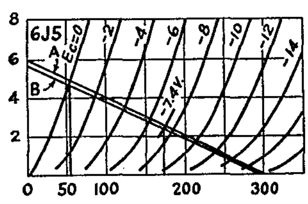


Fig. 9 — **Load lines for 6J5 in the circuit of Fig. 1-C and Fig. 8. An expanded curve is shown in Fig. 10.**

We have said that the voltage across R_1 will stay constant, so our a.c. load line is not 53,070 ohms, but 50,000 ohms. So, we ought to draw in the a.c. load line. In Fig. 10 is an expanded picture of these load lines to show what they would look like. For the purposes of this rough analysis, we shall go ahead and use the 50,000-ohm load. Now the tabulation of Table III can be prepared.

As before, we choose values of E_c and find the plate currents from the load line. E_1 will stay constant. E_2 will be (50,000) (I_b). E_1 and E_2 are in series with the grid-cathode voltage. Hence, E_s must be the sum of E_2, E_1 and E_c. It is easier, though, to think in terms of *changes*. In the static condition there is no signal voltage. Under these conditions the bias is the voltage across R_1, or E_1, which is 7.4 volts. The voltage E_2 is (50,000) (0.00241) = 120.5 volts, so the output changes up and down about the value 120.5 volts.

Now suppose the input voltage causes the grid-cathode voltage to change to − 6 volts. What is the magnitude of this change of input voltage? What will be the magnitude of the change across R_2? We follow the load line to the − 6-volt line and find that the current is 2.8 ma. Then E_2 is (50,000) (0.00028) = 140 volts and the *change* in E_2 is ΔE_2 = 140 − 120.5 = 19.5 volts. So the signal had to change by at least this much. We know that ordinarily the bias comes from E_1, which is going to stay constant at 7.4 volts. But it was stated that the grid-cathode voltage was

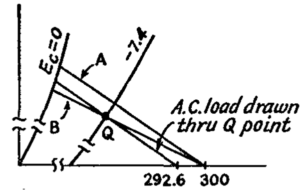


Fig. 10 — **Expanded sketch of curves of Fig. 9.**

going to be changed to − 6 volts. If E_1 still is 7.4, then the signal will have to supply the difference between E_1 and the chosen value of E_c which is 1.4 volts. So ΔE_s = 19.5 + 1.4 = 20.9 volts.

With these circuit connections we get the same reduced input capacitance and increased input resistance as with Fig. 1-B.

Circuit of Fig. 1-D

This circuit is quite similar to that of Fig. 1-C, except that we have left out the cathode by-pass condenser. The result is that now the drop across R_1 does not stay constant with changes in signal voltage. The output voltages will be somewhat different from those shown in Table III. The author respectfully leaves this little business as a problem for the interested amateur to solve. A question might arise as to where we might wish to

TABLE III

E_c	E_1	I_b	E_2	ΔE_2	E_3	ΔE_s
0	7.4	4.65	232.5	112	7.4	119.4
− 2	7.4	4.1	205	84.5	5.4	89.9
− 4	7.4	3.41	170.5	50	3.4	53.4
− 6	7.4	2.8	140	19.5	1.4	20.9
− 7.4	7.4	2.41	120.5	000	000	0000
− 8	7.4	2.25	112.5	− 8	− 0.6	− 8.6
− 10	7.4	1.7	85	− 35.5	− 2.6	− 38.1
− 12	7.4	1.2	60	− 60.5	− 4.6	− 65.1
− 14	7.4	0.75	37.5	− 83	− 6.6	− 89.6
− 16	7.4	0.40	20	− 100.5	− 8.6	− 109.1
− 18	7.4	0000	0000	− 120.5	− 10.6	− 131.1

use this circuit, instead of the more sensible one of Fig. 1-C. Well, a case in point is the horizontal-deflection amplifier of the Dumont type 208 cathode-ray oscilloscope. The circuit has been described before; we present it here in Fig. 11 to

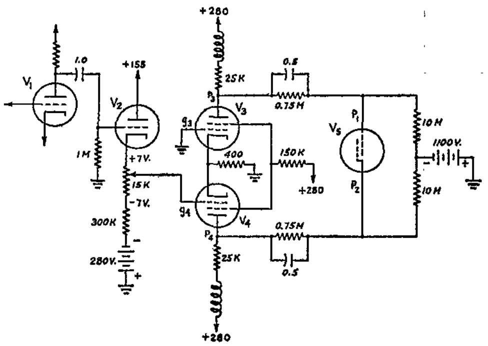


Fig. 11 — **Circuit of vertical deflection amplifier used in the Dumont 208 oscilloscope.**

demonstrate the acute usefulness of the cathode follower in certain applications.

Here V_1 is one of two triode amplifier stages feeding the cathode follower V_2, which is one triode unit of a 6F8G. The cathode follower drives two 6V6Gs in a cathode-coupled push-pull circuit which furnish the deflection voltages for the vertical plates of V_5, a 5-inch cathode-ray tube. The circuit is used because the Dumont people wished to use direct coupling between the push-pull amplifier tubes and the cathode-ray tube. If direct coupling is used, one must devise some system of providing centering voltages to the plates so that the spot may be moved around on the screen of the cathode-ray tube. It turns out that the bias on the push-pull grids must be varied to get a d.c. potential difference between P_1 and P_2. The operation of the cathode-coupled amplifier is rather nvolved, but we can take a quick look. Suppose we momentarily make g_4 more positive. This increases the plate current of V_4 which increases the voltage across the 400-ohm cathode resistor which, in turn *increases* the negative bias on V_3, since g_3 is returned directly to ground. The plate current of V_3 decreases; causing the potential at P_3 to *increase*, to a value of say 10 volts higher than it was originally. The increase of plate current through V_4 causes the potential of P_4 to *decrease*, to a value of 10 volts, for instance, lower than it was before. And there we have push-pull output. The thing is like a snake with its tail in its mouth, because of the cathode coupling.

We said that we would make g_4 momentarily more positive; this can be done easily by moving the tap on the 15,000-ohm potentiometer up a little. Now let us suppose an alternating voltage is placed across the 315,000 ohms in the cathode of the cathode follower, V_2. This voltage will vary around a d.c. voltage determined by the setting of the tap on the potentiometer. The 20 volts d.c. potential difference we got by moving the tap — that is, the 20 volts across the deflection plates — is the centering voltage, and this will move the spot up about a half inch. The push-pull amplifier goes ahead and amplifies the signal as though nothing had happened, and the spot accommodatingly returns to that point, a half-inch up, after each excursion. So conditions have been met for both centering voltage and amplification.

Why use direct coupling in the first place? Well, consider a circuit like Fig. 12. There will be a certain voltage across the condenser C. Now move the tap on the potentiometer R_2. This changes the voltage at the tap. But the voltage at P_1 *cannot change instantly* because it is not possible instantly to change the voltage across a condenser where there is resistance in the circuit. There is a time constant, (C) $(R_1 + \text{part of } R_2)$. This time interval may be quite long, for R_1 often is of the order of 2 or more megohms and C is around 0.1 μfd. or larger. This means that there is quite a time lag — we turn the center control knob and then settle back and wait for the spot to take its time to get where it's going. Direct coupling eliminates the condenser and the waiting.

The 280-volt battery in the cathode of the cathode follower is necessary to cancel the large voltage drop across the 300,000-ohm resistor. Why use this resistor then? Well, the larger the cathode-load resistor, the more linear the device will be. The net result is that the cathode follower can be operated with a bias of -7 volts, where we'd like to operate it, and yet 300,000 ohms can be used for a load. Also the grid resistor can be

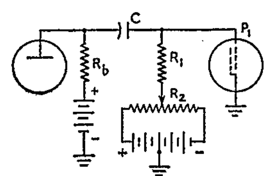


Fig. 12 — **Conventional circuit for obtaining centering voltage for cathode-ray tube.**

returned directly to ground, instead of back to a tap on the cathode resistor.

Doesn't varying the tap vary the output voltage (the a.c. voltage, that is) applied to g_4? Yes, it does, but the tap can be varied only up or down over a range of 7,500 ohms out of over 300,000 ohms. That won't vary the output a.c. voltage much, will it? It is hoped that the usefulness of the cathode follower in unexpected ways has been demonstrated by this very clever circuit.

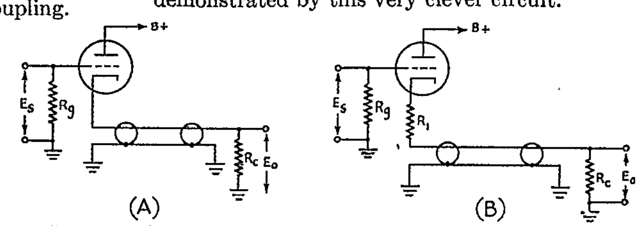
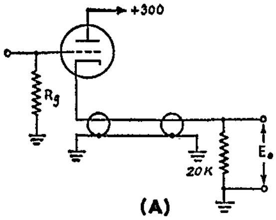


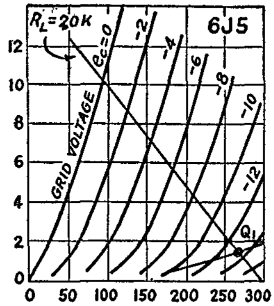
Fig. 13 — **Cathode follower feeding a low-impedance line as used frequently between television chassis. Impedances are matched in (A): cathode impedance is higher than line impedance in (B).**



(A)

Fig. 14 — (A) — Cathode follower feeding a concentric cable. (B) — Load line for 6J5.

(B)



Feeding a Low-Impedance Load

Often in television it is necessary to transfer video voltages from one chassis to another, as from the camera to the sweep-generator chassis, or from the sweep-generator chassis to the modulating tubes located near the power-amplifier tubes of the transmitter. These video voltages include frequencies up to perhaps 750 kc. for ham television. It is not possible to use a high-impedance line for such connections and one must resort to the use of coaxial cables or twisted-pair lines.

Let us suppose that we have a nice piece of crystal-mike cable or regular "coax" cable to use somewhat as in Fig. 13. Can we use the regular 20,000 ohms for R_c? A transmission line, we thought, should be terminated in its characteristic impedance, which in this case is 72 ohms, to avoid reflections and standing waves. Now the highest useful frequency for ham television is around

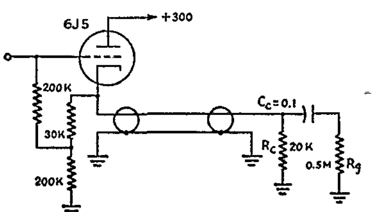


Fig. 15 — Another circuit for feeding low-impedance cable. Here the grid is returned to cathode.

1 Mc. But let us say that we want the line to transmit a maximum frequency of 2 Mc., just to be on the safe side. The length of a 2-Mc. wave is about 490 feet. If the cable is 6 feet long, for example, it corresponds to an electrical length of (6/490) (360) = 4.41 degrees. So the cable will "look like" a capacitance to the cathode of the tube. If the cable has a capacitance of 5 $\mu\mu$fd. per foot, the total will be 30 $\mu\mu$fd. We saw that the 6J5 looked like 366 ohms *to the cable*. Hence the cable is shunted by 366 ohms so far as the a.c. signal is concerned. Almost any reasonable-size resistor could be hung across the far end of the cable and the tube would still act as though the resistance were 366 ohms. So there is no need to worry that this small shunt capacitance will hurt the high-frequency response.

There might be applications where we would wish to transmit higher radio frequencies along the cable. (By "higher radio frequencies" we mean 12 or 20 or 50 Mc.) In this case we would have to terminate the cable in its characteristic impedance. Then the circuit of Fig. 13-A or 13-B might be used. However, the bias with only 72 ohms in the cathode would be very low, and the plate voltage would have to be reduced to around 110 volts to keep the plate current down. The zero-signal current would be about 9.7 ma., and the bias about 0.7 volts. From previous analyses, it is easy to guess that this is not so good, for most of the positive parts of the wave would be distorted with such a low bias. We could use some fixed bias on the grid return, but that wouldn't help any because the range over which the plate current would vary still would be no more than a few milliamperes. And a few milli-

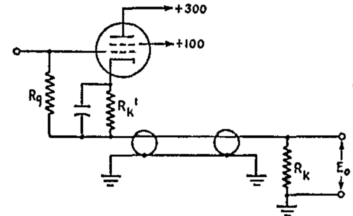


Fig. 16 — Pentode cathode follower feeding a low-impedance line. A load line is plotted in Fig. 17.

amperes times 72 ohms results in very few volts indeed! Of course, if we wish to transfer such high-frequency currents, link coupling can be used, as in coupling transmitter stages, but that falls under the head of r.f. cathode-coupling systems and we won't go into that subject here.

Let us consider the behavior of the gadget in a circuit often used, Fig. 14–A. Using our little trick, we find the static bias at point Q_1, Fig. 14–B, about 13.3 volts. The circuit will work like the one of Fig. 1–A. The circuit of Fig. 1–C can be used with a bit of alteration. The grid must be tied back to the cathode. Fig. 15 shows a connection to accomplish this readily. The output voltage, E_o, will be similar in form to that obtained from the circuit of Fig. 1-D.

We have not said much about hooking this output voltage to the succeeding circuit. Bear in mind that there will be a constant d.c. voltage across R_c — the static bias in the case of Fig. 14–A, and the static d.c. voltage across R_c in Fig. 15.

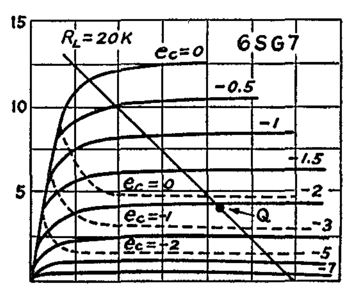


Fig. 17 — 20,000-ohm load line plotted on 6SG7 characteristics.

So care must be used in hooking a grid directly to the hot terminal of R_c. The coupling condenser C_c and grid resistor R_g will take care of the situation.

Pentode Cathode Followers

Perhaps we should see what results can be obtained by using a high-transconductance pentode for a cathode follower as shown in Fig. 16. Let us take a 6SG7. The g_m is 4700 micromhos, r_p is 0.9 megohms, normal plate current is 11.8 ma., and normal screen current is 4.4 ma. The tube will act like a generator whose internal impedance is $1/g_m$ or $1/0.0047 = 213$ ohms. For this circuit we must go to the characteristic curves of Fig. 17 to see what happens. Let the plate supply be 300 volts, screen voltage 100 volts and R_k 20,000 ohms. How do we find the static bias? Can we use our little trick, like we did with the triode? Nope, it won't work. Here is what must be done, as shown in Fig. 18. Suppose R_k is 400 ohms, where the 400 ohms is the part of the resistance in the cathode circuit which provides the bias. The curved line in Fig. 18 must be

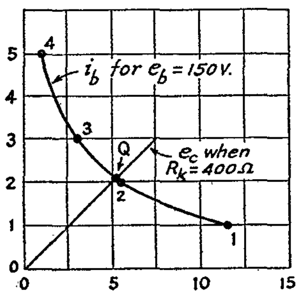


Fig. 18 — Graph for finding zero-signal bias for pentode with resistance load.

constructed as follows. First, assume a constant plate voltage of say 150 volts. Then, let $e_c = -1$ volt. From the tube characteristics the plate current will be 8.4 ma., the screen current 3.2 ma., or a total current of 11.6 ma. Plot this point, as at *1* in Fig. 18. Now let e_c be -2 volts; i_b is 4.2 ma., I_s is 1.3 ma., a total of 5.5 ma. Plot this at *2*. Similarly we get points *3* and *4* and the curve can be drawn. Now, if R_k is 400 ohms, 5 ma. will give a 2-volt bias, and we have the straight line. The intersection of the two lines gives the zero-signal cathode current and the bias.

What has been gained by using this pentode? Not a great deal if we wish to provide a *voltage* at the termination of the cable — voltage as against appreciable *power*. Many television-viewing tubes require magnetic deflection circuits, instead of electrostatic deflection, and it is necessary to feed some appreciable power through the deflection coils. These coils are commonly wound up as a unit — it is not advisable to attempt to make them. Their d.c. resistance is in the neighborhood of 250 ohms, while the inductance is of the order of 50 to 100 mh. The deflection sensitivity is about 12 to 18 ma. per inch. If the picture on the screen is 4 inches wide, we will need around 64 ma. change in current through the coil to move the spot across the picture. It is not easy to speak of the *impedance* of the coil, because the current going through it is not sinusoidal but saw-tooth in form. There are other ways of considering the problem. For our purpose we will show merely the cathode follower driving the inductance coil.

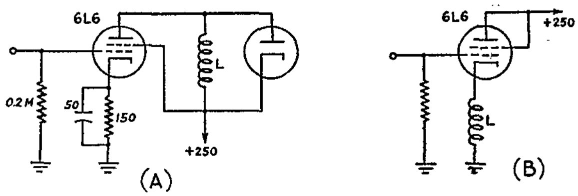


Fig. 19 — Circuits for supplying signal voltage to magnetic deflection coils of television-viewing tubes.

In Fig. 19–A we show a 6L6 tube connected as an amplifier with the coil as a plate load. The coil looks back at the tube and sees r_p — perhaps 70,000 ohms or so. This means that there is very little *damping* on the coil; it will tend to resonate with its distributed capacity and the circuit capacity, causing the current in the coil to oscillate at some fairly-high frequency. This, of course, will cause the spot to tend to flop back and forth across the screen — something eminently undesirable!! So the engineers came up with the diode hung across the coil, so that current in the wrong direction flows through the diode, which acts like a very-low resistance to current in the desired direction. The current then flows through the diode on the reverse swing of the oscillation and promptly is damped out.

The coil itself is not a good load for the tube, so a coupling transformer sometimes is used between the coil and the tube. Since the current is of saw-tooth form, it has many many harmonics; for 144-line television the fundamental frequency is 4320 cycles and the harmonics go to at least 43,000 cycles. A transformer to handle this wide frequency range is not an easy thing

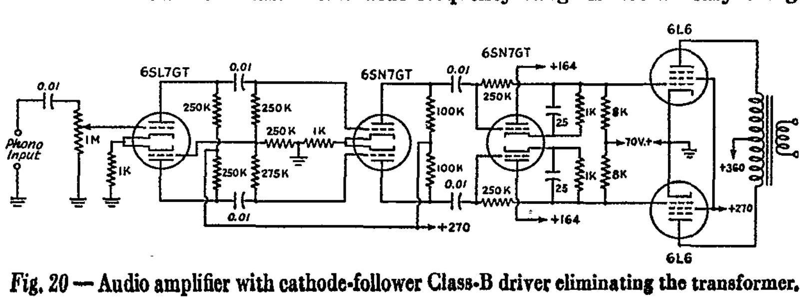


Fig. 20 — Audio amplifier with cathode-follower Class-B driver eliminating the transformer.

TABLE IV

E_s	E_1	I_b	E_2	ΔE_2	E_g	E_3	ΔE_s
0	6	14	112	64.0	42	6	74
− 2	6	11.1	88.8	40.8	18.8	4	40.8
− 4	6	8.4	67.2	19.2	− 2.8	2	21.2
− 6	6	6	48	000	− 22	0	00
− 8	6	3.65	29.2	− 18.8	− 40.8	− 2	− 20.8
− 10	6	2	16	− 32	− 54	− 4	− 36
− 12	6	0.7	5.6	− 42.4	− 64.8	− 6	− 48.4
− 14	6	000	000	− 48	− 70.4	− 8	− 56

E_g is the potential of the 6L6 grid with respect to ground.
E_3 is the drop across the 6L6 grid resistor.

to make. In Fig. 19-B we use our old friend. Here the coil is a well-matched load for the tube. The coil, on the other hand, looks back at the tube and sees about 250 ohms, which is so low that any tendency toward oscillation in the coil is damped out, and we forget about diodes. If one 6L6 does not provide sufficient current for some tubes, two or more may be used in parallel with no ill effects.

Other Applications

Now we get to some nice meaty ideas. In Fig. 20 we have a pair of 6L6s and a crying need for 47 watts of audio. Immediately we require a nice push-pull input transformer to feed these Class-AB_2 grids. Good engineering says that the secondary impedance and resistance should be very low and that the driver should have good regulation, which means low internal resistance.

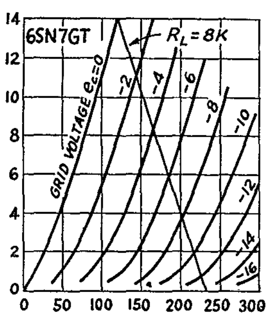


Fig. 21 — 6SN7 characteristics (one triode unit).

Usually this transformer is none too good, unless we pay upwards of four or five bucks for it, and the secondaries are often wound with fine wire which disconcertingly burns out when the grids are pushed harder than normally.

Our good friend Lt. Louis G. Walters of the Air Forces Weather Wing, has suggested the circuit of Fig. 20. We believe the 6SN7 will out-perform any transformer made for this use — certainly the cathode follower has the lowest internal impedance we have yet found! The 6L6s require 72 volts, grid to grid, and − 22 volts fixed bias on the grids. Hence the cathodes of the 6SN7 must be at a potential of − 22 volts with respect to ground. We ought to have about 50 volts drop across R_k so as to accommodate a 36-volt swing on each cathode. This would make the cathode + 50 volts. Hence we return the cathodes to − 72 volts, and the net potential of the cathode is the required − 22 volts.

This circuit will be recognized as that of Fig. 1-C in push-pull form. Going to the over-worked characteristic of Fig. 21, we experiment a little and see that a zero-signal current of about 6 ma. will permit operation over the linear part of the curves. With 6 ma., it will take around 8,000 ohms at R_k to get the static-voltage drop of about 50. Looking at the curves again, it is seen that 6 ma. and 6 volts at point Q_1, is a good operating point considering linearity. For 6 volts at the grid, 1000 ohms is needed at R_1. The load, then, is 8000 + 1000 = 9000 ohms. So through

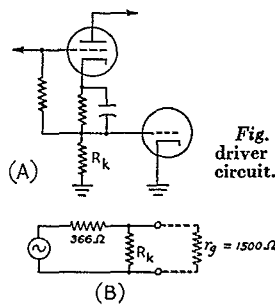


Fig. 22 — Cathode-driver and equivalent circuit.

point Q_1 we draw a load line for 8000 ohms — 8000 ohms because the 6 volts across R_1 is held constant by the by-pass condenser across it.

Fig. 21 shows the curves with the load line; the required plate voltage is 235 volts. Now we prepare a table (Table IV) to make sure the circuit behaves as we surmised. We do it just like we did for Fig. 1-C. The results are gratifying; the cathode follower hardly works at all to get out the required 72 volts. The usual transformer is required to have not over 500 ohms grid-to-ground impedance, for a distortion of 2 per cent. The cathode follower has only 366 ohms impedance — one up for the tube. The transformer has a step-down ratio of about 1 to 3 to obtain this characteristic; our circuit has a step-down ratio of about 0.9 to 1 — two up for the cathode follower. You know what must be paid for a transformer whose frequency response goes much beyond 7000 cycles — three up for the cathode follower — it hasn't any practical frequency limit!

There may be some argument about the validity of our analysis, and we are the first to admit that all is not fragrant in Denmark. For consider that E_g ceases to be negative and goes positive —

(Continued on page 88)

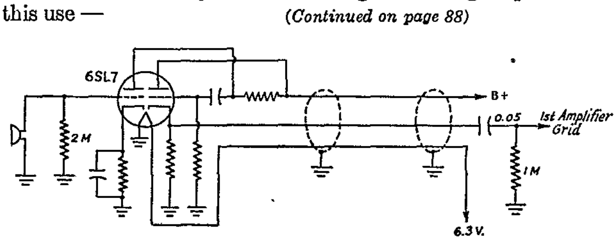


Fig. 23 — Microphone preamplifier using a cathode follower.

HAPPENINGS OF THE MONTH

BOARD MEETING HIGHLIGHTS

The ARRL Board of Directors had its annual meeting in Hartford on May 4th, with every division represented. The one new face was that of Director John A. Kiener, W8AVH, of the Central Division.

The Board heard reports from its officers and committees and, against that background, dealt with many pending matters in the affairs of amateur radio. Chief of these was the restoration of amateur frequencies after the war, a subject which occupied the Board for many hours. Appropriate instructions were given League officers to guide them in the future handling of this subject. Disclosure of the details of these instructions in the columns of *QST* at this time would not be in our best interests but it is expected that they can be reported when the whole subject of postwar amateur allocations is concluded in the not-too-distant future. The Board also reaffirmed its grant of extraordinary powers to the president to act as a committee of one in all aspects of protecting amateur operation and made an open authorization of $10,000 available to him for the defense of amateur frequencies.

Authorization was given for the representation of ARRL at the inter-American regional conference to open in Rio on September 3rd, our representatives to be selected later by the president. Further in postwar preparation, the Board set up a new committee to begin the study of desirable changes in postwar amateur operating regulations. Personnel will shortly be named by the president.

Confronted by prospective great growth in the number of amateur stations after the war, the Board has been studying the problem of devising a new plan that would make a sufficient number of station calls available. A plan was approved and ordered transmitted to FCC with a recommendation for its adoption. Time does not permit its detailed description here but we shall present it to you in our next issue. Briefly, it provides for ten call areas, the new one to use the numeral 0, with some redistricting of the areas to equalize their loads. Mainland calls would continue to be W calls, with the additional series WA1AA-WZ9ZZ used, so that no call exceeded five characters; and K would continue to indicate the territories and possessions. Watch for details next issue.

Directors are henceforth to be elected one month earlier. Every step in elections is advanced one month. Nominations will be solicited in August and September *QST*, will close Sept. 20th. Balloting will begin in October, will close Nov. 20th, the results to be determined as soon thereafter as possible. Director terms will still begin at noon Jan. 1st.

Miscellany: In the name of *QST*, $1,000 is contributed to the IRE building fund. . . . League's financial position is examined and found good. . . . Messrs. Bailey and Warner are commended for their presentation for the amateur before FCC last autumn. . . . The Planning Committee continues, under Vice-President Blalack. . . . Board hereafter meets the second Friday in May.

The text of the minutes of the meeting will appear in our next issue.

ALLOCATION NEWS

Up to our presstime there was still no announcement from FCC of its postwar frequency allocations. The job on the frequencies below 25 Mc. is nearly completed and is believed to await now only the writing of the actual report of the proposals and of the order setting dates for briefs and arguments. The f.m. matter is still under study and has held up the final FCC announcement of assignments above 25 Mc. Both documents are imminent and may come out just too late to make this issue of *QST*.

Allocation studies are extremely difficult, require a long time even during the easy days of peace. The original deadline for completion of the work was December 1st but it was only well started then. Many times dates have been suggested for the appearance of the reports and orders, and we have repeated them to you, only to find successive postponements caused by the sheer magnitude of the task. So not yet, but soon.

The Rio regional conference has been postponed until September 3rd.

W.E.R.S. EXPANDED

On April 10th some important changes were made by FCC in the regulations governing WERS, Part 15 of the FCC Rules, acting upon a request filed by ARRL about a year ago. As the regulations have read, WERS stations must be licensed primarily in connection with national security and defense and, although the regulations were changed some time ago to permit *such* stations to operate during natural-disaster emergencies, no provision has hitherto existed for the organization of WERS primarily on behalf of the relief of disasters. The regulations are now expanded to permit the CD type of WERS stations to operate in an emergency jeopardizing public safety, and new networks may be established and existing licenses renewed even though the Citizens' Defense Corps or equivalent civilian defense organizations are no longer active in the areas involved. WERS is the only agency through which amateur services may be utilized in the traditional duty of the amateur to cope with communication difficulties flowing from public emergencies, so this is a very significant expansion, as we comment upon in this month's editorial.

Some additional amendments authorize WERS stations to coöperate with the United States

Weather Bureau in the operation of their proposed flood- and storm-warning emergency radio network. This, too, will provide some interesting opportunities for stay-at-home amateurs.

Let us first examine the wording of the new amendments. Get down your copy of Part 15. The first two sections, under Definitions, have been amended to read:

Sec. 15.1. *War emergency radio service.* The term "war emergency radio service" means a temporary radio communication service intended solely for emergency communication in connection with the national defense and security or conditions jeopardizing public safety.

Sec. 15.2. *Civilian defense stations.* The term "civilian defense station" means a station operated by a municipal government for emergency communication relating directly to the activities of the United States Citizens' Defense Corps or other equivalent officially recognized organization, or relating directly to governmental activities to alleviate or prevent any emergency which jeopardizes or may jeopardize public safety.

In the matter of coöperation with the Weather Bureau, the following new section was adopted:

Sec. 15.12. *Applications for authority to transmit communications in coöperation with the United States Weather Bureau.*[3a] The licensee of any war emergency radio service radio station desiring to transmit communications relating to flood forecasting and storm warnings in coöperation with the United States Weather Bureau (in accordance with Sec. 15.56(b)) shall make specific notarized request, in duplicate, for authority to render such service. Applications for such authority shall state which unit or units of the station have been designated for the proposed service.

ARRL has collected opinion from WERS radio aides indicating that more of the 112–116-Mc. band ought to be made available for the less stable variety of signals, in consequence of which the dividing line has been shifted to 113 Mc., thus providing the same amount of space for each degree of stability, by the following amendment to Sec. 15.25(a):

Sec. 15.25. *Frequency stability.* (a) Transmitting equipment used in the war emergency radio service must be capable of maintaining the operating carrier frequency (without readjustments during operation) within the limits set forth in the following table:

Operating frequencies within the bands (kilocycles):	*Maximum deviation band-width*
112,000–113,000	1.1 of 1 per cent
113,000–116,000	0.3 of 1 per cent
224,000–227,000	0.1 of 1 per cent
227,000–230,000	0.3 of 1 per cent
400,000–401,000	0.2 of 1 per cent

The existing single paragraph of Sec. 15.56, on service that may be rendered for the U. S. Government, has now been lettered (a) and an additional paragraph adopted to deal further with the Weather Bureau matter:

(b) Any station unit licensed in the war emergency radio service, designated by the licensee in accordance with written request of the United States Weather Bureau and approval of the radio aide or communication officer, may be authorized by the Commission (1) to transmit to similarly designated units of the same or other licensees, and to designated radio receivers, communications essential to flood forecasting and storm warnings as requested and directed by official representatives of the United States Weather Bureau and (2) to participate, upon request of official representatives of the United States Weather Bureau, in such drills as are required for proper maintenance of the communication system.

The scope of service to be rendered by CD stations is expanded by the new language of Sec. 15.63:

Sec. 15.63. *Service which may be rendered* — (a) Except as otherwise provided in these rules, civilian defense stations may be used only during emergencies endangering life, public safety, or important property, for essential communication relating to civilian defense, national security, or public safety. Civilian defense station licensees, when requested in specific instances by the licensee of any State guard station or the licensee of any civil air patrol station, may use their licensed civilian defense stations for essential communication with such State guard or civil air patrol station(s) during emergencies endangering life, public safety, or important property. Civilian defense stations shall not be operated on board any aircraft unless specific authority for such operation has been granted by the Commission upon showing of need therefor.

And the language dealing with drills is similarly liberalized:

Sec. 15.76. *Drills.* Licensees of civilian defense stations may conduct drills during practice alerts, practice blackouts, practice mobilizations or other comparable situations as may be requested by (a) the proper military authority, (b) a governmental agency having responsibility relative to preventing or alleviating an emergency affecting public safety, or (c) local civilian defense authority; *Provided,* That a notice, by mail, of such operations is sent within 24 hours after the drill to the inspector in charge of the radio district in which the stations are located, and a copy to the Federal Communications Commission in Washington, D. C.

It is to be noted in Sec. 15.2 that CD WERS stations are still to be licensed only to municipal governments. In this section, and again in Sec. 15.76, where reference is made to "governmental" activities, it is not meant to refer solely to the Federal Government. The term also includes the agencies of municipal government such as the municipal safety services — the police and fire departments, etc.

The general philosophy is this: civilian defense activities may have largely disappeared and a municipality desires to revise its WERS to cope with situations affecting the public safety, including natural disasters. It will be logical for it to arrange such plans around its existing safety services, which generally will mean the fire and police departments. Or perhaps it is a community which in the past never had a civilian defense organization but which can now perceive the desirability of installing WERS to deal with the special problems of floods, hurricanes, etc., again built up around its own "governmental activities."

Let it here be clearly noted that WERS may not be used in connection with the *normal* activities of the municipal safety services but only during *emergencies.*

The Weather Bureau Plan

Since emergencies jeopardizing life and public safety frequently involve floods and severe storms, the U. S. Weather Bureau has sought permission to set up emergency flood and storm

[3a] To facilitate consideration of applications for such authorizations they should be forwarded first to United States Weather Bureau, Washington, D. C., which in turn will submit them to the Commission.

warning networks within WERS — to be the last line of communication when other facilities fail. The Weather Bureau issues weather forecasts and storm warnings, displays weather and flood signals, gauges and reports the rivers and issues all necessary warnings concerning weather and flood conditions. The adequacy of forecasts and warnings depends on forecasting skill, which itself leans heavily on communication facilities. The River & Flood Service is conducted through 85 selected central offices located at strategic points on rivers subject to flooding. Observers at precipitation and river gauges transmit reports by telephone or telegraph to the center. When storms and floods disrupt the land lines the Bureau is unable to receive reports from its observers or to transmit warnings to the field. It was in preparation for such situations that the Weather Bureau and ARRL were coöperating in an organized emergency network shortly before the war. Now the Bureau has been granted authority by FCC to resume this work, using WERS as the basic structure. As will be seen from the wording of the amendments above, the plan is to establish intercity networks — actually lanes of communication along river basins — by eliciting the coöperation of WERS radio aides. While generally this will occur at the request of local Weather Bureau officials in a particular locality, it may arise through the desire of the radio aide to establish a service to assist. Since this service will require relatively long hauls, it seems desirable that the radio aides in near-by cities along river basins coöperate with each other in selecting from their WERS organizations those stations which have a proven ability to work each other over comparatively long distances, and it is obvious that there should also be alternate stations. Experience shows that frequently the best stations for such a service are not the present control stations.

We commend the subject to all WERS radio aides in river-bottom country, suggesting that they make contact with local Weather Bureau officials — who have already been informed on the availability of the service. The mechanics of authorization are simple and are described in the quoted amendments. Briefly, a notarized letter in duplicate should be addressed to FCC, requesting authority to render such service, and should be sent first to the U. S. Weather Bureau, Washington, D. C. The station unit or units selected for the service must be designated, and we suggest that there should be some indication of a proposed communication plan. The Weather Bureau additionally desires a brief description of the equipment, its location and the names of operating personnel.

Section 15.56(b) provides that the stations engaged in this service may be authorized, at the request of the Weather Bureau, to conduct special drills. *QST* understands that a new and additional drill period will be authorized for the Weather Bureau gang — Fridays from 8 to 11 P.M. EWT.

The national coördination of this work will be in the Weather Bureau at Washington, D. C., under the direction of Dr. E. Dillon Smith, who is W3PZ — and with whom ARRL is collaborating in the development of further plans for the establishment of this service.

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.

WEBSTER CHAIRMANS I.R.A.C.

THE chairmanship of the Interdepartment Radio Advisory Committee changes annually in April, the vice-chairman succeeding to the chair. IRAC's chairman for the new year is Captain E. M. Webster, Chief of Communications of the U. S. Coast Guard. He succeeds Commander Paul D. Miles, USN. Under the latter's presidency, IRAC the past year was engaged in the biggest task of its history, the planning of post-war allocations — a job which is nearly, but not quite, done and which Captain Webster must now carry forward to completion.

Colonel A. G. Simson, officer in charge of the Liaison Branch of the Army Signal Corps, is the new vice-chairman destined to succeed to the chairmanship a year hence. Marion H. Woodward, chief of FCC's International Division, continues as secretary. Lieutenant Commander Arthur L. Budlong, W1JFN, also carries on as chairman of IRAC's technical subcommittee.

U.S.M.S. OPS NEEDED

THE need for radio operators to meet our expanding shipbuilding program continues urgent and the U. S. Maritime Service Radio Training Station at Gallups Island, located in Boston harbor, is now training many students for this interesting and essential contribution to the war effort.

After receiving six weeks' basic training as an apprentice seaman at one of the USMS training stations, an enrollee may apply for appointment to the radio school. Radio trainees are selected from the apprentice seamen on the basis of competitive examinations. General scholastic ability, mechanical comprehension, arithmetical computation, proficiency in algebra, code-learning ability, previous education, proficiency in swimming and a personal interview determine whether an applicant will be selected for radio training.

Enrollees in the radio school are paid $54 per month for the first three months and $66 per month for the remainder of the course. Graduates receive ratings from radioman, third class, to warrant radio electrician. Further information and application for enrollment may be had at any of the USMS enrolling offices in the principal cities of the U. S.

AMATEUR WAR SERVICE RECORD

Name	Call, present or ex; or grade of op-license only
Present mailing address	**SERVICE**
	☐ Army ☐ Navy ☐ Coast Guard ☐ Marine Corps
Rank or rating	☐ Maritime Service ☐ Merchant Marine ☐ Civil Service
Branch or bureau: Signal Corps, AAF, BuShips, WAVES, etc. If civilian industry, give title and company.	☐ Radio industry, 100% war

GROSS TO BERNE

Commander Gerald C. Gross, W3GG, former FCC assistant chief engineer and more recently assistant naval attaché at the American Embassy at Bogotá, has been appointed a vice-director of the bureau of the International Telecommunications Union at Berne, Switzerland. He succeeds Dr. Franz Schwill, who has been for some years vice-director in charge of the radio section of the Berne Bureau, as it is commonly called.

When it was learned that Dr. Schwill was retiring, the United States Government nominated Commander Gross as his successor and he was ratified therein in early April by the Swiss Federal Council, the bureau operating under the general supervision of the Swiss Government. There are four such international unions having headquarters in Berne and it is understood that Commander Gross is the first American ever to be appointed to any of them. He has an extremely wide acquaintanceship in the radio world, having attended practically all the international radio conferences held in the past twenty years.

YOUR WAR SERVICE RECORD?

For a couple of years we have run an item in *QST* every month about the card record we are compiling at Headquarters on the services of radio amateurs in the war. You'd think by now that every U. S. and Canadian ham would know of this project and be registered with us, but we still get enough of them every day to keep two people busy.

How about you? Are you registered with us? The information we want is very simple and can be supplied in a moment on the form at the top of this page — or its essentials reproduced on a post card if you prefer. The purpose is to show the extent that the know-how of the ham has contributed to the winning of the war, to prove that the nation's policy of fostering amateur radio is a wise one. Men and women in the armed forces, in other government service, in the sea-going services, and in the radio industry 100% devoted to war effort: we very much want the simple essentials about you and your job — just to provide the statistics for the defense of amateur radio. Won't you please see that we hear about you and your amateur buddies?

Microwave Relay Stations

The A. T. & T. Company has filed application with the FCC for authority to construct seven microwave relay stations between the terminals of the New York–Boston radio relay project. FCC approval on the two terminals was granted last year.

Purpose of the proposed stations is to determine, in practical operation, the relative efficiency and economy of radio relay for transmission of long distance telephone messages and of sound and television programs, compared with transmission over the familiar wires and cables and the recently developed coaxial cable.

Sites for the relay stations, about 30 miles apart, were chosen for their elevation. This not only takes into account the fact that microwaves do not travel much farther than the horizon, but it also puts the transmitting and receiving antennas well above intervening obstructions so that the waves can be beamed from hill to hill.

The stations will be built on the following:

Jackie Jones Mountain, 35 miles up the Hudson from the New York terminal in lower Manhattan. The mountain, west of the river, is in Haverstraw Township, 5 miles west of Stony Point, N. Y.

Birch Hill, in Patterson Township, 5 miles southeast of Pawling, N. Y.

Spindle Hill, in Wolcott Township, 4 miles southwest of Bristol, Conn.

John Tom Hill, 7 miles east of Glastonbury, Conn.

(*Continued on page 92*)

An "Anti-Squealer" for Superregenerative Receivers

Eliminating Receiver Radiation with a Simple Preselector

BY PHILIP S. RAND,* W1DBM

The preselector described here by W1DBM eliminates radiation and reduces antenna effects when used in conjunction with a superregenerative receiver. While this particular model has been designed especially for the Abbott TR-4 transmitter-receiver, the same idea readily may be adapted to receivers or transceivers of other types.

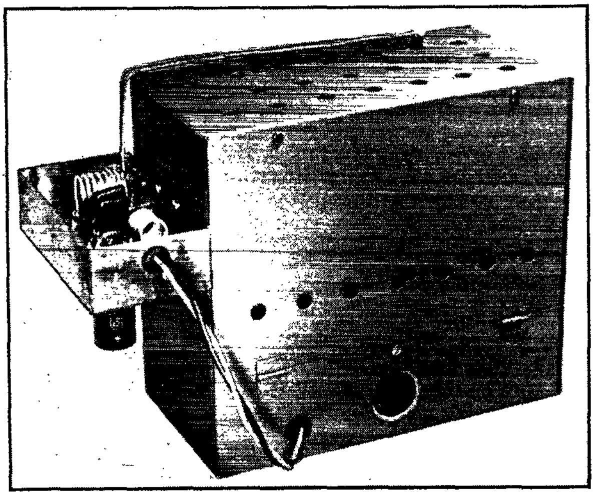
One of the most annoying obstacles in WERS net operation is the constant squealing interference caused by radiating superregenerative receivers. This problem always existed before the war when working two-and-a-half with superregenerative receivers, but at that time you always could wait until neighboring hams had gone to bed or to the movies before you fired up the rig. But this can't be done in WERS work.

The locations of the various stations in the Middletown, Conn., Warning District were chosen so that each station would be in a strategic position in case of an emergency. This means that several stations in certain towns may be either close to each other or close to their control stations, with severe interference as a result.

The receivers used at the district and net controls, WKNQ-1 and WKNQ-2 of the Middletown area, both are of the superheterodyne type with superregenerative second detectors and therefore they have given us no trouble in this respect. The receiver at WKNQ-1 has a tuned r.f. stage with a 9001 which eliminates all traces of radiation even in the operating room. The one at WKNQ-2 has no r.f. stage ahead of its triode grid-leak detector and consequently the radiation can be picked up very weakly in the operating room and just outside the station. The rest of our seventeen outlying stations, however, are equipped with ordinary TR-4 superregenerative receivers and we soon realized that a problem confronted us in the interference which resulted. In the case of Unit 17, located in a fire station a short block from the district control, the interference created was so severe that only the signal from the net-control station, WKNQ-2, could be copied solidly at WKNQ-1. The other signals were buried in QRM.

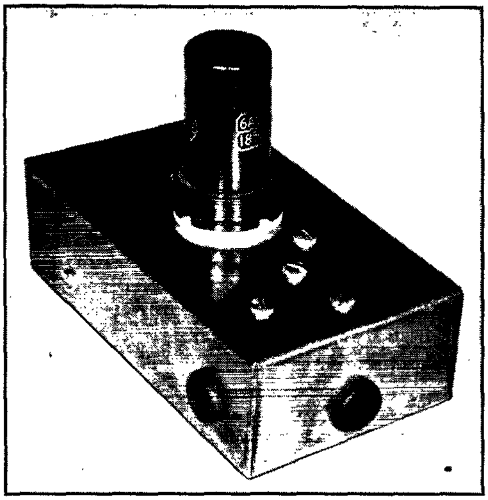
The first attempt at a solution to this problem was to hold district drills on Monday nights and the local Middletown tests on Wednesday nights. We realized, of course, that this was only a temporary remedy because in the event of an emergency all stations would have to be on at the same time. In another instance we tried a reflector behind the antenna, beaming both its transmitter signal and its receiver squeal in the opposite direction. This helped slightly, but the operator at the unit station always had a tendency to crank up the receiver to hear weak signals off the back of his array which simultaneously increased the interference. Still another measure taken was the use of very inefficient indoor antennas which would permit each station to hear only its control and thereby limit receiver radiation. This did not work out very well in practice because it was difficult to get operators to man stations which did not have "hot" receivers.

The real solution to the problem, we realized, was in the design and construction of an "anti-squealer" which would eliminate all receiver radiation noticeable on a sensitive receiver at a distance of 100 yards and yet would not decrease the sensitivity of the receiver. Furthermore, it should be something requiring a minimum of parts, which could be attached easily to the Abbott TR-4s without introducing tuning in-



The preselector in place on a TR-4. Power-supply leads are brought out through a hole drilled in the TR-4 case.

* District Radio Aide, Middletown, Conn.; Remington Rand Inc., Electronics Div., Middletown, Conn.



The r.f. stage for superregenerative receivers. The grommet at the side is for the output-link connections, while the one in the end is for power leads.

conveniences. In the design of such a device our first thought was a tuned r.f. stage using a 954, or possibly a 9001. However, after an investigation it was found that there would be considerable delay in obtaining tubes of either of these types and their sockets. The next choice was the 1852, a sufficient quantity of which was found in an old f.m. receiver and the junk box. It was thought desirable to equip eight or ten of our seventeen Abbott TR-4s, so a preliminary experimental model was constructed and tested for several months at Unit 17, the worst offender.

Circuit Discussion

Several different circuit arrangements were tried before we settled on the one shown in Fig. 1. In the first model, a two-plate midget variable condenser tuned a three-turn coil with the grid tapped at about the middle. A lead was brought from the plate prong of the 1852 socket through to the inside of the case and attached to the TR-4 antenna coil. This one-turn coupling coil was replaced by a three-turn plate coil for the 1852 and fed back into the preselector where its lower end was by-passed. So far as suppression of radiation is concerned, this first model was 100-per-cent perfect. However, the operators complained that they could no longer hear all of the net stations. So, before constructing the remainder of the units, this model was brought in and checked with a Ferris v.h.f. signal generator. We were discouraged to find that the sensitivity was of the order of several thousand microvolts. Nevertheless, we set out to attempt to improve matters.

