QST
devoted entirely to amateur radio

In This Issue:
An A. M. - F. M. Transmitter for 50 Mc.
A Four-Tube Superheterodyne for 144 Mc.
Crystal Control in the New Ham Bands
Getting Acquainted With the "Lighthouse" Tube
Yes, for you there could very well be a citation which would read
"For distinguished service to the American people ..."
... that is, there could be if the nation only realized as well as we, who have worked with you, what a splendid job you have done as a radio technician during the emergency.

If they only knew how you overlooked the word overtime and how an eight-hour day lost its meaning when we most needed to be informed.

If they only knew how you coddled and repaired the irreplaceable tools of your trade so that not even one valuable radio moment was lost in wartime.

If they only knew how the nation was kept informed each twenty-four hours because of your personal effort.

... Well, perhaps they don't realize to whom the thanks belong, or their tongues don't give voice to their feelings ... but in their homes and hearts there has been mute appreciation for the privilege you extended to all, the privilege that could not have been forfeited easily, the privilege that is used so casually, the privilege of switching on the radio.
The key man in world-wide peacetime communications is the amateur. Just as the amateur proved himself an invaluable asset to the country's war effort, so will he continue to make important contributions to the science of communications in a peacetime world. The amateur's quest for something new, something better, the accomplishment of something that "can't be done" leads inevitably to further progress. Hallicrafters, backed by a score of years experience, will spark this progress with new and better amateur equipment. Amateurs high up in the management of the company, amateurs on the engineering and production staffs and thousands of amateurs from all over the world serve to keep Hallicrafters close to the amateur ideal and in the van of high frequency developments. The amateur will be the key man in communications . . . Hallicrafters will be the key company in producing constantly improved equipment for the amateur.
Hallicrafters and Very High Frequency

Based on the facts in the case, Hallicrafters can stake out a very strong claim to leadership in the very high frequency field. The facts include such things as the Model S-37, FM-AM receiver for very high frequency work. The Model S-37 operates from 130 to 210 Mc.—the highest frequency range of any general coverage commercial type receiver.

Hallicrafters further supports its claim to domination in the high frequency field with the Model S-36A, FM-AM-CW receiver. The S-36A operates from 27.8 to 143 Mc., covers both old and new FM bands and is the only commercially built receiver covering this range.

Further developments in this direction can soon be expected—adding further support to Hallicrafters claim to continued supremacy in the high frequency field.
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subscription rate in United States and Possessions, $2.50 per year, postpaid; all other countries, $3.00 per year, postpaid. Single copies, 25 cents.


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NOVEMBER 1945
VOLUME XXIX
NUMBER 11

QST devoted entirely to
AMATEUR RADIO

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

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Centralab medium duty power switches are now available for transmitters (has been used up to 20 megacycles) power supply converters and for certain industrial and electronic uses.

It is indicated in applications where the average Selector Switch is not of sufficient accuracy or power rating. Its accuracy of contact is gained by a square shaft, sleeve fit rotor, and individually aligned and adjusted contacts. It is assembled in multiple gangs with shorting or non-shorting contacts. Torque can be adjusted to suit individual requirements. Furnished in 1 pole...2 to 17 positions (with 18th position continuous rotation with 18th position as "off"); and 2 or 3 pole...2 to 6 position including "off".

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Top honors to Galvin Manufacturing Corporation for building it, and a salute to the police and fire departments of Miami, Florida, for putting it to work in spite of the skeptics! It's the first two-way police radiotelephone system in the United States on frequencies above 100 mc. Twenty-four hours a day, 12 patrol cars in Miami's busy area tune in on signals as solid as a dinner-table conversation from this Motorola 250 watt, 118 mc. FM transmitter.