In the first place it was found that the tuning condenser tuned very broadly, so we decided to use only the input capacity of the tube to tune the grid coil. With the input of the 1852 connected across the entire coil, two turns of No. 14 wire, ½ inch in diameter and spaced the diameter of the wire were required to tune to resonance. Similarly, experience showed that there was no particular advantage in using a tuning condenser in the plate circuit. This discovery led to the final elimination of all tuning controls. In the ultimate final arrangment, the antenna-coupling coil in the TR-4 is not used as the plate coil for the 1852. A separate plate coil of five turns of No. 14 wire, ½ inch in diameter, is placed in the amplifier unit itself and this is link coupled to the input of the TR-4 detector circuit. This not only gives better performance, but it also has the advantage that it is not necessary to make any changes in the antenna-coupling coil in the TR-4. Both L_1 and L_2 are coupled very tightly to their respective tank coils.

After these changes were made and the coils had been pruned carefully, squeezing turns here and spreading them there, it was found that the sensitivity had increased tremendously.

We encountered some difficulty with oscillation in the amplifier, despite thorough shielding and by-passing, when everything was tuned up on the nose. This trouble finally was cleared up and the sensitivity improved still more by by-passing the suppressor directly from the socket terminal to the side wall of the chassis and adding C_4 from a point on the plate coil a half turn from the "cold" end to ground. The latter remedy was discovered by accident and its function is not quite apparent, since an equivalent detuning of the plate circuit by adjusting the coil does not suffice. After these latest changes, the sensitivity measured 3 or 4 microvolts, or slightly better than that of the receiver alone without the preselector, so we proceeded with the construction of similar units for the other TR-4s.

Construction

Referring to the photographs, each unit is constructed on a small chassis 2½ inches deep by 2½ inches wide by 4½ inches long bent up from sheet metal. The socket for the 1852 is placed in the exact center of the chassis with the control-grid terminal toward the front and the plate terminal toward the rear. Plate and grid coils and their links are mounted at right angles and are isolated from each other by the shield which divides the chassis into two compartments. This shield is notched out at the bottom so that it fits

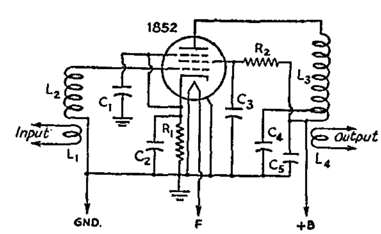


Fig. 1 — **Circuit diagram of the fixed-tune preselector.**
C_1, C_2, C_3, C_4, C_5 — 0.002-μfd. mica.
R_1 — 150 ohms, ½ watt.
R_2 — 75,000 ohms, ½ watt.
L_1, L_2, L_4 — 2 turns No. 14 wire, ½-inch diameter, turns spaced diameter of wire.
L_3 — 5 turns No. 14 wire, ½-inch diameter, turns spaced diameter of wire.

snugly over the socket to form a shield also between the plate and grid tube-socket terminals. The "hot" end of each coil is soldered directly to the proper socket terminal, while the "cold" ends are supported by small fibre lug strips. All ground connections, with the exception of that for the suppressor by-pass mentioned previously, are made at a single point on the chassis.

This small chassis is fastened in an inverted position to the right-hand end of the TR-4 cabinet with machine screws. A diagonal metal brace underneath will add materially to the strength of the assembly and is especially desirable if mobile work is contemplated. In operation, an overlapping cover is provided for the "bottom" of the chassis as shown in the photographs.

To reduce radiation to a minimum it was necessary to change the wires which originally ran from the antenna change-over switch to the receiver coupling coil since apparently they were picking up some signal from the detector. These leads were replaced with another pair from the switch which go directly up through holes in the top of the cabinet and then externally over to the preselector antenna coil, L_1. The output link, L_4, is connected to the original receiving antenna link in the TR-4 by a pair of leads passed through rubber grommets set in matched holes in the end of the TR-4 case and the preselector chassis.

Power-Supply Connections

Plate voltage for the r.f. amplifier is obtained from the receiver proper by running a wire through a hole drilled in the rear of the cabinet and soldering it to the high-voltage side of the regeneration control. With this arrangement, the "B" supply to the preselector is turned on and off by the send-receive change-over switch and, although full supply voltage is not applied to the amplifier tube, it is ample. Connection to the ungrounded side of the heater is made through a second lead to the insulated heater prong of the modulator-tube socket. Ground return is, of course, obtained by contact between the units.

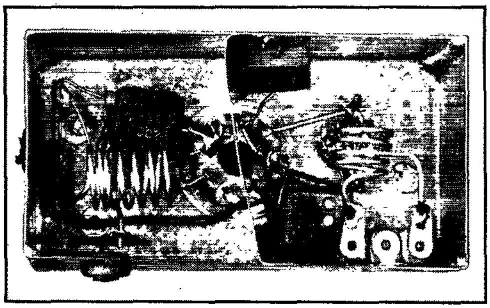
These units have been put back into operation and have proved satisfactory in every respect. The frequency response or band-width is sufficient so that the entire band is amply covered without any tuning adjustment. The usual operation of the TR-4 is in no way affected. Last, but most important, not a trace of receiver radiation is audible more than 300 feet from the unit. These preselectors may be installed on any existing receiver and should work out especially well on mobile units since mobiles are very apt to be cruising in the vicinity of various fixed stations or might stop close to one.

TR-4 Kinks

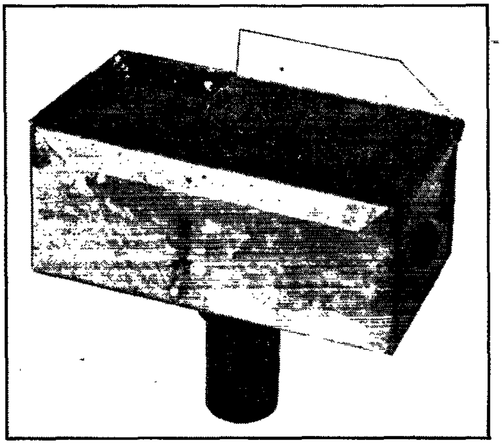
It should be mentioned that three other changes have been made for convenience in operating. The first is an extension on the send-receive switch which brings the knob out beyond the microphone plug. The second is the removal of the knob on the transmitter dial and the installation of a dial lock so that the frequency adjustment cannot be accidentally disturbed when operating the send-receive switch. A third improvement is the loosening up of the springs on the ganged send-receive switches. Each of these switches has a spring which in itself is plenty strong, and two of them in parallel make repeated operation very tiresome. They may be loosened by a little careful prying with a screwdriver.

In general we have found that one of the most common causes of poor quality with a TR-4 is the use of too-tight antenna coupling or running the gain control too high when transmitting with a sensitive mike. Excessively close coupling also will cause the frequency to be spattered around the band. Another cause of distortion is the use of long leads to the mike battery. Since this battery also furnishes bias for the 7F7 it should not exceed 3 volts, otherwise the amplifier tube will be biased too high and if the leads are too long a.c. hum will be picked up. If the power supply, which we have limited to 250 volts to prolong tube life, is mounted to the right of the TR-4, the power transformer should be as far from the set as possible, otherwise a.c. hum will be picked up by the audio transformer in the TR-4 which is near the

(Continued on page 86)



Inside the chassis showing the shield separating the grid circuit to the left and the plate circuit to the right. The shield is notched to fit closely over the tube socket.



The cover for the preselector chassis is provided with an overlapping flange where it contacts the case of the TR-4. The opening is for entrance of the leads from the change-over switch.

IN THE SERVICES

Not bigger, but better, photos are what we need, fellows. Many of you have answered our call for snapshots to liven up this department but in too many cases some of the most interesting had to be discarded because they lacked detail, were light-struck or were too dark. To reproduce well in the magazine, they should be on glossy paper, sharp of detail, not too contrasty and preferably with a bit of background to provide additional interest. An informal unposed group or individual looks better than the same standing at salute or attention. Tnx for your coöperation, OMs and OWs, and let's see what you look like.

ARMY—AACS

1AVL, Powers, Cpl., Miami, Fla.
ex-1DNJ, Mitchell, M/Sgt., Presque Isle, Me.
1KLR, Barolet, S/Sgt., Grenier Field, N. H.
1KOG, Iafrate, Sgt., foreign duty
2AAP, Whalen, Lt., Asheville, N. C.
2AZA, Oscanyan, Lt. Col., Asheville, N. C.
2HUX, Akerman, T/Sgt., foreign duty
2HXW, Baldwin, T/Sgt., foreign duty
3HOS, Ross, T/Sgt., foreign duty
4FOJ, DeBray, Sgt., foreign duty
4FSD, Bradley, M/Sgt., foreign duty
4IEI, John, Major, Presque Isle, Me.
5AHW, Perry, S/Sgt., Presque Isle, Me.
5FRW, Latimer, M/Sgt., Presque Isle, Me.
5IHS, Balusek, T/Sgt., foreign duty
5JFE, Mulcahy, Capt., foreign duty
ex-6MG, Farman, Brig. Gen., Asheville, N. C.
6SGQ, Beman, Sgt., Presque Isle, Me.
6TJ, Crawford, Capt., foreign duty
8FWK, Farrell, S/Sgt., Grenier Field, N. H.
8HGG, Papp, Pvt., foreign duty
8NIT, Michelis, T/Sgt., Scott Field, Ill.
8WGU, Schmalzel, Sgt., foreign duty
9BG, Clark, Lt. Col., Grenier Field, N. H.
9CDL, Irion, Cpl., foreign duty
9FKJ, Benton, Capt., foreign duty
9HXD, Domke, S/Sgt., Presque Isle, Me.
9JBY, Kirfman, Cpl., foreign duty
9UBK, Woodworth, S/Sgt., foreign duty
9UXV, Steele, Cpl., foreign duty
9ZLY, Nelson, S/Sgt., Presque Isle, Me.

Operator's license only:

Guthrie, 2nd Lt., Fort Bragg, N. C.
Graham, 2nd Lt., foreign duty
Kaff, Cpl., foreign duty
Metropolis, M/Sgt., Patterson Field, Ohio
Preston, Cpl., foreign duty

NAVY—GENERAL

1EP, Hoffmann, Lt. Comdr., Washington, D. C.
1HRL, Vargus, RM3c, foreign duty
1KLN, McMorrow, RM2c, Springfield, Mass.
1LNV, Waden, SKT3c, Brooklyn, N. Y.
ex-2BRT, Reardon, Lt. (jg), foreign duty
2KGI, Cutting, A/S, Sampson, N. Y.
2LJK, Rees, SKT3c, Brooklyn, N. Y.
2MKV, Carlock, CRM, foreign duty
2MTC, Morse, CRE, Forest Hills, N. Y.
2NSC, Panzarino, RM1c, Washington, D. C.
3HTA, Hoffecker, SKT3c, Brooklyn, N. Y.
3IHX, Wapeikis, RM3c, foreign duty
4AJY, Dixon, Ens., Washington, D. C.
4GED, Lawrence, CRM, foreign duty
4GYF, Patterson, Ens., Livingston, Tenn.
5GBU, Brown, SKT3c, Brooklyn, N. Y.
5GSE, Williams, RM3c, Purcell, Okla.
5JOY, Walker, CRM, foreign duty
5JSR, Page, RM2c, Santa Barbara, Calif.
5JSY, Schmitz, SKT3c, Brooklyn, N. Y.
6CCD, Kellogg, Lt., foreign duty
6GPS, Barrus, SKT3c, Brooklyn, N. Y.
6IUL, Burns, CRE, foreign duty
6KNL, Hart, CRM, foreign duty
6KOE, Degregori, Lt. (jg), foreign duty
6NWI, Jago, A/S, Santa Monica, Calif.
6OKK, Patterson, RE, foreign duty
6QPH, Bissell, RE, foreign duty
6RFL, Levin, CRM, foreign duty
6RKH, Daly, CRM, foreign duty
6SSC, Okeefe, CRE, San Diego, Calif.
6TNA, Hoffmann, RM1c, foreign duty
K6UCD, Lyon, RM3c, foreign duty
6ULZ, Crowe, RM2c, foreign duty
7APT, Kalberg, Lt., Chicago, Ill.
7COU, Semmes, RM2c, foreign duty
7GRA, Bryant, SKT3c, Brooklyn, N. Y.
8AAK, Barbour, SKT3c, Brooklyn, N. Y.
8JPD, Heeger, SAD3c, San Diego, Calif.
8NGF, Hales, SKT3c, Brooklyn, N. Y.
8PDP, Lewis, S1c, Muirkirk, Md.
8TKK, Speray, CRM, foreign duty
8TQZ, Novak, RM3c, foreign duty
8UEJ, Gormsen, Lt., Greenbelt, Md.
ex-9DGI, Ward, SKT3c, Brooklyn, N. Y.
9JSE, LaVanchy, SC3c, Farragut, Idaho
9KBH, Guilette, SKT3c, Brooklyn, N. Y.
9KCC, Hecker, S1c, New London, Conn.
9NHT, Sharp, Lt. (jg), foreign duty
9NOF, White, Ens., foreign duty
9SAB, Sullivan, Lt. (jg), Vallejo, Calif.
9TRC, Smith, CRM, Bremerton, Wash.
9VUQ, Hudek, Ens., Brunswick, Me.
9YRQ, Dennison, Ens., foreign duty
9ZKY, Kennedy, Lt. Comdr., Brooklyn, N. Y.

Operator's license only:

Bruce, SKT3c, Brooklyn, N. Y.
Connell, RM1c, foreign duty
Martin, A/S, Sampson, N. Y.
Paterchok, S1c, Sampson, N. Y.
Pearce, S1c, Sampson, N. Y.
Rendina, S2c, Farragut, Idaho
Spengler, RM2c, foreign duty
Washington, EM2c, Port Hueneme, Calif.

NAVY—AERONAUTICS

1NDA, Wondergem, Ens., Hutchinson, Kans.
5JFG, Bell, CRE, Atlantic City, N. J.
6AXM, Farrelle, Lt., foreign duty
6MIO, Wauchope, Lt. (jg), foreign duty
6NTW, Prell, Lt. (jg), Alameda, Calif.
6TQX, Bullock, Lt. (jg), foreign duty
9BAI, Raynes, ART1c, Shelton, Wash.

Operator's license only:

Fingerman, ARM2c, Norfolk, Va
Pierpont, ART2c, Banana River, Fla.
Randall, ART1c, Corpus Christi, Texas
Rye, ART2c, Jacksonville, Fla.
Snook, ARM2c, foreign duty
Warnes, ARM3c, Corpus Christi, Texas

A group of officers, all radio amateurs, stationed at the U. S. Naval Training School, Princeton, N. J., got together recently for an enjoyable evening shooting the breeze about the usual thing — and we don't mean girls! *Seated, l. to r.:* Ens. Goldberg, W9RTM; 1st Lt. Vietsch, U. S.A., W3IEB; Lt. Lewis, W1GP, Officer-in-Charge, Pre-Radar Unit; Lt. (jg.) Sawin, op license, instructor, and Lt. (jg.) Redman, W5IGL, instructor. *Standing:* Ens. Green, op license; Ens. Brolley, W9TNR; Ens. Lytle, W9WEO, and Ens. Shreve, W3ISE. The five ensigns are all student officers, Pre-Radar Unit.

ARMY—SIGNAL CORPS

ex-1IEP, Soroka, S/Sgt., Elmwood, Conn.
1LPY, Brown, T/5, Pawtucket, R. I.
2KCP, Ruska, Capt., foreign duty
2NEC, Findeis, Pfc., foreign duty
3HRU, Widenor, Pvt., Warrenton, Va.
3HXV, File, Pfc., Long Island City, N. Y.
4AUO, Smith, 2nd Lt., Arlington, Va.
4DXI, Griffin, Lt., foreign duty
4EZF, Charles, T/5, foreign duty
4GMK, Clegg, Pvt., Camp Crowder, Mo.
4GTK, Melton, T/4, Battle Creek, Mich.
5FIK, Ashley, 2nd Lt., Camp Crowder, Mo.
5GWT, Boone, T/Sgt., foreign duty
5HMJ, Gano, S/Sgt., foreign duty
5JUI, Bost, Cpl., foreign duty
6SCW, Wheelock, Lt., foreign duty
6SXF, Stanley, Sgt., foreign duty
7IOS, Babcock, T/5, foreign duty
ex-7MZ, Manning, M/Sgt., foreign duty
8AKA, Johns, Lt., foreign duty
ex-8DEW, Withington, T/Sgt., foreign duty
8LMS, Van Zoest, M/Sgt., foreign duty
8MVD, Finch, Cpl., foreign duty
ex-8QIV, Bryant, T/Sgt., foreign duty
8SLD, Kohl, Lt., foreign duty
8SYP, Chirozzi, T/Sgt., Newark, Del.
9AIA, Hachoogan, S/Sgt., Wood, Wis.
9APY, Way, T/Sgt., foreign duty
9BOK, Lueck, S/Sgt., foreign duty
9DEH, Ekman, T/4, Camp Crowder, Mo.
9NAL, Bixler, 2nd Lt., Camp Ritchie, Md.
9QXU, Pemberton, T/Sgt., foreign duty
9UBJ, Hamman, Capt., Arlington, Va.
9WBU, Glass, Sgt., Berkeley, Calif.
9YYR, Baecher, T/3, foreign duty
9ZCR, Vavra, Lt., Burbank, Calif.

Operator's license only:

Courtney, M/Sgt., foreign duty
Dent, Sgt., foreign duty
Jones, Sgt., Burlingame, Calif.
L'Esperance, Pvt., foreign duty
Maxey, T/4, foreign duty
Mouis, Sgt., foreign duty
Stevenson, Lt., foreign duty
Walker, Cpl., foreign duty

NAVY—SPECIAL DUTY

1DTY, Willey, RT2c, foreign duty
1LYV, Connell, RT1c, Taunton, Mass.
1NBA, Lanciani, RT3c, Shoemaker, Calif.
2GYQ, Felt, RT1c, Boston, Mass.
2NFU, Tritsch, RT1c, Long Island City, N. Y.
4DMZ, Pope, RT1c, Washington, D. C.
4GDS, Hubbard, RadM3c, Little Creek, Va.
6PIZ, Hardacker, CRT, foreign duty
6RFF, Hill, RT3c, Treasure Island, Calif.
6SZC, Elgin, RT2c, foreign duty
6TQT, Kochenderfer, RT1c, Treasure Island, Calif.
6UND, Styles, RT1c, San Leandro, Calif.
8IOZ, Breen, RT2c, Chicago, Ill.
8NYV, Keyser, S1c, Chicago, Ill.
8VHS, Gilley, RT1c, Dayton, Ohio
9CLB, Winslow, RT3c, Virginia Beach, Va.
9JUS, Janzow, RT2c, foreign duty
9RZS, Goff, S1c, Great Lakes, Ill.
9ZUM, Beach, RT3c, Treasure Island, Calif.

Operator's license only:

Fairbanks, RT1c, foreign duty
Kasten, S1c, Great Lakes, Ill.
Richter, S1c, Great Lakes, Ill.
Ross, CRT, foreign duty
Searle, RT2c, Little Creek, Va.

ARMY—GENERAL

1ELJ, Harlow, Pvt., Camp Ellis, Ill.
2BLD, Smythe, T/5, Aberdeen Proving Ground, Md.
2MMA, Bunce, Pvt., foreign duty
2MWO, Mavromatis, T/5, New York, N. Y.
ex-3EM, Bower, Pvt., Texarkana, Texas
3FWH, Armbruster, Pvt., Fort Bliss, Texas
5FGS, Penix, S/Sgt., Fort George G. Meade, Md.
5GQG, Armstrong, Sgt., Camp Mackall, N. C.
6BGS, Litchfield, Pfc., Van Nuys, Calif.
6JQA, Chesterton, T/Sgt., Venice, Calif.
7ELL, Thomas, Lt., foreign duty
7HUK, Hatanaka, T/5, foreign duty
ex-8GOG, Patterson, Lt., foreign duty
8NMA, Mowery, S/Sgt., Camp Croft, S. C.
8PYM, Keim, Pfc., foreign duty
8RAZ, Fulton, T/4, foreign duty
8ROG, Kott, Pfc., foreign duty
8TRZ, Nelson, T/Sgt., foreign duty

9FLF, Hilblink, Sgt., foreign duty
9MRF, Jackson, Pvt., Camp Crowder, Mo.
9OYJ, Field, T/4, Oak Ridge, Tenn.
9TYF, Gusicki, Pvt., Camp Wolters, Texas
9YXP, Elledge, Major, Danville, Ill.
9ZYV, Landis, Pvt., Hot Springs, Ark.

Operator's license only:

Kramer, T/4, New York, N. Y.
Larkin, Pvt., Camp Croft, S. C.
Swain, Pfc., Memphis, Tenn.
Turkal, Cpl., foreign duty

ARMY—AIR FORCES

2KUV, Champagne, M/Sgt., West Palm Beach, Fla.
2NFN, Anzer, Capt., Culver City, Calif.
3BKZ, Edwards, Capt., foreign duty
4EQH, Woodward, Capt., Cambridge, Mass.
5HXP, Oliver, Lt., foreign duty
5JBO, Gohmert, Pfc., Alcoa, Tenn.
5JKD, Schrader, S/Sgt., Hamilton Field, Calif.
6PNU, Haven, Lt., Williams Field, Ariz.
K6QMA, Gomes, Pfc., foreign duty
7EYB, Brown, Lt., foreign duty
8DPQ, Warnick, Capt., foreign duty
8PQU, Flora, Capt., foreign duty
8SLY, Kohl, Capt., Dayton, Ohio
8WGG, Ayers, T/Sgt., foreign duty
9RPM, Proetz, Cpl., foreign duty
9ZZY, Rowland, S/Sgt., foreign duty

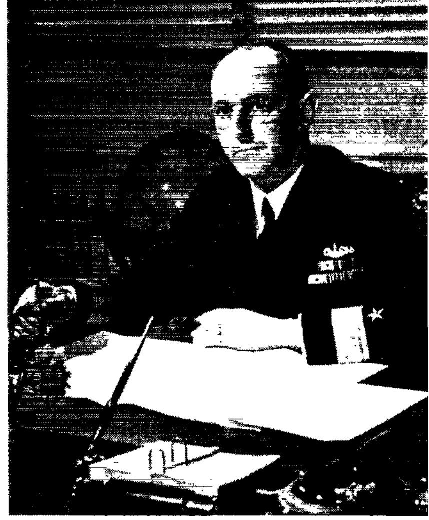
Operator's license only:

Baer, Cpl., Boca Raton Field, Fla.
Bancroft, M/Sgt., foreign duty
Bassett, Sgt., Anaconda, Mont.
Butts, Sgt., foreign duty
Chick, A/S, Eagle Pass, Texas
Cooper, Liberal, Kansas
Davis, S/Sgt., foreign duty
Emerson, S/Sgt., Boca Raton, Fla.
Hayes, 2nd Lt., Boca Raton Field, Fla.
Liebman, S/Sgt., foreign duty
Mann, Cpl., Scott Field, Ill.
Ozza, Pfc., Sioux Falls, S. D.
Patrick, 2nd Lt., Chanute Field, Ill.
Scotton, Sgt., Drew Field, Fla.
Scurlock, Lt., foreign duty
Siemens, Pfc., Scott Field, Ill.
Somerville, Pfc., Sheppard Field, Texas
Talbot, T/Sgt., Bedford, Mass.

MERCHANT MARINE AND MARITIME SERVICE

1KXL, MacDowell; 2FEO, Hutton; 2KXF, Earley; 2LPC, Green; 2MMB, Chestnut; 2NMS, Vogt; 3JIU, Schoch; 4FF, McKinney; 4IFC, DeFoe; 6QVN, Krulish; 6UDK, Stanton; 8KYJ, Gamble; 8USQ, Smurthwaite; 9EUN, Kron, and 9KTT, Sekela. Berg, Berger, Gainey, Goslin, Hoyth, Humphrey, James, Spinks and Velasco hold operator's license only.

Captain F. Boyd Couch, W8BDT, formerly a practicing physician in Springdale, Pa., is now on duty with a portable surgical hospital supporting the Chinese Expeditionary Force. His first foreign service was in India. In April, 1944, he was flown over the "Hump" to China and the Y-Force, and has been in combat area work much of the time since. *Official U. S. Army Signal Corps photo.*



Commodore J. V. Murphy, Deputy Director of Naval Communications, Washington, D. C., has held amateur licenses since 1925, operating in the past under the calls of KA1JM, W7AIW, W6MU and W3AIW. His present station call is W3FN. Many amateurs will remember him as being very active on 20-meter 'phone.

CIVIL SERVICE

ex-1CGW, Kelley, Bureau of Immigration, engineering aide, St. Albans, Vt.
1HQY, Bassett, ASF, chief inspector, Boston, Mass.
2ASL, Battersby, SC, associate radio engineer, Ft. Monmouth, N. J.
2BQN, Sussdorff, SC, radio engineer, Belmar, N.J.
2IYX, McCoy, SC, radio engineer, Philadelphia, Pa.
2KPC, Notbohm, FCC, radio inspector, New York, N. Y.
3AXU, Power, NDRC, laboratory technician, Trenton, N. J.
3BOL, Hackerty, CAA, chief radio electrician, Emmans, Pa.
3BXP, Corn, CAA, foreign duty
3CHX, Rosenberg, Navy Dept., radio technician, Washington, D. C.
3DOR, Lanzalotti, SC, electrical engineer, Eatontown, N. J.
3GVR, Zugermayer, Navy Dept., aircraft mechanic, Southampton, Pa.
3HZ, Dorsey, Coast and Geodetic Survey, Washington, D. C.
ex-3TS, Meighan, SC, Chicago, Ill.
4DYZ, Wheelock, CAA, aircraft communicator, Hialeah, Fla.
4EDA, Preddy, Navy Dept., Washington, D.C.
4HIZ, Moore, CAA, chief radio electrician, Pensacola, Fla.
4JU, Calhoun, AAF, radio engineer, Clermont, Fla.
4QK, Colley, Pensacola, Fla.
5DNB, Fehrenbach, AAF, aircraft instrument mechanic, foreign duty
5FBT, Whitely, SC, Schenectady, N. Y.
5IIK, Maguire, War Dept., Austin, Texas
5MD, Gaddis, SC, radio mechanic, Camp Shelby, Miss.
5ZG, Sherrod, War Dept., engineer, Galveston, Texas
6KSG, Thornburg, CAA, resident maintenance supervisor, Salt Lake City, Utah
6NCT, Wilson, Navy Dept., radio material officer, Santa Barbara, Calif.
6PH, Bardin, Dept. of Justice, Washington, D.C.
6TSM, Lewis, SC, radio technician, Seattle, Wash.
7BVH, Robertson, Army Engineers, Bonneville, Oregon
7BWC, Burris, CAA, chief radio electrician Everett, Wash.
7BXU, McGinley, FCC, Portland, Ore.
7CDC, Wallis, CAA, Seattle, Wash.

7EKX, Davis, CAA, aircraft communicator, foreign duty
K7FJJ, Bramhall, AAF, foreign duty
7GGE, Hasbrouck, Dept. of the Interior, electrical engineer, Portland, Ore.
7HKU, Cameron, radio technician, Portland, Ore.
8FQF, Dean, SC, radio engineer, Pontiac, Mich.
8HSH, McLeod, AAF, Sioux Falls, S. D.
8KXK, Foley, OSRD, engineer, Washington, D. C.
8NSE, Ross, Dept. of Commerce, chief radio technician, Washington, D. C.
8ORB, King, Dept. of Commerce, assistant radio technician, Washington, D. C.
8OUO, Francisco, SC, Ft. Wayne, Ind.
8QIQ, Blair, electrician, Baltimore, Md.
9EWF, Piotrowski, CAA, aircraft communicator, Casper, Wyo.
9IBR, Stanton, SC, supervisor, Philadelphia, Pa.
9LVK, Strope, Chicago, Ill.
9RJF, Robieson, CAA, aircraft communicator, Minneapolis, Minn.
9UAB, Simon, OWI, foreign duty
9VAW, Gerhardt, SC, engineer, Chicago, Ill.
9VHW, Maier, SC, radio operator, Chicago, Ill.
9VOA, Berton, SC, Newark, N. J.
9VRG, Malloy, Navy Dept., Norfolk, Va.
9VWY, Williams, SC, radio repairer, Redlands, Calif.
9WBR, Dunlevy, SC, assistant physicist, Dayton, Ohio
9WKF, Roderick, AAF, radio instructor, Scott Field, Ill.
9WPD, Rodiger, SC, Chicago, Ill.
9WRE, Hanson, AAF, radio mechanic, Liberal, Kans.
9WWV, Carl, Navy Dept., Hastings, Nebr.
9WXV, Nalley, AAF, radio instructor, Truax Field, Wis.
9WYA, Newell, CAA, foreign duty
9YLY, Walker, SC, Springfield, Ill.
9YOE, Valleau, CAA, foreign duty
9ZDZ, Hites, SC, Washington, D. C.
9ZGI, Kleason, SC, radio engineer, Wright Field, Ohio
9ZKW, Ludwick, SC, radio instructor, Bardstown, Ky.
9ZTR, Henry, CAA, foreign duty

Operator's license only:

Ballou, FCC, assistant radio engineer, Washington, D. C.
Bell, Navy Dept., inspector, Kansas City, Mo.
Bloss, FCC, Grand Island, Nebr.
Buckley, assistant chief aircraft communicator, foreign duty
Buell, SC, inspector, Ogallala, Nebr.
Comstock, AAF, instructor, Scott Field, Ill.
Curley, CAA, aircraft communicator, Waldin, N. Y.
Dearen, AAF, Scott Field, Ill.
Drummond, aircraft electrician, Boonville, N. Y.
Erickson, Navy Dept., engineer, Chicago, Ill.
Gerstner, AAF, instructor, Scott Field, Ill.
Hilmer, SC, radio engineer, Dayton, Ohio
Johnston, Navy Dept., electrician, Philadelphia, Pa.
Kauffman, SC, radio engineer, Belmar, N. J.
Kramer, AAF, radio mechanic, Layton, Utah
Kuberski, SC, aircraft technician, foreign duty
Lanzalotti, SC, Eatontown, N. J.
Lodge, SC, radio engineer, Compton, Calif.
Long, Post Office Dept., Dayton, Ohio
McCormick, SC, radio mechanic, Mobile, Ala.
McDermott, AAF, Scott Field, Ill.
McGee, AAF, radio instructor, Scott Field, Ill.
Moore, SC, inspector, Marion, Ind.
Paslay, SC, radio mechanic technician, Fort Worth, Texas
Peterson, AAF, Sioux Falls, S. D.
Portella, SC, inspector, Rochester, N. Y.
Renner, AAF, instructor, Sioux Falls, S. D.
Sabat, foreign duty
Scarborough, AAF, radio instructor, Sioux Falls, S. D.
Schwartz, Navy Dept., radio inspector, Philadelphia, Pa.
Smith, SC, Oakhurst, N. J.
Smith, Navy Dept., Washington, D. C.
Terry, CAA, aircraft communicator, St. Charles, Mo.
Trindle, AAF, foreign duty
Wehe, Army, radiotelephone operator, Oakland, Calif.
Wheeler, SC, technician, foreign duty

100% WAR WORK — INDUSTRY

Underwater Sound Lab., New London, Conn.

1CJN, Schaffhouser
1CLI, Grom
1DCM, Guadliana
1FNY, Dorsey
1FOZ, Skeels
1HNW, Holden
1HRN, Wood
ex-1HV, Sienkowski
1IOH, Speirs
1IOW, Rast
1KRB, Tucker
1KYW, Welles
1KZQ, Seidel
1LVI, Aldrich
1QV, Chapman
2FHR, Martin
2HO, Vollkommer
2HTF, Haefner
2JCR, Taylor
3AMD, Bougher
3EC, Carreras
ex-5EQV, Archer
ex-6ARE, Van Lennep
6HI, Bumbaugh
6IZU, Miller
6RCY, Lucas
6UBT, Espy
ex-8BEL, Rodger
ex-8BNC, Jacob
8CXM, Hudson
8IPU, Widlar
ex-8JM, Fox
8JUG, Farnett
8LNM, Gardner
8LOM, Bingham
8MAP, Griffin
8PEY, Smith
ex-9ARC, Hultgren
9AWL, Snyder
ex-9BCZ, Mode
9BNI, Whannel
9BNZ, Bush
9DBG, Hill
9DGP, Callen

The nucleus of a radio operator crew at one of our West Indian island outposts is shown in this photo. When not busy with AACS duties, they find time to convert some of the non-amateur operators to ham ways of thinking and doing. *Left to right:* Pfc. Dobkins, W5KKN; Sgt. Sinclair, W1HWY; S/Sgt. Elder, an ex-ham, and Pfc. Fichthorn, W1BGJ.

9SAG, Westneat
ex-9TCZ, Quest
9UZI, Nosker
9VQD, Baird
9WRA, Larsen
9DIT, Dunn
9HKY, Dunn
9IFM, Boyers
9JMR, Warren
9KEY, Bonvallet

The Hallicrafters Company, Chicago, Ill.

8TZO, Stuart
9AA, Read
9AGN, Garity
9ATA, Cook
9BRT, Wilbur
ex-9BVV, Mudra
9CUK, Conner
9IEV, Whitman
9JU, Frank
9LQL, Perasovich
9MJD, Mitterer
9MUB, Stankiewicz
9NHH, Voznak
9OKZ, Rensch
9OYU, Leonhardi
9PTD, Burandt
ex-9QKT, Mitchell
9RFX, Jenkins
9SRU, Malley
9TAL, Zornes
9TDF, Wiot
ex-9VAA, Livenick
9VWF, Mackie
9WBB, Schuble
9WNG, Hartley
9WZE, Halligan
ex-9YEO, Sauer

Operator's license only:
Kauma

Miscellaneous

1AAM, Spicer, elect. draftsman, Electric Boat Co.
1AHI, Holbrook, tester, Sylvania
ex-1AIF, Davis, radio installation & testing, Quincy, Mass.
1ANM, Mack, radio technician, Hytron Corp.
1AOK, Cowles, supervisor, Crystal Research Labs.
1ATX, Cook, engineer, Foxboro Co.
1BDV, Saunders, instructor, Whitinsville, Mass.
1BGY, Steiger, radio engineer, F. W. Sickles Co.
1BHD, Dunbrack, James Millen Manufacturing Co.
1BJN, Scofield, National Co.
1BLA, Grenier, Douglas Aircraft Corp.
1BNL, Kelley, radio technician, Crosley Corp.
1BUC, Wiley, Johns Hopkins University
1BWB, Hanscom, inspector, Saco-Lowell Shops
1BYF, Kilkelly, radio technician, Hytron Corp.
1CBG, Coe, NDRC, Silver Springs, Md.
1CJA, Keenan, Electric Boat Co.
1CJR, Howe, instructor, Worcester Polytechnic Institute
1DCC, Whitehead, transmitter operator, International Transmitters
1DPG, Walker, engineer, Sylvania
ex-1ELB, Mehaffey, radio technician, Hytron Corp.
1ENI, Smith, NDRC, Brooklyn, N. Y.
1EQC, Minter, engineer, Measurements Corp.
1FEC, Prowell, Aerovox Corp.
1FJP, Reynolds, instructor, Fleet Sound School
1GLP, McDonagh, Radio Test & Repair
1GMF, Cook, engineer, Goided Radio Co.
1HE, Battison, Test Lab.
ex-1HXD, Lajoie, radio mechanic, United Airlines
1HZW, Bonnette, Harvey-Wells Comm., Inc.
1IBR, Gray, radio electrician, Bath Iron Works
1IDC, Diamond, radio technician, Hytron Corp.
1IF, Maguire, engineer, Sylvania
1IHQ, Cohen, general manager, F. W. Sickles Co.
1IIN, Hayes, engineer, University of Calif.
1IJT, Bordeau, electronics research, Ill. Tool Works
1IXI, Sheehan, Bird Machine Co.
1IXO, Thomas, engineer, Airborne Instruments Lab.
1JCX, Cole, engineer, Kelvin & Wilfrid O. White Co.
1JPY, Skeffington, engineer, Sylvania
1JUN, Lautieri, electrician, Harris & Parsons
1JVE, Mackora, crystal grinder, Crystal Research Labs.
1JZB, Norman, NDRC, Middletown, Conn.
1KDX, Ferry, NDRC, Silver Springs, Md.
ex-1KHG, Sargalski, Silver City Crystal Co.
1KPZ, McSheehy, technician, Cambridge, Mass.
1KXB, Rondoe, foreman, United Cinephone Corp.
1KYD, Zakrzewski, National Radio Service
1KYH, Battin, engineer, New York, N. Y.
1KZH, Lalanne, Crystal Research Labs.
1LDD, Fernandes, engineer, Roxbury, Mass.

1LGF, Nelson, engineer, Simplex Wire & Cable Co.
1LGH, Kelley, superintendent, Schuck Mfg. Co.
1LGW, Vacca, inspector, Cinaudagraph Corp.
1LLV, Mitchell, physicist, Sun Oil Co.
1LUH, Leferson, engineer, Machlett Labs.
1LZV, McGregor, Dorchester, Mass.
1MEG, Hopper, Valpey Crystal Corp.
1MJD, Kelly, radio technician, Sprague Electric Co.
1MPL, Geer, instructor, Westfield, Mass.
1MSW, Crane, quarterman, Bethlehem Hingham Shipyard
1MYK, Fowlie, foreman, James Millen Mfg. Co.
1NFQ, Maxcy, supervisor, Foxboro Co.
1NJL, Griffith, radio engineer, E. F. Johnson Co.
1NNK, White, radio opr., Cruft Lab.
1NOF, Sanborn, tester, Electric Specialty Co.
1NQP, Sale, radio engineer, Airadio Inc.
1NRZ, Cunningham, radio technician, Gloucester, Mass.
1NVP, Black, Technical Apparatus Co.
1NVT, Muckel, Crystal Research Labs.
2ACA, Reynolds, foreman, Airadio Inc.
ex-2ADH, Peacox, Stromberg-Carlson
2AER, Hollywood, American British Lab.
ex-2AHY, Stanton, engineer, Allen B. Dumont Labs.
2AJL, Yellin, engineer, Pilot Radio Corp.
2ANR, Madlinger, tester, Pilot Radio Corp.
2AQJ, Grim, field engineer, Lepel High Frequency Labs.
2ASI, Freedman, instructor, Queens Vocational High School
2ATM, Temple, lab. technician, CBS Television Labs.
2BCF, Kirdahy, Brooklyn, N. Y.
2BEW, Peschel, engineer
2BFB, Whitaker, engineer, Hammarlund
2BR, Reiss, sales engineer, Birtcher Corp.
2BRB, Glaser, engineer, Square-D Co.
2BS, Felton, engineer, United Cinephone Corp.
2BTC, Mottl, radio supervisor, Mackay Radio Telegraph Co.
2BUR, Haviland, purchasing agent, Communications Measurements Lab.
2BUU, Forman, Brooklyn, New York
2BWN, Preston, electrical engineer, American Transformer Co.
2CFS, Sarapo, radio technician, Premier Crystal Labs.
2CN, Schwartz, field engineer, Eimac
2CRX, Prevet, foreman, Hamilton Radio Corp.
2DBQ, Nebel, R. E. Nebel Lab.
2DDB, Maron, radio engineer, Dobbs Ferry, N. Y.
ex-2DUQ, Quinones, MacKay Radio Co.
2DXG, Burns, radio mechanic, Hempstead, N. Y.
2EMV, Ackerman, engineer, Tung Sol Lamp Works
2ENY, Christaldi, engineer, Allen B. DuMont Labs.
2EUI, Hatler, radio specialist, Eastern Aircraft
2EVI, Bender, engineer, Wallace & Deknan Products Co.
2FAQ, Newman, installation man, MacKay Radio Co.
2FCT, Cicierska, engineer, Freed Radio Corp.
2FHP, McEntee, engineer, Finch Telecommunications
2FID, Treadwell, lab. assistant, Hammarlund
ex-2FNZ, Magid, engineer, United Cinephone Corp.
2FPD, Malakoff, Wheeler Ship Building Co.
2FTX, Smith, Hazeltine
2FXE, Tucker, radio engineer, General Instrument Corp.
2FXM, Reyling, Mineola, N. Y.
2GDG, Babkes, Hudson American Corp.
2GL, Klesse, design engineer, Fairchild Camera & Instruments Corp.
2GRB, Palmer, Hudson American Corp.
2GVX, Caldicott, New York, N. Y.
2HAA, Tatrault, lab. technician, Clarostat
2HAN, Baker, Pilot Radio Corp.
2HAY, Ottway, test engineer, Fada
2HFP, Gerlach, Eastern Aircraft Co.
2HGB, Jennings, manager, Emerson Radio & Phonograph Corp.
2HII, Dailey, N. Y. State Communication School
2HJM, Soehl, Hazeltine
2HNS, Polhemus, engineer, Washington, D. C.

It was a radioman's get-together in Los Angeles when Ensign Fred Shilzony, W6OUV, married Miss Margaret Patt, both of whom were former employees of RCA Communications. Pictured at the event are, *left to right:* M. O. Smith, W6HSC; RM3c Holmes, W6KBF; the groom, W6OUV; Pfc. Renfro, AAF radio technician, and M. Schaefer, W6PRK. The photograph was taken by Pvt. Taylor, SC, W5JYQ, then stationed in Hollywood.

2HNX, Van Velsor, electrical tester, Allen B. Du Mont Labs.
2HOH, Goldberger, engineer, Precision Apparatus Co.
2HQZ, Loewy, engineer, Communications Measurements Lab.
2HZW, Lindner, radio engineer, Tropical Radio & Telegraph
2IGW, Schmitt, electrician, Couse Labs.
2INS, Hoffmann, field service engineer, Hazeltine
2IZO, Hesse, Division of War Research
2JAD, Kantner, Division of War Research
2JJM, Montress, Weston Electrical Instrument Corp.
2JUC, Schroeder, Palisades Park, N. J.
2JUO, Schubert, engineer, Allen B. Du Mont Labs.
2JUX, Zimet, engineer, Freed Radio Corp.
2JVO, Maley, draftsman, Electronic Instrument Design
2JZ, West, field engineer, C. P. Clare & Co.
2KHV, Retzkin, wireman, Espey Radio Mfg. Co.
2KOH, Aldea, inspector, MacKay Radio Co.
2KR, Kahn, president, Equipment Mfg. Co.
2KVW, Madden, radio technician, Grumman Aircraft
2LCA, Oberle, ARPN Mfg. Co.
2LCC, Litt, Superior Instruments Co.
2LGC, King, tester, Hazeltine
2LJF, O'Brien, lab. technician, Fairchild Camera & Instrument Corp.
2LKC, Di Blasi, sales engineer, Cooper-Di Blasi
2LKW, Sanford, assistant manager, Isolantite, Inc.
2MCI, Murcott, supervisor, Amperex
2MDL, Berenbaum, Radio & Underwater Sound Section, New York Navy Yard
2MID, Gargani, electrician, Federal Shipbuilding & Drydock Co.
2MIV, Laemmel, Polytechnic Institute
2MKD, Bedoian, engineer, Hammarlund
2MKR, Booth, engineer, Wright Aero Corp.

HAM HOSPITALITY

FROM England, three hospitable British amateurs have written us they would be glad to welcome hams from overseas who have the time and opportunity to get in touch with them.

Ernest Banks, G2CNC, 59 Holme Rd., Hatfield, Hertfordshire, assures any amateur of a pleasant rag-chew and a probable visit to the Stone House Hotel for refreshments.

Cecil H. L. Andrew, G2HF, 9 Fore St., Wellington, Somerset, has devised a novel way of attracting passing hams by placing a number of prewar QSL cards in his shop window with an invitation to drop in. Recently a Navy man came in with the remark, "Say, you have my QSL card in the window: I'm W1JFG, Willard Cook of Woonsocket, R. I." Quite a coincidence.

J. C. Martin, G6MC, Holyoak Ave., Bingley, Yorkshire, writes he would be glad to welcome any W or VE ham to his shack. He has worked some 1500 of them since 1926, many during the 1937–1938 DX Contests, and he looks forward to meeting some of his former QSOs.

Several French amateurs have advised of chance meetings with amateurs in the Allied forces now on the continent and we have a definite request from Jean Hébré, F8WL, 13 Route de Port Bessin, Bayeux, Calvados, France, that his name be included in this column. He says any amateurs will always be welcome in his home.

Hyperbolic Functions

Their Notations and Meanings

BY CAPT. WILLIAM H. MINOR, SC,* W9DSN

Hyperbolic functions often are employed in the design of long lines and wave filters. In this article W9DSN discusses the development of these functions, drawing a parallel between the relationship of these functions to the equilateral hyperbola and that of the trigonometric functions to the circle.

It becomes necessary to involve such expressions as *hyperbolic sine, hyperbolic cosine* and *hyperbolic tangent* in the mathematical discussion of many physical phenomena. For those who are interested in radio this is particularly true in the development and understanding of equations for long lines and wave filters. Much may be lost to the readers of articles about these useful equations if there has been a failure to become acquainted with these functions, their notations and meanings.

Generally speaking, the average knowledge of hyperbolic trigonometry consists of a definition of the function and no understanding of its origin. It is not too difficult.

The hyperbolic functions are related to the unit equilateral hyperbola in the same manner as the trigonometric functions are related to the unit circle. It is true that *sinh, cosh,* and *tanh* may be defined, then used as they occur, but better handling may result if the operator has a more complete picture.

The derivation of the correlation between the trignometric function and its equivalent hyperbolic function depends upon the solutions to linear differential equations of the first order. These equations are parallel in their developments but differ in solution because of a difference in sign between the equations representing the circle and hyperbola. A quick examination of the equations will show this difference,

$$x^2 + y^2 = 1 \text{ (unit circle)} \tag{1}$$

$$x^2 - y^2 = 1 \text{ (unit hyperbola)} \tag{2}$$

Our final results will contain a function ϵ. This natural function comes to light in calculus when $(1 + t)^{\frac{1}{t}}$ must be evaluated. The limit of $(1 + t)^{\frac{1}{t}}$ as t approaches 0 is equal to 2.71828 and is designated as ϵ or, in mathematical notation,

$$\lim_{t \to 0} (1 + t)^{\frac{1}{t}} = 2.71828 = \epsilon \tag{3}$$

The term ϵ is used as a base for the natural system of logarithms since it aids in the ease of handling the operations of differentiation and integration of transcendental equations.

*Chief Radio Maintenance, Atlantic Overseas Air Technical Service Command, Port of Newark, 5, Newark, N. J.

Upon referring to Fig. 1 we may recall from calculus an expression for the increment in area as dA.

$$dA = \tfrac{1}{2} r^2 d\Theta \tag{4}$$

In rectangular coördinates,

$$r^2 = x^2 + y^2 \tag{5}$$

$$\Theta = \tan^{-1}\frac{y}{x} \tag{6}$$

To find $d\Theta$, differentiate Θ.

$$d\Theta = d\tan^{-1}\frac{y}{x} = \frac{xdy - ydx}{x^2 + y^2} \tag{7}$$

Substituting values from (7) and (5) in (4)

$$da = \tfrac{1}{2}(xdy - ydx) \tag{8}$$

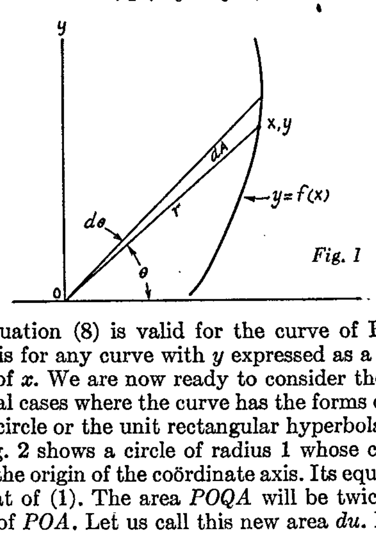


Fig. 1

Equation (8) is valid for the curve of Fig. 1 as it is for any curve with y expressed as a function of x. We are now ready to consider the two special cases where the curve has the forms of the unit circle or the unit rectangular hyperbola.

Fig. 2 shows a circle of radius 1 whose center is at the origin of the coördinate axis. Its equation is that of (1). The area *POQA* will be twice the area of *POA*. Let us call this new area *du*. From equation (8),

$$du = xdy - ydx. \tag{9}$$

Solving Eq. (1),

$$y = \sqrt{1 - x^2} \tag{10}$$

Substituting this value of y in Eq. (9),

$$du = xd\sqrt{1 - x^2} - \sqrt{1 - x^2}\,dx \tag{11}$$

Equation (11) is a differential equation of the first order with a simple solution.

$$du = (x)\left(\frac{-2x\,dx}{2\sqrt{1 - x^2}}\right) - \sqrt{1 - x^2}\,dx \tag{11–1}$$

$$= \left(\frac{-x^2}{\sqrt{1 - x^2}} - \sqrt{1 - x^2}\right) dx \tag{11–2}$$

$$= \frac{-dx}{\sqrt{1 - x^2}} \tag{11–3}$$

Integrating both sides of the equation,

$$u = \int_1^x \frac{-dx}{\sqrt{1-x^2}} = \cos^{-1} x \qquad (11\text{–}4)$$

or, solving for x in terms of u

$$x = \cos u. \qquad (12)$$

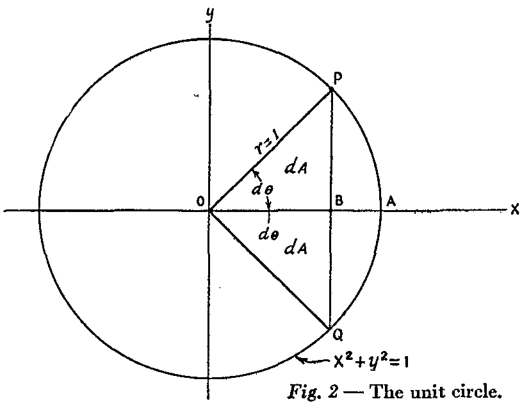


Fig. 2 — The unit circle.

Fig. 3 gives a unit rectangular hyperbola, its axis lying on the x axis and its vertex at the point (1, 0). Again the area $POQA$ will be twice the area POA. The area $POQA$ will be designated as du. From equation (8),

$$du = xdy - ydx \qquad (13)$$

Solving (2),

$$y = \sqrt{x^2 - 1} \qquad (14)$$

Substituting (13) in (14),

$$du = x\, d\sqrt{x^2-1} - \sqrt{x^2-1}\, dx \qquad (15)$$

Compare Equations (11) and (15).

Prepare 15 for solution:

$$du = \left(\frac{x^2}{\sqrt{x^2-1}} - \sqrt{x^2-1}\right) dx \qquad (15\text{–}1)$$

$$= \frac{dx}{\sqrt{x^2-1}} \qquad (15\text{–}2)$$

Integrating,

$$u = \int_1^x \frac{dx}{\sqrt{x^2-1}} = 1n\,(x + \sqrt{x^2-1} \qquad (15\text{–}3)$$

Changing from a logarithmic to an exponential expression,

$$\epsilon^u = x + \sqrt{x^2-1} \qquad (15\text{–}4)$$

Squaring both sides,

$$\epsilon^{2u} = 2x\,(x + \sqrt{x^2-1}) - 1 \qquad (15\text{–}5)$$

Since $\epsilon^u = x + \sqrt{x^2-1}$,

$$\epsilon^{2u} = 2x\,\epsilon^u - 1. \qquad (15\text{–}6)$$

Solving for x in terms of u,

$$x = \frac{\epsilon^u + \epsilon^{-u}}{2} \qquad (16)$$

Now compare equations (12) and (16). In our operations using the unit circle, the results brought us to the familiar cosine. The operations with the unit hyperbola were step for step the same as with the circle and our results are shown in Equation (16), which must bear the same relation to the hyperbola as (12) does to the circle. We can then define.

$$x = \frac{\epsilon^u + \epsilon^{-u}}{2} = \text{hyperbolic cosine} = \cosh u \qquad (17)$$

Had Equations (1) and (2) been solved for x instead of y, and the solutions been substituted in (9), our solutions would have brought us to the sin and sinh in the same manner.

Equation (12) would have become

$$y = \sin u, \text{ and} \qquad (18)$$

Equation (16)

$$y = \frac{\epsilon^u - \epsilon^{-u}}{2} = \sinh u, \qquad (19)$$

From trigonometry we have the relation

$$\tan u = \frac{\sin u}{\cos u} \qquad (20)$$

The same relation may be carried into hyperbolic functions and

$$\tanh u = \frac{\sinh u}{\cosh u} = \frac{\epsilon^u - \epsilon^{-u}}{\epsilon^u + \epsilon^{-u}} \qquad (21)$$

One fact may be confusing at first. Ordinarily the sine and cosine are thought of as the ratio of two sides of a triangle while in these developments the sine and cosine have been expressed as areas. The ratio of two sides is a pure number, so it makes little difference whether the number represents the length of a line, an area or, for that matter, apples.

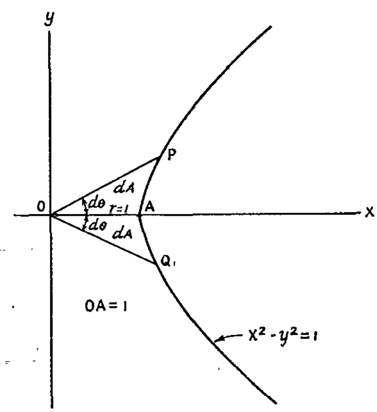


Fig. 3 — The unit equilateral hyperbola.

The values of the hyperbolic functions may be taken from tables or slide rule. In the event neither is available, the values may be computed by means of the following infinite series:

$$\cosh u = 1 + \frac{u^2}{2!} + \frac{u^4}{4!} + \frac{u^6}{6!} + \ldots \qquad (22)$$

$$\sinh u = 1 + \frac{u^3}{3!} + \frac{u^5}{5!} + \frac{u^7}{7!} + \ldots \qquad (23)$$

$$\epsilon^u = 1 \pm u + \frac{u^2}{2!} + \frac{u^3}{3!} + \frac{u^4}{4!} + \ldots \qquad (24)$$

Captured Enemy Radio Equipment

Interesting Gear Picked up by Hams in Action

GERMAN and Japanese signal equipment which falls into American hands is hastening the defeat of our enemies in more ways than one. Carefully studied and analyzed by the U.S. Army Signal Corps, it plays an important role in the eventual destruction of the hostile armies that developed it.

Four vital uses are made of this captured equipment:

1) It gives direct aid in developing counter tactics to make enemy signal devices less useful and effective.

2) Any valuable ideas or devices worked out by the enemy are incorporated in American equipment.

3) American signalmen are trained in the use of enemy radio sets and other communications items.

4) Intelligence officers are enabled to assess the economic state of an enemy country by checking for inferior materials found in the equipment.

These advantages are not left to chance or to the varying technical capacity of different men. Not only captured signal equipment but all possible information relating to it is forwarded to the Camp Coles Captured Equipment Section of the Signal Corps Ground Signal Agency at Bradley Beach, and to the branches at Camp Evans and Fort Monmouth, where it is minutely studied, analyzed and correlated. The results are made known to appropriate channels so that signalmen in the field are well versed in the specialties and peculiarities of enemy devices. They are able to repair, operate and maintain them for their own use.

Teams specially trained to further this knowledge follow the troops into combat and apply their training to the practical work of testing and repairing and to the no less vital task of teaching other men to operate the equipment that is captured.

In general it has been found that captured radio sets and other instruments of German manufacture reveal considerable originality of design. Those of Japanese manufacture are curious mixtures of German, American and British designs and often are of a type which our Army would consider obsolete.

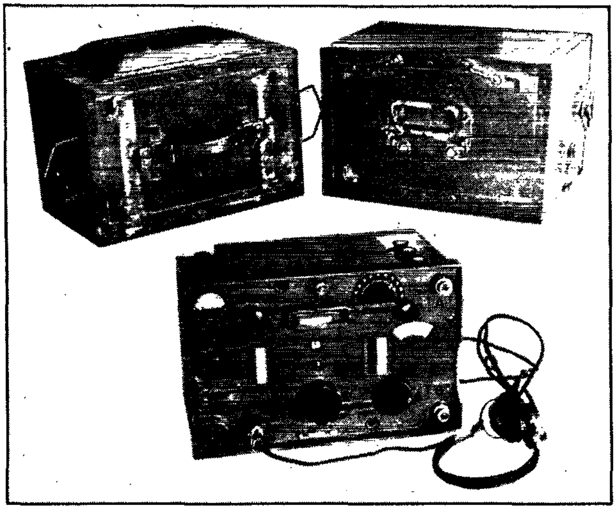
German Receiver

The compact unit shown in the photographs is a German mobile receiver. It was picked up by W9UIN on the second day of the invasion of France and later forwarded to Hq. for inclusion in ARRL's museum of captured enemy equipment.

While there is nothing exceptional about the circuit, the Nazis have done their usual excellent piece of mechanical design. The receiver is a simple t.r.f. job with two tuned amplifier stages, a regenerative detector and a single stage of audio. Probably the point of greatest interest, so far as the circuit is concerned, is that it is designed around a single tube type — a 2-volt battery pentode. This practice is followed quite often in German equipment. While it seems probable that the performance may suffer to a certain extent because of this practice, it is undoubtedly adequate for the purpose for which the set was designed and the replacement problem is simplified appreciably.

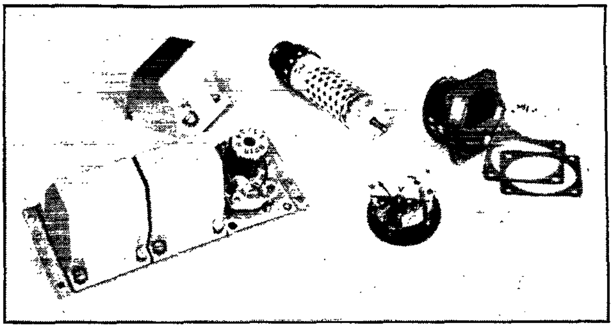
A frequency range of 96 to 7100 kc. is covered in eight overlapping bands selected by means of a coil-turret arrangement. The receiver operates from a storage battery and vibrator supply, each contained in a separate unit.

The mechanical design is one from which amateurs might glean some constructional ideas. For one thing, it gets away from the chassis-panel idea, which was pretty well standardized in prewar ham construction, and makes almost 100 per cent use of the space inside the cabinet which measures 8 × 8 × 12 inches. The construction essentially is a collection of discrete units any one of



A captured German mobile receiver with battery compartment and vibrator supply. The large knob in the lower center of the receiver is for turning the coil turret. The calibration charts showing through the windows at either side are changed simultaneously. The crank-type dial to the right is the tuning control while the knob and scale above are for the regeneration control.

which may be replaced quickly without disturbing the others, by removing a few screws and unsoldering a minimum of easily accessible connections. One section is made up of the variable-condenser-gang and another of the r.f. tubes with associated resistors, chokes and by-pass condensers. The coil turret is a separate unit, while the last unit contains the audio stage.



One of the individually-shielded coil units removed from the turret is shown at the left, a tube with its control-grid pin in front is at the center, and a captured miniature meter is at the right.

The tubes are quite unconventional from a Yankee point of view. The elements are contained in a glass envelope which, in turn, is enclosed in a perforated metal shield. The control-grid connection is brought out to a heavy pin terminal set in a ceramic button at one end, while all other connections are made to short radial pins set in a bakelite base fitted with a handle for easy removal. These radial pins make contact with spring prongs in a ring-shaped socket *through* which the tube plugs in in an inverted position. A permanently mounted jack takes the grid terminal as the tube is plugged in. Therefore there is no loose dangling grid-clip lead.

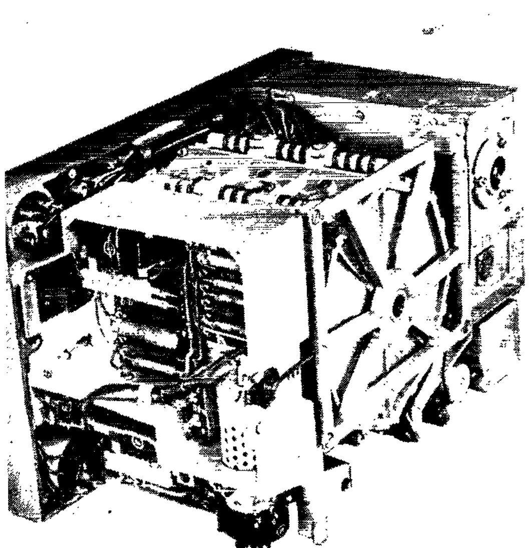
The coil turret is a well-designed and constructed unit which operates smoothly and positively. It is in the form of an octagonal-shaped barrel. Each set of three r.f. coils with their tracking trimmer condensers are arranged as a wedge-shaped unit to fit the barrel. Each of the coils in each set is shielded individually as shown in the detailed photograph. Each coil unit carries its own set of ring-shaped contacts mounted along a ceramic insulating rod. These connect the desired set of coils in circuit through a set of wiping spring contacts which lead directly to the tubes and three-gang tuning condenser. The shaft of the turret carries a dial which labels the band in use and provides also a frequency calibration for every five degrees of the tuning dial.

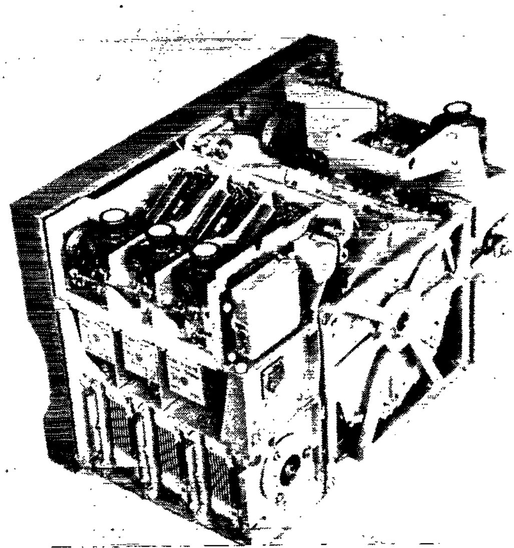
The supporting framework and shielding compartments of all units are die cast from magnesium alloy — a process which would be very costly in this country. The alloy, a necessary substitute for aluminum since the latter has become scarce in Germany, is light in weight and strong mechanically, but we are told that it has a tendency to disintegrate when exposed to salt-water atmosphere.

To facilitate servicing by inexpert personnel, all components of this set not only are stamped with a number corresponding to labeling in the circuit diagram, but every terminal and wiring anchorage is numbered as well. A wire which may be used to connect several widely-scattered components is not only color coded but a number is stamped on the chassis at every point at which that wire makes a connection. Thus, for example, if a connection is labelled No. 26, it will be found that all other points in the set labelled No. 26 are connected together. This makes it unnecessary to follow wiring which may disappear into cavities where tracing otherwise would be difficult. In this, as in many other respects, it is obvious that one of the main objectives in the design of this equipment is the reduction of in-the-field servicing problems to a minimum, even at considerable expenditure of time and labor at the production source.

(Continued on page 90)

Left — The audio end of the receiver. Here the set is inverted showing the turret contactors which connect the coils in circuit. *Right* — The tuning gang in the foreground, the r.f. tubes with their associated resistors, by-passes, etc., the coil turret at the center and the audio section at the far end are individual units which may be replaced without disturbing the others.





A Simple Automatic Relaying System for WERS

One Method of Overcoming Unfavorable Terrain

BY NEAL H. McCOY,* W1FMN

With reasonable physical separation of antennas and a sufficient difference in frequency, it is possible to operate both transmitter and receiver simultaneously in WERS operation. Such an arrangement has been successfully applied to the automatic relaying of messages in the WKKW net at Northampton, Mass., as described in this article.

In setting up the WKKW net in Hampshire County, Mass., some problems arose from the fact that certain individual units were unable to contact others because of the presence of intervening hills. This is, no doubt, a very general problem. Quite likely it has usually been solved by placing the net-control station in a favorable location, the control station then relaying the messages from one station to another. This was the arrangement originally contemplated in the WKKW system, and the control station accordingly was set up at about the highest point in the city of Northampton. From this point all stations of the WKKW net could readily be worked by the control, and the problem of getting messages from one station to another was solved effectively and permanently.

However, when practice message handling was the order of the day it became obvious that too much time was wasted in taking an incoming message and then repeating it so that the operator to whom it was addressed could copy it as sent out from the net-control station. This suggested the desirability of a relaying system which would obviate the necessity for repeating the message — which meant, of course, some kind of automatic relaying system. Subsequent experiments disclosed a way to achieve the desired result by the use of an exceedingly simple method requiring a minimum of extra equipment.

* 53 Ridgewood Terrace, Northampton, Mass.

The operating position at WKKW-2, Northampton, Mass. The relay receiver is on the small table to the left, while the TR-4 into which it feeds may be seen at the extreme right.

The rig at the net-control station is a TR-4, and there also is available at the station an extra receiver for monitoring purposes. This is a simple four-tube superheterodyne receiver, essentially as described by Grammer[1] in *QST*, with the exception that only one stage of audio (a 6F6) is used since the receiver originally was planned for headphone operation only.

In the diagram shown in Fig. 1, J is the 'phone jack on the receiver and it will be noted that the d.c. plate voltage is isolated from the 'phones by the condenser C_1. The terminals A and B go to the 'phones or, as was the case during our experiments, to an external second audio stage and speaker. The transformer, T, is a double-button microphone transformer with the high-impedance secondary connected across AB. Naturally, a single-button transformer would do just as well, but the double-button one happened to be available. The low-impedance winding is simply connected to a microphone plug, P_2, with a condenser, C_2, of 2 to 4 μfd. in series. In operation, P_2 merely is plugged into the TR-4 in place of the usual microphone. Obviously, C_2 is included in the circuit to prevent short-circuiting the microphone battery used in the TR-4 hook-up.

The arrangement of apparatus at WKKW-2, the net control station, is shown in the photograph. The auxiliary superheterodyne receiver is at the left and the TR-4 at the extreme right-hand end of the operating table. A distance of about ten feet separates the two units which are connected together with a transmission line of ordinary twisted-pair conductor. At the center is the frequency-measuring equipment consisting

[1] Grammer, "More Selectivity in WERS Reception," *QST*, September, 1943, p. 17.

of a 100-kc. oscillator with a multivibrator and frequency-meter-monitor with a stabilized 14-Mc. oscillator whose eighth harmonic just covers the range of 112 to 116 Mc. Winslow Copeland, W1NGH, deserves much credit for this frequency-measuring equipment.

Operating Procedure

The procedure is simplicity itself. The operator who wishes to have a message relayed to another is asked to shift his transmitter to a prearranged frequency, and transmit the message. This is tuned in on the superhet receiver at the control station and a part of the output is fed directly into the TR-4 by plugging P_2 into the microphone jack. The signal therefore also is automatically transmitted from the net-control station and picked up by the operator or operators to whom it is addressed.

Obviously, separate antennas are required for the receiver and the transmitter at the relaying point. In our case, both are of the extended double-Zepp type. The permanent antenna is used for transmission and a portable unit is available for use with the receiver. Since the permanent antenna is approximately one hundred feet away from the operating position, this assures a

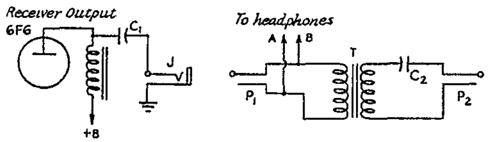


***Fig. 1* — Diagram showing the connections between the auxiliary-receiver output circuit and the TR-4 microphone input circuit. The plug, P_2, goes to the TR-4 mike jack.**

C_1 — 0.01 to 0.1 μfd.
C_2 — 2 to 4 μfd.
J — Open-circuit headphone jack.
P_1, P_2 — Microphone plug.
T — Single- or double-button carbon microphone transformer.

good physical separation of the two antennas and thus minimizes interference. The transmitting antenna is about sixty feet higher than the one used for receiving. No experiments were conducted to determine how much the receiver and transmitter must differ in frequency but, in our case, the receiver is operated at 112.7 Mc. and the transmitter at 114.6 Mc. without appreciable interference.

In addition to the relaying of messages as indicated above, two operators who wish to communicate with each other but who cannot make contact directly may set their transmitters at 112.7 Mc. and their receivers at 114.6 Mc. and carry on two-way communication in a perfectly normal way. However, instead of actually hearing the signal from the station being worked, each operator actually hears the signal as relayed from the net-control location.

Numerous refinements will readily suggest themselves. For example, it might sometimes be desirable to incorporate some means of adjusting the output level available at P_2. However, in our case, it happened that this level was suitable for modulating the TR-4 when the signal in the loudspeaker was at normal volume. It would probably also add to the convenience of operation if a d.p.d.t. switch were connected so that a simple throw of the switch would shift from the microphone to the input from the receiver.

It is to be hoped that others will experiment with this and other simple means of relaying, since it is an interesting field of experimentation and one which offers a good return in the way of improved WERS operation. It suggests, also, interesting possibilities for postwar amateur activities at the high frequencies.

A number of the WKKW operators have helped materially in conducting the tests. In particular, Radio Aide Walter I. Barrows, W1MLU, and David M. Howland were of great assistance.

Missing in Action

W9CRK, Sgt. James R. Wolff of Milwaukee, Wis., who was stationed with a bomber group in Italy, has been reported missing in action.

Silent Keys

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

W1NKV, Henry Fritsch, Clinton, Mass.
W2FJ, Francis Beard, Cold Spring, N. Y.
W2SJ, Raymond Strong, Schenectady, N. Y.
W3FRY, James W. Hodgman, Merion Station, Pa.
W3GEF, S/Sgt. Henry B. Hill, Bernardsville, N. J.
W4HY, Edward M. Winter, Jacksonville, Fla.
W5MS, Leonard Nelson, Corpus Christi, Texas
W8RQT, Robert C. Runyon, Shortsville, N. Y.
W9FPT, Lt. Robert H. Fisher, Foley, Mo.
W9ZUX, Elmer L. Schultz, RM1c, Milwaukee, Wis.

Strays

Sir Ambrose Fleming, distinguished English electrical physicist, engineer and inventor, and a pioneer in the field of radio, died April 19th at the age of 95. Sir Ambrose was the inventor of the widely known and used "Fleming valve," one of the ancestors of the now great and complex family of vacuum tubes. Among his other contributions to radio and electrical engineering were his numberless writings on electromagnetic wave phenomena.

His Last Strike

Just before we pushed over into the dive Joe pressed his face against the window of his plane, looked at the target, then over at me, grinning like a Cheshire cat.

BY JEAN HUDSON,* W3BAK

Everyone in the squadron loved Joe. . . . No one ever had a worry in the world when he was on the job, for we all knew that Joe was the best radio man in the outfit. . . .

THUS in tribute wrote a friend and fellow crewman of Lt. Joseph Hyland, USNR, W2ITR, who was killed in action January 12, 1945, on a bombing raid on Japanese shipping in the Pacific.

It was a tribute to Joe as the person who had won the affection of all the crew aboard his aircraft carrier — from the skipper down to the plane wipers. But more especially it was a tribute to Joe as the highly skilled technician whose task was to train his squadron's radiomen in the techniques of radar to guide the carrier's planes to their targets and bring them safely home again. It was work he undertook with enthusiasm and which he performed far beyond the demands of duty — becoming himself a combat air-crewman and participating in many raids against the Japanese.

Joe's skill in performing his highly specialized work — for which he was recommended for two decorations — had its birth many years before the war-spurred development of radar. It began, in fact, back in 1933 when, as a youngster of twelve, Joe walked into the FCC office in the Federal Building in New York City accompanied by a man who might have been his father.

*530 E. 90th St., New York 28, N. Y.

The room was already well filled with prospective hams, waiting for a chance to prove their ability to copy ten words a minute (at that time the 13 w.p.m. requirement was not yet in effect). Joe looked about him with interest. His was such a good-natured grin that the examiner — who wasn't always so good-natured — spoke to him.

"Sonny," he said, "why don't you sit down over by the window and root for your Dad? He may need all the good luck you can bring him."

Joe's eyes half closed and a grin spread over his little Irish face. He threw back his head and laughed so loudly and with such evident relish that everyone in the room turned to look and grin in sympathy. The man at the code machine wasn't aware that he had said anything particularly witty. Concluding that he was being taken for a ride, he snapped, "What's so funny, young man?"

"Well," said Joe, "first of all, he's not my Dad and, second, I'll need more luck than he does — because I'm going to take the test, too."

Joe was still laughing when he took his place at the desk with his pencil and headphones — the youngest contestant in the examining room and one of the youngest in the city of New York ever to try for an amateur license.

Oh, yes, he passed all right — got by on theory, too — and some six weeks later received his ticket while at Camp Marquette, where he was spending his fourth successive summer vacation. The man who had been mistaken for Joe's father — W2ISO — received his license, too. Together, as assistant director and camper, they set out to rig up a station at the camp.

Shortly afterward Joe organized a radio club among the boys and a club station was licensed with the call letters W1JKG — letters which inspired Joe to add to his CQs the interpretive words, "WI *J*oe *K*isses *G*irls." (Marquette is a boys' camp!) The radio shack became one of the principal gathering points of the camp. The club flourished, and Joe conducted code and theory classes for all the members.

But the long sunny hours of camp called the boys to the baseball field — to tennis, basketball, swimming, hiking, and canoeing — and Joe dearly loved athletics. He did everything with all his heart. He studied hard, played hard, and, when he had to, he fought hard. Though he never picked a quarrel, he never ran away from one. He abhorred a bully, and was always ready to champion those who could not defend themselves. Joe could use his fists with the best, too! But mostly he was happy, cheerful, laughing — forever getting a great kick out of his young world.

And so, too, on rainy days and in the evenings, Joe put his whole heart into amateur radio. As a result his love for and interest in the hobby grew steadily, and an endless string of QSOs were chalked up on the station log.

He progressed from camper to councillor at Marquette and earned an enviable record for reliability, judgment and character in a profession where those qualities are most in demand. A natural born leader, he was always popular with the boys and his never-failing good humor kept everyone in high spirits.

At home in the winter Joe operated his own station, W2ITR, and starred in math and science at Loyola until he entered Columbia Engineering School, bent on mastering communications. The college years went by and Joe received first his B.S. and then his M.S. in engineering. From several positions offered him during his senior year at Columbia he elected to become one of the staff engineers at Hazeltine Corporation, where he was employed for about a year before enlisting in the Navy early in 1943.

Joe was sent to Notre Dame for preliminary training and then to Harvard for additional schooling in radio work. Before leaving he took a competitive examination, as a result of which he and eight others were selected to do advanced electronics work at the Massachusetts Institute of Technology. He succeeded so well that he was chosen to become an instructor in the Navy's new school in Gainesville, Ga., where he remained for several months. In February, 1944, he was sent to the Pacific where, after further training, he was assigned as a radar instructor on an Essex class carrier in Torpedo Squadron 11.

"When Joe came to us," recently said Lt. Lew Richfield, Joe's best friend aboard the carrier, "I guess we were a little prejudiced. We'd heard about radar all right, but we didn't take much stock in it. Besides, fliers are sort of clannish and, though we always get along with all the boys, the non-flying officers just don't seem to belong. I suppose it's because our job is so very different from theirs.

"But, as I said, we didn't take to radar at first and maybe, also, Joe seemed pretty young for the big job he had. His work in the squadron was to train our radiomen in the different and newest techniques of radar — and, boy, that's just what he did a lot of. It didn't take him long to convince us, and you can forget that crack about the fliers hanging a bit to themselves, at least where Joe was concerned. He was as much one of our crowd as any of us.

"Everyone in the squadron loved Joe, from the skipper on down to the plane wipers. He was a wonderful guy at a party, always ready and willing and able to laugh and to make others laugh. His Irish stories gained him the nickname of 'Shamus O'Toole' and the name stuck right up to that last fatal day.

"I remember one occasion when we'd all had a pretty bad time of it. We'd lost the skipper and we were all crowded about the ready-room in a blue funk, not even bothering to take off our flying clothes. No one spoke a word and when Joe walked in we must have presented a pretty weird picture. He apparently thought so, for he roared with laughter and turned on that Irish brogue of his. The tension lifted immediately and we were soon on an even keel again. No one but Joe could have done it. We'd have resented any funny cracks from anyone else at that time, but from Joe it was different. You see, we knew that he wasn't feeling a damn bit better than we were, only he knew it wasn't doing anyone any good to

Lt. Joseph Hyland, USNR W2ITR.

be moping there like a bunch of dopes, so he did something about it. That was Joe — always doing something about something!"

Asked how Joe came to be flying, for no one at home knew that he ever left the deck, his friend explained it this way:

"He didn't *want* you to know. He was afraid you'd all worry about him, and he couldn't bear that. He had his own office on the carrier and he could have stayed right there. His job was training men, the radiomen who were to fly with us, and had he done only that his would have been a grand job. But Joe just couldn't see it that way. He did his training, all right, but he felt his real place was with the rest of us, hunting out the Nips and then blasting them.

"Joe was mighty important to us — he did such a terrific job training our men. But no matter how well he trained them, Joe always was a little bit better than his pupils — the 'grand old master' at 24! He was directly and personally responsible for a high percentage of the total enemy shipping sunk by our outfit. He was marvelous at locating the targets and then, in spite of some terrible weather, we could always depend on Joe to get us safely back home again."

Joe had many combat missions, including strikes against Okinawa, Leyte, Manila Bay, airfields on Luzon, Formosa and French Indo China, and he participated in the second Philippine Sea battle.

In mid-December he received wounds for which he was awarded the Purple Heart. Flying with Lt. James L. Hooper, of Chicago, and Calvin McJilton, ACM2/c, of Dallas, he led his flight over Clark Field to a 20-mm. antiaircraft position. Jap guns were blazing, and — just as the bombs were dropped — the plane was hit twice. Joe was wounded in his head and hands.

One shell wrecked the Avenger's belly-gun and rammed into the engine, and when Hooper pulled out of his dive at 1500 feet the engine sputtered and quit. It looked like the cue for all to jump, but suddenly the motor caught again and the plane stayed in the air, though staggering badly. Other trouble soon was discovered. Half the airline controls had been shot away and the Japs were still firing on the ship. The pilot let the sick Avenger down to 100 feet and hedgehopped behind some trees, trying to shake the tracers.

At last they got out of it and tried to climb, but it was slow work. Hooper could get no more than 24 inches manifold pressure, and though he coaxed the dying plane with skill and prayer all hands got ready to bail out. Luck was riding with them that day, though, and slowly, little by little, the plane climbed to 4000 feet and into the clouds.

Joe plotted the way home and announced that there were hills to be crossed ahead — hills 4500 feet high. In eight more minutes the gallant Avenger staggered up to 6000 feet and started across the ridge. All was looking rosy when, right in the middle of it, the motor quit once more. But that engine apparently wanted to go home, too. It cut in again and they finally made it back to the fleet, though the motor quit three more times on the way.

Back at the carrier Hooper stalled the ship at 6000 feet to test power and controls. They weren't good enough to risk landing on the deck, so he made a water landing. Ten minutes later Joe was being patched up aboard a destroyer.

Then came January 12, 1945. The story of that last mission was told by Lt. Lew Richfield in this same letter which first brought news of the tragedy to Joe's family.

"By the time you receive this letter you will have been notified that Joe is missing. This letter is so difficult to write, knowing that your reading it will serve only to awaken the pain of your loss. However, I know you will ask yourselves the unanswerable question — why? At least I am able to tell you how it happened, since Joe and I were together all the time.

(Continued on page 94)

The morning's attack group jubilantly described how they had completely annihilated a Jap convoy.

25 YEARS AGO THIS MONTH

WE ARE investigating the fading of 200-meter signals. Some of our members are carrying out tests for the Bureau of Standards, as reported last month. In addition to this, the League announces, in *QST* for June 1920, its own ARRL QSS Tests. Selected transmitting stations to be announced next month will send broadcasts on schedule, the transmissions consisting of the repeating of each letter of the alphabet five times at an even speed of 18 words per minute. All members of the League are invited to listen and record the audibility of the signals, on the 0–9 Eccles scale, on a report form illustrated in this issue. Fading assistants have been appointed in each division to analyze the recorded data, a tremendous job, and we hope to learn something of the nature and cause of fading signals.

With the summer season of lightened traffic approaching, Editor Warner urges concentration on the reconstruction of stations, a pretty hasty job having been done as we rushed on to the air when the lid went off last October. Traffic Manager Smith, however, points out that with an increasing number of c.w. stations able to operate through summer QRM, there will be a much smaller let-up than usual during the summer months. The vacuum tube situation is a bit easier. Moorhead offers two new tubes in this issue, one being the familiar gaseous Electron Relay now stuck in a four-prong base, at $6; and the other a hard amplifier-oscillator, being the wartime Navy SE-1444, at $7. And one of our largest corporations, whose name we are asked not yet to divulge, will soon present to the amateur market a new line of tubes, really including a splendid moderate-power transmitting bulb at a reasonable price.

The leading technical article is "Recent Development of Radio Telephones," a Radio Club of America paper by Walter S. Lemmon, chiefly descriptive of the WE and GE wartime sets. R. H. G. Mathews reports on "The Underground Antenna Adapted to Amateur Waves," recommending for 200- to 250-meter signals two insulated wires 47 feet long, buried between two and four feet. Such an installation greatly improves the signal-to-static ratio.

Robert Muns, 2ACQ, describes the "Construction of a 500-Volt Rectifier Transformer for C.W. Work." In the correspondence section Bowden Washington, chief engineer of Cutting & Washington, points out a number of theoretical errors in Mr. West's "Notes on Improving Transmission" in April *QST*. Fred Roebuck, an RCA ship operator, lists a large number of amateur stations heard on March 9th 1493 miles south of San Francisco en route Panama, while NSF, an i.c.w. station in Washington, was roaring in March 15th 3009 miles south of S. F. The Old Man, completely fed up with the lousy gibberish on the ether, unloads his peeve under the title "Rotten Air."

Because of the burdensome load on the division managers of the League, and to provide an opportunity for many more good men to take an active part in the affairs of the League, the Operating Department announces a rearrangement of the divisions, increasing their number from six to twelve. The six new divisions are known as the New England, Roanoke, Delta, Midwest, Dakota, and Northwestern. . . . Traffic Manager Smith reports complaints of messages going astray and calls on all concerned to note that League rules provide that if a message cannot be relayed by radio within forty-eight hours after receipt, it must be forwarded by mail either to destination or to a station that can handle it promptly. . . . The Washington and Chicago chess clubs, represented respectively by Norman T. Whitaker and Edward Lasker, played a game by wireless on April 14th, the messages being handled by NSF and 9ZN. Wire telegraph games require at least a half-hour for each move, whereas the longest transmission in this game did not require two minutes including calls. The game was adjourned after five hours with both sides claiming victory and the position was submitted to Capablanca for adjudication. . . . Ellery W. Stone has a new book, "Elements of Radiotelegraphy," an understandable text which we think a good book for Junior Operators.

The best amateur convention to date was the big one pulled off by the Philadelphia Amateur Radio Association in their home town on May 8th. Nearly two hundred radio men filed into the banquet hall at Mosebach's Casino, with tags on their coats telling who they were, an inspiring sight. There were many prominent speakers, including officers of the League, but KBW was not present, having just got married. "What we want to direct attention to is the scheme of our Philadelphia and 3rd District brothers. It is a good one. They say, let us not have a meeting of some club, but instead let us have a convention of amateurs from all over the District. Let all the clubs take part and send as many of their members as they can. And let the unattached come and join hands and get acquainted with the splendid brotherly spirit of amateur radio."

Strays

Ted McElroy, head of the McElroy Mfg. Co. and holder for many years of the world's high-speed code record, has shipped out in the merchant marine as a lieutenant, senior grade, USMS.

A Coaxial Antenna for 112 Mc.

Its Application in Mobile Work

BY LT. R. H. PARKER,* CAP, W1TO

At the higher frequencies it becomes important to pay careful attention to the method of feeding an antenna, since the transmission line may have adverse influence upon the radiation pattern. The coaxial type of antenna makes use of a feeding system which reduces this effect materially. A model for 112-Mc. mobile work is described in this article.

The advantages of the coaxial-type antenna are well known to most amateurs. The greatest of these, of course, is the reduction in influence of the transmission line upon the radiation pattern of the antenna. This is especially important at very-high frequencies where line radiation is difficult to control and where even a small physical length of line represents an appreciable portion of a wavelength. In such a case, the presence of the line in the immediate field of the antenna often results in a serious alteration of the radiation pattern from the theoretical for a half-wave antenna — usually resulting in a shift of the chief portion of the radiated energy to relatively high and ineffective angles.

The use of an antenna of this type also results in improved stability when operating mobile self-excited rigs at 112 Mc. The shifting of frequency with the movement of open-wire lines, so familiar to all WERS operators, and other capacity effects largely are eliminated. Making necessary allowances for thermal drift, it is possible to go back to the same frequency at the same dial setting time after time when the set is installed in a car. It's a real pleasure to use a superregenerative receiver with this antenna. It performs better than anything else we've tried and it has been well worth the time and care required in its construction.

*Communications Officer, Augusta Squadron, Maine Wing, Augusta, Maine.

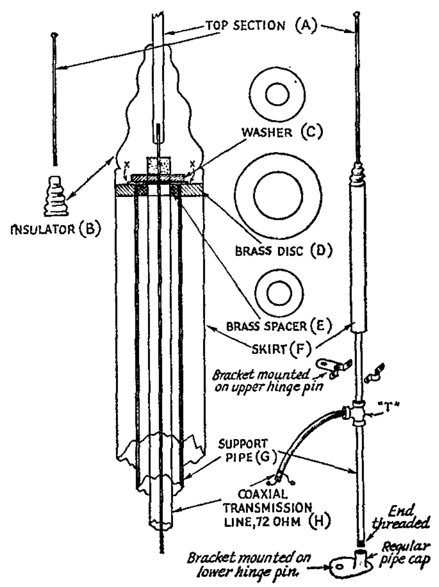


Fig. 1 — **Sketch showing details of construction of the 112-Mc. coaxial antenna.**

It would appear that the difficulties of constructing an antenna of this type are not beyond the home work-shop scope, and no special tools are required in its construction. While a lathe certainly would be useful, it is not a necessity, and even an old file can be used as a substitute for the grinder for cutting the groove in the insulator.

Radiator Dimensions

The sketch of Fig. 1 shows the details of construction. There seems to be considerable misunderstanding of the dimensional requirements of the elements for this type of antenna. The essential dimensions are the *lengths* of the radiator and skirt, which should be cut to a very close tolerance. The radiator length in feet should be $243.3/f_{Mc.}$ and that of the skirt $235.6/f_{Mc.}$ The diameter of either radiator or skirt is not critical and there is no required relationship between dimensions, nor does the supporting member have a required diameter. It is essential that the skirt be clear of the supporting member throughout its length, and if spacers are used at the lower end to maintain this separation, they should be of very low-loss material, preferably polystyrene, and of quite small cross-sectional area.

The quarter-wave top section, *A*, of the antenna should be made of good springy material. Ours was cut from a section of an old car antenna. The lower radiating section or skirt, *F*, is a piece of plumbing fixture, a section of thin-wall brass tubing 1⅜ inches in diameter. The shorting disc, *D*, at the top of the skirt is a piece of brass plate about 3/16 inch thick. It is shaped to fit snugly between the skirt, *F*, and the support pipe, *G*. A brass collar, *E*, is required to fit between the mounting pipe, *G*, and the coaxial cable, *H*. This spacer also should be 3/16 inch or so in thickness. A washer, *C*, of polystyrene or lucite about an inch or so in diameter and about ⅛ inch thick is desirable for the top of the coaxial line.

With the exception of the pipe required for mounting, the only other part needed is the insulator, *B*, at the top of the skirt. Unfortunately we had no polystyrene stock large enough to make this part so we used a ceramic stand-off insulator whose diameter at the bottom is the same as the inside diameter of the skirt. The steatite material is much finer grained and softer than porcelain and can be readily ground to the required size to fit within the skirt. Also, it is quite easy to grind a groove around the base into which the upper end of the skirt may be "rolled" to form a solid support, this, in turn, furnishing a support for the upper radiator section. This groove should be about ¼ inch from the base of the insulator and less than ⅛ inch deep. All dimensions given above are based upon the parts that we used and, of course, they will be subject to revision with the necessary substitutions, remembering only that the *lengths* of the radiator and skirt *must* be exact.

Assembly

Having cut the skirt to proper length for the frequency and the two brass spacing washers to snug fits, it is time to start assembly. With all of the above parts well cleaned where they contact one another, they should be assembled so that the upper surface of the inner spacer, the supporting tube, and the brass disc all are even, and this assembly set about ¼ inch below the top edge of the skirt. (This will allow the material necessary at the top of the skirt to roll into the groove in the insulator.) With all parts thus assembled they should be well soldered together. Since a considerable amount of heat is required, the use of either a torch or very large soldering copper with rosin-core solder is advisable.

Now the coaxial line should be prepared, and care should be used in this operation. About two inches of the outside insulation should be removed, being careful not to cut or rupture the shield. Then the line should be fed through the mounting tube until the bared shielding extends above the spacer in the supporting pipe. The strands of this shielding should be separated and bent to about ½ inch in length and laid flat on the brass disc, to which they all are to be soldered. This should be a good secure joint and it is desirable, if possible, to have the shielding soldered to the brass spacer where it passes through. This job can be done with care. When completed the upper surface of the brass disc should be quite smooth and if it is not, it will be necessary to scrape the solder until there is a flat surface upon which the lower surface of the insulator will rest.

Next, the polystyrene or lucite washer, which has been cut so that it will fit over the coax line and will go within the opening in the insulator, is slipped into position and cemented in place. In the construction shown in Fig. 1, the hole in the top of the insulator is a sliding fit for the radiator, so it was possible to slide the insulator into position after the radiator had been soldered to the center conductor of the line.

This being done, there remains the job of "rolling" the upper edge of the skirt into the groove of the insulator. This is not very difficult, but it does require care. With the upper edge of the skirt resting solidly on a hardwood block, the

(*Continued on page 90*)

★ ★ ★ ★ ★ ★ ★ ★

Gold Stars

LT. COMDR. WILLIAM O. BEACH, USNR, W7BHH, 28, was killed December 13, 1944, during an enemy air raid in the Philippine area.

W7BHH received his amateur license in 1931 and in 1934 he enlisted in the Naval Reserve. During the next few summers he was a radio operator aboard various ships of the Alaska Steamship Co. After attending the University of Washington for two years he held the post of operator at Seattle's Harbor Dept. station, KPE, until he was called to active duty with the Navy in 1940.

W7BHH served first on the *Pennsylvania* and then on the *West Virginia*. During early 1941 he was attached to the staff of the Commander in Chief, Pacific Fleet, and later to the staff of the Commander, Battleships, Battle Force. In September, 1941, he reported for communications duty to the *Maryland* and was aboard that ship at Pearl Harbor when the Japs attacked on December 7th. The ship was only slightly damaged and after it had been repaired he continued to serve aboard it until June, 1943, when he reported to the Post Graduate School at Annapolis for special instruction in communications. In July, 1944, W7BHH flew out to the Southwest Pacific to join the staff of an amphibious force. Before his death he had participated in several actions, including the initial landing on Leyte.

CAPT. JOHN S. INGRAHAM, AC, W7CYC, was killed in a plane crash on Florida Island in the Central Pacific on July 26, 1944. No details of the accident have been released by the War Department.

W7CYC joined the Army Airways Communications System in September, 1942. He served with that organization for nearly two years as technical officer at various Army air fields and later as technical and tactical inspector at Hq. 2nd AACS, Chicago, Ill. He was sent to the Pacific Theater in July, 1944.

Previous to entering the service W7CYC was senior technician at station KVI, Tacoma, Wash. He had been an amateur for the past ten years.

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Graphical Solution of Bandspread Problems

Simple Calculations for the Parallel-Condenser System

BY VELIO S. BUCCICONE,* W9IIL

The determination of proper values of fixed and variable capacitance to give any desired degree of bandspread is a problem which often confronts the ham designer of transmitters and receivers. The graphs presented here by W9IIL serve to eliminate most of the math usually required to obtain a solution.