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<tr>
<th>Filament: Thoriated Tungsten</th>
<th>Direct Inter-electrode Capacitances (Average)</th>
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<td>Voltage</td>
<td>5.0 volts</td>
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<td>Current</td>
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<td>Plate Dissipation (Max)</td>
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<td>Grid-Plate (Without shielding)</td>
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<td>Output</td>
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<tr>
<td>Transconductance (is = 50 ma., Es = 2500 v., Es = 400 v.)</td>
<td>2450 umhos</td>
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All amateurs, especially League members, are invited to report communications activities, training programs, classes, theory-discussion groups each month (16th of the month for the last 30 days) direct to the SCM, with the exception named, will be made.

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MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT
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 at the administrative headquarters at West Hartford, Connecticut.

"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.

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

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"IT SEEMS TO US—"

RECONVERSION HEADACHES

The world is not finding it as easy to return to the ways of peace as all of us at first imagined. Take a look at the troubles of the world as displayed in your morning newspaper and you'll see that everybody from the Council of Foreign Ministers to Sam's Hamburger Stand is bedeviled by worries of all sorts — delays, strikes, lack of materials, disagreements, shortage of personnel, tired minds and bodies, tremendous new problems. Many people find themselves thinking almost wistfully of those days a few months back when all we had to do was win a war. The road back is a far from smooth one.

That is precisely the situation in radio, including amateur radio. Things have not moved with the speed and facility that first seemed possible, and, although the difficulties are but temporary, they are disappointing to a group filled with such high hopes as our gang. This is in the nature of a report to you on the score to date. In telling you the way things seem to be we must simultaneously warn you that plans and intentions change, particularly as to dates, both for better and for worse. The only reliable information will be the current information of the moment. Keep yourself posted.

The best source of information will be W1AW. We are pleased to say that our headquarters station is back on the air, on a special limited authorization arranged through the collaboration of IRAC and FCC, for this very purpose. The frequencies are 3555, 7145 and 14280 kc. The hours are 8 to 11 P.M., E.S.T., Monday through Friday, and week-ends too when there is hot news. Transmissions will generally take the form of broadcasts repeated at 8 P.M., 9 P.M. and 10 P.M. Make it a habit to listen daily. Incidentally, some idea of the difficulty of finding channels these days is given by the fact that the clearing of just these three channels for us took a month of work by the Signal Corps, Air Forces and Navy and involved both the Pacific and European theatres and diplomatic negotiations with Canada.

There are two major problems in our restoration. One is licensing arrangements and the other is the release of our frequencies. FCC has not yet been able to set up shop and open its doors for the receipt of new amateur applications. That is an extensive activity, requiring about thirty people. While we had it before the war, it was not in operation when the last budget was made up, and the money to pay for it now is not available until FCC gets a new appropriation from Congress. The Amateur Unit is not alone in this trouble; it affects every branch of FCC. The Commission's last appropriation was geared to wartime conditions. Now the entire vast structure of civilian radio is ready to roll and the whole national economy requires that FCC be given immediate funds to administer the greatly-expanded post-war activity of the country. That problem is on the way to solution but meanwhile it has prevented readying things as rapidly as we had hoped. Forms are being printed and distributed, regulations looked over, orders drafted. It may still be some weeks away but soon the whistle will blow and licensing will be resumed. W1AW will carry the news.

In the meantime FCC has done the best it could for us: it has put all presently-licensed amateurs back on the air on a temporary blanket authorization, on the only frequency band available. If formal relicensing isn't available by the end of the temporary period, the latter will be extended. As additional bands are released for our use by the military, FCC will make them available to presently-licensed amateurs by announcement. Simple, workable and sensible.

The 112-Mc. band is scheduled, at the moment of writing, to be shifted to 144-148 Mc. about November 16th. It will not happen until FCC announcement. Thereafter there must be no working on 112-115½. Don't put money into gear for the old band; instead, prepare for the new one. Copy W1AW.

Now for more pleasant news — in fact, momentous news: As we write, we are on the very verge of being reopened on every amateur frequency above 28 Mc. Yes, including the 10-meter band, although its DX performance will probably be pretty disappointing right now. Yes, including the 5-meter band, although at its new location of 60-54 Mc. (which now makes it a 6-meter band) — as soon as