VERY often bandspread problems present themselves to the amateur as well as the experimenter and designer. For instance, a certain band of frequencies is to be spread over the entire dial, or a portion of the dial of a receiver, electron-coupled oscillator, wavemeter or other typical device. The design of such a circuit involves the accurate determination of the correct values of inductance and variable and fixed capacitances to meet the requirements. If, in addition, some particular *LC* ratio is required, such as in a high-*C* tank for stability in an electron-coupled oscillator, the problem is complicated further. Then, of course, it may be that the values of *L* and *C* in a circuit are known and it is desired to determine the frequency limits between which the circuit will tune.

The solution of such problems is not too difficult for the average ham, especially if the data are available in the form of graphs which eliminate the perhaps tedious part of the calculations. In this article, we shall deal only with the simple parallel-condenser bandspread system. A mathematical solution for finding the proper ratio of fixed to variable capacitance will be given first and later these calculations will be reduced to simpler form by the use of curves or graphs.

*826 Grant St., Gary, Indiana.

A typical circuit is shown in Fig. 1. C_1 represents the variable portion of the capacitance, i.e., the difference between the minimum capacitance of the variable condenser and the capacitance at any desired setting. The latter value, of course, will be the maximum capacitance of the condenser when computing the total frequency coverage. C_2 is the capacitance of any fixed condensers in the circuit, while C_o represents the sum of all stray wiring and tube capacitances

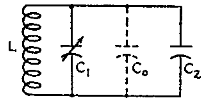


Fig. 1 — **The parallel-condenser bandspread system. C_o includes the minimum capacity of the tuning condenser, C_1, as well as all other stray capacitances. C_2 is the fixed parallel condenser.**

as well as the minimum capacitance of C_1. The total circuit capacitance, C_t, is the sum of C_1, C_2 and C_o.

$$C_t = \frac{25{,}330}{f^2L}, \text{ where} \qquad (1)$$

the capacitance is in micromicrofarads, the inductance in microhenrys and the frequency in megacycles.

In the following calculations, the total circuit capacitance at the lowest frequency, f_1, will be designated by C_{t_1}, while the total circuit capacitance at the highest frequency, f_2, will be represented by the symbol, C_{t_2}.

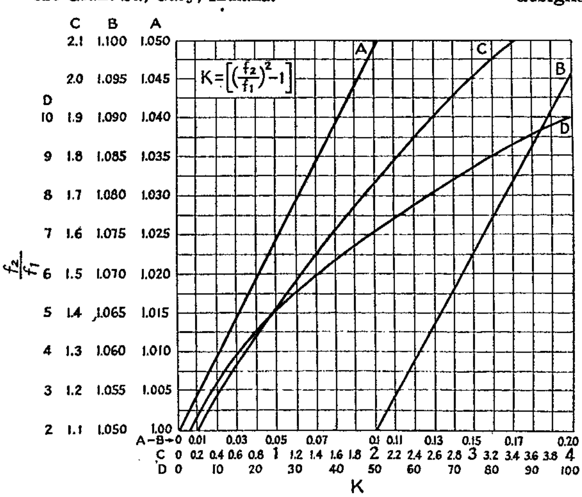


Fig. 2 — **Chart for determining *K* from the ratio f_2/f_1.**

The conditions when the variable condenser is at maximum capacitance (or any other desired portion of C_1) are given by

$$C_{t_1} = C_1 + C_2 + C_o$$

When the variable condenser is turned to minimum capacitance,

$$C_{t_2} = C_2 + C_o$$

From Eq. (1),

$$L = \frac{25{,}330}{f_1^2 C_{t_1}} = \frac{25{,}330}{f_2^2 C_{t_2}}$$

$$f_2^2 C_{t_2} = f_1^2 C_{t_1}$$

$$C_{t_1} = \left(\frac{f_2}{f_1}\right)^2 (C_{t_2})$$

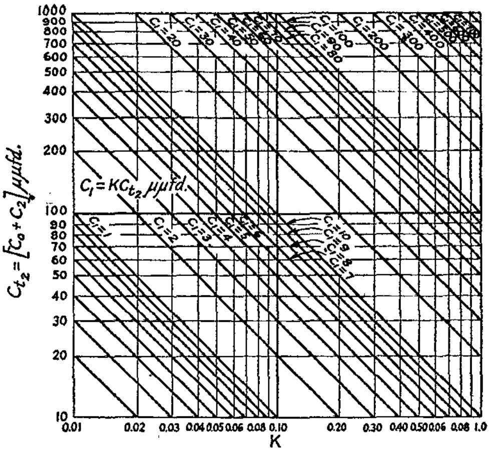


Fig. 3 — **Chart for evaluating C_{t_2} from selected values of C_1 and K.**

Substituting for C_{t_1} and solving for C_1,

$$C_1 = C_{t_2}\left[\left(\frac{f_2}{f_1}\right)^2 - 1\right] = \left[C_2 + C_o\right]\left[\left(\frac{f^2}{f_1}\right)^2 - 1\right]$$

Letting $K = \left[\left(\frac{f^2}{f_1}\right)^2 - 1,\right]$

$$C_1 = KC_{t_2} = K\ (C_2 + C_o) \qquad (2)$$

$$C_2 = \frac{C_1}{K} - C_o \qquad (3)$$

The above equations will provide a complete mathematical solution. By plotting the ratio f_2/f_1 against K, the curves of Fig. 2 are obtained. Similarly, by plotting values of C_1, C_{t_2} and K on log paper, the chart of Fig. 3 may be drawn up.

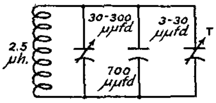


Fig. 4 — **Circuit and values for first example in text. C_3 is a trimmer for setting the minimum circuit capacity.**

Typical Problems

The sample problems which follow will illustrate the use of Fig. 2 and Fig. 3 in their graphical solution.

Example:

It is desired to spread the band of frequencies from 7.0 to 7.3 Mc. over the entire 180 degrees of the tuning dial. A straight-line-frequency type of condenser with a minimum capacitance of 10 µµfd. and a maximum capacitance of 70 µµfd. is to be used. Design the complete LC circuit to accomplish this.

$$\frac{f_2}{f_1} = \frac{7.3}{7.0} = 1.043$$

From the curves of Fig. 2, $K = 0.083$

$$C_1 = 70 - 10 = 60$$

From the chart of Fig. 3, $C_{t_2} = 730$ µµfd.

$$C_{t_1} = 730 + 60 = 790 \text{ µµfd.}$$

$$L = \frac{25{,}330}{(790)\ (7.0)^2} = 0.65 \text{ µh.}$$

As a check,

$$L = \frac{25{,}330}{(730)\ (7.3)^2} = 0.65 \text{ µh.}$$

Assuming that tube capacitance from grid to cathode is 4 µµfd. and stray capacitances total 6 µµfd. for this particular circuit,

$$C_o = 10 + 4 + 6 = 20 \text{ µµfd.}$$

$$C_2 = C_{t_2} - C_o = 730 - 20 = 710 \text{ µµfd.}$$

The circuit then would be as shown in Fig. 4. C_3 is a small trimmer condenser for final adjustment of the total fixed capacitance.

Example:

An electron-coupled oscillator is to be designed to cover the band of frequencies from 3.0 to 3.5 Mc. This band is to be spread over the entire scale of the tuning dial. The minimum capacitance must be 500 µµfd. or more for good stability. Find the values of L, C_1, and C_2.

$$\frac{f_2}{f_1} = \frac{3.5}{3.0} = 1.166$$

From the curves of Fig. 2, $K = 0.35$

Let $C_2 + C_o = 750$ µµfd.

From the chart of Fig. 3, $C_1 = 270$ µµfd.

Use a variable condenser with a minimum of approximately 30 µµfd. and a maximum of 300 µµfd.

$$C_{t_2} = 750 \text{ µµfd.}$$

Let the stray capacitance be 10 µµfd.

$$C_o = 30 + 10 = 40 \text{ µµfd.}$$

Then,

$$C_2 = C_{t_2} - C_o = 750 - 40 = 710 \text{ µµfd.}$$

$$L = \frac{25{,}330}{(750)\ (3.5)^2} = 2.76 \text{ µh.}$$

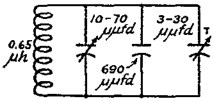


Fig. 5 — **Circuit and values for second example given in the text.**

As a check,

$$L = \frac{25{,}330}{(1020)\ (3)^2} = 2.76 \text{ µh.}$$

The circuit is arranged as shown in Fig. 5.

In estimating the required size of tuning condenser it is useful to note that its range in capacitance always must be the square of the frequency range. Thus, a 2-to-1 change in frequency will require a 4-to-1 change in circuit capacitance.

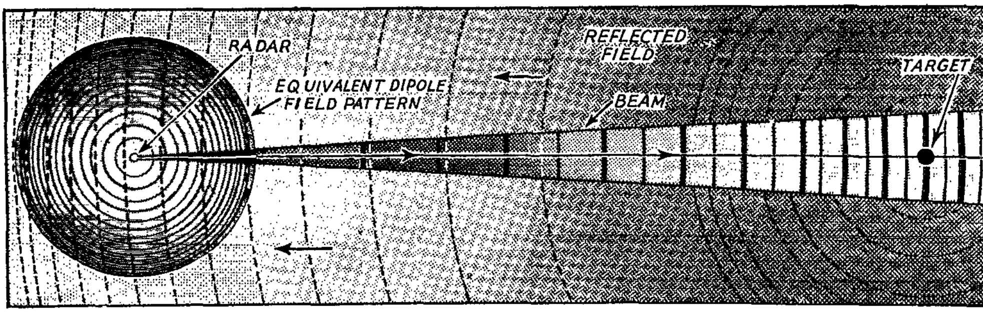


Fig. 1 — An idealized representation of the space link in an illustrative radar system, in terms of relative radiated field intensity indicated by equal-intensity contours and shading values. Field patterns are arranged in three superimposed layers, as indicated by variation in contour intervals, to convey the relative amplitudes involved within the limits of illustrative reproduction. They are, in order: (1) The sharply directional transmitted radar beam, having a conical radiation pattern with an arbitrarily selected (but not necessarily typical) beam width of 6 degrees. At the target its field intensity is comparable to that at a point near its first contour line indicating the outer edge of the (2) circular pattern showing the field-strength pattern of an equivalent simple dipole for comparison. (Parenthetically, the close approach to a plane-wave characteristic of small segments of spherical wavefronts at great distances is clearly disclosed here by the shape of the beam contour lines near the target as compared with those at the edge of the dipole circular pattern.) The reflected radiation field (3) actually contains only a small fraction of the transmitted energy, and therefore is shown here proportionately magnified approximately ten-fold (the label "reflected field" lying between the first and second contour lines as they appear in terms of the scale of the transmitted-wave patterns). The energy reradiated from the target is scattered more or less omnidirectionally, depending upon the size and shape of the target, the reflected waves displaying complex divergent standing-wave patterns.

Radar Techniques

III—Charges, Fields and Waves

BY CLINTON B. DE SOTO,* W1CBD

In the past, the typical radio amateur's approach to radio circuit and even antenna theory has been pretty much restricted to thinking in terms of voltage and current. These are, of course, highly useful quantities which, for the practical radio man, pretty well suffice in circuit analysis. When dealing with three-dimensional problems such as radiation and re-radiation, however, their inadequacy becomes apparent.

For example, in contemplating voltage and current waves traveling along a conductor, most of us automatically visualize electronic current flow inside a metallic conductor and consider that to be the means whereby the "electricity" — the electrical energy — is transported. Actually, however, the energy resides entirely in force fields set up in the space surrounding the conductor. The wire serves chiefly to guide the alternating fields containing the energy.

There is, of course, nothing novel in this idea. In fact, its original conception predates man's knowledge of "radio." The physicists have thought in such terms all along, and radio textbooks contain discussions of it; but when the practical amateur gets down to work on a new rig in the shop he's been inclined to think of realizable voltmeter and ammeter readings and to disregard such hypothetical "theory." When he comes to deal with u.h.f. and even v.h.f. gear, however, he will find that the emphasis lies in the other direction.

*Editor, *QST*.

Pursuing the basic policy of this series — that of reviewing the general theory underlying radar technique — for the benefit of readers unfamiliar with microwave concepts we shall attempt a general description of the principles and approximate physical representations of fields and waves.

Charges in Motion

Rather than burden practical-minded ham readers with the need to look back through the theory chapters of the *Handbook*, here first are a few paragraphs of review.

Let us begin with the electron. Even though it isn't "electric current," it does play a very important role in the transport of electrical energy.[1]

We recall having read that an electron is a minute rudimentary particle bearing a negative charge of electricity. Its "diameter," to establish a physical reality, is about 10^{-13} cm. At rest, it has a mass — again in terms of a physical picture — of about 10^{-27} gram. This view of the electron, that it resembles a tiny electrically charged grain of sand, is a comparatively simple one and serves in depicting many kinds of electrical phenomena.

In a unidimensional picture it is acceptable to consider the electron a discrete particle of static energy. Literally, however, energy in the physical sense cannot exist without accompanying quantities of mass and velocity. It is important, therefore, to establish a distinction between an electron at rest and in motion. The electron in motion conforms with physical law; although still nonmaterial, it now has both mass and velocity, and therefore can be described in terms of dimensions and force.

The modern theory of the electron defines it as a complex energy wave train, propagated in space with both group and wave velocity. Within an atom each electron wave train travels an individual orbital path, collectively occupying all of the space around the nucleus to a radial distance of about 10^{-8} cm. and neutralizing all the excess of positive charges therein. Additionally, in certain monatomic crystalline materials, classified as conductors, there exist "free" electrons which roam the equal-potential boundary regions between the layers of atoms, which are held fixed in lattice structures of various conformations.

As popularly understood, the concept of electric current in metallic conductors — conduction current — is that of a drift or flow of "free" or unattached electrons, passed along or transferred from one atom to the next like a kind of bucket brigade. By the same view, the conductivity of a substance is a measure of the relative ease with which an electron can be detached from one atom and passed along the line.

Such an explanation may suffice for simpler phenomena, but in relation to more complex actions, such as reflection, it must be extended. Assume an individual free electron coasting along the equipotential interatomic boundaries in a conductor. If an electric charge is applied to the conductor, the electron, responsive to the force in the charge, will move at a velocity proportional to the applied potential. As the velocity increases the apparent mass of the electron similarly increases; if it should achieve the velocity of light, theoretically its mass would be infinite. Such a condition being incompatible with our physical picture of the electron, we can assume that it is unattainable.

What happens, then, when an electromagnetic wave — which does travel with the velocity of light — acts upon a free electron? Its velocity increases, of course, responsive to the force exerted by the wave. As it progresses, however, its kinetic energy is gradually dissipated at each successive interatomic potential barrier until finally it is no longer able to overcome a final potential step. The relative distance it may travel in the meantime and the maximum group velocity attained determine the relative resistivity of the conducting material. Thus the atomic construction and the type and uniformity of the lattice structure of the material become a more realistic measure of the conductivity of the conducting material.

Fields

The above still falls within our conventional picture of current flow — so far as it goes. The question still remains, however — where, and how, is the electrical energy transported?

The answer is that it resides in the fields created as a result of the charge. In the case of d.c. we can accept the traditional explanation that current flow results because of the potential or voltage difference between the two ends of the conductor, disregarding the intermediate process of an electric field created because of that difference. In this case, with uniform voltage drop, or gradient, the electric field also is uniform. With a.c., however, particularly at very high frequencies, the original electric field resulting from the potential difference is augmented by an induced electric field resulting from the magnetic field created by the alternating current flow. Thus, while the *average* current flow may be evaluated by the simplified theory, the actual current strength or density at any point is a complex quantity determined by the sum of the electric field from the external source of charge and that induced by the changing magnetic flux caused by the current.

In considering electricity from the field standpoint, the electron becomes important primarily because it represents the smallest unit of energy — the universal quotient for any physical phenomena, mechanical, optical, hydrostatic, etc. — and therefore the smallest unit of electrical charge.

A good concept of charge is difficult to attain. At rest it constitutes merely a latent force. A charge in motion attains dimensions, and thereby creates an energy field. An oscillating or periodically varying field, in turn, becomes a vehicle for the transport of energy through space.

In all cases where energy is transferred motion is involved. In the "static" case of a charge moving in one dimension the energy density lodged in the accompanying field at all points will be constant. If the motion of the charge, or the effect of other external forces on the field, is such as to cause a deviation, or divergence, in its direction, the energy state will be changed because of the mutual action of the forces.

Thus in the static condition a state of equilibrium exists, but in the two-dimensional dynamic state there is continuous change — balanced, it is true, so that over-all equilibrium and equaliza-

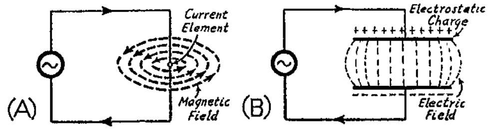


Fig 2 — Quasi-steady-state charges and fields. In the "closed-loop" circuit at (A), with conduction current flow in the direction indicated, equal-intensity contour lines of magnetic force (flux or "flow" lines) in the surrounding dielectric form concentric circles around the conductor; lines of electric intensity similarly exist in the direction of the wire, at right angles to the magnetic flux. Direction of energy flow is into the wire, and potential difference, *V*, is proportional to electric field intensity, *E*, and the length (number of unit current elements; inductance) of the conductor. In the "open-loop" circuit at (B) with a condenser replacing the inductance loop, in the steady-state condition charging (conduction) current flows to the positive plate, building up a positive charge, only until it is balanced by an equivalent flow of negative charge from the negative plate. When the condenser is fully charged (i.e., after a time interval determined by its physical dimensions and the dielectric constant of the intervening dielectric medium) a homogeneous static electric field spans the dielectric space. In both (A) and (B) the magnetic and electric fields have constant gradients of intensity; i.e., no potential difference exists along any parallel (tangential) plane, but only in the vertical (normal) plane.

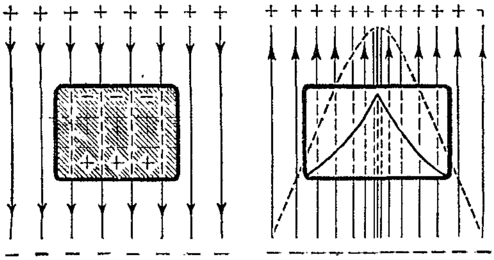


Fig. 3 — Exposing a closed conductor loop or disc to a constant-gradient electric field between uniformly charged plates (A) causes it to receive equal and opposite charges by means of electrostatic induction. No measurable current flow can be detected, however. When the applied charge is reversed, causing the steady current flow of constant density to be anticipated between two points of unequal but steady potential (B), an induced displacement current flow can be detected during the interval in which charging or discharging conduction current flows — i.e., when the electric field is building up or collapsing, creating a changing magnetic field.

tion of forces, integrated over a period of time, is maintained, but different at any instant from a preceding or following instant.

Electromagnetic fields of force are as imaginary — but equally as significant — as the gravitational field or the forces employed in theoretical mechanics. They accompany all electrokinetic phenomena. When "current" flow (literally, free electron motion responding to unequal charge distribution along the surface) is set up in a conductor, a magnetic field is produced linking the stream lines of current flow. Such a field is shown in Fig. 2-A, the flux lines being pictured in the traditional manner as closed concentric circles of constant magnetic force surrounding the conductor, the number and extent of which are proportional to the electric displacement or density of charge.

To repeat, it is the magnetic field which contains the energy being transported through the circuit — and this magnetic field is dependent upon the varying electric field resulting from the conduction current, represented by the moving electric charge in the conductor.

In Fig. 2-B is shown the alternative case — where the circuit constitutes not a closed loop, or inductance, but an open-ended conductor, or condenser. Were d.c. applied to this condenser, of course, conduction current would flow until the condenser was charged to the limit of its capacity, whereupon a static unbalance of charge would exist between the two plates — until the applied potential was removed or the condenser shorted, when equilibrium would be restored.

With a.c. applied, however, the circuit apparently behaves much like that of Fig. 2-A. Conduction current flows in the leads to each plate alternately just as though the condenser were not there. How does it get through? The answer is that it doesn't; the energy, which along the conductors resided in the magnetic field, now is transferred to the electric field, as dielectric flux between the condenser plates. Since this field also is constantly changing, in synchronism with the alternating conduction current and the magnetic field, it too must result from a species of current flow which effectively matches or couples the charging current to the condenser.

Displacement Current

This is displacement current, the explanation for which is based on the altered structure of dielectric substances as opposed to conductors. Such materials (apart from amorphous dielectrics with random molecular distribution such as glass, wax, etc. — which have been characterized as "liquids in a solidified state," in contrast to the crystalline solids) are, in the main, so constructed that separation of free electrons is difficult and recombination of migratory electrons and ions rapid. This arises both from the interior structure of individual atoms and also because, in contrast to good conductors, the atoms are combined as rigidly fixed diatomic molecules with relatively vast intervening field-free spaces.

Thus, while electronic conduction is negligible in a good dielectric, the propagation of force fields is essentially unhampered — in contrast to the situation in good conductors, where electrons can travel freely but fields cannot.

This does not mean that the component electron in the dielectric are wholly oblivious to the attraction of an applied charge, however. In fact, they — and perhaps their galactic atoms and molecules as well — stretch themselves to the utmost in the direction of the complementary charge. The resulting displacement, as they crane from side to side following the rapidly alternating charge like a gallery at a tennis match, is sufficient to generate a magnetic field in the same manner as the free-electron motion in a conductor. A possible analogy might be that of a yo-yo ball compared with a similar ball unleashed from its restraining rubber band.

At low frequencies the possible density of the displacement current is small, but with increasing frequency it can attain appreciable values. Thus, in the case of air-dielectric, with an applied potential of 1000 volts the displacement current

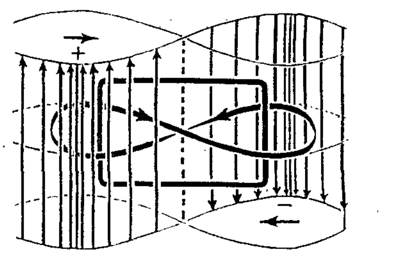


Fig. 4 — A condition of continuously varying charge, resulting from the application of an alternating potential, results in a constant variation in the intensity of the electric field, setting up a "magnetic" (displacement) current flow in the dielectric which creates a closed magnetic field loop. This varying magnetic field loop in turn induces a moving electric charge in the closed conductor loop, causing current flow in the loop. In this three-dimensional representation, current (magnetic field) density is shown by the vertical amplitudes of the closed loops, while the potential (electric field) density is indicated by the spacing between vertical field lines. The median time plane is that of the paper.

density at 1 Mc. would be only about 0.5 ma. per square cm. while at 1000 Mc. it would be 500 ma. over the same area. In substances of higher dielectric constant — i.e., lower velocities of propagation — even higher densities could occur.

Propagation of Fields

Returning now to the magnetic field surrounding a conductor carrying an alternating current, if a conductor loop is placed in the pulsating field some of the energy will be transferred to the loop by induction. If the ends of the conductor are connected together, forming a closed loop, the coupled energy will be apparent as a measurable current flow. Conversely, if the loop is open there will be a perceptible difference of potential between the two ends, or one end and any neutral point (ground). This seems routine enough, although we may never have thought to inquire into the reason for such a state of affairs.

In neither case do the loops have a metallic connection to the conductor generating the initial magnetic field. They are linked only by the space between them (or, more specifically, by the air or other dielectric medium).

Now it is significant that, while current can be measured in the case of the *closed* loop and potential (voltage) in the open loop, it is not possible to detect a corresponding voltage on the closed loop or current flow in the open conductor. These normally inseparable quantities can be detected only by the use of static (field) measurement devices.

Yet obviously energy has been transferred from the current-carrying circuit to the loop. Moreover, the transfer of energy involves power, and in electrical conduction that means both current and voltage — or so we've always thought.

In the case of the closed loop it seems reasonable to believe that the continuous gradient of potential in the changing field cutting across the loop causes one end of the loop to be at a different potential than the other. This causes an induced current flow *in the loop conductor* despite the absence of a physical electrical connection.

The explanation pictured in Fig. 3 serves also to confirm that the induced voltage in the closed loop is not the familiar e.m.f. or electric field potential associated with conduction current, which we customarily measure as voltage. It is, rather, a force derived from the magnetic field — m.m.f., or "magnetic voltage." Correspondingly, the current associated with the dielectric field set up by the open loop is "magnetic" or displacement current, as discussed above.

There is an important implication in this. Just as we commonly think that the energy in an a.c. circuit resides alternately first in the coil and then in the condenser, or in voltage and current respectively, so it may occur alternately in either the electric or the magnetic field, arising from either conduction or displacement current.

Fields from Fields

So far we have considered the behavior of fields only in terms of one dimension. It has been shown that a changing magnetic field caused by conduction current can set up a steady electric field, and that the converse also is true — a

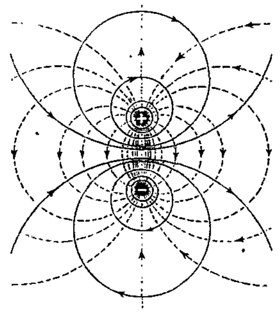


Fig 5. — **Bipolar coordinates showing field force lines and equipotential surfaces for a magnetic (dipolar) doublet, two-conductor transmission line, etc. Equipotential lines (dashed) indicate points at the same voltage "altitude" or amplitude, like the vertical contour lines on a topographic map.**

changing electric field can create a magnetic field. Now carry the process one step further, as shown in Fig. 4. The electric field here is seen to set up a new magnetic field in the surrounding dielectric — circling around the displacement current, which varies according to the non-linearity of the initial field. Note that the new induced field is entirely disassociated from any conductor; it exists wholly in the dielectric.

Carrying the sequence yet one step further, the new induced magnetic field in turn also is time-varying, so it is wholly logical to assume that it in turn will generate a new electric field — a process which can continue, on and on. The creation of each additional induced electric field slice separates a certain proportion of the energy in the original displacement current; so long as this energy is replaced at the source propagation will continue. Fig. 4 illustrates how a changing electric field varying both in density and direction can create an alternating magnetic field, which in turn can induce a continuous current flow in a supplementary closed loop conductor. Carrying this a step further, the loop itself may be eliminated and the varying magnetic field will produce a secondary electric field in space — a process which can be carried on indefinitely so long as the energy required is regularly replaced at the source.

This can be correlated with the transmission line experiments discussed in the second installment in this series, further detailing the similitude of a familiar two-conductor transmission line and a beam of radio waves in space. The initial input pulse charge on the open-conductor line causes a conduction charging current because of the difference in potential it establishes. In each element of the line, in turn, this current creates an electric field which induces current in adjoining portions of the conductor — causing it to display the retardation characteristic of an inductance coil. Simultaneously the dielectric between the conductors is energized by lines of dielectric flux, establishing an electric field.

Thus when a current pulse is handed the synthesized transmission line, each of n lumped-constant elements of inductance and capacity contributes a separate — but interlinking — effect, and these effects each have corresponding secondary effects. In an actual transmission line with distributed constants these effects all are

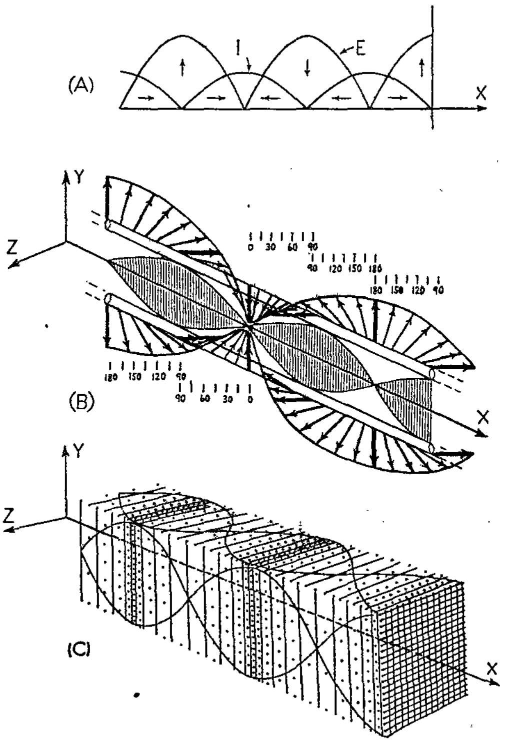


Fig. 6 — General relationships for transverse electromagnetic (transmission-line) waves on a parallel line and in space. (A) shows the customary "standing-wave" voltage and current waveforms and direction as measured on an SWR r.f. voltage or current indicator. These correspond with the more usual representation, showing superimposed sine waves of *I* and *V* above and below a reference line. The latter lead to an incorrect concept, however, as may be seen by reference to (B), in that they imply longitudinal voltage and current differentials over the length of the line, whereas the measurement actually is of the transverse differential which is the resultant of the sum of the individual currents in the conductors and the instantaneous transverse potential difference. In other words, "conduction" is between the conductors, not around the loop, and power is transmitted by the fields in the dielectric between them. The conductors in this case serve only to guide the energy — or, more correctly, to confine the wave front. They may be removed and the energy still will be propagated as a space wave, as shown sectionally at (C), where the vertical lines represent relative E-field density at a given instant and the horizontal lines similarly the H-field density.

interrelated, each minute part of the conductor creating a magnetic field which results in an induced retarding current in adjacent portions, and in turn behaving as one plate of a condenser in conjunction with the opposite integral of the parallel line, the displacement current in between meanwhile setting up electric fields.

A typical transmission-line wave, illustrated graphically in terms of voltage and current relationships, is shown in Fig. 6. In this type of wave the electric field polarization is vertical (Y axis) and the magnetic field horizontal (Z axis), both at right angles to the direction of propagation (X axis). This is the same relationship as is found in a vertically polarized uniform plane wave propagated in space. The latter is depicted in Fig. 6-C, showing relative field densities and equivalent waveshapes at a given instant.

In Fig. 6-B it is apparent that the displacement current along the line is a complex value, determined by the relative amplitudes and direction of the conduction currents at any instant. Thus at the starting instant the two current arrows (they represent rotating vectors, actually, but we won't concern ourselves with the mathematical significance) are traveling in equal but opposite directions, resulting in maximum displacement current but a net potential difference of zero — as indicated by the shaded voltage "wave" pictured between the conductors. Turning progressively forward and inward, 90 degrees later both are in the same direction; and so they produce maximum voltage, even though the apparent total current is zero. Upon reaching another voltage minimum at 180 degrees the direction of the current appears to reverse, leading into the negative half-cycle of current flow. The E-field component is 90 degrees out of phase with the current — so there is no average power flow, and the energy in the field oscillates between the source and the surrounding space.

It must be understood that in any case the wave "travel" as such is figurative; whether on the line or in space the waves do not move physically, but merely represent pulsations in the field density, as energy is progressively acquired and released by the field at any one point.

Induction and Radiation

From this it may be seen that the parallel-conductor line and the space line have more in common than that both involve the transmission of electrical energy through continuous media.

The two significant effects involved are induction and radiation. Both have the same practical utility — the transfer of energy. In induction energy is coupled — induced — from one circuit element to another by means of the attached local field created by a moving charge. In radiation successive units of periodically induced fields are given an extra push and detached from the source, thus being propagated through space in a train of waves. Another way of putting it is that radiation occurs when a magnetic field, resulting from an initial moving electric field-charge, creates an electric field which becomes accelerated — or, more specifically, is alternately accelerated and decelerated, as when the induced field expands and contracts.

In the hypothetical case of an infinite line, the inductive chain could continue forever. In an actual finite line, what happens when the pulse reaches the end depends, of course, on the termination. If the line is correctly terminated in its characteristic impedance, making it the practical equivalent of an infinite line, the energy is simply absorbed by the load — which, so far as we are concerned, is the end of it.

If the line is open ended — particularly if it is opened out at the end to a spacing comparable to a half-wavelength at the operating frequency (i.e., converted into a matching line to an antenna) — spatial propagation as described above occurs, whereby the electric field at the open end induces a linking magnetic field in the surrounding dielectric. This space-propagated magnetic field in turn establishes interlinking electric fields, and so the energy continues as radiated waves in space.

As is well known, the energy in the radiated field at the fundamental frequency at any given distance is equal to the inverse square of the distance. Also of importance — as will be seen subsequently — is that, for harmonics of the fundamental frequency, the radiation field is proportional to the *square of the order of the harmonic.*

This provides us with a physically realizable picture of how energy transmitted via the propagation of waves in space can occur, utilizing only space — the variation of energy in terms of changing electric and magnetic flux in a dielectric medium — with no dependence on metallic conductors carrying electronic currents. This is, of course, a very fundamental concept, applicable to many aspects of u.h.f. technique, including communication as well as radar.

Reflection

It is a basic rule, under the law of conservation of energy, that voltages and currents must be equal in any circuit.

Where an impedance change occurs at any point in a transmission line — or in the path of a radiated wave — some of the energy will be reradiated, or reflected. The respective amounts of the transmitted and reflected waves will be determined from the condition that current and voltage must be continuous (equal) on the two sides of the discontinuity in impedance.

For an electromagnetic wave at a boundary between one medium and another, the ratio of the transmitted and reflected waves similarly will be determined by the condition that the tangential electric and magnetic fields must be continuous on both sides of the discontinuity.

In a uniform electric field incident upon a plane boundary, the number of lines of flux passing through the surface — i.e., inducing a field within the body — will be determined by the field strength, the area of the reflecting surface, and the electrical characteristics of the reflecting medium. If the field direction is not normal (i.e., perpendicular) to the surface, the angle of incidence also becomes a controlling factor. As was shown in Part II under optical analogies, for zero incident angle (tangent ray, parallel to the surface) no flux can penetrate the boundary.

In the case of reflection at normal incidence from a conducting boundary, as in Fig. 7, the E wave on encountering a boundary attempts to set up a charge by virtue of the potential difference represented by its amplitude at incidence. However, as soon as the charge is set up it disappears because, the boundary being conductive and so unable to sustain an electrostatic charge, it promptly allows current to flow, moving the charge and redistributing the energy. The H wave, however, is reflected unchanged.

Thus, although E and H components in either the incident or the reflected wave are in time and space phase, the reversal of the E component at reflection causes the resultant standing waves to be in time and space quadrature. In other words, the sum of the incident and reflected waves at any point will result in sinusoidal "standing" waves in space.

The above is in terms of elementary sine waves and complete reflection at normal incidence. With complex waveforms and transmission modes and intermediate degrees of reflection, the situation becomes decidedly more involved. This we shall consider next month.

This is Part III of a series. Part IV will appear in the July issue of QST.

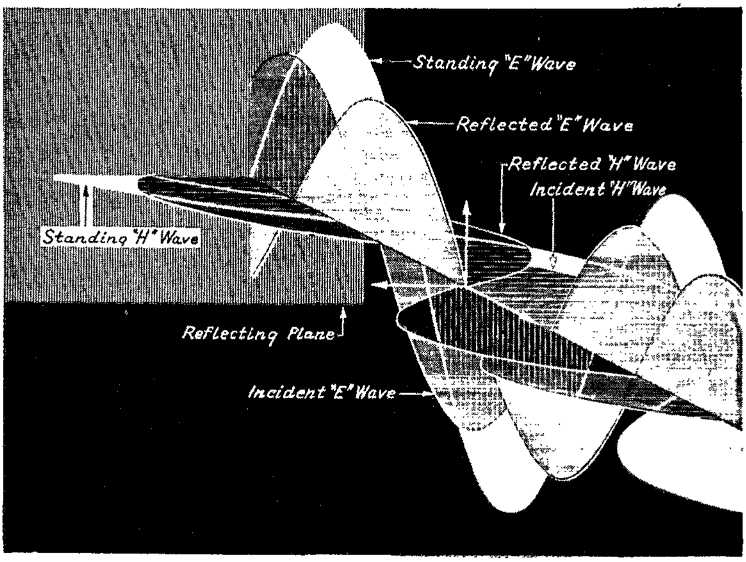
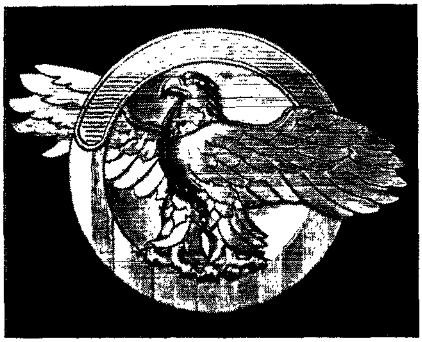


Fig. 7 **— Three-dimensional space diagram of reflection of transverse electromagnetic waves at a perfectly conducting infinite plane boundary. Energy in the arriving incident wave is equally divided between the E and H waves, which are in phase. On arrival at the boundary the incident E wave is turned downward and reflected with reversed phase, complying with the requirement that the value of electric field potential at the boundary be zero. Thus the standing E wave begins at zero. The H wave, on the other hand, is reflected without change in phase, and the resultant initial amplitude of the standing H wave is doubled. In the complete reflected wave, therefore, the E and H components experience a 180° phase shift.**

STRAYS

Do you recognize the Honorable Service Button pictured below? One is issued to each individual on his discharge from the Army, Navy, Marine Corps or Coast Guard and more than a million veterans are now entitled to wear them.



While this button should entitle its wearer to the respect of Americans everywhere, the public does not generally recognize the meaning of the emblem. Veterans with long combat service overseas, now returned to civilian life, have had the unpleasant experience of being challenged for failure to appear in uniform because their badge of honorable service has not been recognized.

Any veteran who has lost the button originally issued to him may obtain a duplicate at cost (seven cents) by presentation of his discharge certificate to the Quartermaster Supply Officer at any post, camp or station, or by writing to the Adjutant General, War Department, Washington 25, D. C.

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In the record-breaking time of three days, American scientists duplicated a complicated German vacuum tube thus enabling our forces to use abandoned Nazi telephone equipment. In their retreat from Belgium and France the Germans left communications equipment substantially intact, except that they removed the tubes essential to the telephone repeaters. One tube was found and rushed to America where NDRC placed contracts with Bell Laboratories and Western Electric for copies of the sample. One firm, which was to rush through approximations of the tube, constructed eight duplicates within three days and delivered 1000 within three weeks. The other firm, which was to make exact replicas, completed 1000 in five weeks. Equipped with the new tubes, the Nazi telephone equipment functioned efficiently. The German tube, a cathode-type pentode, was different from American-made tubes not only in electrical characteristics and in heater voltage but also in its dimensions and pin arrangement. In addition, the glass bulb was sprayed with metal.

I built one of those gadgets that Lenore Conn described in the August, 1944, issue of *QST* for cutting out the speaker during commercials by means of a speech amplifier working a relay when you clap your hands. Worked fine, too, until some quartet sang "Deep in the Heart of Texas." Boy, did that ruin the routine! — *W2JA.*

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A new speed record for reception of the International Morse code was set by Cpl. James Ralph Graham, a Signal Corps instructor, who recently demonstrated his ability to average 79.4 words per minute for a ten-minute period, copying on a standard typewriter. Cpl. Graham, a veteran Morse telegrapher and teletype operator, learned International code after entering the Army last October.

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That electric shock may have a damaging effect on memory and ability to re-learn is indicated by results of shock treatment experiments for the mentally ill. The experiments, made on rats, were conducted independently by Dr. Carl P. Duncan of Brown University, and Dr. Elliott M. McGinnies, jr., of Harvard University.

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It is easy to make a crystal for a "foxhole" radio. Take any kind of nut, brass or steel, fill the center hole with lead from a broken storage battery and heat until the lead is molten. Sprinkle a very small amount of powdered sulphur on the molten lead. Powdered sulphur may be obtained from the medics who have a large supply as it is used in the treatment of a common skin disease. These "crystals" work well and in my unit there are at least a hundred of them in use. A fine wire or needle acts as a "cat whisker." Another source of crystal action is to hold the flat surface of a razor blade across a carbon rod obtainable from any dry cell. The razor blade is held in place by a bolt through the hole in the blade at the end away from the rod. — *W2MIB.*

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On my *QST* binders, I put scotch-tape over the proper gummed label, then trimmed it before putting it on the binder. This protects the label from getting dirty or scratched and gives it a nice appearance. — *W9FLA.*

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Discovery of the fact that a hollow steel ball half filled with metallic powder will not bounce has led to the use of similarly filled hollow contacts in electrical relays to prevent poor connections by eliminating bouncing and chattering. The same results are accomplished by attaching hollow powder containers to solid contact points.

Tests conducted by RCA Victor have shown that separate shielding of proper design for electronic power generators, work assemblies, and transmission lines will reduce the field strength of radiations which might interfere with radio reception and other electronic services by a factor of 45,000 to 1.

A most unusual method has been developed for adjusting the frequency of quartz crystals used in radio transmitters without lapping or etching the plate. By irradiating the quartz plate with X-rays, even while the plate is oscillating, if desired, the oscillation frequency decreases. The adjustment precision is limited only by the accuracy of the frequency measuring equipment. — *The Ohmite News.*

A new line of 2½-inch hermetically sealed panel instruments, housed in steel cases and immune from the effects of humidity, moisture, chemical fumes, and other harmful agents, has been announced by the General Electric Company. These new instruments include direct-current voltmeters and ammeters and a.c. radio-frequency ammeters.

A new water-repellent and thermal-shock resistant coating for wire-wound resistors has been developed at the Mellon Institute of Industrial Research. The material is a member of the new group of resins known as Silicones and, because of its high elasticity, may be applied to any combination of ceramic or metal tubes with high resistance wire of suitable electrical characteristics.

A new electronic tube has been developed that is capable of amplifying grid currents as minute as 10^{-14} (0.00000000000001) ampere. The tube is used for measuring the pH of chemicals or minute currents such as those produced by photo tubes exposed to starlight. — *The Ohmite News.*

A cathode-ray tube, flat instead of curved at the screen-end on which the image is projected, has been developed by the Allen V. Du Mont Laboratories, Inc. The new tube, 20 inches in diameter, has been shown privately to directors of the Television Broadcasters Association and will be publicly announced in the near future. Since the projection surface is absolutely flat, the picture can be viewed from virtually any angle without the distortion that characterizes images shown on the curved-end tubes now generally in use.

Philco announced development in prewar years of the first flat face tube, but it was about half the size of the new Du Mont model. Du Mont claims a superior picture with an image size 18 by 13½ inches in sharp black and white.

Corning Glass Works, which has a department especially devoted to fabrication glassware for use in television bulbs, is blowing the new tube.

A midget 22.5-volt battery considerably smaller than a pack of cigarettes, opens the way for renewed interest in the field of portable amateur gear. The new battery is the No. 412 "Eveready" Mini-max "B", weighing 2.5 ounces and measuring $2 \times 1\frac{1}{2} \times \frac{23}{32}$ inches.

P. R. Mallory & Co. of Indianapolis have announced the development of a dry battery of radically new type design particularly for improved performance in tropical climate. In addition to features which resist the effects of moisture and high temperatures, the cell has other unusual characteristics. Whereas the voltage of a conventional cell drops throughout the operating life, the voltage of the new cell, within practical limits, remains substantially constant up to the end of the cell life. Also, unlike conventional cells, the new cell, within the rated current range, possesses the same ampere-hour service life whether the battery is operated intermittently or continuously. Under normal conditions, no recovery time is required.

Radio amateurs at the recent meeting of the New York State Chapter of the Associated Police Communication Officers at the General Electric Company, Schenectady, April 20–21. *Left to right:* C. E. Dengler, W8KS, Rochester; Vin Zeluff, W2AZI, New York City; J. M. Mulligan, W8RTW, Elmira; C. L. Race, W3HHI, Philadelphia; V. D. Chipman, W8GPS, Jamestown; H. H. Spitzer, W4BRH, Chattanooga; G. M. Brown, W2CVV, Scotia; L. W. Goostree, W5YF, Dallas; G. E. Kinne, W8OSF, Warsaw; H. J. Bradford, W1BPT, Holyoke; W. J. Zalner, W8JGM, Binghamton; H. W. Squires, W8AMO, Binghamton; C. Z. McDonald, W8NXX, Batavia; R. J. Wood, W8CO, Syracuse; W. Evans, W8FPG, Rome; P. L. Chamberlain, W8HAU-ex 9DZY, St. Louis; John Stone, W8MVQ, Oswego; Mike Hawkins, W8---, Syracuse, and E. R. Linne, W9QME, Duluth.

HINTS AND KINKS FOR THE EXPERIMENTER

CODE-PRACTICE OSCILLATOR USING NO TRANSFORMER

The code practice oscillator shown in Fig. 1 may be built readily by even the most inexperienced beginner as it requires few parts, none of which are critical in value.

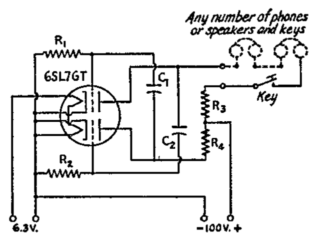


Fig. 1 — A transformerless code-practice oscillator.
R_1, R_2, R_3, R_4 — 50,000 ohms.
C_1, C_2 — 0.05 μfd.

If a variable tone is desired, a 1-megohm variable resistor may be substituted for R_1 or R_2. — *Pvt. James E. Shea, Hq. Co. 136th Ord. Bn., Camp Campbell, Ky.*

ANTENNA COUPLER FOR THE RECEIVER

Many of the modern communications type of receivers possess different input impedance characteristics, and receiving antennas, with their varying types of transmission lines, have different terminal impedances. Therefore it may be seen that the receiver transmission line should not necessarily be connected directly to the antenna binding posts on the receiver. An impedance mismatch will occur in many cases, and as a result, a lowered transfer of radio frequency energy will exist between the transmission line and the receiver input circuit.

One of the simplest and most effective antenna impedance arrangements, known as the link antenna coupling circuit, is illustrated in Fig. 2. The correct adjustment of the secondary coil is determined by the "cut and try" method. However, each tap must be adjusted the *same number of turns each side of the center tap on the coil.* Condenser tuning will give a sharper impedance match than would be possible with the tapped coil arrangement alone. — *Lt. Art Monsees, AACS, W6HJP.*

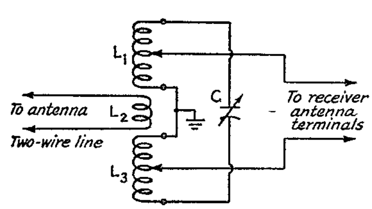


Fig. 2 — Antenna coupler for the receiver.
L_1, L_3 — 15 turns, No. 22–24 wire on 1-inch diameter form.
L_2 — 3 turns wound between L_1 and L_3.
C — 50-μμfd. variable.

AUTO-TRANSFORMER FOR FILAMENT SUPPLY

The output tube on a Jerry broadcast short-wave receiver went dead. Except for a slightly high filament voltage, a 2A5 was just the thing. However, none was available and a 47 could not be biased without putting the same bias on the rest of the tubes.

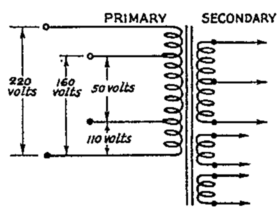


Fig. 3 — Tapped primary circuit of receiver power transformer.

We finally found a 50L6 and got its filament voltage from the primary of the power transformer (European sets usually are adjustable) by connecting the 50L6 between the 110-volt and 160-volt taps as shown in Fig. 3. We used the base of the old tube as an adaptor so we didn't have to rewire the set. — *Major Edsen B. Snow, W2BZN, and Capt. Louis D. Blessin, W9TCF.*

A RUGGED PIPE MAST

I have a suggestion for a simple, inexpensive antenna mast that can be adapted for permanent or semi-portable work. I have used one of these masts for the past six months with excellent results.

The mast consists of a 2½- to 3-inch iron pipe buttwelded to make a single section fifty feet long. The pulley is bolted to the top and a heavy hinge welded to the base. The hinge is spiked to a four-foot log buried on end. One set of four guys is fastened about fifteen feet from the top.

A block and tackle or truck can pull the mast upright with one of the guys. The other guys can be fastened into place before erecting the pole.

I have raised the mast in less than one hour, but it took considerable practice first. The same mast has been used in several locations, both as a single pipe and later as a jointed pipe, and gives excellent results.

For semi-portable work, the mast is cut into convenient lengths and slightly smaller pipes welded so as to make a two-foot joint similar to a jointed tent pole.

This is cheaper than a telephone pole and certainly less expensive than the mast Jim Lydon mentions in the August, 1944, issue of *QST*. — *Robert O. Holm, APO 896, New York City, N. Y.*

SERIES OR PARALLEL TUNING WITHOUT RELAYS OR SWITCHES

Here is a simple device designed for easy changing from series- to parallel-tuned antenna feeders. Permanent connections are made to a group of banana jacks arranged on a strip of insulation to form a socket as shown in Fig. 4. A plug is made with banana plugs using the same hole spacing. When the edge of the plug marked *A* is placed to match *A* on the socket, C_1 and C_2 are in series with their respective feeders. When the plug is upset (plug *B* over socket *A*), C_2 is out of the circuit and C_1 is in parallel with the feeders and the inductance. — *T/3 Ernest R. Carlson, W7HTH.*

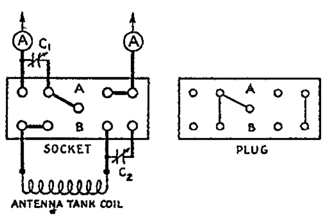


Fig. 4 **— Series or parallel antenna feeder tuning condensers without switches.**

AN "INTER-COM," "PHONO-AMP" AND RECEIVER COMBINATION

This combination inter-communication system, phono-amplifier and conventional receiver arrangement may prove valuable in these days of equipment shortage.

Fig. 5 shows the output circuit of my superheterodyne receiver and the modifications and additions necessary to permit this flexible operation.

With S_2 in position *B*, and S_1 in position *E*, the detector circuit of the receiver is connected to the triode section of the second detector and the receiver speaker is connected to the output transformer, T_3, in a normal manner.

With S_1 in position *E* and S_2 at *C*, the triode section of the 6SQ7 amplifies speech from speaker No. 2 (used as a microphone) through the microphone transformer, T_1. Speaker No. 1 is still connected to the output transformer, T_3, and receives the output of speaker No. 2. Push-to-talk operation, with control at the receiver end of the circuit, is possible by placing S_1 at *D*. Phono-amplification is obtained with S_2 at *A*.

With S_2 at either *A* or *B*, on either phono-amplifier or radio, speaker No. 1 may be used alone, if S_1 is at *E*. However, if S_1 is at *D*, both speakers are operated in parallel.

In the present installation, we have our remote speaker (No. 2) located in the movie-projection booth. By connecting the primary of a second microphone transformer to terminals *X* and *Y*,

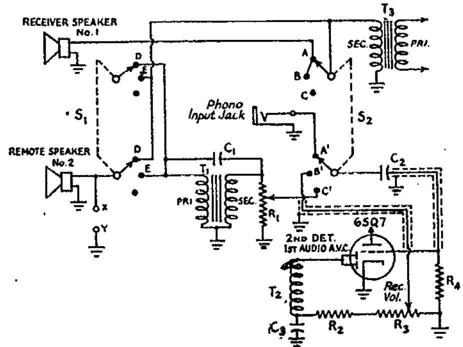


Fig. 5 **— Combination radio, phono-amplifier, and intercommunication circuit using a standard receiver.**

R_1 — 1-megohm "inter-com" gain control.
R_2 — In receiver.
R_3 — In receiver, volume control.
R_4 — 2 megohms.
S_1, S_2 — 2-gang, single-pole, 3-position switch.
T_1 — Microphone transformer.
T_2 — I.f. transformer secondary, in receiver.
T_3 — Speaker output transformer.
C_1, C_2 — 0.01 μfd.
C_3 — In receiver.

and the secondary to the phono-jack in the movie sound amplifier, we are able to pipe radio programs or music from records into the movie hall, or to use either speaker for announcement purposes. — *Lyman H. Howe, ACRT, USNR, W8TJH.*

A PLUG FOR YOUR BUG KEY

Here is a practical homemade plug that I have used on my bug for the past four years. It may prove useful to other bug handlers.

My plug, shown in Fig. 6, was made from the tapered part of a discarded fountain pen. The closed end was sawed off, and the "works" inserted. I used two straight blades from an old 'phone jack and a flat piece of insulation cut just a little wider and about a quarter-inch longer than

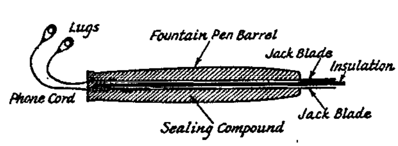


Fig. 6 **— A plug for your bug.**

the jack blades. The cord extends out the other end of the pen barrel after having been soldered onto the jack blades. Although it may not always be necessary, sealing compound or wax may be poured in to fill the area around the blades to hold them firmly in place. The cord was then attached to my bug using the lugs on the ends of the cord. — *Wesley W. Brogan, W3ARM.*

"This Is Your Armed Forces Radio Station"

A Description of One of the GI's Own B.C. Stations

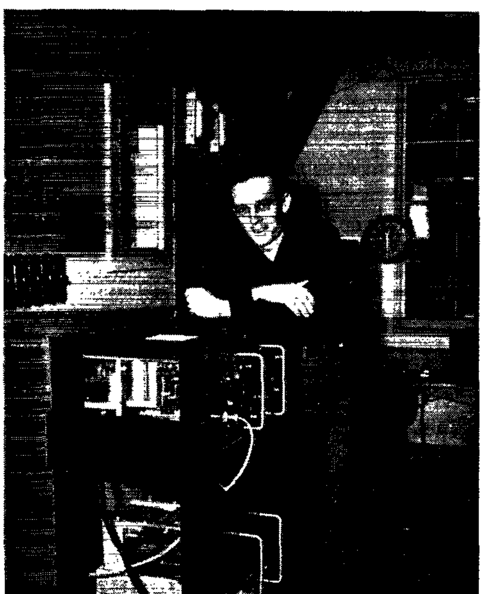
BY CPL. BILL GRANBERG*

WHETHER it's the "Mosquito Network" in the South Pacific, or the "Bridge to Victory" net in the Aleutians, whenever the words "'This is your Armed Forces radio station" come over the air, GI Joes and Jills get set to relieve the day's monotony by listening to the latest news from home, a quip by Bob Hope, or the sultry songs of Ida James.

War isn't all fighting and, after basic training, a lot of men in the Army never fire a gun or even see a battle. For many of them it is a war of waiting. For when an island is seized and the last of the enemy liquidated, there begins the tedious business of just sitting there and holding on. Thus does monotony and loneliness involve a greater number of men than does front-line action. The function of the Armed Forces radio stations is to combat this stagnation and monotony.

GI Joe abhors the word "morale." He never uses it. He just knows if he's happy—or isn't. And when he hears swing music, news, comedy skits, and mystery thrillers by radio, he's more apt to be happy. The average soldier will readily admit that radio is the best of the whole bag of tricks designed to keep men happy overseas.

* Somewhere in the Aleutians.



Ed. J. Wolfe, EM3c (Seabees), W2DFW, takes time out in his tour of duty as chief technician at APO 726's AF radio station. The transmitter, a 50-watt job, dispenses jive, news and happiness sixteen hours a day. *Official U. S. Army Signal Corps Photographs.*

The Armed Forces station at APO 726, "somewhere in the Aleutians," is typical of them all, in whatever theater. It was started in August, 1943, and the important thing was to get it on the air. The original station was somewhat of a makeshift affair in a Pacific hut, set up by two men from the infantry who apparently knew how much music would be appreciated.

The station was on the air only a few hours a day, mainly because the only items on hand to broadcast were a handful of transcriptions, aside from news reports received by short wave from the States. But popularity of the station was sudden and overwhelming. Soon the latest transcriptions of favorite programs from back home were being received. Equipment was improved and the number of hours of "air-time" was extended. Last December the station moved to a roomy frame building, complete with a stage in a studio with seating capacity for 100 men.

As might be expected, the chief technician of the station at APO 726 is a ham — Edward J. Wolfe, EM3c (Seabees), W2DFW. Before the war Ed worked for CBS in New York City and now it is his job to see that the AF station in his care stays on the air sixteen hours a day.

The rig at APO 726 is a 50-watt, high-efficiency, grid-modulated Taylor transmitter. It is a portable outfit and can be broken down and packed into chests, like GI field radio equipment, and carried on a man's back, if necessary or desirable. The operating frequency (a military secret) is low, but the range is sufficient to reach all listeners within the area the station is designed to serve. The low frequency and relatively low power ostensibly prevent Tokyo Rose and others from listening in on the strictly local programs of APO 726. A Hallicrafters' communications receiver is used to receive short-wave newscasts from the States for rebroadcasting. The newscasts rank high in popularity, as they are the only means GI Joe has of staying on top of the war he is sweating out in his lonesome vigil in the Aleutians.

Armed Forces stations are operated coöperatively by the Army and Navy, on a fifty-fifty basis, under an agreement signed on October 28, 1944. A governing board, composed of two officers, one representing Navy Welfare and the other Army Special Services, fixes the policy of each station, acts in an advisory capacity, and aids in staging any special local programs.

Working personnel of the stations is divided about equally between Army and Navy. In the case of the APO 726 station, the general manager, Russ Jones, SM1c, and Wolfe, W2DFW, both are

(Continued on page 88)

CORRESPONDENCE FROM MEMBERS

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

"POLYPHASE SYSTEMS"

Educational Dept., Navy Pier, Chicago, Ill.

Editor, *QST:*

Although the article on polyphase r.f. systems by S/Sgt. R. W. Bickmore on page 11 in the March issue is timely and offers many very interesting possibilities, I doubt that all of the author's applications are practical. The auto-resonator idea seems to be a sound and a very good one but the circuit for automatically rotating the radiation pattern of a two-element array and for the "Ionoscan" does not appear to be in keeping with a.c. theory.

The two components of excitation applied to the array will (as illustrated by the author in connection with multiphase excitation of power-amplifier grids) resolve into excitation of the two elements at some phase angle between 0 and 180 degrees, depending upon the relative amplitudes of the exciting voltages. If the capacitively-coupled and inductively-coupled voltages are equal and the circuit is at resonance, the elements will be driven 90 degrees out of phase. This condition, along with ⅜-wavelength spacing, will result in a unidirectional pattern with one minor lobe and will not produce uniform radiation in all directions as claimed by the author. This reasoning also applies to the "Ionoscan" which will have a characteristic radiation pattern rather than a lobe with a radiation angle sweeping between 10 and 90 degrees once every half radio-frequency cycle.

In connection with the auto-resonator circuit, I might add that, for conventional applications, it may be desirable to provide a switch for removing the capacitive coupling when normal amplifier operation is desired since the in-phase component of excitation will cancel in the plate circuit and will produce only excessive peak plate current.

Keep up the good work on *QST* which is still tops among Navy radio men and hams alike.

— *Howard W. Knoebel, RT1c, W9MBD*

Asheville, N. C.

Editor, *QST:*

Your attention is invited to this discussion of the article published in the March issue of *QST* entitled "Polyphase Systems Applied to R.F," by S/Sgt. Robert W. Bickmore, W6QDY. The fallacy in his idea can be shown by establishment of several facts.

Any circuit or any antenna, when excited by two voltages 90 degrees out of phase, will "see" the net voltage (algebraic sum of the two). This net-voltage wave appearing in each antenna is clearly shown in Fig. 9 on page 13 of the issue mentioned. The resultant voltage in one antenna is 90 degrees out of phase with the resultant voltage in the other antenna. Thus, our first fact is established; this system is merely an ingenious method of exciting two antennas 90 degrees out of phase.

By taking field-strength measurements of two dipoles, spaced ⅜ wavelength, and excited in phase quadrature, the pattern will be cardiodal in shape with a gain (3 db. is correct) in maximum-gain directions, but with definite losses, including nulls, in some other directions. It is admitted that instantaneous voltages in the antennas are at times in phase and other times 180 degrees out of phase, during each half cycle, but the same conditions exist in any two dipoles with ⅜-wave-length spacing and fed 90 degrees out of phase, regardless of how this phase difference is obtained, or how the antennas are fed. The author's claim of a rotating pattern and gain in all directions is in error and it is too bad that such is the case, as many fellow hams would welcome an idea of this sort, if true.

To obtain a rotating field by the use of a polyphase idea, four antennas are required, and several practical examples of the same are now employed in AACS equipment.

Fig. 1 shows a novel idea for feeding four antennas in phase quadrature, so that opposite antennas are always 180 degrees out of phase, but adjacent pairs change polarity throughout the cycle so that at one instant antennas Nos. 1 and 2 will be of like polarity, while at another instant antennas No. 1 and 4 would be of like polarity. In this method we would have a figure-eight pattern rotating in a complete circle.

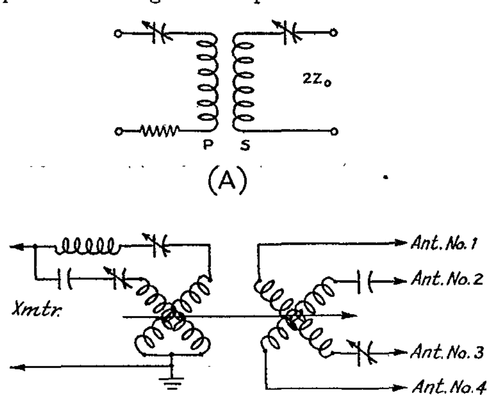


Fig. 1 — Method of rotating antenna pattern. The four antennas under discussion are verticals at the corners of a square.

With the primary and secondary of Fig. 1-A each resonated individually and the secondary matched to two transmission lines, pure resistance will be reflected from the secondary.

$$Z_p = \frac{(\omega M)^2 R_s}{R_s + X_s^2} \quad \frac{(\omega M)^2 X_s}{R_s^2 + X_s^2}$$

But since no reactance is present (as stated above) Z_p is a pure resistance.

$$Z_p = \frac{(\omega M)^2 (2Z_o)}{2Z_o^2 + 0} \text{ etc.}$$

Therefore by feeding current and voltage in phase through either X_C or X_L equal to R_p, a 45-degree lead or lag in current will exist.

Now if two primaries are orientated at right angles to each other and two secondaries likewise as in Fig. 1-B, voltages induced in the secondaries by current in the primaries all are in phase quadrature. Sine-wave or vector plotting will reveal that a figure-eight pattern rotates in a complete circle caused by the phasing and polarity of the antenna pairs. This occurs the same as if the secondaries of the coupler above were being rotated in relation to the primaries. Other types can be found in different engineering manuals under "Polyphase Antennas" or "Turnstile Antennas," but each type will be found to employ four antennas or four sections fed in phase quadrature.

What is the result? If a normal value of input is used to each pair of antennas, we will get a circular field pattern (approximately) equal to twice that of a single antenna, but we are not getting something for nothing because we are now using twice the original power to excite the *two* pairs of antennas.

— *Cpl. John M. Pemberton, AACS, W9YJH*

Gallups Island, Boston

Editor, *QST:*

The article entitled "Polyphase Systems Applied to R.F.", which appeared in the March, 1945, issue of *QST*, contains certain features and presents certain results which are either misleading or fallacious, and might therefore have unfortunate effects.

A considerable danger exists, I believe, in the possibility that the article may lead some amateurs to incorporate in their rigs, devices whose practical value is questionable and which would result in less efficient operation of the equipment. In the case of one of the antennas suggested it is certain that the results achieved would be disappointing. In the following paragraphs I will deal briefly with the major points of the article to which exception is taken.

First, the automatic resonating circuit which, as the author indicates, is an adaptation of the Foster-Seeley discriminator circuit. While I have no doubt that this circuit can be made to operate, it appears to be subject to two major disadvantages. The first of these is the practical disadvantage that the phase relation between the two voltages which are added to obtain the diode plate voltages depends only on the tuning of the grid tank and not on the adjustment of the driver plate tank, and that the value of the current which must actuate the control relay depends not only on this phase relation, but also on the actual value of the two voltages. Therefore, unless the voltage across the driver plate tank is maintained above some minimum value by preventing it from becoming accidentally detuned, there would be no actuating current.

This difficulty could probably be overcome by maintaining proper tracking of the two tank circuits and using one control mechanism. However, if sufficiently accurate tracking can be obtained, a manual control should be just as convenient and would not involve the dangers of failure of the additional control equipment and loss of control such as might occur if the oscillator frequency were to be suddenly, rather than continuously, changed to a value which might be beyond the control limits of the circuit.

The second and perhaps more important fault which may be found with the system is the reduction of plate-circuit efficiency which would occur as a result of the components of plate current due to parallel excitation of the grids. These components of plate current would tend to be rather large and would not contribute to power output since the load impedance presented to them is essentially zero. This disadvantage could be eliminated if the plate circuit included loading facilities for both parallel and push-pull components. A suggested plate circuit is shown in Fig. 2. A plate circuit such as this would, of course, require careful adjustment of loading so that the plate voltages would have proper phase relations with the plate currents if optimum efficiency is to be maintained.

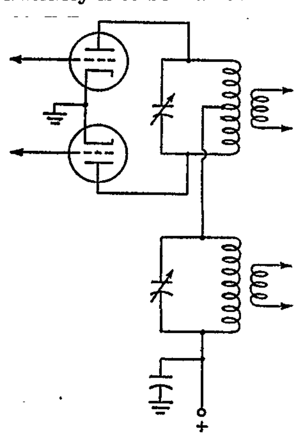


Fig. 2 — Output circuit for coupling both parallel and push-pull components.

The portion of the article dealing with antennas contains several misconceptions concerning the nature of electromagnetic radiation and the basis of operation of directional antenna arrays. There are, however, two main points of argument against the propositions set forth in this section of the article. The first point involves the fact that a rotating beam of radiated power would provide no gain in effective radiated signal strength over an antenna providing no discrimination in the directions under consideration, and that rotation or "sweeping" of the radiated beam would cause the signal at a reception point to consist largely of frequencies other than those present in the output of the transmitter. It should be obvious without any calculation that if a given amount of power is radiated equally in all directions, the effective signal strength at any point will be independent of whether a non-directional radiating system or a sharply directional rotating beam is used in the transmission. A little calculation will also indicate that the signal produced by the rotating beam will consist of a carrier modulated by a periodic function whose period is equal to the period of rotation of the beam and will therefore contain additional frequencies whose differences from the carrier will be harmonically related to the frequency of rotation.

A second and perhaps more important point is that the antenna systems described in the article will not and cannot behave in the manner desired. It is probable that the reasons for faulty reasoning in the article are, first, a misconception of the nature of radiation which is a dynamic rather than a static phenomenon and, second, a misunderstanding of the meaning of the term "difference in phase." If some such misunderstanding did not exist, the actual results which would be obtained from the operation of these antennas should become immediately apparent.

First, let us consider the so-called "Ionoscan." The similarity between the simple turnstile antenna and this combination of a horizontal and a vertical element excited 90 degrees out of phase should immediately suggest that it operates as an array with very little directional effect, radiating an elliptically polarized wave. Neglecting the other fallacies which appeared in an article on a similar antenna in another magazine, it is probable that this characteristic accounts for the apparent improvement in communications which was noted in conjunction with its use.

Next, consider the array consisting of the two vertical elements using combination coupling to the final amplifier. A moment's reflection will show that this consists of two spaced elements with currents approximately 135 degrees out of phase and will produce a radiation-intensity pattern similar to that shown in Fig. 3 (if there is no radiation from the line connecting the elements).

While the desired result might be achieved if the elements of an array were fed with currents which had previously been phase modulated at the frequency of the desired sweep, it is questionable if there is any meaning in a beam sweeping at carrier frequency and even at lower sweep frequencies. It should be remembered that no gain in signal strength can be expected and that sweep could only be accomplished with the danger of producing interference. Such a device would probably be of value only in equipment whose purpose was similar to that of radar and even there it is likely that mechanical systems would be more practical.

The sections of the article in which the adjustment and loading of the amplifier are discussed are as misleading as any and they succeed in demonstrating nothing more than that the sum of two equal sinusoids with a ninety-degree phase difference represents a sinusoid with the same period whose amplitude is the square root of 2, times that of either of the two components and

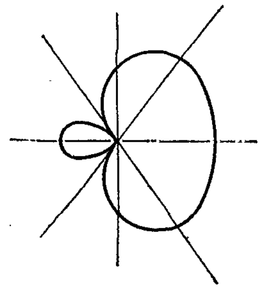


***Fig. 3*— Approximate radiation pattern for two element antenna with both parallel and push-pull excitation.**

forty-five degrees out of phase with them. This fact has no bearing upon the question which is under discussion.

The fact is that if the two components of output current are maintained so that the resultant is the square root of 2 times either component and the output impedance does not change, the resultant power output will be doubled, and since the plate-supply voltage is a constant, the plate current will double if the efficiency does not change (an assumption which is implicit in the article but is, of course, unjustified.)

I do not doubt, however, that the writer of the original article on the "Ionoscan" found the plate-current relations which he claimed. Such a result can be predicted from an approximate calculation based on an assumed full-load efficiency 70 per cent for the tube if the effects of coupling on the plate load impedance are taken into account.

— *Ensign Argyle W. Bridgett, USMS*

NARROW-BAND F.M. FOR HAMS

APO 565, c/o Postmaster, San Francisco, Calif.
Editor, *QST:*

Over here on this beautiful Pacific island we have been watching with considerable interest the progress being made at Washington concerning our postwar ham bands. . . .

I enjoyed the article on narrow-band f.m. which appeared in the December, 1944, issue of *QST*. For some time now I've been getting some ideas about using narrow-band f.m. in some of our ham bands such as on 28-Mc. and on the new 21-Mc. spot we hope to receive.

A band-width limit could be set at about 5000 cycles which would then make it okay for ham work. We have used it on point-to-point 'phone circuits and it works fine. I'm sure that quite a few of the fellows would be interested in giving it a try.

I have been doing a lot of postwar planning lately! That new rig will do just about everything except the family laundry.

— *M/Sgt. Wm. H. Kiblinger, W3HBH*

W4HVV FINDS MEMENTOS OF KA1A-

2110 Reaves Drive, Raleigh, N. C.
Editor, *QST:*

Yesterday I received the following letter from my son Charles, W4HVV, who is serving with the Signal Corps in the Philippines:

"Dear Dad:

The other day I saw something which touched me more than anything I have seen in many years. While visiting the ruins of a city near here in some of my time off, I walked about the rubble of what was once a respectable civilian home. In the rear of the house were the remains of two impressive pipe masts which supported a center-fed Zepp. This was one of the hundreds of lucky homes which enjoyed the benefits (?) of the 'co-prosperity sphere.' In desperation, the fleeing japs (little j on purpose) burned them, systematically and diabolically. The stench of flesh was all around.

"Among the ruins I found the remnants of an old ARRL *Handbook,* a 1940 Edition, I think. On the back of its front cover was part of a Filipino name and of a call, KA1A—

"All this seemed to justify my being in the Army and overseas. I am sure that if I were a civilian and saw this I would not hesitate for a moment to go into service again. . . ."

The above is, of course, self-explanatory. I never get a letter from Charles that he doesn't mention ham radio. It is one *great* thing that we have in common. My greatest desire now is to be as good a ham as my son has turned out to be.

— *G. H. Wright, jr., W4AVT*

AMATEUR RADIO—AN INTERNATIONAL BROTHERHOOD

232 W. Washington Ave., Pleasantville, N. J.
Editor, *QST:*

In recent months I have come more and more to appreciate the work of the ARRL. I am very gratified with each additional issue after reading the allocation news in "Happenings of the Month." What the ARRL is doing for the amateur cannot, by any stretch of imagination, be measured in cash value. I am a whole-hearted amateur radio man myself, and no amount of money could pay for the enjoyment I derived from it in prewar days — and hope to get from it when I am discharged from the Navy when the war is over. The amateurs, as I see it, are a huge international brotherhood of friendship, always ready to give the other fellow a friendly word or a helping hand whenever the circumstances require. I am proud to have the opportunity of being one of them.

I thank you from the bottom of my being for what the League is doing for each and every one of us. We all know that you will do the very best that can possibly be done, and you can count on us to give you all the backing that you need — and more.

— *Henry V. Leih, AP1/c, W9PHC*

W6IOX REVIEWS QSOs WITH KB6GJX

1017 Indio Muerto St., Santa Barbara, Calif.
Editor, *QST:*

The story in March *QST* about W/O George Tweed brought to mind QSOs I had with him in prewar days.

I first worked KB6GJX on February 14, 1941. All subsequent contacts I had with him were made in the 7-Mc. band. My last contact with him was on June 7, 1941. At that time he said he feared he would have to quit amateur radio at the request of the Naval authorities because too many Japs were in the vicinity of Guam.

The last time I heard KB6GJX on the air was June 14, 1941, on 20-meter 'phone, when he was finishing a QSO with a K6. I put my rig on 20 meters, but failed to raise him. The next I heard of KB6GJX was when I saw his name listed as missing on Guam.

I had many contacts with Tweed. He seemed particularly interested in talking with me because he previously had been stationed near here and was consequently quite familiar with our city — Santa Barbara. In addition, he had relatives living in Santa Paula, Calif., and I was able to handle messages for him.

Tweed also was interested in photography. A commercial photographer was visiting my shack one night while I was working KB6GJX and when Tweed found it out he plied the photographer with technical questions. It seemed that Tweed's camera lens had acquired a web-like type of fungus. He was anxious to find out how to remove it there rather than have to ship the lens all the way to New York for repairs.

I was a member of the "Hit and Bounce" traffic net during the days when I used to work KB6GJX and he was a fine outlet for the occasional traffic our net had for Guam. In addition to traffic handling, we used to chew the rag for an hour or more on many occasions. Tweed worked a lot of fellows on forty meters and on twenty-meter 'phone. I am sure many of them will recall those contacts, especially if they associate his name with his call, and then realize that he is the "Ghost of Guam."

The only souvenir I have that actually came from KB6GJX while he was on Guam is a QSL card which he sent me in March, 1941. I regard it highly as a memento.

— *Vincent J. Haggerty, W6IOX*

REPORT ON AMATEUR TUBE MAKING

3035 East Van Buren, Phoenix, Ariz.
Editor, *QST:*

I noticed in the January, 1945, issue of *QST* that T/Sgt. Warren H. Donnelly asks about glass blowing, vacuum pumps, and tube parts. I wonder if there are others interested enough to want to know about and use these things.

I made my first tube nearly twenty years ago and have made many electronic devices since and always as an amateur.

(Continued on page 80)

OPERATING NEWS

CHARLES A. SERVICE, W4IE
Acting Communications Manager

LILLIAN M. SALTER
Asst. Communications Manager

FCC Announcement. The Federal Communications Commission recently modified Part 15 of its rules and regulations governing the War Emergency Radio Service to permit the expansion of the scope of service of WERS stations. Civilian defense stations now may be operated during any emergency endangering public safety in addition to their use in connection with national defense. New licenses may be issued or old licenses renewed even though local civilian defense offices have folded up. This relaxation of the rules presents a fine opportunity to all communities to organize a WERS set-up. No doubt many cities and towns which do not have a WERS organization because of the inactivity or non-existence of civilian defense offices in their areas will wish to build up a WERS network. In this connection we again wish to call to your attention our booklet, *A Manual for the War Emergency Radio Service*. This pamphlet is available upon request and contains all the information needed to organize, operate and maintain a WERS network. Operators will be needed both for new and old expanding units, and we therefore urge all interested persons to write for a copy of this booklet and for the name of the radio aide of existing WERS licensees near them.

The amended portion of Part 15 also permits existing WERS licensees to coöperate with the United States Weather Bureau in the operation of a proposed flood and storm warning emergency network. Two new paragraphs regarding this new service have been added. The complete text of the new and amended rules and regulations appears in the "Happenings of the Month" department in this issue.

Personals. From time to time we receive letters from interested persons inquiring as to the activities and whereabouts of Communications Department members now in the military services. We feel sure that all of you will be interested in the pictures of these CMs and ACMs which appear on this page. Since many of those writing in request addresses we are pleased to give you this information.

The present location of Lt. Comdr. E. L. Battey, USNR, is 519 Spring St., Falls Park, Falls Church, Va.

Lt. Col. F. E. Handy, AAF, may be reached by writing to 4202 Oakridge Lane, Chevy Chase 15, Md.

Lt. George Hart, AAF, is located at 119 Carroll Ave., Asheville, N. C.

John Huntoon, CRM, USCGR, is in Washington, D. C., at 4527 Chesapeake St., N. W.

Carol K. Witte, HA1C, WAVE, may be addressed c/o Dispensary, Naval Air Station, Pasco, Wash.

Of the thirteen blue stars on the League's service flag, five represent communications managers or assistant communications managers who are engaged in active military duty. Those shown below are: *Upper left:* Lt. Col. Francis E. Handy, W1BDI, AAF, who has had overseas duty, and *lower left*, Carol K. Witte, W9WWP, HA1c, WAVE. The others, *left to right:* Lt. Comdr. Everett L. Battey, W1UE, USNR; John Huntoon, W1LVQ, CRM, USCGR, and Lt. George Hart, W1NJM, AAF.

WERS on the Job in the Spring Floods

When the Ohio River reached the point where a high flood could be anticipated, all mobile and portable units of WJKK, Jefferson County, Ky., were readied for action. These units went on the air at 6:30 P.M. March 6th with control station WJKK-1 operating from the city hall tower. A direct line through the city police switchboard gave instant communication with all departments involved.

Mobile and portable units were dispatched to the points desired by civilian defense and city authorities. One unit was placed at the canal and reported the river rises each hour, which enabled Mayor Wyatt to plan the relief campaign. Orderly evacuation of low sections was accomplished without the hectic scenes usually associated with such events. WJKK units were set up at these evacuation points and rendered prompt and efficient communication service. As regular communications facilities were greatly overloaded, WERS stations handled messages that required swift and urgent attention. The Coast Guard asked for, and received, two units, one operating from their land control point and the other on their boat headquarters. Auxiliary police used WJKK mobile units as cruisers for their inspection work on barriers and traffic control. The flood crested at 47.1 feet March 8th, but WERS operators were kept on watch until 7:30 P.M. March 9th.

Since relief was impossible, several operators worked twenty hours at a time. Those taking part were Anthony Ambrose, Earl Bacon, Milton Berman, William Brian, Joseph Colvin, Julie Conway, Glen Cook, Orville Cox, Otto Funk, Jack Gardner, Stuart Gates, William Hague, Virginia Heustis, Davis Jarett, Charles Leonard, S. W. Mather, James O'Donnell, Jack Parkhurst, J. B. Smith, Agnes Snyder, Billie Martain, Edward Wallace, Clyde Freed, and Martin Wheeler. Stations used were fixed WJKK-1, 2, 11, 44; mobile 300, 501, 502; portables 400, 401, 403, 404, 412.

In Connecticut, two weeks previous to the expected freshet, the Middletown district network, as well as the three local networks, operated on their emergency supplies for the entire drill period and everything was found in readiness should there be an emergency. On March 21st the four mobiles were called out on a special test to give complete coverage to the warning district, and maintained reliable contact with WKNQ-1 in Middletown from Marlboro, East Hampton, East Haddam and Middlefield. Contact was maintained through WKNQ-1 with Durham, Haddam, Portland, Cromwell and Middletown. In this way, all towns in the warning district were covered by battery-powered equipment. On Sunday afternoon, March 25th, when all danger of a serious flood had past, the four mobile units were dispatched into the flooded areas to patrol roads which were completely inundated. In some places, the water was over the running boards of the cars. Constant contact was maintained with various fixed stations and several mobiles were reported heard in West Hartford.

WERS of the Month

Pittsfield, Mass.

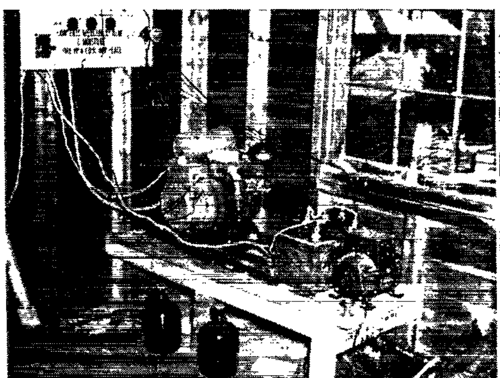
Prior to Pearl Harbor, the Pittsfield Radio Club had organized an emergency net, in coöperation with the local Red Cross, under the direction of R. M. Stephens, W1JLT. This net, like all others, had to shut down upon the declaration of war by this country. However, there was an excellent nucleus for the civilian defense WERS organization which followed. J. W. Farr, W1LUD, was appointed radio aide to head up the planning and organizational work and he appointed the following assistants: R. M. Stephens, W1JLT; P. M. Bailey, W1AZW; W. T. Buchanan, W1IZN, and M. A. George, W1BKG.

In June, 1942, a WERS license for eighteen stations and operators, under the call WKHW, was received. This license now covers twenty-two stations — ten mobile, eight portable, and four fixed stations. The equipment is largely home-made and consists almost entirely of the contributions of local amateurs. One rig belongs to the state. Two TR-4s have been purchased by industrial concerns for the stations located at their plants. The equipment at the local net control includes an m.o.p.a. with an 815 in the final. The antenna is an extended double Zepp about 75 ft. high with a concentric line feed. Excellent coverage is obtained throughout the city and surrounding towns. The most popular design for the other rigs is the parallel-rod oscillator using 76s. One rig uses the horseshoe oscillator described in *QST*. A couple of rigs use a coil and condenser combination. The most popular antenna is the "J." This is easily mounted in a window of a car for operating mobile. Great emphasis has been placed on battery operation.

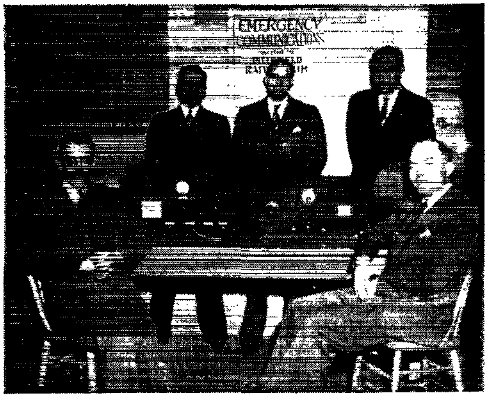
The stations are divided into two nets — the warning center net and the Pittsfield local net. The control station for the warning center net is located at the warning center for the region and works into the various report centers. Control for the local net is located at the Pittsfield report center and handles all Pittsfield stations.

Considerable work has been necessary to determine coverage of the area served by the license. The region is located in the heart of the Berkshires. Thus, numerous problems have been presented by the hilly terrain. Deadspots have been pretty well located and, through relays, contact has been established with New York State on the west; North Adams, Mass., on the north; Gardner, Northampton, Springfield, and Fitchburg, Mass., on the east.

The original operation was entirely by local hams, but it soon was evident that additional operators were required.



WKNQ, the Middletown, Conn., district network, was on the job during the threatened spring flood. *Left* — Emergency supply used to power district master control station, WKNQ-1. *Right* — WKNQ mobiles patrol inundated roads during a test mobilization on March 25th. The units are, *left to right:* No. 12, Abbott TR-4; No. 27 and No. 25, both composite jobs using HY75s, and No. 11, Abbott TR-4. No. 25 was described in *QST* for Nov., 1944.



Among those most active in the Pittsfield, Mass., WERS set-up, WKHW, are, *left to right:* William H. Buchanan, W1IZN, in charge of local Pittsfield net: Milton A. George, W1BKG, in charge of drills and operating procedure; John W. Farr, W1LUD, radio aide; Prentice M. Bailey, W1AZW, in charge of warning center net, also regional radio representative, and Robert M. Stephens, W1JLT, assistant radio aide.

Accordingly, classes were held at the local high school under the direction of Messrs. Farr and Bailey. Restricted radiotelephone permits were obtained by twenty-six additional operators. Inclusion of these operators within the nets made necessary some training in operating procedure and message handling. After drills to show requirements and weaknesses, complete operating instructions were developed under the guidance of Messrs. George and Buchanan and distributed to all operators.

It has been found that constant drill is required to maintain the organizations efficiently. Consequently, WKHW religiously holds a weekly drill. All testing, etc., is done during one of the other assigned periods. The drill starts with a roll call of stations. Then some time is spent in answering questions or discussing operating procedure. Next a station is requested to start the drill by a message reporting some possible emergency condition such as invasion, fire, hurricane, earthquake, flood, train wreck or ice storm. All stations then base their messages on the imaginary incident. Usually thirty to forty average-length messages per hour can be handled.

While WKHW was originally organized as a civilian defense unit, it is felt that the organization can be of invaluable assistance during any emergency. Therefore, there has been a constant effort toward improvement. When disaster strikes and the services of WERS are required, WKHW operators want to be ready to do a good job.

— *John W. Farr, W1LUD*
Radio Aide, WKHW

Each month under the accompanying heading we shall publish the story of an outstanding WERS organization as an item of general interest to all WERS participants. Contributions are solicited from any radio aide or WERS participant, whether he be an amateur or a WERS permittee. Descriptions of organizations which have already been featured in *QST* articles will not be considered. The story may describe the organization in general, how it came into being, how it was set up and how it operates; or it may describe some particular phase of the organization which makes it unusual or unique. Contributions should be brief (two or three typewritten pages, double-spaced, is maximum) and may include photographs if desired, although only one photograph will be printed with each story. Each story must be released for publication by the radio aide of the licensee, in writing. Address your contribution to the Communications Department, ARRL, and mark it: "For WERS of the Month."

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 full 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 full 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 on the dates specified.

Due to a resignation in the San Joaquin Valley Section, nominating petitions are hereby solicited for the office of Section Communications Manager in this Section, and the closing date for receipt of nominations at ARRL Headquarters is herewith specified as noon, Monday, July 2, 1945.

Section	*Closing Date*	*Present SCM*	*Present Term of Office Ends*
N. Y. C. & L. I.	June 1, 1945	E. L. Baunach	June 9, 1945
No. Minnesota	June 1, 1945	Armand D. Brattland	June 15, 1945
So. New Jersey	June 15, 1945	W. R. Tomlinson	June 22, 1945
San Joaquin Valley	July 2, 1945	Antone J. Silva (resigned)	———
Hawaii	July 2, 1945	Francis T. Blatt	Feb. 28, 1941
Sacramento Valley	July 2, 1945	Vincent N. Feldhausen	June 15, 1941
Alaska	July 2, 1945	James G. Sherry	June 14, 1942
Southern Minn.	July 2, 1945	Millard L. Bender	Aug. 22, 1942
New Hampshire	July 2, 1945	Mrs. D. W. Evans	Sept. 1, 1942
West Indies	July 2, 1945	Mario de la Torre	Dec. 16, 1942
Western Fla.	July 2, 1945	Oscar Cederstrom	Oct. 1, 1943
Idaho	July 2, 1945	Don D. Oberbillig	April 15, 1944
South Dakota	July 2, 1945	P. H. Schultz	May 18, 1944
Alabama	July 2, 1945	Lawrence Smyth	May 22, 1944
Los Angeles	July 2, 1945	H. F. Wood	July 1, 1944
Arkansas	July 2, 1945	Edgar Beck	Aug. 17, 1944
North Dakota	July 2, 1945	John McBride	Aug. 17, 1944
Virginia	July 2, 1945	Walter G. Walker	Oct. 15, 1944
New Mexico	July 2, 1945	J. G. Hancock	Oct. 15, 1944
Santa Clara Valley	July 2, 1945	Earl F. Sanderson	Oct. 15, 1944
Tennessee	July 2, 1945	James B. Witt	Nov. 15, 1944
Georgia	July 2, 1945	Ernest L. Morgan	Nov. 29, 1944
Kentucky	July 2, 1945	Darrell A. Downard	Dec. 15, 1944
Western N. Y.	July 2, 1945	William Bellor	Feb. 15, 1945
Mississippi	July 2, 1945	P. W. Clement	April 1, 1945
Rhode Island	July 2, 1945	Clayton C. Gordon	April 15, 1945
North Carolina	July 2, 1945	W. J. Wortman	May 3, 1945
Vermont	Aug. 1, 1945	Burtis W. Dean	Aug. 16, 1945
East Bay	Aug. 1, 1945	Horace R. Greer	Aug. 16, 1945
Indiana	Aug. 1, 1945	Herbert S. Brier	Aug. 16, 1945

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 full members residing in the Sections concerned. Ballots will be mailed to full 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 full members residing in any Section have the privilege of nominating any full 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 full 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 full members are required.)

The candidates and five or more signers *must* be League full 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 full 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.

— *Charles A. Service, Jr., 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 official, the term of office starting on the date given.

Western Pennsylvania   Roy Rosenberg, W8NCJ   April 1, 1945

Ham Yarns

What is the most unusual experience you have ever had in connection with ham radio? Have you ever had a QSO that took place under peculiar circumstances, or that resulted in an exciting adventure? Have you ever been surprised, terrified, or highly amused at some incident that occurred during the good old days when you were operating your ham rig?

CD invites you to submit your story of the most unusual ham yarn you know of, whether experienced by yourself or a fellow amateur, for possible publication in Operating News. All stories should contain approximately 500 words, must be true, and must center about the subject of ham radio.

Each winning "Ham Yarn" will be published in this department, and the author may select a bound *Handbook* (Defense or regular edition), *QST* binder and League Emblem, Lightning Calculators, or any other combination of ARRL supplies of equivalent value ($2.00), as his prize.

All entries should be marked "Ham Yarns" and addressed to the Communications Dept., ARRL, West Hartford 7, Conn.

Ham Yarn No. 6

BY A. DAVID MIDDELTON,* W2OEN

It was awfully foggy at W2OEN that December night. Inside and out the atmosphere was depressing.

Three carefully arranged 112-Mc. schedules with W1MEP on Glastonbury Mountain, Vermont, had fallen flat — as flat as the low end of the 20-meter band. At seven-fifteen that evening the third and last schedule ended. The 112-Mc. gear was shut down. No hits — no runs — all errors!

The gloom inside the shack was lifted somewhat by the arrival of two visitors, Bill Schwartz, W2AEL, and a non-ham pal of Bill's.

After a bit of rag-chewing, some of Major Armstrong's f.m. music from W2XMN and a lot of jive records on the alleged high-fidelity amplifier, the washed-up schedules and the rainy, foggy night were almost forgotten.

"Let's try two and a half," suggested W2AEL, as he flopped over "Marie" to give "Song of India" a whirl.

Several minutes slipped by while W2OEN expressed his opinion of 112-Mc. DX, the Jersey weather, uncompleted schedules and radio in general. But Bill persisted. For as he announced in truth — "At least W2NKO would be on — rain or no rain." Since W2AEL also hailed from Brooklyn, a contact between those two Dodger fans always proved entertaining even if the accent did get pretty thick at times.

The switch was thrown in and the 112-Mc. gear started to warm. By the time "Marie" had again ground to a finish, the familiar superregen hiss filled the shack.

Then a miracle happened — for there, fading slowly in and out of the hiss, was an i.c.w. signal. The call came through clearly — "W1JFF W1JFF de W1MEP AR." The hiss came up as the carrier died.

It just couldn't be possible. But there was W1MEP! The call had been too clear to fool the listeners in that shack. Never mind the weather or that W1MEP had been calling W1JFF! This was a plain case of every man for himself.

A flip of the transmitter switch and the nine watts input roared into the HY75, keyed by W2OEN's Lake Erie swing. The pleading cry rang out in the damp Jersey air. Never had such a heart-rending call been heard around those parts.

The rest is history! Mallory at W1MEP heard that call and a swell QSO resulted. I.c.w. gave way to voice as the signals came up in strength. At times Walter's signals completely killed all the receiver noise. Attempts to improve reception by tuning the receiver failed. W2AEL dashed out into the rain and fog to swing the 16-element beam. Much shouting through the window and several swings of the capstan bar controlling the antenna direction produced no better results. Both the receiver and the beam were set dead on W1MEP. A five-degree movement of the antenna from the correct position cut out the Glastonbury station! The antenna had been sitting right on position. The calculation of the frequency and direction, made for the earlier schedules, had been correct and, by chance, had not been changed.

After an exchange of greetings by all hands present, a great temperature inversion 112-Mc. DX contact, perhaps the last such in the prewar era, was over!

It was nine-forty in the evening of December 3, 1941.

* Assistant Editor, *QST*.

BRIEFS

Lt. Col. F. E. Handy, W1BDI, reports that a station was heard through official channels on May 6, 1945, at 1920 GMT on 14,230 kc. calling "CQ USA CQ de D4NEW." ARRL would appreciate full reports from anyone hearing this station.

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The Stratford Amateur Radio Club welcomes visitors to its radio "shack," which is located at 2427 Main St., Stratford, Conn. Officers of the club are: Rene Sawyer, president; Joe Dietz, vice-president and scribe, and Walter Keeling, secretary-treasurer.

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The Radio Corps, which was organized at Northwestern Military and Naval Academy, Walworth, Wis., three months ago, now has thirty-five active members. Of that number, nine have passed the 9-w.p.m. code test, three have passed the 13-w.p.m. test, and all have passed the amateur radio theory course offered. The advanced radio class, which consists of the members of the senior class who are in the ROTC, plans to take the FCC exam for Class B license shortly. Of the graduates of NMNA, three are licensed radio amateurs, two possess commercial licenses, and seven are engaged in radio work in the armed forces.

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A hamfest was held by the radio amateurs of Belgium in Mons, March 24th, attended by several American hams. Those present were W4FKR, W9DPU, W9IVB, W9YNZ, ON4PC, ON4SS, ON4TP, ON4BM, ON4DS, ON4IS, ON4FS, ON4CN, and ON4AXZ. The Americans were told that the Belgians were limited to ten and fifty watts power output. They used 203As in the final, this tube being very popular with them. When the Germans entered their country the Belgian hams were forced to turn over all of their equipment to the German government and since that time have been kept in the dark on the progress and future of radio. They requested the American amateurs to bring to the next meeting copies of *QST* and the latest edition of the *Handbook* and have asked one of the Americans to speak on any technical subject whatsoever at that time.

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The Radio Society of Northern Ireland (GI5HU, secretary) is again active and meetings are held in the YMCA Radio Club each month. At a recent meeting VE4TJ and VE5UR were elected members.

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Several months ago, the executive director of the Cleveland Chapter, Mr. John Cremer, jr., made available to the Cuyahoga Radio Association a meeting room and radio room in the Red Cross Headquarters Bldg. To show its appreciation, the CRA installed three radio transmitters and these are available to the Red Cross at all times for use in emergency. A group of skilled operators is also available at any time. One transmitter is rated at 500 watts input and is designed to operate in the 40-meter amateur band. The second transmitter is rated at 700 watts input and operates in the 80- and 160-meter amateur bands. The third is a 2½-meter WERS transmitter with 20 watts input for local coverage. This rig is operated during WERS and civilian defense drills under the call WJJH-80. Any part of Greater Cleveland can be reached with it and communication with the 75-odd mobile units in the county can be had. This is an arrangement which can be worked out to the mutual benefit of the Red Cross and amateurs of any locality.

AMATEUR ACTIVITIES

ATLANTIC DIVISION

EASTERN PENNSYLVANIA — SCM, Jerry Mathis, W3BES — The hams of the section are sorry to learn of the death of one of our best-known and popular operators, 3FRY. His big kilowatt was always in there helping the low-power lads get hooked up with the rare DX. 3HJE came home from the Near East to get hitched. 3DOS was best man and 3HXA was an usher. It is quite likely that 3ENX will be back with us in Philadelphia. 3BXE is working in Washington, D. C. 3CHH is temporarily in Philadelphia with Western Electric. 8CP paid us a nice visit. 4MS is currently visiting the local hams, taking movies for a post-war hamfest film. 3GML is in the Pacific theater. 3IGK is reported to be engineer of WINS in N.Y.C. 3HFD will not move into his new QTH until July but the BCL QRM has started already. The BCLs are afraid that Frank will "improve" the terrain with sky hooks. We regret to hear that 3EQ is ill and in the hospital. 3FLH has fully recovered from his operation. 8MTO, former member of the Frankford Radio Club, was in Philadelphia recently and wishes to be remembered to all the gang present at the last Field Day. 3IJN sent his first SOS. 3IBB, merchant marine operator, survived a collision. 3FWH dropped in to say so long before going overseas with Uncle Sam's Army. The WERS operators were thrilled over some 2½-meter DX when WKIB, Philadelphia, QSOed WNYJ, N.Y.C. 73, *Jerry*.

MARYLAND — DELAWARE — DISTRICT OF COLUMBIA — SCM, Hermann E. Hobbs, W3CIZ — IEM writes as follows from his present location, somewhere in India, with the AACS: "I still recall the good old days of hamming on 80 and 40 c.w., and am looking forward to the time when we can all get on the air and bat the breeze to our heart's content." He is looking forward to hearing from his radio friends. Write to the SCM for his complete address. The WERS gang is showing excellent progress. There were twenty-two stations on the air at the last drill and the fellows have hopes of reaching New Jersey and Philadelphia with their 150-Mc. frequency. All are on the same frequency. George W. Bailey, president of the ARRL and Miss Zandonini, president of the Washington Radio Club, recently enjoyed a Chinese dinner given by Kung Shao-Hsiung, formerly manager of the Chungking Branch of the Chinese Amateur Radio League and at one time an operator of XU6KL. Frederick County has received its WERS license. The following hams helped in the organization: ATQ, BJV, JCV, AKX, and WN. WN has been appointed radio aide and I. L. Hankey, Class A, no call, deputy radio aide. Successful tests have been run with WMWC, Washington Co.; WMDD, Montgomery Co.; WJGS-70, state control, and WMSK-4. Using TR-4, it was heard by WJYC-5. Most of these tests have been worked from west of Frederick at Gambril State Park. Sgt. EKZ writes from Germany as follows: "I have been getting my copies of *QST* and enjoyed them very much but notice that the Baltimore gang has let you down when it comes to giving you news for the activities section. I know those that are left are very busy but the WERS gang has been very active and could give some dope. I am now a technician 4th grade but am not in radio. For some unknown reason the Army made a clerk out of me and put me in the administrative end. I am going to write to the Md. Council of Defense and get Tom to give some information on what is happening there. I know all the boys overseas are very interested in reading anything about home. I hope that we will soon be able to contact each other by radio." 73.

SOUTHERN NEW JERSEY — SCM, Ray Tomlinson, W3GCU — Asst. SCM. Ed. G. Raser, W3ZI. ASQ and ye SCM were guests recently at a meeting of the Somerset County Firemen's Association. As guest speaker, Dal gave a very interesting and enlightening talk on the function and operation of WERS. Great interest was apparent, inasmuch as several companies were unaware of the valuable potentialities of this work during emergencies. ASQ reports that the main drill night for the WKPX net has been changed to Monday, and that Wednesday evening will probably be set aside for operation with the special traffic network. This change was necessary because of a change in working hours of several of the members of the Hamilton Twp. WERS Operators' Assn. The by-laws of this organization were presented for final approval at the April 18th meeting. The radio aide for Hillsboro/Branchburg Twps. reports five new operators have WERS permits and the WKXQ organization now is ready to start forming an organization along the lines suggested in a recent OCD bulletin from Trenton. Radio Aide ABS again has found it necessary to change his QTH because of rapidly changing housing conditions. He should be addressed: P. Stanley Case, RFD 2, Somerville, N. J. A V-mail from JAV gives his latest QTH as: Sgt. Phillip Catona, Navy 225, Fleet Post Office, San Francisco. Phil says, "I am very pleased to see that you fellows are keeping the 'spark' alive, and also serving the WERS." EED, radio operator in the merchant marine, attended convoy school before putting to sea on a liberty ship. Pfc. HWO, jr. reported for duty after a furlough. HOJ may be reached at his new QTH: Ens. Walter Scott, N. Y. Navy Yard, RMO, Bldg. 77, 4th Floor, New York, N. Y. Walter tells us they had a swell reunion recently when HUZ was home from Camp Croft, S. C., together with HHY, just back from twenty-three months in England, and JIX recently home from the China-Burma-India theater. JAU still is at Philadelphia Navy Yard. GMY is with Radio Condenser Co. FXV is reported as being in Germany. Maj. ATP took upon himself a bride, Lt. V. Severson, chief nurse at Blair Field, Ind. Al is stationed at Ledalia Air Base, Knobmaster, Mo. EQF is enjoying a thirty-one day furlough after twenty-two months in Africa. IOU has changed positions and is now looking for a suitable place to live nearer his work. Billy Bryce, radio technician with Signal Repair Co., has been reported stationed somewhere in Holland. Maj. VE has been awarded the Bronze Star for outstanding service as executive officer. Sam made a reconnaissance trip into enemy-occupied territory under enemy fire; aggressive and heroic action on his part and information thereby received was instrumental in preventing the entire battalion from walking into an enemy trap. T/Sgt. HAZ now is at Brooklyn Signal School taking a course on marine wireless gear. HW now is with Palmer Labs. IUQ is radio operator with the merchant marine. ITS is the papa of a brand new YL. Latest QTH of Bob Haworth is: Robt. Haworth, ART2c, c/o Fleet Post Office, New York, N. Y. Hank Bennet writes that he is on detached service with General Patch's Seventh Army, pounding brass, and just recently found out the OM on the other end was none other than 6ZIS from Utah. Hank says there are four hams in his company, 8WSW from Pennsylvania; Harvey Paul Monsch of Mt. Holly, N. J.; 8MON from Apple Creek, Ohio; and the company commander, a W5, from Texas. IIC now is in the furniture business. The SJRA welcomed ten visitors at its March meeting and the film, "Radio At War," loaned by RCA, was greatly enjoyed by all present. Two new members were welcomed, Mr. Lon Dorfnor, and Mr. Frank Pinolt. IZP won the meter in the auction for two bucks. Three members of SJRA have had success with c.c. communication; IAS, AKI, and George Harrold have held lengthy QSOs between Haddon Heights and Haddonfield. The Delaware Valley Radio Association also welcomed two new members into the fold, Chas. E. Maahsen, and Richard B. Marotte. The DVRA wishes to acknowledge and sincerely thank Sgt. Jimmy Hassal and BO for their kind donations to the DVRA building fund and *DVRA News*. Thanks also to ASQ for the donation to the *News*. It was erroneously reported in this column last month that FMU was confined to a hospital bed. It should have read, GQX and not FMU. GQX is FMU's dad; and we are happy to report that he now is at home recuperating. HVO has relinquished her position with the C. V. Hill Co., Trenton. A special committee has been appointed to obtain a meeting place for the DVRA which will be central to all members. George Hulse, formerly of American Radio, Trenton, is stationed in Italy and, it has been reported, is in charge of the G. I. theaters. BO, formerly of Merchantville, now is living in Baltimore, Md. 73 'til next month. *Ray*.

WESTERN NEW YORK — SCM, William Bellor, W8MC — CMW took a WERS unit to Vernal Corners, a point approximately halfway between Rochester and Buffalo, and was able to hear WHNH-1 and 9 and WQWT-1. No relay contact was made, but the experiment shows possibilities. A state-wide emergency tie-up should be of considerable value when needed. The boys of the Syracuse, Buffalo and Rochester groups are endeavoring to accomplish this. SZB had a letter from STA's XYL telling us that Herbie is in Italy with the Seabees. The CAP-WERS group in Rochester has added several new units and has been making many interesting plane-to-ground tests. WJPX, Rochester, has three new Abbott TR-4 transceivers and now is doing message center work; the lieutenant is an ex-ham, EJO. According to LQT, secretary, the RARA hamfest on March 31st was a huge success, with an attendance of over 50. BCL won a 160-meter transmitter in the prize drawings but it looks like he will have to do a little pruning on the coils. NCM has developed an automatic key involving time-delayed relays. VUY's job with the Signal Corps is deciphering Jap codes. RDX has just built a new 112-Mc. superhet. We hear with keenest regret that RO RQT was lost on a bomber in the Pacific. Bob used to operate 160 out of Shortsville, N. Y. NVK was home on a ten-day leave recently. 73, *Bill.*

WESTERN PENNSYLVANIA — SCM, R. R. Rosenberg, W8NCJ — Word has just been received of my election as SCM. I am very happy to have been accorded this honor and earnestly solicit the cooperation of all Western Pennsylvania amateurs so that we may have an interesting write-up each month in *QST*. Please note the change in my QRA and mail all reports not later than the fifteenth of each month. The Erie Amateur Radio Club held a hamfest April 23rd, at which time plans were discussed for reactivating the club. TTD and AOE are very much interested in reading more news from hams now in the services. IYI is b.c. engineer at WCED, Du Bois. WQ is working for the Sylvania plant at Brookville. A very nice letter was received from RWJ, somewhere in Germany. He mentions that he hears often from OWC, now stationed near Paris. Let's have more reports, fellows. My complete QRA is: R. R. Rosenberg, W8NCJ, 927 East 23 St., Erie, Pa. 73.

CENTRAL DIVISION

INDIANA — SCM, Herbert S. Brier, W9EGQ — UCT is doing his regular civilian job in France, but the sooner he can do it as a civilian in the States, the better he will like it. WIB is planning on a new frequency-meter, receiver and e.c.o. when the Navy is through with him. HUV found an Air Force radiosonde balloon. He admits it was temptation to "swipe" the 955. NXU is studying receivers for the Army. SNF was home on furlough in April. WKMR, Gary, had a hidden transmitter hunt. MVZ and MTL located the unit. T/Sgt. ROF is in the States after three years in India. ZNC and his unit captured a brewery in Germany. WXG is praying for the safety of the Navy since he learned that CKP is a CRT. EHT reports as news that he purchased a copy of *QST*. CWY, in Italy, has just learned how important antennas really are. EBB completed the "Nan Super-Gramyfone" at last, and is well satisfied with it. ABB writes from the Marianas, "Ah, wonderful Washington, 20 girls for every man. IIL says, "I can say without blushing that I have the best looking radio shack (from the inside) in the U. S. Army! AB wishes Mishawaka WERS had some higher antennas. FDS built a two-stage preamplifier for four mikes. YWE is studying radio engineering in his spare time. NZZ fixes a b.c. set once in a while. WEU sent me an air mail letter from Michigan City (about 20 miles); his wife agrees with KBL's that the oven is the only place for hams. OOG is in Paris. 73, *Herb.*

KENTUCKY — SCM, Darrell A. Downard, W9ARU — AHL, at Mt. Sterling, intends paying ARTS a visit when he can get some gas. DFW is experimenting with a three-element beam on his 115-Mc. job. Ed Wallace is acting radio aide for the second district. For the benefit of the gang in the services, we might say that we found out the fee we pay the C.C. is for YL Observation — it can't be for the food. YXF says "he thought" the 112-Mc. band was screwy on one Monday night. The third district recently lost one of its most active members in mobile operation, Julie Conway, to the WAVES. Joe Colvin has escaped entanglement with the law in the last 30 days now that the police have been informed as to the legality of the WERS program. No. 33 has been very regular in attending drill each Monday night. GOM, control station for the third district has two crystal-controlled transmitters and superhert receivers going. No. 32 is having transmitter trouble. No. 34 has a superhet receiver which supers but doesn't het properly. The Amateur Radio Transmitting Society meets the second Saturday in each month at the Canary Cottage. Dinner is served at 6:30 P.M. and you fellows at Bowman Field, Ft. Knox and Nichols General Hospital are cordially invited to meet with us.

MICHIGAN — SCM, Harold C. Bird, W8DPE — 8ROV sends us a nice letter from the AACS in the South and reports doing a lot of c.w. work. 8HKT writes from the Pacific that he would trade the whole thing for a good hamfest at Ypsi once again. The following report was sent in by 8PLP of Lansing WERS: 8WCI, unit No. 18, left for the Army recently. 8AHV, unit No. 8, has portable along with fixed transmitter and receiver. S/Sgt. 8WDA, unit No. 9, is radio gunner and has completed twelve missions. 8VDC, unit No. 5, has three units, one a battery portable-transceiver, another an a.c. transceiver, and the third a high-power transmitter and separate receiver. Unit No. 1 is crystal-controlled for spotting stations. 8UXS, unit No. 11, now is in the merchant marine. 8PLP, unit No. 12, is getting along without a Collins matching system on his antenna. Unit No. 5 uses a folded dipole antenna with success. Unit 12 is using a J antenna very successfully. 8PUK, unit No. 21, is doing radio service work. 8ADB, unit No. 13, is doing 100 per cent war work, and reports 8KER doing similar work. 8CQT, unit No. 20, is doing his duty as a war worker. 8RQS, unit No. 10, is working for the city police as operator. 8VIZ, unit No. 22, is operator for state police. Ralph would be pleased to receive a card from anyone hearing WKCJ. His address is: Ralph Ziegenbein, 920 Clyde St., Lansing, Mich. 8UGR is hopeful of getting back on the medium frequencies soon. 8JO would like to contact any fellows with 2nd-class 'phone or c.w. licenses with some experience. If interested, write your SCM for information. NQ has managed to survive a rugged winter in New Baltimore. 8QQK has a new address. 8BIU is busy with war work. Clark, who used to be 8IHN at Fort Sheridan, sends a nice letter from Oklahoma. He spent twenty-two months with 8NIT in the Aleutians. NIT now is in Scott Field. Clark says that 8NNX, former Edison Institute boy, was married not long ago in Batavia, N. Y. Clark would like to hear from Capt. TNU. The DARA held an enjoyable pot-luck supper on March 24th. Ed Gocha and your SCM supplied the entertainment by showing talking pictures. At a recent meeting the guest of honor was Mr. Brown of the RID. The DARA and the Edison Radio Club held a joint meeting at the Legion Hall in Detroit. Paul Bauerle, Lansing radio aide, sent us a recording of the WERS stations in operation. The Pontiac WERS Club is plugging along with code classes but expects to hold drills again very soon. WKYM has been relicensed for another year. Your SCM will welcome reports on your activities. Thanks and 73, *Hal.*

OHIO — SCM, Carl F. Wiehe, W8MFP — CBI reports WJTW, Dayton WERS, has grown to sixty-one stations, all of which will be licensed as portable or portable-mobile. WJTW stations regularly contact WHIK at Troy, WKOD at Hamilton, and WKHO at Cincinnati. QDI says he is in Hawaii en route to a new station in the Pacific area. ENH, changing stations from Corpus Christi to Naval Instructors School at Chicago, enjoyed a furlough in Dayton. MFV finds the Arctic not half bad. TDY has been hospitalized for some necessary but not serious repairs. QDD, in the Air Corps en route to the Pacific, was in town for a few days. OJF, doing radio work at Wright Field, was a guest at WJTW-2 recently. The Dayton WERS group meets at the Engineers Club the second Monday of each month. Visiting hams are welcome. PZA reports an attendance of 125 at the April meeting of the Cuyahoga Radio Association. Members were conducted thru NBC's WTAM by courtesy of LEX, an engineer there. Radio theory lectures will be given beginning April 16th by Prof. Martin at the club rooms in Red Cross headquarters. OFF, in the merchant marine, says hello to the gang. UCY, a Navy nurse, is an ensign stationed at the Marine Air Station at Cherry Point, N. C. OPK is S1c taking radar training at Great Lakes, Ill. EFW says that he likes Hawaii. UYN, operating Army radio gear in Germany, says he prefers ham gear for flexibility and that when hams get together over there they talk about radio, DX and women. A picture in a 1916 radio magazine found at the public library shows DS in a Boy Scout uniform operating a spark coil transmitter. LZE was recently married to an Air WAC in England. MXK is reported a P.O.W. in Germany. JNF's son is home on furlough. BAH wrote from Hawaii. GD sent the CRA a Jap radio tube. Hams visiting Cleveland are cordially invited to visit the new CRA club rooms. Contact QV at American Optical. VUV writes from Germany that when the Germans start their radio jamming it sounds worse than the old roaring forties. MFP would like to include more news. 73.

WISCONSIN — SCM, Emil Felber, jr., W9RH — T/Sgt. OEB writes from England that he has his electronic key working and gets in a little brasspounding even if it's only an a.f. oscillator. S/Sgt. Jesse D. Wheaton, in England, would like to see a "Tri-State Amateur Assn." composed of all ham clubs in Wisconsin, Minnesota, and Illinois, which could include a monthly club paper, etc. Any clubs interested write to the SCM for Wheaton's complete address. Sgt. H. E. McDonnell now is in France. Sgt. Don L. Hayner, located in Italy, has not met any hams there. Ed. Thornley, S1c (RT), finished his boot training. Carl Rohde, S1c (RT), was a visitor in Milwaukee. JWN-CRM, after four years on the Pacific as radio operator, has been transferred to take a course at a Naval school in Detroit. Ex-8AJX, formerly of Conneautville, Pa., now is a Milwaukeean and is working for Allis Chalmers. Capt. JWT, USMCR, met ERS, of Appleton, on the Isle of Palau. Capt. EFX, of the Signal Corps, located in Red Bank, N. J., wrote that ex-KWV dropped in to his office on business. Lt. ANA, USNR, located in Luzon, reports his collection of radio parts has reached such proportions that he would require an LST in order to get the stuff home. 1st Lt. VKC, located in New Delhi, India, is on the staff of the "*Roundup*," the best service paper that HRM has ever seen. T/Sgt. FQO has been transferred from Alaska to New Guinea. Sgt. CRK, who was in a bomber group in Italy, has been reported missing. Pfc. John Holmes is stationed at Amberly Field down under. Pvt. Paul Ripple is stationed at Versailles, France. Sgt. Gil Rink still is in Paris. Sgt. Frank Detzek is kept busy standing watch on radio flight line maintenance, experiments and school three times a week in Kansas. Sgt. Bernard Kellner has been transferred from Texas to California. Lt. KFB, Air Corps, has been stationed in England for over a year. RM1c ZUX, previously reported as missing, was killed in action in Lingayen Gulf, P. I., on Jan. 6, 1945. Units of WMFI, of Milwaukee WERS set-up, are continuing Wednesday night drills with the second operators of each unit taking over in order to have the less experienced men "get the feel" of things. On May 30th the Milwaukee Radio Amateurs Club will wind up its meetings until the fall. 73, *Emil.*

DAKOTA DIVISION

SOUTH DAKOTA — SCM, P. H. Schultz, W9QVY — ZBU, of Platte, reports that he had a letter from BZI stating that his ship had been damaged. Out of the affair he got a new radio repair shop and equipment and a new gang to work with. OXZ has resigned from the highway department and is now chief engineer for the new state-wide f.m. communications system which the South Dakota law enforcement bodies are installing. WUU reports from Oahu, T. H., that he has been transferred from the Signal Corps to the Air Corps. He is a corporal and is plenty busy dabbling in electronics. He also states that his brother, Lt. Ray Johnson, lost his life on Leyte, December 6th. Melvin sends his 73 to all the old gang. 73, *Phil.*

NORTHERN MINNESOTA — SCM, Armond D. Brattland, W9FUZ — BBL, CRT/CG, informs us that he has found time to complete a dandy v.f.o. with 60 watts input to a 807 in the final. Frank has been in the C.G. almost four years, enjoys his set-up and says that he has been very active recently because of floods and the necessity of maintaining the gear in 1st-class condition. MTH took his 1st-class radiotelephone exam the other day. He finds time to continue building equipment for CAP-WERS. RM1c ICQ, of Minneapolis, is an instructor in convoy school at San Pedro; he used to operate 40 and 160. YKV has been reported quite ill. HZM is in France. 4HZY/K4, ex-9UKB, writes that he has put in four years with P.A.A. and now is in the Caribbean Islands. FUZ, of the merchant marine, gets a few days now and then to visit his family. He has visions of the uses he could make of auto alarms and high frequencies. RPT recently completed an overhaul of his rig and says it's raring to go. BMX is lining up some instruments and test gear which he claims are necessary for fixing things. GVO recently completed the remodeling of his store. RIL, at St. Cloud, is doing a fine job for CAP as squadron commander and group communications officer. He has conducted some interesting experiments with remote-controlled 2½-meter transmitters, coupling directly to the center dipole of a three-element beam. JNC writes from Delray Beach, Fla., where he is completing an advance course in blind landing approach radar. He states that many of his fellow officers and men are amateurs. TYN, of the Navy is taking an engineering course at the U. of California. S/Sgt. JRI, of St. Paul, is at Corpus Christi taking a refresher course in radar. Jack spent a year overseas in radar. No word recently from ZWW — he has probably located a prospective OW. BHY recently completed a new heterodyne frequency meter which will more accurately keep CAP-WERS in line. 73, *Army.*

DELTA DIVISION

LOUISIANA — SCM, Eugene H. Treadaway, W5DKR — HSH, who is CRT, sends the following dope on the gang: JNQ is back on his ship after being in the States for fifty-eight days, nineteen of which he spent at home. IDI and IBT are assigned to the Fleet. HNW is a full lieutenant in the Navy and is communications officer on an escort carrier. DWW is a busy man with his duties at KRMD and fixing BCL receivers on the side. INF is back in the Navy as RT2c and is stationed at Oceanside, Calif. HZO, former secretary of Caddo Amateur Radio Club, is in Patuxent River, Md. HEJ and HEK are carrying on, on the home front. KHH writes the SCM that he is leaving for the Navy as S1c (RT) and asks the gang to help keep this column going. JET, reporting from New York, says he enjoys the "big city" in between trips overseas, and sends 73 to the gang. Will be looking for the postman to bring more dope from the gang for our next report. 73, *Gene.*

HUDSON DIVISION

NORTHERN NEW JERSEY — SCM, Winfield G. Beck, W2CQD — Cpl. EAM is back home after his graduation at Yuma, Ariz. as radio operator gunner. Pfc. LTP writes from McLellan Field, Sacramento, Calif. to say he doesn't get the same kick out of operating for AACS that he did from ham radio. His two-and-one-half-years stay in Alaska makes him think of home, a brand new kilowatt, two receivers and a twenty-meter beam. 2nd Lt. MAX, in the Aleutian Islands, is in communications work, and from his short note he's entranced with the scenery and the variety of WX! S/Sgt. GJC, Roselle, sends a V-mail from Germany and hears two U. S. broadcast stations there. Drop a line about yourself and any of the gang when you have time. Let's have a walloping big column next month. 73, *Win.*

MIDWEST DIVISION

IOWA — SCM, Leslie B. Vennard, W9PJR — LAC is new EC of Burlington and is planning on a WERS license. BGU is new EC for Mt. Pleasant. NLA, of Mt. Pleasant, sends in a picture of himself in a ham shack deluxe. It shows why the Army hour always gets through on Sundays. The Burlington club still holds weekly code and theory classes and has kept up the membership of all its members in the services. SEE sent in the only report this month. Council Bluffs is waiting for its WERS license and hopes to be going soon. QUF is located at Minneapolis in radar work. REV, chief radio technician on an escort carrier, kept radio communications going during the invasion of Luzon and got his picture in the papers for his good work. QAQ now is at Wright Field. UQJ is with U.P.RR. in u.h.f. train control work and has hopes that all will work well. A small hamfest was held at SEE's ham shack. FLI, QAQ, CCY, PGG, PDM, UQJ, and LCD are the only ones left of the Council Bluff's gang. Let's have those EC certificates for renewal, gang, and a few reports, please. 73, *Les.*

KANSAS — SCM, A.B. Unruh, W9AWP — YAH, formerly active in contests and traffic work, is radio operator in the merchant marine. YRN is instructor in electrical engineering at K.U. MKU is a lieutenant in the Signal Corps at Ft. Monmouth, N. J. He recently acquired a YF. PHY is with the telephone company at Goodland. T/Sgt. QZT was home from the So. Pacific and will go to California for reassignment. WGW, who was a technician for Sinclair at Independence for twenty-five years, has accepted a job as electronics installation mechanic with Schlumberger in Houston, Tex. CJK, formerly active in USNR work in Wichita and Topeka, is a lt. comdr. with duty as communications officer. While in Washington, D. C., some time ago, he acquired radiotelephone and radiotelegraph first-class tickets. BCZ is spending a week-end at Fort Leavenworth, and will take advantage of a free physical examination and free meals while there. JZE is stationed at Boeing-Wichita as radar field-service engineer for Western Electric. RQF, of the Air Forces, is in the Marshall Islands. DMF, of Boeing-Wichita's engineering department, recently returned from M.I.T., where he studied radar. He now has gone to Wright Field for further study. GUO operates a typewriter shop, and is quite busy. 73, *Abie.*

MISSOURI — SCM, Mrs. Letha A. Dangerfield, W9-OUD — JWJ is wearing a diamond, presented by GYZ, who hopes to get back from Europe in time for a wedding in

June. The OM wrote "Invasion Hams" in April *QST*. FOR/FIR spent his 24th birthday at sea with the merchant marine and suggests we see to publicizing the value of ham radio to make sure we keep our bands. He wants dope on TWP, BAA, UCK and George Blaze. KIK reports that HUZ is back in civvies. GHD had that thirty-day leave he had anticipated for eighteen months and is back in the Aleutians. Dave visited AEJ's folks and reports that Bill is on a carrier. BIU, from Poplar Bluff, writes from India, where he is living in a tea planter's bungalow and enjoying life and the country very much. He is co-pilot on a C-47, and manages to keep in touch with radio by working with the radio operators building up circuits. ZAO is with the merchant marine. Ex-IGW is back at sea. UUA, at Gieger Field, expects to bring his family back to Kansas City on his furlough. ZJG sent a German G.I. transmitter to PYK from France where he is kept busy repairing equipment. Converting those German outfits so they will work on G.I. power supplies is quite complicated. KM, stationed in Pennsylvania, received one of these German transmitters from CXE. BMS is still at the crystal plant and OUD has found there is more than one way to stretch a steak — finding one is more tricky than working a K7 on 80. 73.

NEBRASKA — SCM, Arthur R. Gaeth, W9FQB — KHBW-1, in Ashland, with "Doc" at the mike, contacted KHKN-2 and 39 on April 8th, and one week later duplicated this and in addition heard KHKN-46. KHKN license has been renewed for one year. YDC, KHKN radio aide, took unto himself an XYL. Paul Russum, KHKN-36, track man at Benson High, has a 615 rig (KHKN-15) working portable-mobile. ZPZ, KHKN-33, is contacting local CAP regarding WERS, and is going to demonstrate for them, via airplane-to-ground contacts with KHKN net. Cliff Allwine, KHKN-39, is working his soldering iron overtime, on the grid of his HY75, each drill period. UFD, KHKN-30, is working with panoramic reception. 5ABI, KHKN-13, added a few more feet of wire to his antenna in the chimney and still has the landlady fooled. YMU, KHKN-59, says the valley and trees at his present location are too much competition. Henry L. Peterson, KHKN-43, is pumping 425 volts into a 6V6 and is getting away with it. FSR, KHKN-11, is building a deluxe 2½-meter receiver. UEV, KHKN-31, has tamed the r.f. within the shack, is putting out a mean signal from down south, and is copying KHBW-1. Oral C. Chapin, KHKN-22, received 2nd-class commercial radiotelephone ticket. JCK built a midget 2½-meter receiver and a J antenna, and now is completing transmitter and applying for WERS permit. The AK-SAR-BEN Radio Club received its charter from ARRL, and is planning a field day. EKK, KHKN-2, offered to donate a frequency meter to the club and passed around cigars because of Catherine May Kinsey, just arrived. Pfc. BXW, of Minneapolis, was a visitor at the club meeting, and is qualifying as a frequency-measuring expert for the Army Two new members added to club roster are Paul Russum, KHKN-36, and Max H. Lohse, who hopes to be on WERS net soon. Congrats to Lt. BZV, who acquired a lieutenant nurse for his OW. AYC is hanking for some knuckle wear on the good old c.w. bands. "Cellophane," 4GFH operator No. 1, reports that she and Lt. Comdr. A. L. Budlong had a nice visit recently, and that she is custodian of 7HKM's rig for the duration. Capt. HTE is on detached duty with air echelon of his squadron. RWV is working for KMMJ and building h.f. equipment for program control extending from Grand Island to Phillips. Sgt. FLF is radio repairman in anti-aircraft in Belgium, and sends dope on NPL and MUK. LTL reports that he now has a civilian student pilot's license, and has sights set for private pilot license. Also, that KVP, not KYP as previously reported, is instructor in E.F.B., at Sioux Falls. PHW is with AACS in S.W. Pacific. FQB, KHKN-10, is rebuilding 809 rig in anticipation and is conducting code classes for WERS. 73, *Art.*

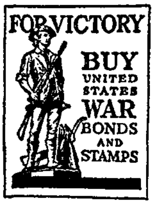
NEW ENGLAND DIVISION

CONNECTICUT — SCM, Edmund R. Fraser, W1KQY — The following have received licenses: Amateur Class A: ATH, LTZ, MEF, NCL, IND, MVH, Fred Burkle (LSPH), and Frank Luddington (LSPH). Amateur Class B: George Dunbar, Ed Bates, and Les McLellan. Commercial radiotelephone 2nd-class: BW, IJ, and KAT. APA writes that he is back in the East after eleven months in Camp Crowder, Mo. with the Signal Corps. At present he is confined to the hospital with a skin infection. He enjoys reading station activities, sends 73 to the gang and can be reached by writing to Gilbert Williams, Co. D., 1st Regiment, Indiantown Gap Military Reservation, Indiantown Gap, Pa. BFS writes from San Francisco where he is RM1c in the Navy aboard a mine sweeper. He now is married and one of his XYL's duties is to forward his copy of *QST*. QV, whose telephone number is 7388, recently spent several days in New Haven where the past and future of amateur radio was discussed at length with KQY. Bob was scheduled to speak at GB but had to return home because of a throat ailment. Contrary to last month's report, he now is with Johns Hopkins U. in Silver Springs, Md. MVH went to Boston, where he secured his restricted radiotelephone permit, and now is working at broadcasting station WEEI. CTI still is playing with wired wireless in Norwalk but says he is ready to chuck up everything when the opportunity to work c.w. again avails itself. WERS news: Norwich: Eli Crumb reports that WJTR-2, 5, and 6 have been hearing WKNQ-1, WKWG-70, and WKOB-14 consistently. Improvements are being made on the Norwich units, all of which now operate off emergency power. Hamden: Mary Creaven, ex-WERS operator for WJLH-1 and 39, writes from the West Coast, where she is in the WAVES, that she hopes to visit 6RBQ and 6TI as well as West Coast WERS units. New Haven: IND, MVH, and KQY are experimenting with beam antennas. One using four-elements worked out very satisfactorily but when the number of elements was increased to ten NEK, who was operating WKOB-14 in New London, reported a signal strength of R-9 plus all over the room, which blocked out a local unit four miles away. Kit Jackson, ably assisted by Betty Doyle, Lillian Kaas, and Jane Terrill, is operating WJLH-1 in the absence of KQY. West Haven: TD has been acting as radio aide and has been doing a swell job of keeping units in operation. LZM is active again, operating WJLH-24 portable-mobile. Bridgeport: Don Mathews has returned to the air with WKAO-48 with his usual R-9 signal in neighboring districts. Waterbury: WKWG-70, who is the most consistently heard WERS unit in Connecticut, is on every Sun., Mon., and Wed. Carl entertains the gang with his television receiver when not operating WKWG-70. Middletown: DBM has been heard quite a bit from WKNQ-25. Hartford: EAO, State radio aide, recently originated two messages for relay to Washington, D. C. Units participating were WMHC-33, WKNQ-25, WKWG-70, WJLH-32, WKAO-64, and WJQA-32. EAO reports a route from New York to Washington has already been established. Connecticut units hear WNYJ-150 very consistently for distances up to 130 miles. Your contributions to keep this column active will be greatly appreciated. 73, *Ed.*

MAINE — SCM, G. C. Brown, W1AQL — The Maine CAP held a reconnaissance maneuver recently with headquarters at Augusta. CBV and UP were on duty with 115-Mc. sets at Bangor and Brewer to contact ground and air mobile stations during operations. AWY has returned from the shipyards in Portland and is doing radio maintenance work at Dow Field, Bangor. JSY paid the SCM a short visit; Ken says that he is the only ham left in Fort Fairfield. JKV is working in the Portland shipyards. Harry Dalahunt, former operator-in-charge at station CEM at the Bangor State Armory, has been discharged from the Army and is now doing radio work at Dow Field. GKJ says that DEO has signed up with the merchant marine. JRS is working at the So. Portland shipyard, and LNI's XYL has presented him with his second jr. operator. GCB has terminated his duties with Presque Isle Air Base and has accepted a position with the New England Tel. & Tel. Co. 73, *"G. C."*

EASTERN MASSACHUSETTS — SCM, Frank L. Baker, jr., W1ALP — KDF, radio aide for Boston, says that things are going well. Ten new operators are being added, making a total of sixty. SE, HPV, and 2LIX are at M.I.T. IIL now is a married man. DBH writes from Asheville, N. C., that he finally got into radio. The South Shore Amateur Radio Club held its monthly meeting with the following present: MMU, MPT, MMH, IS, LZW, FWS, IYU, FJN, IHA, CCL, MD, FKV, CT, ALP, KBM, 5JLO, the Mugford twins, and Dan Hoxie. JGQ says he still is teaching school and is doing part time work at National. MQB, USN, is in the S. W. Pacific. JOH is in merchant marine radio. BB and DJ just finished a new concentric antenna for WERS. Jim Brady, ex-7ALB, is working at M.I.T. MJE says that KON now is a lt. (sg) in the Navy; he had dinner with HDQ recently. GJZ is in the Pacific area. LXE is in France. MCC is RM1c in the Coast Guard; his brother, LMP, is CRM in the Coast Guard.

(*Continued on page 68*)



We have been receiving so many letters on the series we have been running here that it seems like a good idea to take time out to cover some of the points raised.

Perhaps we had better begin by admitting that we made a mistake in a decimal point in our page in February *QST*. To relieve the burden on the letter carriers, we hereby admit that under the conditions specified the equivalent shunt resistance of a 2A3 is a little over three ohms, and not a third of an ohm as we stated. However, 2A3's are still the best bet among the tubes listed.

Our mail informs us that our suggestion for rewinding power transformers (March *QST*) has been tried out by a number of readers with the same excellent results that we obtained. "The results exceeded my fondest expectations." For instance, one amateur pointed out that the primary is usually next to the core, and wanted to know how to remove it from the inside of the winding without wrecking the secondary outside. This is most easily done by unwinding the primary from the inside out, in much the same way that string is sometimes drawn from the inside of the ball. If the XYL does knitting or crocheting, she will know all about it.

We seem to have provoked a lot of discussion on Class-A triodes versus AB or B operation. When we said Class A sounded best to our ears, we meant only that. We had simply listened to results and had not bothered to inquire into reasons. However, now that the point has been questioned, we have looked into the matter a bit. In textbooks, we find such statements as "Push-pull Class-A triode operation is generally regarded as providing the highest standard of fidelity" (Radiotron Engineers' Handbook, 3rd Edition, Page 13). More specifically, Class-B operation has the objection that distortion is high at low signal levels, and furthermore is wide open to additional distortion if the power-supply regulation and the driver stage are not of the best. Class-AB_1 amplifiers using triodes give better results, but distortion is quite appreciable. Tube handbooks list the distortion for various tubes in the circuits for which they are suited. In making comparisons, remember two things. By common usage, power output for a triode Class-A is that output for which the distortion is 5%. As a result of this convention, a Class-A triode is almost always listed as having 5% distortion. However, this distortion is almost all second harmonic, which cancels out in push-pull. More important still, at reduced output even this distortion is greatly reduced. Unlike Class B, Class A is almost completely free of distortion at low signal levels.

We have been asked our opinion of phase inverter circuits. For a high-quality job we prefer a transformer. Good audio transformers have ample frequency range and negligible distortion. They are expensive, but if you are willing to pay the price, they do an excellent job. Phase inverter circuits, in general, have several drawbacks as compared to transformers. Their output is not as well balanced, so that the output tubes may not be equally loaded, and the even harmonics may be imperfectly canceled. They have less voltage gain, so that the driver tube may have to work close to the overload point in order to supply enough signal to the grids of the output stage. They introduce a relatively high resistance into the grid circuit of the output stage. They require an extra tube.

We do not wish to belittle the phase inverter. You can buy much higher quality for a dollar if you use a phase inverter, so they will always be valuable and justly popular. However, you can buy much higher quality for ten dollars if you use a transformer.

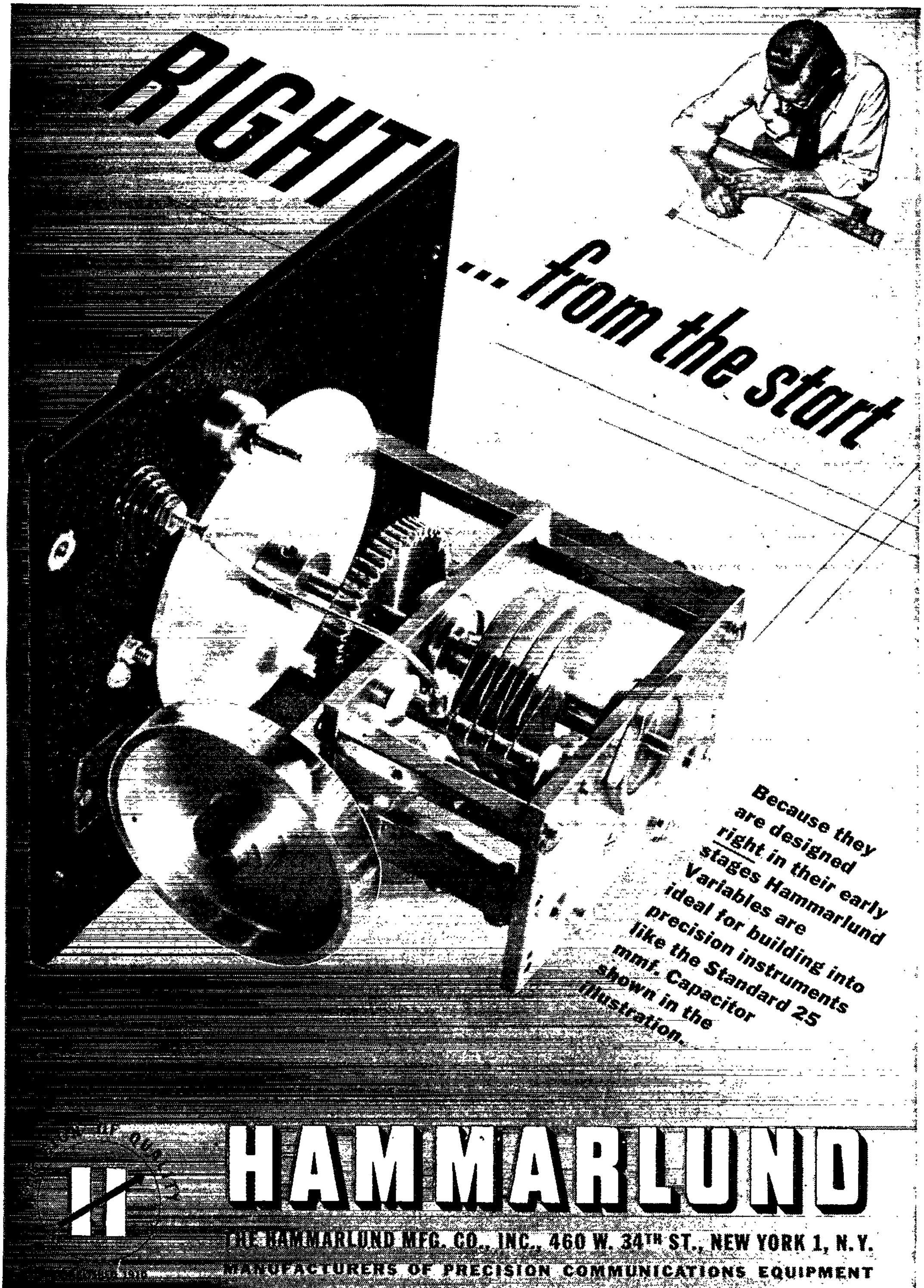
Throughout this series of pages on high-fidelity reproduction, we have been discussing our experience in getting the best results. No one will accuse the equipment and circuits we have described of being cheap, but anyone who hears them at their best will concede that they make a very pleasant noise. And that's what we were after.

William A. Ready

(Continued from page 66)

MJE has a recording of RM2c MWK's voice, made in N.Y.C. while he was on leave. IEQ is a captain in the Signal Corps. 7BOG is a lt. (jg), still at M.I.T. MSY, of Ipswich, now is CRM and got married in March. JZV is in New Guinea. JFS says that AGX and XYL and AKS called on him. AOT still is at WOV in N. J. AFF and XYL are planting a big garden. LTR visited JFS also. TY is working in a radio store in Lynn. ZZC got Christmas cards in March. MKN, of Saugus, writes from England and says he spent a year in the Signal Corps, another year in ASTP and finally ended up in the Air Corps, still working on radio. IUX writes from Germany and says he noticed a lot of familiar calls in this column, among them, JLI, NHN, JNX, AYG, IXI, ESV, and KH. He has been in the Signal Corps over five years. Ens. 3HAE now is located at Gainesville, Ga. 3IUV is an Army student at M.I.T. 9GDQ, who is a specialist 1c in the Navy, is working at M.I.T.; he is attached to N.R.L. in Washington, D. C. On March 25th another State WERS test was held. Coöperation of the State Guard (WMSB) and Civil Air Patrol (WKTK) helped to make it a success. For the first time messages were completed between Boston and Fall River, North Adams, Pittsfield and Hartford, Conn. Routes into Boston were: WJSU to WMSB-87 (Manomet) to WJQH-4 to WKXH-1. WMHC-20 to WKHF-1 to WJBB-16 to WJQH-4 to WKXH-38/1. WJPG-1 to WKKW-7 to WKKW-3 to WJBB-16 to WJQH-4 to WKXH-38/1. WKHW-2 to WJBB-1 to WJBB-16 to WJQH-4 to WKXH-38/1. High lights: GAG had to work. WKXH-1 gave trouble and WKXH-38 came to the rescue. WKXH-38 copied the WJSU message direct from WMSB-87 as he relayed to WJQH-4. WJSU heard WMSB-87 (R9 plus), No. 125 (R5), WJQH-4 (R3), WKTK-67 (R1), No. 1 (R1). WKKW heard some WMHC (Hartford) units, WKHW, WKHF, WLSO-26, WJBB-1 and 16. WKNM-2 heard WKTK-1 and 5, WJID-27 and 28, WJRG-3, 12, 17, and WKXH-1. WKTK units activated: No. 1, net control, Newton; No. 5, relay, Waltham; No. 30, Westboro; No. 60, Ashland; No. 75, Norwood airport; No. 80, Bolton; No. 62, airplane over southeast section of State; No. 81, plane over midwest section of State. WMSB units activated: No. 87, Lt. Boote at Manomet; units in Worcester and Springfield areas were alerted. Special locations: WJSU, Copicut fire tower, Fall River; WJBB-16, Mt. Wachuset; WKKW-2, Round Hill, Northampton; No. 3, Pelham, Route 202; No. 7, Westhampton, Route 66; WKHW-16, Chester Mt. Gratifying reports were received from the following: WJPG, WKHW, WKKW, WKHF, WJBB, WLSO, WJRG, WLDC, WKNM, WJID, WJPY, WJYM, WJQH, and Region 5C, WKRN, WKXH, WKTK, WMHC (Conn.), and WMSB.

WESTERN MASSACHUSETTS — SCM, William J. Barrett, W1JAH — BVR reports for Springfield WERS, WKHF. The network has been holding monthly get-togethers with the individual towns and cities serving as hosts in rotation. JOT reports from A.S.F., Hdq., First Service Command, Boston, where he is stationed after release from Percy Jones Gen. Hospital, Battle Creek, Mich. Dick Atwood reports for Worcester WERS, WJBB. In the recent state-wide WERS test, WJBB relayed messages from WJPG-1, WKHW-2, WKKW, WKHF-1 and WMHC-20 to WKXH-1 via WJQH-4. A return message from WKXH-1 to WMHC-20 was passed on to WKHF. Time did not permit relay of message from WKXH-1 to WKHW, due to the end of the test period. IHI with WJBB-16 and AQM with WJBB-4 cleared the state-wide traffic, with Dick Atwood aiding in the operation. After the drill a special meeting was held to hear suggestions and draw up new operating plans to eliminate the trouble. Plans are going forward to include more towns in the WJBB net. The message from North Adams, WJPG, was relayed from the summit of the Mohawk Trail to the Pittsfield, WKHW, control station, thence via WKHW-16, stationed on Chester Mt. MIM/8 reports again from Ogdensburg, N. Y. KJO started off from radio school to a civilian branch of Signal Corps, then to Army Enlisted Reserve and to Air Corps. Turned down on A.C. physical he joined the merchant marine and was torpedoed on his first voyage. Later he married a YL in England, took part in the Normandy invasion, and was on one of the first ships to enter Cherbourg. After a medical discharge from the merchant marine he settled down with the XYL in Worcester where he now is operating at WORC. MND, who was wounded in Germany in February, now is in an Army hospital in England. LX is somewhere in France. LDV still is somewhere in the So. Pacific. MCF is a Jap prisoner. Congrats to BVR on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(*Continued from page 68*)

his reëlection as New England Division director. 73, *Bill.*

NEW HAMPSHIRE — SCM, Mrs. Dorothy W. Evans, W1FTJ/4 — AVL is back in this country and is, we understand, a corporal. We learn that his job is definitely along radio lines. LBD and CMB had a get-together recently at Pearl Harbor. KKQ was home on leave recently. Leora now is stationed at Warrenton, Va. BFT visited Fort Smith and Arkadelphia, Ark., representing the Navy in making "E" presentations. Am very sorry about the short report this month, fellows, but no news has been received "down yonder" in Tennessee. How about writing a card so that New Hampshire can make a much better showing next month?

RHODE ISLAND — SCM, Clayton C. Gordon, W1HRC — Another nice letter was received from Norm Gertz this month. Norm had been on Iwo Jima and says that he couldn't find a tenement to rent that suited him and the hospitality was so poor he never wants to go there again. He reminded me of the time the P.R.A. used to meet out in Olneyville, when I beat him out for third place in a code contest, at 25 w.p.m. JP received a box of interesting samples sent from France by LYE. We looked them over the other night at AFO's and decided Uncle Sam could build better radio equipment. AFO has high-fidelity record-playing amplifier using four 6L6s in push-pull parallel, in which the screen grid is used as the control grid, the control grid being tied to the cathode. HRC was away for two weeks, as guest of the employer, to a school on K-carrier at Albany. This delayed the usual planting season somewhat, but I liked it and got some new angles on negative feed-back, Wein bridges as oscillators, and thyratrons. Don't look now, but the April issue of *QST* said my term as SCM had run out.

VERMONT — SCM, Burtis W. Dean, W1NLO — The Burlington Amateur Radio Club has completed another successful year instructing high school students in code. Classes were held every Monday night at the Burlington High School. BME visited HPN and NLO at the WCAX studios recently. Ed Rybak (LSPH) reports he has plenty of work to do at WENT but can't get parts. AVP and NLO got together at the Sugar House and talked over Vermont ham activities past, present, and future. Bill is very active in the State Guard as a pfc. Ex-LVP now is stationed at Deshon Hospital, Butler, Pa., after spending several months in the Pacific. 8BHW was in Burlington recently and had a chat with ex-BRG and NLO. Your SCM spent part of his vacation visiting GE's f.m. and television station on the Helderbergs. He met 2MYA and 2OOR at the television studios in Schenectady, N. Y. 73, *Burt.*

NORTHWESTERN DIVISION

MONTANA — SCM, Rex Roberts, W7CPY — A nice letter was received from Ens. IOC, USN, now located at Boca Chica, Fla. Hank talks as if the FB WX in Florida has got him and he won't ever return to Montana. DXQ was renewing acquaintances in Glendive in April. The Butte club has Alan Lyle and Francis Wyatt as new members. Ens. Emmett Sullivan, ex-BSS, is home on leave. He is a charter member of the Butte club and attended a meeting while home. Our best wishes to EQM's daughter, who recently underwent an appendectomy. Maybe you fellows can get out and send me some smoke signals since you seem to have lost the SCM's QRA. 73, *Rex.*

OREGON — SCM, Carl Austin, W7GNJ — A letter from Cardboard Harry mentions that, in the line of duty, he has traveled over considerable portions of England, Scotland, Normandy, France, and now is located in Belgium. Cardboard says he meets many hams and that *QST* is well received. BVV has made up a clever mount and mechanism for his rotary beam. Max Dick has gone to sea as radio operator with the merchant marine, and likes the work except for the operating procedure, which is unusual in wartime. Latest "Tribulation of a b.c. man" — ARZ trying to find a gas leak in a 500-foot buried coaxial line. HVX is badly "mysticized." He tried to get into the Army or Navy but could not pass the physical. Now he has been drafted, and has passed the physical. Roy Mickel (LSPH) says his CAP code class is doing FB and that the women learn code faster than men. After putting in ten years working for the other fellow, BS (Beautiful Sunshine) is going to operate his own business. One of the Klamath Falls hams left his RME with a 64-year-old resident when he went to war. This resident was so intrigued with the dits and dahs he heard, he decided to learn the stuff. So, during the past two years he has learned to copy code at better than 30 w.p.m., thus

(*Continued from page 70*)

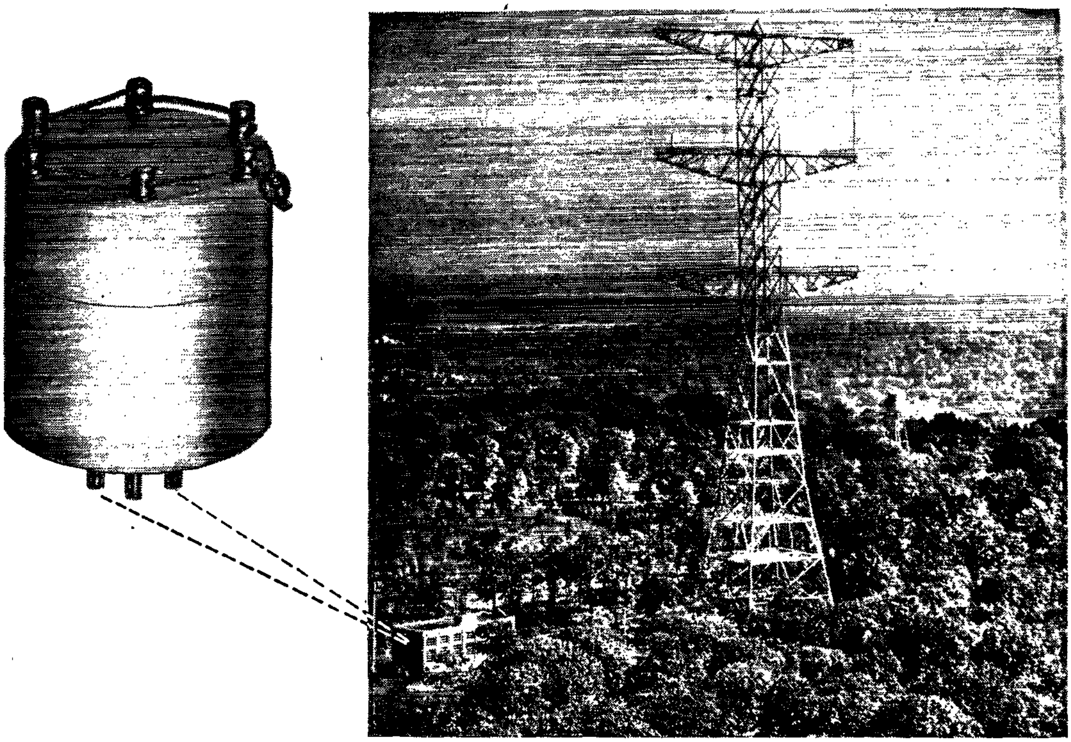
proving that it takes only a little desire plus a little determination to be a ham. 73, *Carl.*

WASHINGTON — SCM, O. U. Tatro, W7FWD — BG, our Director, is packing up for the annual trek to West Hartford. IBC met 1NHN through *Wa'Wa* (FPV's QSO magazine) and announces his intention to marry her as soon as he returns from overseas duty. 1NHN is a member of the ARRL and YLRL and is the first YL ham to attain RM1c in the WAVES. IBC is in radio on one of the new attack transports in the So. Pacific and is thankful for his ham training; he is eager for *QST* and devours the section news. EKW is out of the Aleutians after twenty-seven months and is reporting to Chicago for reassignment. His latest hobby is making recordings and he has done some digging for Old Aleut specimens with the noted archeologist, Dr. Cahn, for a New York and a Chicago Museum. IGM has taken up home movies and showed Major IHJ an Anzio Beachhead picture that Doc says was a different version than what he went through. JCS, when not traveling, is a major at Camp Crowder. Miriam Brown (LSPH) has her Class A ticket. HCE, EC, reports this is home-coming month for Yakima. ETX visited Yakima after a trip to the hospital. AUP was back from California for a short stay. AYO and KIT also were visitors. FAQ was recently in port from India. AGV turned down a trip home until he finishes some business with the Nips. ARF is winding a modulation transformer. Cam has wound one and is interested in automatic recorders. ALH is painting his home. BCS is transmitter technician for ACS in Seattle, and HCE was best man at Bill Preicz's wedding. FWR is raising goldfish. FWD received a nice letter from XU3/8MA; Doc, 83 years old, has his MD license to practice in the State of New York. 73, *Tate.*

PACIFIC DIVISION

EAST BAY — SCM, Horace R. Greer, W6TI — EC, QDE; EC v.h.f., FKQ; Asst. EC v.h.f., OJU; OO v.h.f., ZM. IMI has gone to sea as radio operator, 1st class. April 19th saw another WERS meeting in the Oakland City Hall control room. The meeting was taken up with a discussion of v.h.f. gear. The following were present at the last meeting of the Mid-Pacific Chapter of SARO: NZG, BuShips; Capt. T. M. Dell, USN; Comdr. 9BNL, CinPac; Lt. Comdr. 7ESK, USNR; Lt. Comdr. 2KC, USNR; Lt. Comdr. FMO and ex-RCA; OCZ, USNR; Lt. (jg) FAQ; LCG, WECO; Eng. CZU; 8MBI, WECO; 8RQD; PSN, BuShips; 7DZA, WECO; 9AQR; Lt. Comdr. T. D. Maybank, USNR; Ens. D. Ogg, USNR; and E. Wac, WECO. They also report that amateur operators attached to CinPac or ComServPac Staff or in the forward area are: HZW, CGO, ALK, UQR, BNO, CBX, NX, 3ACD, 3IWD and 7ALP. Send in news. "Another day closer to victory." *TI.*

SAN FRANCISCO — SCM, William A. Ladley, W6RBQ — Phone Randolph 8340. ECs, DOT and 6KZP. OO u.h.f., NJW. Chief Warrant Officer CIS reported in from the Admiralties as he was leaving for the Philippines. Ken says broadcast reception from the States is good. WB advises they still are busy at the Technical Radio on government orders but are planning and engineering some handsome ham gear for the postwar period. RBQ has in mind a small a.c. gas-driven generator for power source in place of storage batteries on portable-mobile ultra-high gear. NKE writes in from Camp Shoemaker, where he awaits orders for sea duty. Comdr. 9FA is on his way West from Pearl. Lt. KB6ILT is visiting relatives in the Midwest. CVP repairs radios during his spare time and keeps the 2½-meter boys on the air. 9BPN is on duty here for Raytheon. 9EKY still is in the islands with the same company. RAH is in the South with his family. Pinky De Lasaux is on duty here after many months aboard ship in the So. Pacific. 6RBQ's son Bob arrived home after a year at sea aboard an aircraft carrier. PGB still is with the Army here at home. LES has been busy painting his home. KZP and NJW are busy with their duties at KYA. Al McGuirk is now with the Board of Public Works for the City and County of San Francisco as an electrician. James Wooldrige, an amateur of long standing in this Section, was killed in an airplane accident at Santa Rosa, Calif. recently while flying with a CAP group. State Guard WERS is proceeding in good form and the following members all attend regular weekly drills: John B. Damonte, M. Stanley Day, Ed. C. Fichtner, M. W. Hewlett, Ed. W. Hintz, Wm. D. Howe, Chas. V. Hummel, Geo. Meulendyk, Victor M. Solorzano, Russell C. Sorensen, Ralph Leon Spiro, Rolph D. Stoddard, Robert W. Thille, E. H. Tucker, Samuel C. Van Liew, Clarence Corbin, Wm.



Pioneer FM station uses BLILEY CRYSTALS

When Major Armstrong's station W2XMN went on the air from Alpine, New Jersey on July 18, 1939, radio history was in the making. This first FM transmitter to be put in service, built by REL, employed the Armstrong crystal-controlled phase shift modulation.

Bliley crystals are doing an excellent job in this outstanding FM installation.

For advanced engineering it is always worthwhile to specify Bliley crystals. An outstanding example of this is the discovery and development by Bliley engineers of ACID ETCHED CRYSTALS*. This technique was an established part of Bliley production before Pearl Harbor. It is now recognized as a prerequisite to dependable service in military equipment.

It is a good habit to consult Bliley engineers when new developments are in the making. Our specialized engineering can often be of real assistance toward solution of your design problems. This kind of service has made Bliley the foremost producer of quartz crystals for amateur and commercial radio in peacetime and for our armed forces in time of war.

**Acid etching quartz crystals to frequency is a patented Bliley process. United States Patent No. 2,364,501.*

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Do more than before...
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UNION STATION BUILDING • ERIE, PENN.

(Continued from page 72)

A. Ladley, Gene Pera, Theresa M. Bonzani, Frances M. Drake, Elizabeth Harwood and M. Frances Jessen, 73, *Bill.*

ROANOKE DIVISION

VIRGINIA — SCM, Walter G. Walker, W3AKN — The present addresses of former Virginia hams are as follows: Brig. Gen. HWJ, Commanding General 3rd Air Force, Tampa, Fla.; Ens. HAE, USNR, NATTC-BOQ, Gainesville, Ga.; Lt. D. B. MacNamara, 541 Boylston St., Boston 16, Mass. NE, IKV and Ed Murdock are radiomen in the merchant marine. S/Sgt. HBF is in Teheran, Iran. Pfc. BZE is an ATC radio operator in foreign service. 4FBD is a captain in the Air Corps stationed in China. HKE reports in from Norfolk. S/Sgt. IKT is stationed in China. Reports received by the SCM indicate that the Norfolk WERS net is active and going strong. NT reports about ten stations are active on their drill periods. 73, *Walt.*

ROCKY MOUNTAIN DIVISION

COLORADO — SCM, H. F. Hekel W9VGC — S1c Bob Perske (LSPH) spent his between-classes shore leave in Denver and at last report was at the Navy School in Chicago, at 2935 Polk St. Bill Lachford became the proud papa of Mary Lynn in February. Bill started laying plans for an antenna farm, etc., for the future, and expects to teach little Mary enough about copper wire so she can do most of the outside work, such as setting poles for his dream antennas, as well as making repairs and stringing new wire after a big storm. 6CTH now is with the Denver Ord. Plant. He was discharged from the AAF about eight months ago after serving as observer, navigator and engineer in Europe, the North Atlantic, the Pacific, and Alaska. 9DAZ, Des Moines, Iowa, now is a law-abiding citizen of Colorado and is making his home in Denver. The Radio Widows held an election at their April 5th meeting and here is the score: Donna Goff, head man; Alberta Markwell, second fiddle; Mildred Suedikum, keeper of the secrets; Mabel Hekel, holding the bag (as soon as I can find out how much money she has hidden away, the Electron Club is going out on a beer bust), and Martha Stedman, flower girl. The Widows are celebrating some sort of an event with a covered dish supper and the OMs are invited to help do the eating. EHC's wife is on the road to becoming a brass pounder; he says she is doing fine as a pupil. WERS activities in Denver seem to be in a fuddle and all units west of Federal Blvd. should not be considered as aliens. In the early days Federal was the west limit of the city but since Sheridan Blvd. has been paved that street has the fence on it. Here are the units in that area: Nos. 2, 4, part time, 6, 10, 11, 14, part time, 24, and 32. The three units east of Federal are 5, 17, and 31 and are a part of the North Net; No. 30 lives down the alley. The reason for so many units in this part of town is that there is easy access to a lot of fresh meat and no red points are required. That narrow strip of land between the western side of town and the mountains is occupied by a few survivors of the early days and a lot of jack rabbits. To get their meat all they have to do is scare up a couple jacks, get them headed into the wind and wait about ten minutes. After the rabbit has run himself to death, they pick up Mr. J. R., clip him back of the ears and, presto — fresh meat. When hunting is good it is no trick to make two or three trips in one day and pickupacoupleabucks just like that. 73, by *Heck.*

SOUTHEASTERN DIVISION

ALABAMA — SCM, Lawrence J. Smyth, W4GBV — Lt. EBZ, making a flying trip overseas, met G3MF, G3WH, 3FYO and G8FC. EBZ has his call painted on the front of his shack; an invitation to all hams to drop in. GBN was among those from Alabama in to see him. EBZ says he had a letter from ELX of Tuscaloosa, and that all letters from Alabama hams are most welcome. DAU, ex-WPFR, is back in Washington after a flying trip to India and China. He bumped into HNG at the Signal Corps annex cafeteria. ERW, who is stationed at Ft. Meade, Md., is in the field artillery as a radio maintenance man. He visited EOX in Washington. EOX has been promoted to lt. (jg). DUM, of Birmingham, is Naval inspector of W. E. Co., Kearney, N. J. plant. CDV, ex-WMPM, WJRD, and other stations in Alabama, was a visitor of DGS. He is a design engineer on blind landing equipment. BTU, ex-Army lieutenant, now is living in Birmingham. DVJ still is overseas. When last heard from GOX was in Maryland. 73, *Larry.*

EASTERN FLORIDA — SCM, Robert B. Murphy, W4IP — The members of Dade County WERS are really

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(*Continued from page 74*)

on their toes. *Activity* is the watchword of the local organization; twenty-three stations report actively each drill night. Mobile day is Sunday, 5 to 7 P.M. It is surprising what WKNW-30, the control station, is doing with mobiles 11, 17, 20, 32, 34, and 39. It seems to be able to work them at will in directions up to thirty miles with good two-way reception. Control is in a good QSO with the State Guard station WKRW-36 located in Ft. Lauderdale. WKRW-36 is operated by Sgt. AHZ of the Ft. Lauderdale State Guard unit. He has built the 815 grid line transmitter from the *Handbook*, and the antenna, a Johnson Q, is 110 feet in the air. No. 16 is operated by Wm. R. Powell with an HY75 in the final — the antenna is the extended Zepp of MacArthur fame. No. 2, Bowers, is getting his 3ERV (Jan. *QST*) receiver on the air. No. 39 has built one of those receivers to his own specifications. No. 17 has one of this type at home. No. 7, IP, is contemplating building one. No. 11, Thwing, has a very nice compact receiver-transmitter in his car, but is having relay contact and "field strength" troubles. No. 14, Salmon, is having trouble talking in the wrong side of the mike. No. 15, Foster, is rebuilding his receiver to add an r.f. stage so he will not QRM No. 2. No. 17, MacArthur, can be heard back to control as far as his gas coupons will hold out. No. 20, Jerguson, has left us again for the south on a PAA trip. No. 31, Russell, is building an 829 job and wonders why you have to be so particular with grounds on the chassis. No. 34, Warren, is revamping his mobile rig. No. 35, Kincaid, is back on after moving to a new location. No. 39, Shepherd, is our guiding light when it comes to doctoring these tricky circuits. It was Shep who found the 3ERV circuit for the superhet receiver. No. 43 is reporting in from Ojus. Burnside came up to control with a 13-tube super the other night; now all the fellows up there have to strain their ears to get accustomed to our normal equipment. ES has just returned from a trip to Camaguey, Cuba, and other points. AOK, one of the best b.c. operators in the business, is in Clermont, Fla. ANP still is copying on his SW3 and was visited by his sister from Toledo. He says FLZ is RM1c at Honolulu. ASR, our Director, gives us the following Daytona Beach news: Spock is with RCA; FSS is still around; FZO is in on a visit after a mine-sweep run in the So. Atlantic; Francis Brachold is in Germany with the Signal Corps, and ASR is busy taking care of WMFJ and local S.B.T. & T. Co. relay point in Daytona Beach. EYI came through, with the following report: IGO has taken unto himself a wife and after a short honeymoon will go to California for active sea duty. 73, *Merf.*

WESTERN FLORIDA — SCM, Oscar Cederstrom, W4AXP — An event of interest to the gang was the wedding on March 28th of Evelyn Sherman, RM1c, and Claude Fallis, RM1c. Evelyn and Claude both were formerly in our code room in Bldg. 606. The young operator, Bobby, of FCT-FJR, celebrated his third birthday recently. He already can tell a transformer from a condenser. VR has been moved from Saufley to Whiting. A near hamfest was had in one of the hangars when Delson, Willie Simmons, Yerby, and the OM got together recently. Foxworth and Ikner are working over in 631. 5KPI has left 709 and is now a member of the O.W.I. FJR is reveling in the performance of that SX28. DLO, over Cherry Lake way, wrote the OM a nice letter. He says Curry, of A.T. & T., our former SCM, is being transferred from Madison to Jacksonville. DLO, our newest EC, is the owner of the telephone exchange at Cherry Lake. One of our well known servicemen, Sgt. EAD, dropped us a line from Boca Raton Field, Fla. He pounded brass on a B-24 for about three years down south of here. He sends regards to the gang and would like to hear from them. Whaley is writing poetry as time allows. Bill Langford visited a wholesale radio store while in Atlanta, window-shopping and dreaming of what he was going to put on the air after the war. Bill has hung up his shingle as a radio repairman. We had a fine letter from Ens. 6AXV, USN, retired. He formerly was stationed in Florida so it brings back memories of old friends when he reads our section summary. The OM was very pleasantly surprised to find that nearly 85 per cent of the total number of hams in the section are ARRL members. What you write in to your SCM interests others and many an old friendship is renewed in this way. 73 to all. *The Old Maestro.*

GEORGIA — SCM, Ernest L. Morgan, W4FDJ — GIA landed an assignment as instructor in Navy's Wright Jr. College. FIN is in Montana with the AAF; his brother, GTS, still is in Italy. FWD now is in Athens because of a promotion by the Georgia Power Co. FGU, who is stationed in Washington, was home in Athens for a few days. EEE is

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14 TRIODES

TUBE TYPE	PLATE DISSIPATION
HK-24	25 watts (Grid lead to base)
HK-24G	25 watts (Grid lead through envelope)
HK-54	50 watts
HK-254	100 watts
HK-354C	150 watts (Low Amplification Factor)
HK-354E	150 watts (High Amplification Factor)
HK-454L	250 watts (Low Amplification Factor)
HK-454H	250 watts (High Amplification Factor)
HK-654	300 watts
HK-854L	450 watts (Low Amplification Factor)
HK-854H	450 watts (High Amplification Factor)
HK-1054L	750 watts
HK-1554	1000 watts
HK-3054	1500 watts

1 PENTODE

HK-257B Plate Dissipation, 75 watts (Beam pentode)

4 RECTIFIERS

HK-253	Inverse Peak Volts, 15,000
HK-953B	Inverse Peak Volts, 30,000
HK-953D	Inverse Peak Volts, 75,000
HK-953E	Inverse Peak Volts, 150,000

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HK-354D	Triode, Medium Amplification Factor	HK-354C or E HK-454L or H
HK-354F	Triode, High Amplification Factor	HK-354E
HK-257A	Beam Pentode	HK-257B
HK-153	High Vacuum Rectifier, inverse peak volts, 5000	HK-253
HK-54S	Triode. Same as HK-54 except fil. current is 3.35 instead of 5 amps.	HK-54
HK-2054A	Triode	
HK-2054B	Triode	

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(*Continued from page 76*)

in Athens. EJN has been home in Atlanta with his New Zealand XYL, whom he met through ZL2RC. ERS is out of the Navy and landed in Waycross. BAC is with the Philco people on a Navy job. Ex-DWQ was home to visit his mother before getting a Pacific assignment. DIZ and XYL visited his family. Both were welcome visitors at FDJ's home. HYW, after two years as chief of a Signal Corps station in the Aleutians, now is being assigned to the Atlanta AAB. EGT attended school in the East but by now probably has been assigned. FGU belatedly reports a jr. op., now some ten months old and QRMing Claude's sleeping hours. FCW still is going strong in Germany. 83, *Pop.*

SOUTHWESTERN DIVISION

LOS ANGELES — SCM, H. F. Wood, W6QVV — The Old Man has been laid up again and hasn't been circulating very much. A note was received from RIO, who is in the hospital at Pasadena and writes that he is in airborne radar work. He informs us that SQO, a CPO in Unk's Navy, was married in New Jersey recently; LVD was married in December; DLL now is a radar instructor in the Signal Corps at Fresno; PMV still is in Washington, D. C., in Navy radar research work, and RCI is overseas with AACS. Lt. (jg) MVL writes that he has been in the merchant marine for four years and has lost out on a lot of dope, but does read *QST* whenever he can find a copy. He is interested in locating GHU. If you see this, Ray, write the lieutenant at 341 Menker Ave., San Jose, Calif. MVL has a new jr. operator, born March 12th. Glass wants to be remembered to FTN in Long Beach WERS and KTY in South Gate. He has run across some W6s in the merchant marine, among them LUR, NRQ, SAE, and TZD. Speaking of merchant mariners, we haven't had any word from SSU for several weeks but last we heard he was going strong, loading and unloading cargo all over the Pacific. Dick will be glad to note that Maj. UQL was released from the hospital early in April and spent about three weeks at home with wife and family. MFJ is home on leave for a few weeks. I am sure that his "Saga of the South Seas" will make mighty interesting listening. Don McCoy of the "valley gang" phoned to say that he had the opportunity of assisting Capt. Van Merrill, from the Netherlands, in contacting some W6s that the captain has worked on 20. Had a very interesting evening recently with my son-in-law's nephew, who has been operating a radio station "somewhere in China" for the past thirty-odd months. He is not a ham yet but undoubtedly will be when he returns to civilian life. Bob is another who reports that the best men he has had working with him have all been hams without exception. He says they show more aptitude for the work, more coöperativeness and more downright ability to get things done. As regards WERS, the Inglewood KGIC, Los Angeles County KGCL, and Long Beach and City of Los Angeles gangs are drilling regularly. *Ted.*

ARIZONA — SCM, Douglas Aitken, W6RWW — Sorry to have to tell you fellows that Doug still is ill. I, MLL, am turning in his notes at his request. First we have two Silent Keys to report: "Doc" Hafford, a gentleman and a ham, who was in Phoenix WERS and seldom missed a drill; and SVV, who was killed in action in the So. Pacific where he was flying a torpedo plane. RLC has completed his tour of K6-lands and is at Terminal Island. RQX is still slinging mail at Tulsa. PCB and TOY, of Pittsburg, hope to be back in Arizona soon. RIA is in WERS, using a TR-4 and operating under the call WHHI-9 from his hospital bed. He reports 5ZV was up to visit him. RXQ is in the Pacific area, and is chief radio technician. GS reports the Tucson Short Wave Association and 25 Club going great guns with twenty-five hams at the last meeting. Meetings are held the third Friday of each month at OZM's store. Progress has been made toward getting a state organization going — a rough draft of a proposed constitution being mailed to a number of persons to get their ideas. I know everyone wishes Doug the quickest possible recovery. 73 from Doug and myself. *G. C.*

SAN DIEGO — SCM, Ralph H. Culbertson, W6CHV — Asst. SCM, Gordon W. Brown, W6APG. VQ has just moved into his new home at Pacific Beach. BWI and EWU have been observed operating scooters during these days of gasoline shortages. The gang is still waiting for return of the license from Washington. It is with deep regret that we report the passing of Henry Williams. Hank was a very ardent SWL and well known by the San Diego gang. Well, gang, how about some news? 73, *Ralph.*

(*Continued from page 78*)

WEST GULF DIVISION

NORTHERN TEXAS — SCM, Jack T. Moore, W5ALA — IR has built a new QTH and is saving fifteen acres just for antennas. TW says the good old U.S.A. looked better than ever after a trip to Panama, South America, and England. CEA reports from Toronto, Canada, where he is employed by civil service as an inspector of Signal Corps equipment. AJG reports a short visit from AJ, who was on his way to a civil service job in Panama. SH sends a V-mail letter from Egypt to tell how much he enjoyed the write-up of the Ft. Worth gang in the February report. EVI returned home after 15 months overseas. GKP is chief radio operator in the Maritime Service and is working the Pacific after spending a year on the North Atlantic run. Bennie found time to send in the following: GVK is with CAA; DXW and BDB are working for Raytheon. GML advises that he is completing a six months' course in communications at Chanute Field and is returning to Ellington Field at Houston as a communications officer. Charles has a captain's commission in the Air Forces and has a multiengine pilot's rating. GML would like the QTH of IFY. HHU has returned from Rio and is in Norfolk, Va., taking a refresher course on radar. It looks like JQY has started an epidemic with GZH also scheduled to become a grandpa in July. KOT reports that he and DO are the only hams left in Jacksboro and that DO is in Wichita Falls taking a watch-repair course. CKW is in San Antonio working for the highway department. HH is a civil service radio engineer located in Galveston. KIO says AEM is a busy man trying to keep all the radios in Vernon working. KIO was home from the USCG training station in Groton, Conn., on a fifteen-day leave and sent in the following information on Vernon hams: EEF is a chief electrician with the Seabees in the So. Pacific, IGG is in communications in New Guinea, Eugene Wright is stationed at Mare Island, Calif. ELC reports that HUU is a captain in the Air Corps. HRK is working for Lone Star Gas and ADG is working in the Army Wood Shop at Ranger, according to IKI. IKI says that he has an NC200 that he would like to dispose of, if some of you fellows can work out a deal with him so that he won't have to take a loss as he is a shut-in. 73, *Jack*.

SOUTHERN TEXAS — SCM, James B. Rives, W5JC — EUL was promoted to 1st lieutenant and has been transferred from Waco to Denver, Colo. Garth Parsons (LSPH) is in the Marine Corps and is stationed in California. FPW is in Warrentown, Va. FAS still is overseas in the S. W. Pacific area. UX is keeping busy with the maintenance of f.m. emergency equipment for the City Public Service Board in San Antonio. EUK, AMJ, CQ, 8KWN, 3BWE and 2LPS are code instructors at San Antonio Aviation Cadet Center. BUV is the assistant signal officer at the same place. Capt. Bill Peel (LSPH) is head of the code department at S.A.A. C. C. At last report: FNA was operating at KMAC; Ens. AX, USNR, was in Washington, D. C.; JC, EUK, EUL, OR and AJW were at Kelly Field; EOS and JMP were at W. E. Col. IUC is assistant to the chief signal officer, Washington, D. C. EN, formerly at W.I.T. school, is with W. E. in Italy. GKI is a 2nd lieutenant in radar. Lt. Ed Conroy, USNR, is a radar officer. Adair, brother of Glenn and Bob of WOAI, is chief engineer for FCC in Washington. BUV is communications officer at Dodd (?) Field. Wall, ex-W5, is S. W. Bell Telephone supervisor, San Antonio. Vir James, with Columbia Television before the war, now is in the merchant marine. Jett, ex-5RR, is radio instructor, Tech. School; Wilbur Jackson is instructor in math, Texas A. & M.; Lt. Col., Pierre Honnel is in the Signal Corps, West Point, N. Y. Ex-ZR, Rodriguez, is radio serving in S. A. Where are Sartain, Carr(s), McCarty, Glass, and others? The San Antonio Radio Club extends a cordial invitation to all hams in that area to attend the regular meetings on the second Friday of each month at the YMCA. 73, *Jim*.

NEW MEXICO — SCM, J. G. Hancock, W5HJF — Congratulations to CSR upon reaching his captaincy; he is assistant officer-in-charge of the Fixed Radio Officers School at Ft. Monmouth and during his spare time dreams of the rigs and QSOs he will have when this is all over. The SCM has not been advised of any change in the status of GUZ; when last heard of he was a prisoner of the Japanese. A new high tension transmission line is being constructed between Portales and Clovis and HJF is working full twenty-four hours trying to find a way to acquire a pair of those 60-foot masts. Your SCM would appreciate some more reports on your activities. 73, *Jake*.

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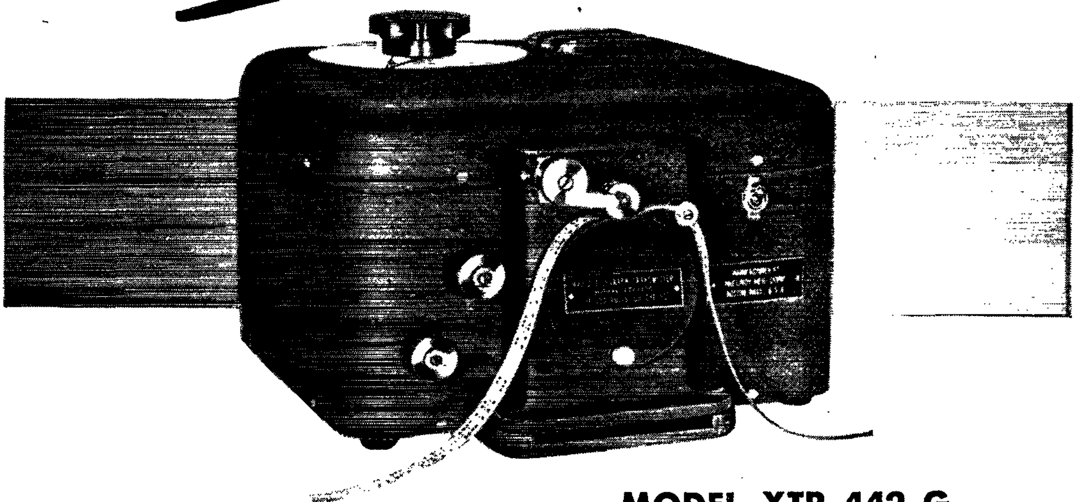

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The Month in Canada

ONTARIO—VE3

From L. W. Mitchell, VE3AZ:

The Wireless Association of Ontario held its regular monthly meeting in Room 21, Electrical Building, U. of T. on Thursday, April 5, 1945, which was one of the best attended of the season, probably because the subject of the paper presented was of prime interest at this time. The attendance was 125, about half of whom are hams, just itching to get their rigs tuned up for the big day when the ether will be ours again.

Nominations for the new Executive were presented and elections were held, as a result of which the following members were elected to office for the coming season: 3AIB, Les Weir; 3SX, Dave Parks; 3AXW, Les Jackson; Alf Edmonds; 3YY, Art Vivian; 3HB, Harold Benson; 3IW, Ash L. Chown; 3MT, Art Potts and 3IB, Wally Hainge. The retiring president will act on the Executive, ex-officio. The retiring Secretary-Treasurer, 3APA, Bill Winter, consented to act in an advisory capacity, but declined to accept active participation in the club's future activities.

The chairman next introduced the speakers of the evening, Messrs. M. C. Patterson, B.A.Sc., 3GQ (ass't to the director of education, Radio College of Canada) and Ray G. Anthes, B.A.Sc. (lecturer in electrical engineering, U. of T.); their subject was the "Basis Concepts and Performance of a Frequency Modulation System, Part I."

Mr. Anthes outlined the principle of radio transmission. By vector diagrams, he showed that in amplitude modulation, the vector length is varied in response to the modulating voltage. In frequency modulation, it is the vector velocity, or frequency that is varied; 100 per cent modulation in frequency modulation is an arbitrary chosen frequency deviation. Frequency modulation is accompanied by an angular shift in the rotating vector. This shift is called phase deviation. The product of phase deviation and the number of shifts per second, i.e., the audio frequency, determines the frequency deviation. Thus at low modulating frequencies, the phase deviation is large, and vice versa. Since the number of sidebands depends on the phase deviation, a large number exist for low modulating frequencies but a small number exist for high modulating frequencies. Thus the band-width tends to be constant for a given per cent modulation, since the sidebands are spaced by an amount equal to the audio frequency. An interfering signal produces a constant phase deviation depending on the ratio between its voltage and that of the desired signal. All amplitude variations are removed by a limiter stage. The resultant frequency deviation depends on this phase deviation and the difference between the two frequencies. Thus high frequency interference is more pronounced. Audio-preëmphasis is used to partially overcome this difficulty. Interference is reduced by swamping out the frequency deviation of the interference by a large frequency deviation in the stronger signal. Part II of this paper will be given on May 3rd.

MANITOBA—VE4

From Art Morley, VE4AAW:

Extra! Extra! Winnipeg hams active. Yes, it's true but they aren't on the air. Thursday, March 22nd, some 30 Peg hams had a social get-together. Among those present were 4ZR, 4ZK, 4WL, 4WA, 4SR, 4QV, 4MY, 4LL, 4KU, 4KF, 4IU, 4FU, 4EK, 4DU, 4BG, 4AK, 4AFL, 4AG, 4AEJ, 4ACR, 4AHU, Tom Dubord, Bill Heathfield, Ed Rutherford and a few others. An interesting talk on the future of the hams and the ham bands was given by Bill Duffield who has just returned from a visit in the USA with a stopover in Montreal where he had a chat with the CGM, Alex Reid. A roundtable discussion brought out promises of interesting rigs. It appears 4QV will have a super ham shack. 4RO will still top the high power boys. 4SR will have the jr. op. taking over. The youngster already runs the receiver. The evening was well spent and it is hoped that such gatherings will be kept up. Apparently it did no good for the SCM to ask for reports cuz since then not a word has been heard.

Had a phone call from 4QC who denies that he is married; sorry, Bill, but that's what I was told. Congrats though on your promotion to sgt. 3QW has also had a promotion and is now a flight-sergeant. 4GC from the last report was transferred to Washington. How about confirmation, Reg? Had a letter from 2BS who is surrounded by hams. 4AAW and 4AJY were presented with a YL op on April 2nd.

Correspondence from Members

(Continued from page 68)

The great mystery of the vacuum tube is not hard to unravel. The hardest part is finding the necessary information and the patience to learn glass working. Glass blowing is a matter of practice. Vacuum technique is a matter of catching all the little things. Tube parts usually can be made from materials found in the home, with the exception of glass tubing and filaments or cathodes. Oxide-coated heaters and filaments are not too difficult. You can make metal tubes easily in some cases. "Getters" are easy to use when you once know how. A small one-piece motor, vacuum pump, and blower (or air pressure pump) can be built. This is used for air for a homemade glass-blowing torch and a vacuum pump for the rough vacuum. The high vacuum is produced by a diffusion- or condensation-pump, and is made entirely of glass. Tools such as small jigs, a small spot-welder, torches, etc., all are easy to make.

It costs less to buy a finished tube, but one can not always find just that special tube, and glass blowing and tube making are lots of fun for those who like to learn and build such things. For those who are very serious about the scientific angle or who for other reasons of their own desire to be able to build tubes of various kinds — it *can* be done at home.

— *C. N. Loewenstein, W6TEG*

A HAND FROM ACROSS THE SEA

Old Stratford, Bletchley,
Buckinghamshire, England

Editor, *QST:*

For a very long time now, and especially just after reading my copy of *QST* each month, I have felt a strong urge to write a few lines to say how very much ARRL's efforts for amateur radio are appreciated over here by British amateurs. Today, after reading through the editorial and correspondence columns of the January, 1945, issue, the urge has become irresistible!

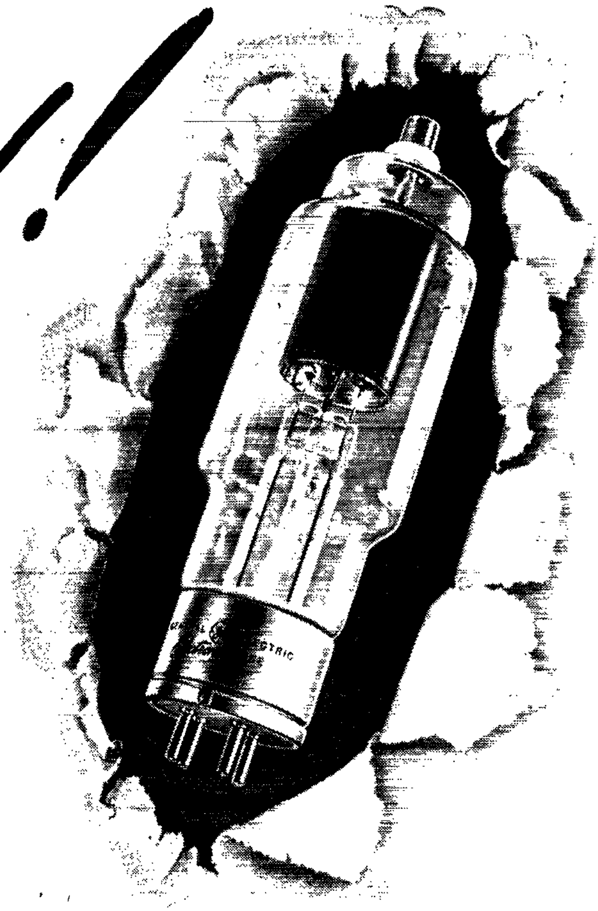
Our own society, the RSGB, has done first class and very hard work for the furtherance of the interests of amateurs over here, and has just published an extremely well-balanced plan for postwar amateur licensing facilities which, it is hoped, will be accepted by the authorities. This plan was published in the March issue of the *RSGB Bulletin.*

As a licensed amateur of ten years' standing prior to the present war and a professional electrical engineer, my enthusiasm for the finest hobby in the world (which is also a first class asset to any community) is undiminished.

Wherever I have met and worked with radio amateurs in my profession and in the services, I have been impressed by their sense of duty, their keen endeavour and their ability to use the background acquired in the pursuit of their hobby to master the ever increasing technical intricacies of the science of radio communication.

(Continued on page 86)

New!



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PRICE $30

General Electric offers you a mercury-vapor rectifier tube with useful "in-between" ratings—priced economically—with heavy-duty base giving large pin-contact area

OF interest to designers and operators of radio transmitters and of electronic heating equipment, G.E.'s new Type GL-673 hot-cathode, mercury-vapor rectifier occupies a useful position between rectifiers of the higher and lower ratings, as exemplified by Types GL-869-B and GL-872-A/872 respectively.

• **The base** with which the improved GL-673 is equipped is of the heavy-duty type, with large pin-contact area, increasing the dependability of performance.

• **The anode** is zirconium-coated nickel for the sake of more uniform quality in production, and to avoid the gassing that occasionally results when carbonized nickel or graphite are employed.

• **The cathode** structure has been specially designed to withstand vibration and shocks in transit or in service.

• **A price of $30** reflects the line production methods, employing newly designed equipment, found in G.E.'s modern tube factory. Telephone your nearest G-E office or distributor for further information on Type GL-673 or other tubes in G.E.'s complete line, or write *Electronics Department, General Electric, Schenectady 5, New York.*

Characteristics of Type GL-673

Half-wave, hot-cathode, mercury-vapor rectifier tube for use in radio transmitting and industrial heating applications. 2-electrode type, convection-cooled. Height 10½", diameter 3". Filamentary cathode, with voltage 5.0 v, current 10.0 amp, typical heating time 30 seconds. Maximum anode ratings are: peak inverse voltage 15,000 v, instantaneous current 6.0 amp, average current 1.5 amp. Fitted with heavy-duty base affording greater pin-contact area.

GENERAL ELECTRIC

161-D6-8850

(Continued from page 84)

In conclusion, to all Allied amateurs — greetings, and a safe return to the great game.

— *Captain R. L. Varney, G5RV*

A CP IN THE PHILIPPINES

Somewhere in the Philippines

Editor, *QST:*

Today for the first time in two months we had a break and our mail caught up with us. In my mail was a copy of *QST*. Words can't describe the quiet joy I felt when I read those pages. Each one was read and reread carefully, bringing back memories of my own shack though I haven't seen it for over three years.

Our National Guard unit was called to service in March, 1941, and since then I have seen Army radio developed to a high degree of perfection in the Hawaiian Islands, Guadalcanal, New Britain, Manus and New Guinea.

My job now is communications officer in a field artillery battalion. Many is the time our sets would have been temporarily out of the net if it weren't for the hams in my repair section.

My stationery, by the way, is through the courtesy of the Japanese government. Our CP is set up at a captured installation and Jap tissue paper must suffice. . . .

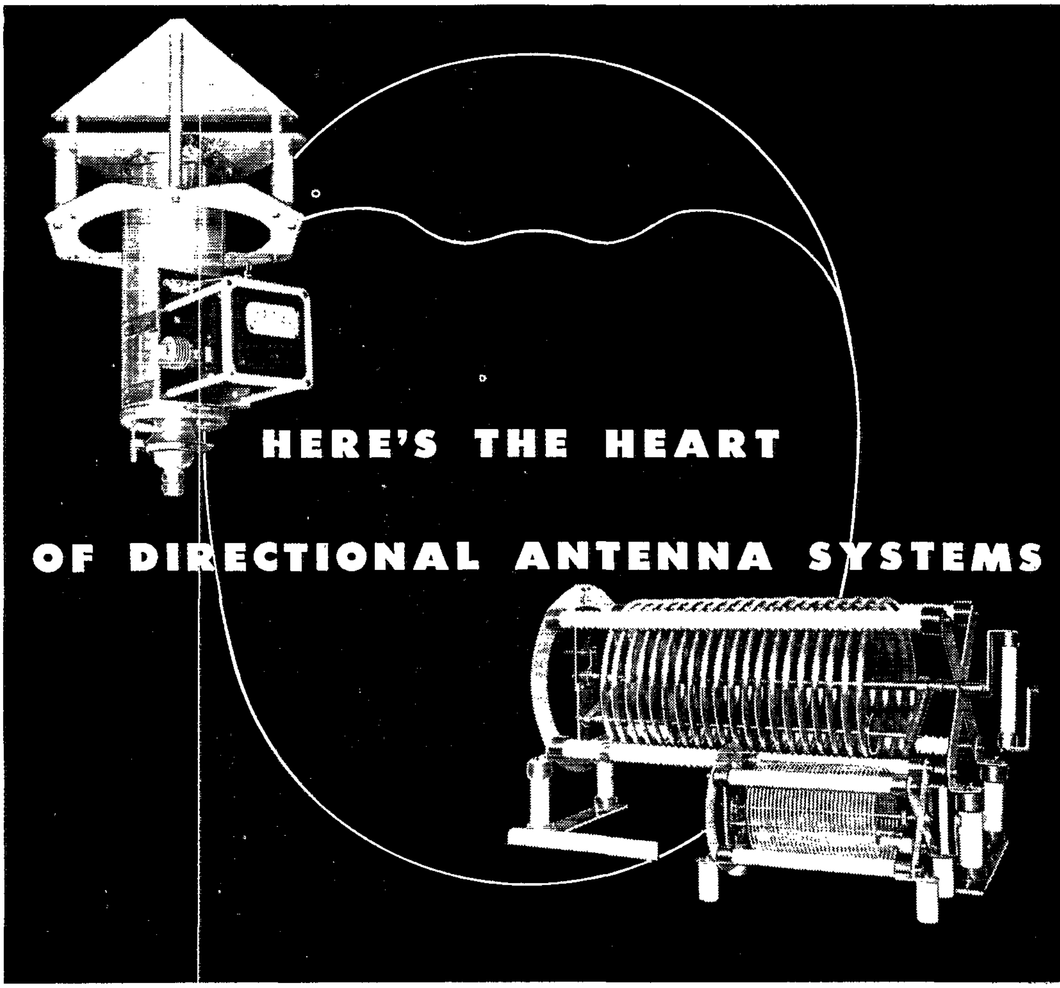
— *Lt. Bob Mayhercy, W9MUH*

An "Anti-Squealer"

(Continued from page 25)

right side. Another cause of poor quality we have experienced is the use of run-down mike-bias batteries. Those we got from the Signal Corps do not last too long since they are already outdated. In the "transmit" position the mike puts such a drain on the battery that the bias goes haywire resulting in poor quality. When this happens we have the operator shift to the other unused end of the battery and the quality comes back to normal. We have reclaimed several HY-75s by the re-soldering method suggested in "Hints and Kinks" in March *QST*.

We have tried many different types of antennas but find the simplest sure-fire one to be the folded doublet. This type always works even if it is tacked to a window frame with thumbtacks and made of bell wire. The best over-all length is 46 inches with 2-inch spacing and a 2-inch-spaced feeder for 112- to 115-Mc. operation. Antennas which peak sharply, such as ordinary doublets, vertical Zepps, and matched-impedance jobs where the match is incorrect, tend to pull the transmitter frequency. In one case we found it impossible to put a transmitter on 114 Mc. because of antenna resonance. The receiver section of the TR-4 simply would not superregenerate there either. The above-described preselector cured the receiver trouble, eliminating antenna effects and making it unnecessary to fiddle with the regeneration control when tuning across the band. However we had to install a folded doublet to cure the transmitter trouble.



Westinghouse tower tuning and matching components shown above are a variable, gas-filled capacitor (top, left) and a continuously adjustable inductor (below, right).

In these dependable tower tuning and matching components lies the heart of directional broadcasting. They help give Westinghouse phasing and matching equipment the high efficiency, reliability and easy adjustment that meet today's needs.

These qualities stem from many features of Westinghouse phasing equipment. High Q inductors, low-loss capacitors and effective circuit design establish high efficiency. Reliability is assured by using all components well within their ratings.

Operation has been simplified. Current division and phasing adjustment can be made while in operation. Phase adjustments can be made by a single control for each tower.

Westinghouse—working with your consulting engineer—offers its wide facilities in installing complete directional equipment for every type of coverage from simple cardioid patterns (above) to more complex, intricate ones. Your nearest Westinghouse office will give you information. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-08109A

XXV RADIO'S 25TH ANNIVERSARY KDKA

Westinghouse

PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

Electronics at Work

Cathode Follower Circuits

(Continued from page 18)

up to 14 volts positive, which is the wherewithal of the 270 milliwatts of driving power required. Looking at Fig. 22, we see that the cathode circuit looks at the 6L6 grid. This grid virtually is an open circuit until it goes positive, when it drops to the order of 1500 ohms from grid to cathode. Well, this same thing happens when a transformer is used and the transformer acts like a generator whose internal impedance is probably quite a bit higher than 366 ohms. The equivalent circuit shows plainly that the 1500 ohms still is quite high compared with the generator's internal impedance. So here we have what nobody thought was possible — a resistance-coupled Class-AB_2 amplifier — or Class-B for that matter! And but cheap, too. . . .

One more of an apparent infinitude of applications, and we will finish it up. Consider the case where we have a condenser mike, or a ribbon or velotron mike, and wish to provide it with a bit of preamplification to cut down loss of high frequencies in long connecting cables, hum pick-up, etc. Fig. 23 shows a one-stage amplifier with what you guessed would be there. Ordinarily we would have to put out the cash for one of those little bitty shielded plate-to-line transformers, and another one for the main-amplifier chassis. But not here — a couple of cathode followers are all that is needed. They don't pick up hum and they're small and inexpensive. That comment could well apply in general to all of these circuits. Wherever one needs a circuit which has low internal impedance, the cathode follower is unbeatable. When one needs to connect to a circuit without loading it, the cathode follower will oblige. When an impedance transformer is re-required, it does the job better than anything else could.

"Your AF Radio Station"

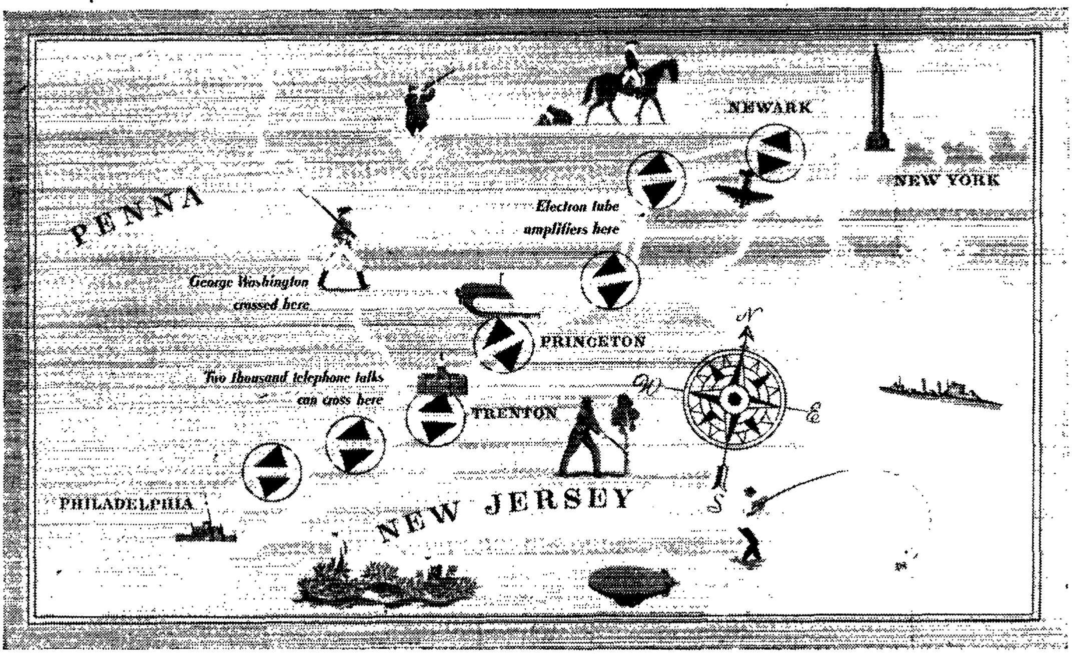
(Continued from page 64)

Navy men. Jones announced at WIOD, Miami, and WFTL, Fort Lauderdale, Fla., before the war. Announcers who leave for the States on furloughs or rotation are replaced by men whose voice and diction fit them for the job. Candidates are invited to try out and the men who qualify are placed on detached duty from their own outfit, if their commanding officer can spare them from their regular duties.

Virtually as important as getting the message through in a combat zone is the morale of the men behind the lines, the men upon whom those in the front lines depend. And there is a lot of morale value in the little 50-watt transmitters operated by AF stations. So radio's on the job as usual and very likely a ham is standing watch at the transmitter — an amateur temporarily on the air the Army way and to whom every Joe and Jill sends grateful "73 and 88, OM!"

90-MILE LABORATORY

for Telephone and Television



BETWEEN telephone offices in New York and Philadelphia once stretched a strange sort of laboratory. Most of the way it was underground; engineers made their measurements sometimes in manholes. It was a lead-sheathed cable containing two "coaxials"— each of them a wire supported in the center of a flexible copper tube the size of a lead pencil.

Theory had convinced Bell Laboratory engineers that a coaxial could carry many more telephone talks than a full-sized voice frequency telephone cable; that it could carry adequately a television program. Experimental lengths were tested; terminal apparatus was designed and tried out. Finally, a full-sized trial was made with a system designed for 480 conversations. It was successful; in one demonstration people talked over a 3800-mile circuit looped back and forth. Now the cable is carrying some of the wartime flood of telephone calls between the two cities.

This cable made television history also: through it in 1940 were brought spot news pictures of a political convention in Philadelphia to be broadcast from New York. Bell System contributions to television, which began with transmission from Washington to New York in 1927, have been laid aside for war work. When peace returns, a notable expansion of coaxial circuits is planned for both telephone and television in our Bell System work.

BELL TELEPHONE LABORATORIES *Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.*

Captured Enemy Equipment

(Continued from page 33)

Dual-Range Voltmeter

Another piece of captured German equipment which has been added to ARRL's collection is a miniature dual-range panel voltmeter sent in by W6DKZ from somewhere in Belgium. It is 1¼ inches in diameter and extends ¾ inch behind the panel. The two ranges are 3 volts, presumably for filament checking, and 150 volts for plate-voltage measurement. A small push-button switch on the face of the meter changes the range. The current required for full-scale deflection is only about 300 microamperes, which is a pretty sensitive instrument for field use.

While this particular model has neither a laminated magnet nor adjustable air gap as most American types and some of the large German voltmeters have, the magnet does have a peculiar shape which is believed to open out the lower end of the scale. The mounting of the coil is quite ingenious and has certain advantages. The jewelled bearings are on the inside of the central iron inside the coil. The little adjusting screws alter the length of a piece of brass holding the jewels, permitting it to be slid inward or outward in respect to the iron pole piece and thus compensate for bearing wear. The current and movement-resisting springs are allowed more freedom of movement, and greater tolerance in producing them can be allowed. Dust and dirt are kept out of the bearings because they are enclosed within the coil. An isolating method of attaching the rear current-carrying spring is simple and accurate and permits easy servicing which often is not possible with meters of conventional design.

— *D. H. M.*

Coaxial Antenna for 112 Mc.

(Continued from page 41)

edge is slightly hammered down into the groove with a flat-peen hammer. This should be done gently, a little at a time while progressing around the whole edge and not completely in one place at a time. With care this can be hammered into the groove so that it will make the insulator very solid. When complete, this edge and the hole in the insulator where the upper radiator section emerges both should be well covered with polystyrene coil dope. If this is applied in several coats there will be a very good watertight joint.

This completes the radiator. There is an almost unlimited number of ways of mounting the antenna on a car. In this particular case the car on which the antenna was to be used had extruded hinges, making the mounting system shown in Fig. 1 very convenient and easily detachable. Later cars do not have this type of hinge. However, the support should be of sufficient length so that the complete antenna will be above the roof of the car. The lower edge of the skirt should be several inches above any part of the car.

Microwave Relay Stations

(Continued from page 22)

Bald Hill, in Stafford Township, 3 miles east of Staffordville, Conn.

Asnebumskit Mountain, in Paxton Township, 5 miles northwest of Worcester, Mass.

Bear Hill, one mile northwest of Waltham, Mass., and 11 miles west of Boston.

The New York terminal will be atop the A. T. & T.'s Long Lines Building at 32 Sixth Avenue, and the Boston station will be on the Bowdoin Square Building of the New England Telephone and Telegraph Company.

The New York–Boston experiments are planned in three parts of the radio frequency spectrum — near 2000, 4000 and 12,000 megacycles. Eight channel assignments, each 20 megacycles wide, are being requested from the FCC in each of these parts of the spectrum. It is planned to use the eight channels to provide two simultaneous transmissions in each direction, with different frequencies in adjacent relay sections.

If the experimental facilities prove as satisfactory as the radio engineers expect, and if this method of transmission is found to be economically feasible, apparatus will be standardized in order that the Bell System may be prepared to install similar systems on other routes throughout the country as the need develops. The same set of frequencies can be used over and over at alternate relay stations on these systems. In cases where two or more systems radiate from one terminal or where branch circuits connect with the backbone network, additional frequency assignments may be necessary. The probable later addition of spur connections to nearby cities and towns points to a spreading out of radio relay channels in all directions from a backbone network. It is entirely possible that the radio relay systems eventually will be connected with the Bell System's coaxial cable network for nationwide telephone service and for sound and television program transmission.

The New York–Boston route was selected for the experimental trial of microwave radio relay because of its nearness to the Bell Telephone Laboratories in New York and because of the continuing need for additional facilities between these two cities. Also, with coaxial cable already in place between New York and Washington, completion of the radio relay system would provide very broad band transmission facilities all the way from Boston to Washington.

It is expected that at the completion of the experiments, the facilities will be available for commercial use. At that time applications will be fi ed with the FCC for commercial licenses.

Strays

With the end of the European War, all radio equipment at that front which can be transferred will be "tropicalized" for use in the Pacific area.

U. S. War Bonds for Stories of War Service

QST wants reports on the experiences of radio hams in active service on the battlefronts — for immediate publication in this section, where feasible, or to be held confidential where security considerations so require.

Do *you* have a story of war service to tell — either your own or that of someone you know? Then write us a letter giving full details, including photographs, clippings and other substantiating data where available. If your story is published in QST, you will receive a $25 U. S. War Bond. Please indicate clearly on the report if it is available for publication in its entirety, if names, dates or places should be deleted, or if all information must be held confidential.

Hams in Combat

(Continued from page 38)

"When Joe joined our squadron we were in the last stages of our training before we were to go into combat. He was a skilled radar technician whose initial assignment was to train our radiomen for the task ahead. He did a wonderful job, and his work with our crewmen paid off in tons of sunken Jap shipping. In order to do this efficiently and thoroughly he had asked to be allowed to fly himself. He spent many hours in the air with me and other pilots in the outfit training operators.

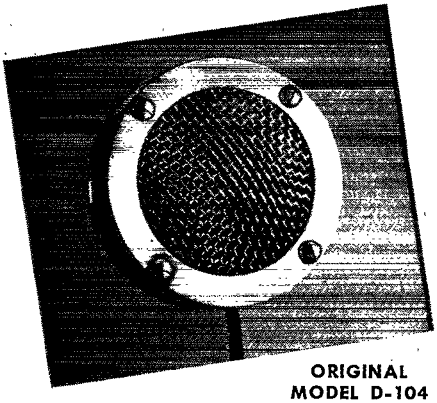
"When we finally came aboard our ship and started a tour of combat duty, Joe wasn't satisfied with sitting back and doing his job from his office. So he requested and became a regular combat air-crewman. He flew with our former executive officer, Lt. Tomasini. I know that Joe never told you of his flying, because he felt that it would worry you.

"During the period in which he flew with Lt. Tomasini, Joe took part in about fifteen raids against the Japs, including the second battle of the Philippine Sea.

"A short time later his pilot became ill and was transferred to a Naval Hospital. Joe then began flying with Lt. William Maier, my section leader, and as fine a pilot as the Navy ever had. We constantly flew together. And on all the strikes I was close enough to Joe's plane to look into his compartment and see him working with his radio gear.

"We all grew to depend on him a great deal. To Joe fell the task of getting us back to the ship when the weather was bad, and the sky beginning to turn dark. No one ever had a worry in the world when he was on the job, for we all knew that Joe was the best radioman in the outfit.

"On the day that Joe was shot down, we were in an area not very much frequented by Naval aircraft. The weather was very poor. Our morning's attack group jubilantly described how they had completely annihilated a Jap convoy in very



ORIGINAL
MODEL D-104
Made in 1933

AWAY BACK IN 1933

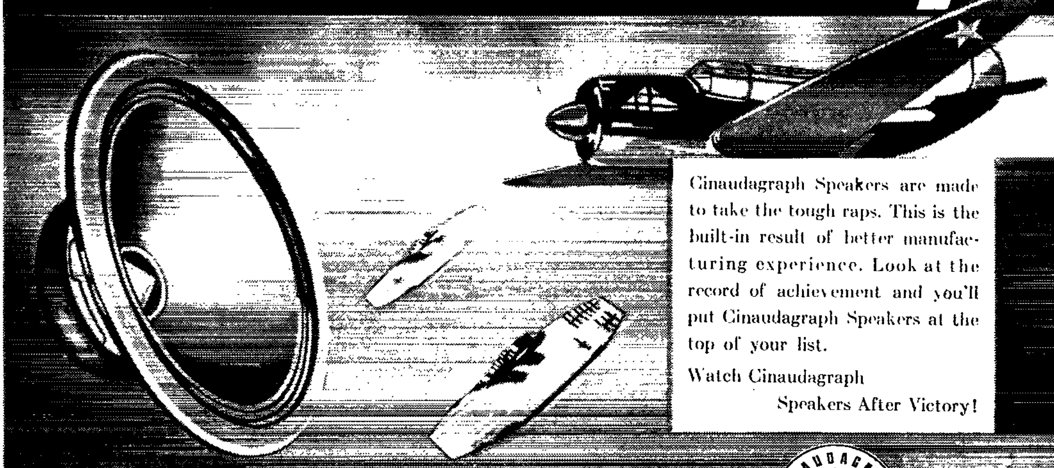
Astatic ***PIONEERED*** *Crystal Microphones with Model D-104*

In the years following 1933, this same microphone, with but minor changes, became a favorite with amateurs the world over. While today but one of Astatic's extensive line of Crystal and Dynamic Microphones, Model D-104 continues in demand and production. It is on performance such as this, in improved products of a new era, that Astatic looks forward to a renewal of friendly relations with the radio amateur of tomorrow through its many jobber outlets.

THE Astatic CORPORATION
CONNEAUT, OHIO
IN CANADA: CANADIAN ASTATIC LTD., TORONTO, ONTARIO

"You'll* HEAR MORE *from Astatic"

TOUGH!



Cinaudagraph Speakers are made to take the tough raps. This is the built-in result of better manufacturing experience. Look at the record of achievement and you'll put Cinaudagraph Speakers at the top of your list.

Watch Cinaudagraph
Speakers After Victory!

Cinaudagraph Speakers, Inc.
3911 S. Michigan Ave., Chicago
Export Div., 13 E. 40th St., New York 16, N. Y.

"No Finer Speaker in all the World"

(Continued from page 94)

short order. The pickings really looked good, so those of us who hadn't flown that day were eager to get started. At noon another convoy was discovered steaming down from the north, and the afternoon's strike group made ready to go to work. While we were donning our flight gear, the navigational data came down and we were all set to go.

"During those few moments before a pilot leaves the ready room he usually sits and tries to quell that nervous feeling in his stomach. I looked over at Joe. He had dozed off in his comfortable leather chair. A moment later we manned the planes.

"The weather was pretty nasty. We flew in rain storms for quite a while. Suddenly we burst into a cloud area and found our target. We were able to find it only because of Joe's work on the radar equipment. We circled out of range for altitude and then made a glide bombing attack, with three planes striking together. Joe's plane was on my left. As we pulled out of the dive I saw his plane hit by an anti-aircraft shell and immediately explode. It happened so fast that it took several seconds to register in my mind. We searched the area for hours afterward, but there were no survivors.

"Those of us who knew Joe are consoled by the fact that he died very quickly and, I honestly believe, happily. Just before we pushed over into the dive he pressed his face against the window of his plane, looked at the target, then over at me, and, grinning like a Cheshire cat, he clasped both hands together in the old fighters' handshake.

"Joe knew what his chances were. I don't think he was ever afraid. He loved to fly, and to think he was fighting his war the best he could. . . ."

"I loved Joe a great deal. Not as you, his parents, of course, but as a very dear friend — one I will never forget."

So ended Joe's last strike — and with it the possibility of a rich and wonderful future for a ham whom we all may be proud was a member of the great amateur fraternity — a ham whom we, too, should never forget.

Strays

We are aware of the frequent deletion of calls and ham lingo from letters written by GIs and from other material which has been censored en route to ARRL Headquarters. We have also observed that, in many cases, when the writer has added a marginal note of explanation to the censor, such deletions did not occur. Such a comment surely must assist the censor in deciding whether to cut out the unfamiliar (to him) phrase. Usually, the notes read "Censor — that is my amateur radio call," or — "Censor — that is the ham radio word for the 'girl friend' — or the wife, etc."

Splatter

(Continued from page 10)

(p. 34), who states that his interest in ham radio originally was fired by an Electro Importing Co. catalog. But, despite this early enthusiasm, Neal did not get around to taking out a license until 1932. Since then he has operated on most of the lower bands, but adds "My main interest has always been on the experimental rather than the communications side of radio." Receiving his Ph.D. in mathematics at the University of Iowa, Neal studied at Princeton as a National Research Fellow after which he joined the Department of Mathematics at Smith College in 1931. . . . Alphabetically last but first in seniority comes **Lt. Robert H. Parker, CAP, W1TO** (p. 40), a genuine OT ("old-timer" to you YSs). Bob learned the code listening to pre-World War I stations and by pounding brass on a neighborhood Morse line. Licensed as 1FA, he discovered *QST* on its second issue at a pal's shack and has been a Constant Reader ever since. (After all these years he deserves a write-up in *QST*, eh?) Among W1TO's prized trophies is one of ARRL's own "War Bonds," issued during the months of reorganization following World War I. After the war, Robert became 1IT, then 1DZ and finally, after operating hiatus, W1TO. Active on all bands from 112 Mc. down, W1TO also acquired a code proficiency award (35) and radio telegraph and 'phone tickets. Currently, W1TO is in charge of the Maine State Police Radio System and also serves as communications officer of the August Squadron, Maine Wing, CAP. But he adds, "I am looking forward to 'that day' when amateur and civilian radio gets the word to go — I still think that it's a great life!"

In addition to the new contributors, several familiar names appear this month with **Lt. Hulen M. Greenwood, AC** (Splatter, April, 1945, p. 94), writing on cathode followers (p. 11); **Capt. William H. Minor, W9DSN** (Splatter, Dec., 1944, p. 90), describing hyperbolic functions (p. 30), and **Philip Rand, W1DBM** (Splatter, Nov., 1942, p. 12), telling how to construct an anti-squealer for superregenerative receivers (p. 23).

Strays

Amateurs will be interested in the convenience and economy of the new Postal Notes. These are now on sale in Post Offices in denominations ranging from $1 to $10 and postal note stamps in denominations of 1 cent to 90 cents. These notes and stamps provide a safe means of sending small sums through the mail cheaper than by money order . . . and save time by eliminating application blanks. All the purchaser has to do is to put down his money in exchange for the note, write in the name of the payee whenever he wishes, and detach the record stub before mailing. A flat charge of 5 cents is made for all notes regardless of denominations.

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 30c 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 7c 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 7c 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 30c 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

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.

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.

CRYSTALS available — all types, including 100 kc., 465 kc. and 100 kc. Broadcast and Aircraft given prompt attention. Scientific Radio Products, Council Bluffs, Iowa.

CRYSTALS: complete units or blanks. All types. Your specifications and tolerances. One or one million. Refinishing and repairing of your present units. Rex Bassett, Incorporated, Ft. Lauderdale, Fla.

FABERADIO crystals will be available to amateurs immediately after hostilities cease. Faberadio, Sandwich, Ill.

RADIO TESTS — Pre-examination Tests for Radio Operators. Tests your knowledge before you appear for commercial radio operator license examinations. Avoids failures. Guides your preparation. Saves your time. Worth investigating at once. Also books for home study. Write for free circulars 5Q. Nilson Radio School, 51 E. 42 St., New York 17, N. Y.

PROMPT Repair Service on meters and electronic instruments. Braden Engineering Co., 3317 Kenmore Ave., Dayton 10, Ohio.

FRITZ for better QSLs after victory! 1213 Briargate, Joliet, Ill.

CLOSING out small lot of tubes, list on request. Abbott, 2101 Grand Concourse, New York City.

RK-49 type tubes wanted. Charles J. Bodnar Co., 58 Marbledale Road, Tuckahoe 7, N. Y.

QRR de LSPH: Need Volumes 1, 2 and 3 to complete my file of *QST*. Will pay good price for bound volumes or single copies in good condition. QRU? E.D.C., 38 LaSalle Road, West Hartford 7, Conn.

IMMEDIATE shipment on priority: new SX28As, $223.00; SX25s, $94.50; PM23s, $15.00; S39s, $110.00; S20Rs, $60.00. In stock without priority: Trimm No. 100 Featherweight headsets, $6.00; No. 65 Dependable headsets, $2.28, meter rectifiers, $1.95, etc. Instructographs for rent. Write for our parts list Henry Radio, Butler, Mo., and Los Angeles 25, Calif.

HIGHEST prices paid for used receivers, test equipment, bugs, oscillators. What have you? W9ARA, Butler, Mo.

WANTED: Typewriter in good condition. Prefer portable. Floyd Howard, Jonesboro, La.

WANTED: A good used Sky Buddy or Echophone EC1. State price and age of unit. John Asaro, EM 2/c, United States Maritime Service, Ft. Trumbull, New London, Conn, c/o Radio Repair Dept.

TRADE: Two-speed dual-field heavy-duty phono-motor, weighted turntable; crystal pickup, mounted portable carrying case. Want portable automatic record changer. Lt. Gridley, W4GJO, Marianna, CCTS, Florida.

SELL: Home-built super communications receiver for ham bands. Best parts used such as National transformers and Isolantite sockets. Sacrifice $30.00. Ralph Hunter, Catskill, N. Y.

WANTED: RCA 1847 miniature iconoscope. Will pay $20.00 for one in good operating condition. R. C. Bitting, W8SEL, Lewisburg, Pa.

WANTED: No. 18 and No. 19 SW-3 coils at your price. W1BB.

WANTED: One 250-watt multi-match modulation transformer. John Blasingame, W4EMO, 770 Myrtle St., Atlanta, Ga.

SURPLUS: radio transmitters for sale: 1 RCA AC200 200-watt 'phone price, $350.00; 1 composite 100-watt 'phone in 36 inch cabinet, price, $150.00; 1 composite 100-watt 'phone in 6-ft. relay rack, price, $250.00; all transmitters set for operation in 3500 kc. Address inquiries to Captain R. L. Hartung, Baltimore Army Air Base, Baltimore 22, Md.

WANTED: Latest model SW-3 without power supply. State price. G. W. McMurray, 3947 San Bruno, San Francisco 24, Calif.

WANTED: Type 1847 Iconoscope. Charles Waterman, 415 West Wayne, South Bend, Ind.

WANTED: National type CRO oscilloscope for 906 3 inch tube, also 250–500-ohm line to grid trans. type LS-10 UTC, or T-17A42 Thordarson or equivalent. Also filament transformer pri. 110-v., sec 10-v. 5- to 10-A. W4DAA, Haralson, Box 489 B Rt. 7, Jax, Fla.

BUILD radio complete with tubes, $10.95, details. Radio, 9418j Avenue "A", Brooklyn, N. Y.

SALE: Dynamotor, 12-volt, 750-volt, 250 ma., $20.00. Roscoe E. Magee, London, Ky.

FOR SALE: Socket power. RCA Model 1019. Input 105-125 v., 60 cycles, primary input, 1.52 amps. Bill Howe, Valley Center, Calif.

TRANSMITTERS and Receivers: Used, U. S. Signal Corps models, B-C-148, range 3960 to 4360 kc., without tubes, $38.50 each, plus $1.50 shipping charges. Signal Corps headsets, types R-14, without head-bands, used, $1.25; with bands, used, $2.50, plus 25 shipping charge. Nico Supply Co., 540 No. 17th, Philadelphia 30, Penna.

WILL sell 300-v., 100-ma. genemotor, 6-v. input, like new, with filter, $20. Also 135-v., 30-ma. ditto, $5. Will buy FB7, Comet Pro, small Howard, or other old model receiver. Carl Austin, W7GNJ, Bend, Oregon.

WANTED: Hallicrafters SX-28 or National NC-200 receiver. W9IJK, Lt. William G. Coxsey, 611 Walnut St., Leavenworth, Kansas.

WANTED: Echophone EC-1, new, used. P. E. Arnold, 25 Court Street, Benning Park, Columbus, Ga.

FOR SALE: Radio parts and ham gear of the late W9STW, W9PKW. Priced right. What do you need? L. R. Scott, Jr., 1929 Freeman Ave., Owensboro, Ky.

FOR SALE: Instructograph, electric motor, ten rolls practice tape. Very good condition, $50. Also Bud oscillator, practically new, $15. William E. Brown, 6223 Tessenden Court, San Diego, Calif.

NEW 954 and 955 tubes, $1.50 each. Used 832 tubes, guaranteed OK, $5.00 each. Lanam Radio, 2320 Shattuck, Berkeley, 4, Calif.

FOR SALE: Abbott TR-4 transceiver, used about 1 hour, $65.00. Also Mallory power supply for same, $15.00. S. Tritsch, W2NFO, 9609 66th Ave., Forest Hills, N. Y.

FOR SALE: National HRO Senior. Good condition. Supreme No. 546, 3-inch oscilloscope, like new. Also 0-250 milliameters. No trades. James N. Blair, W9YJS, 600 City Bank Building, Kansas City, Mo.

WANTED: Ham receiver. Please state condition, price. Graubard, 33 Hilltop Acres, Yonkers 4, N. Y.

MICA R.F. 5 amp. condensers, 0.0012 μfd. 5000 w.v., $14.00 list, $2.50 net. Other sizes in stock. Van Sickle, Indianapolis 6, Ind.

SALE: Xtal mike. Turner 22X. Write Ray Joseph, Hopkinton, Iowa.

WANTED: Crystal and coils for National, FBX general coverage and bandspread, state price, condition. F. H. Jackson, 747 Britton Road, Rochester 12, N. Y.

SELL Abbott DK-3. W3QP.

WANTED: Mimms deluxe rotator without aerial, complete with indicator, also triangular Wincharger tower. F. T. Alderson, 140 S. 8th El Centro, Calif.

CHANGING frequency? Prompt delivery of Eidson fine crystals. Low-drift commercial types available throughout the 100-12500-Kc. range. Also repair and regrinding, and crystals supplied to your holders. Ten years of satisfaction and fast service! Send for folder L-5, mention your needs. "Eidson's," Temple, Texas.

CALLING CQ. Copies of DeSoto's book wanted. Advise price. W2OEN, ARRL Hq.

ECHOPHONE

"The Ears of the World"

HOGARTH TAKES A PEEK AT THE FUTURE

Hogarth's peek into the future forecasts new heights of popularity for Echophone. There will be Echophone equipment for use on the citizens' radio communication service band. It is certain to be low in price, high in performance and completely dependable. The present EC-1 covers from 550 kc. to 30 Mc. on three bands . . . electrical bandspread on all bands . . . self-contained speaker . . . 115-125 volts AC or DC.

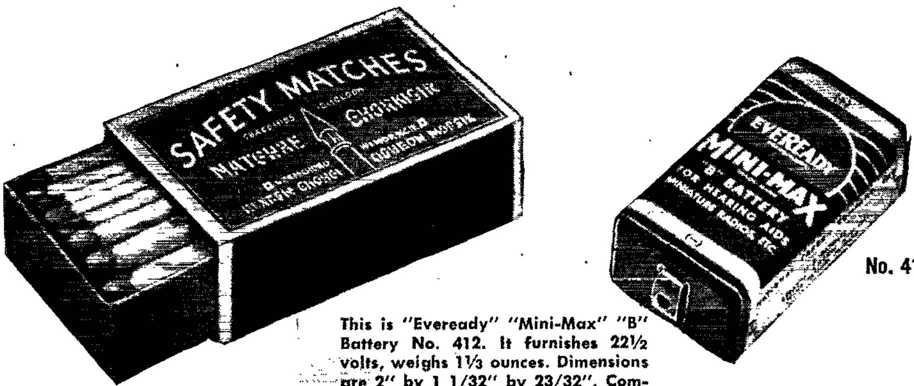
** Citizens' radio communications service band, 460-470 Mc., recently proposed by the F.C.C.*

ECHOPHONE RADIO CO., 540 NORTH MICHIGAN AVE., CHICAGO 11, ILLINOIS

Index to Advertisers

All of the above advertisers are coöperating with the A.R.R.L. to permit publication of an editorially adequate *QST* during this period of war-rationing of paper. Using less advertising space but at higher rates, they continue their customary support of *QST*. Some are using smaller space in each issue and some are using space only every second or third issue. Of the latter, those whose advertising does not appear in this particular issue are indicated by the **above.

GIVE THIS NEW BATTERY A REAL LOOK...



No. 412

This is "Eveready" "Mini-Max" "B" Battery No. 412. It furnishes 22½ volts, weighs 1⅓ ounces. Dimensions are 2" by 1 1/32" by 23/32". Compare its size with that of an ordinary wooden match box.

it's going to REVOLUTIONIZE YOUR BUSINESS

MEET the new "Eveready" "Mini-Max" midget "B" Battery. Embodying National Carbon Company's exclusive construction, it crams 22½ volts into a space smaller than any battery ever before conceived—approximately 2½ times smaller.

Think what it will mean in your business to have a 22½ volt battery "no bigger than a minute" and handy as a match box. It means that the portable radio business—nipped by the war just as it was getting a good start—will return with an even brighter future. It also means that radios can be made for the personal use of an individual. Made small enough to fit snugly in a vest pocket or a lady's handbag.

In this connection, we're cordially inviting America's engineers and designers to consult with us. Bring your special problems to our engineers and our laboratories. We should like to cooperate with you in every way possible in order to speed the development of brilliant new battery uses for the good of the industry, right after the war.

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NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation
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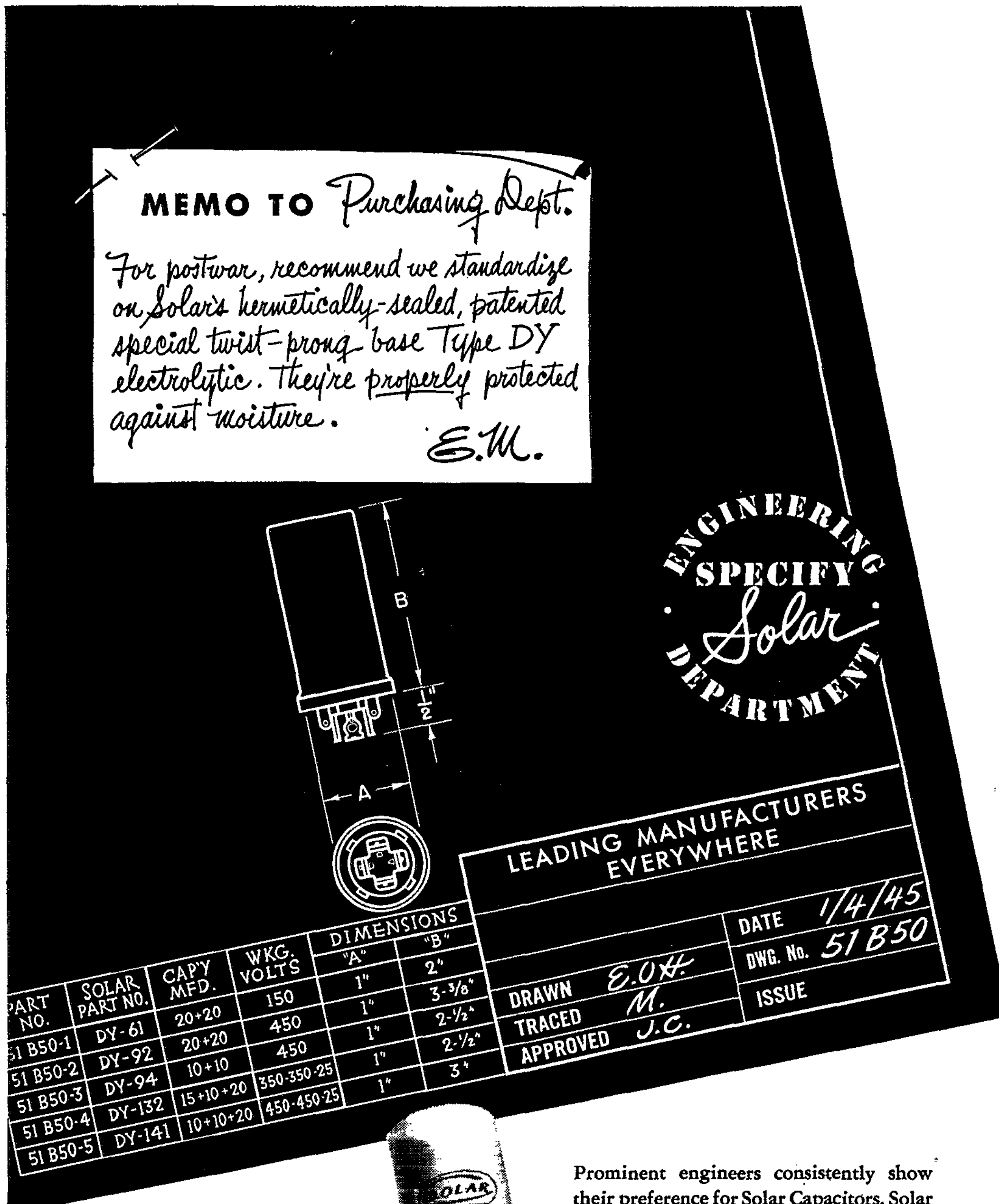
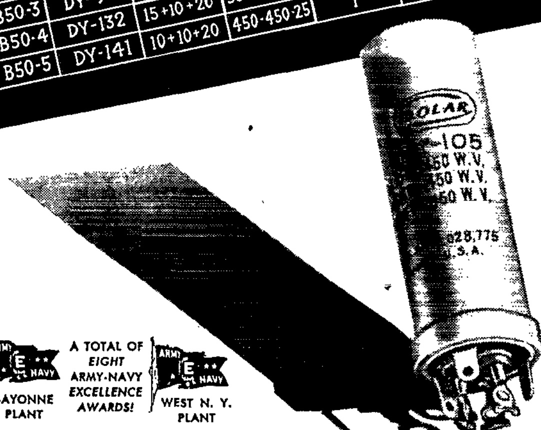
General Offices: NEW YORK, N. Y.

The trade-marks "Eveready" and "Mini-Max" distinguish products of National Carbon Company, Inc.



PART NO.	SOLAR PART NO.	CAP'Y MFD.	WKG. VOLTS	DIMENSIONS "A"	DIMENSIONS "B"
51 B50-1	DY-61	20+20	150	1"	2"
51 B50-2	DY-92	20+20	450	1"	3-3/8"
51 B50-3	DY-94	10+10	450	1"	2-1/2"
51 B50-4	DY-132	15+10+20	350-350-25	1"	2-1/2"
51 B50-5	DY-141	10+10+20	450-450-25	1"	3"



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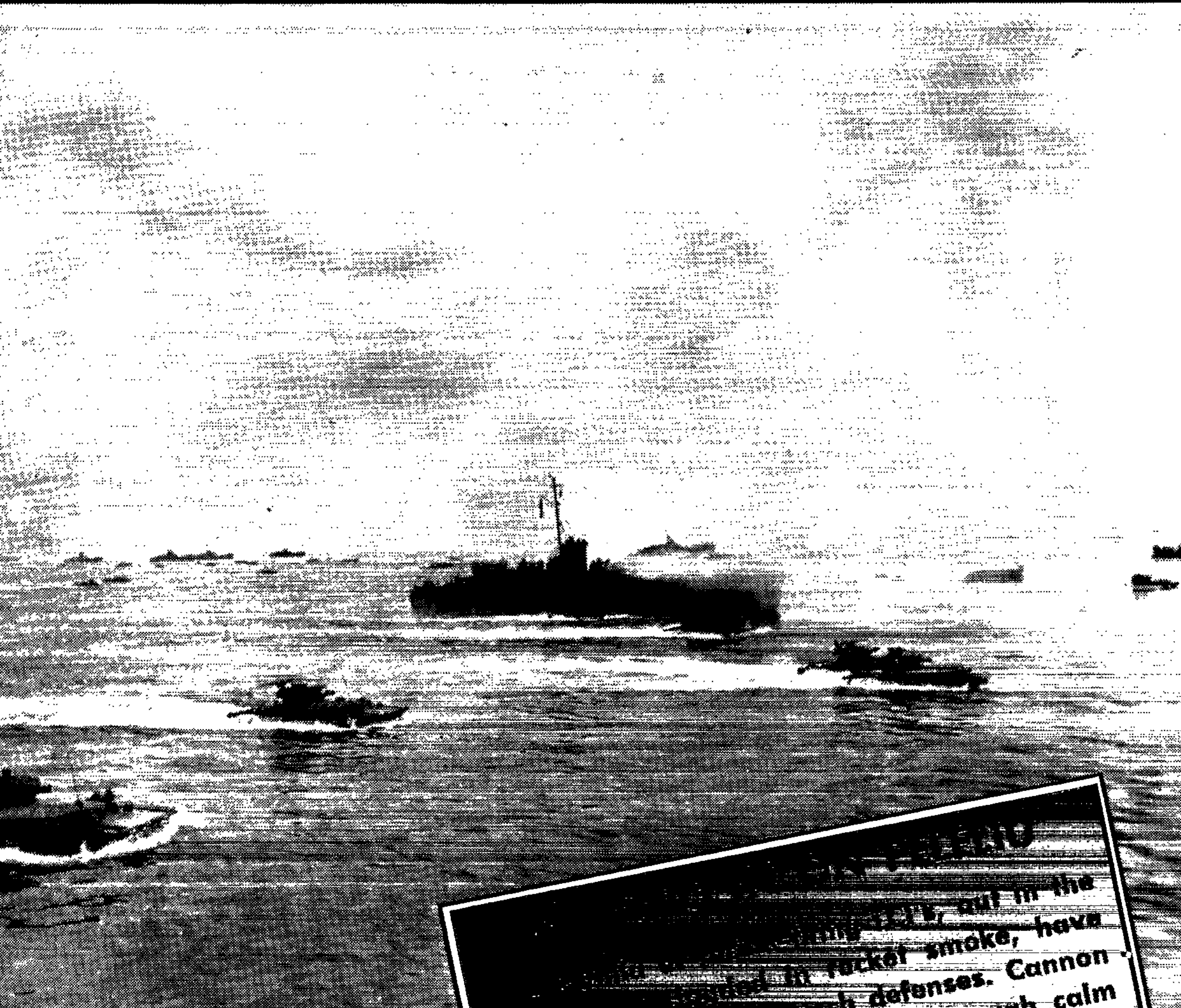
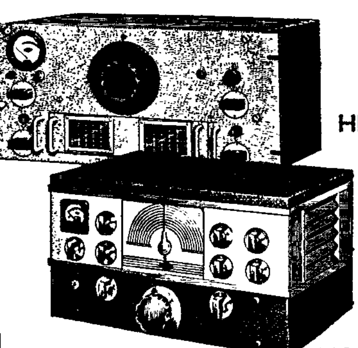


ICIAL U. S. NAVY PHOTOGRAPH

[illegible] out in the
[illegible] rocket smoke, have
[illegible] beach defenses. Cannon
[illegible] tanks plow through calm
[illegible] way for assault troops.
[illegible] and the Americans
[illegible]
[illegible] the Navy's ships — landing
[illegible] equipped with receivers
[illegible] larger — are
[illegible] by National.



HRO

NC-200

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ATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD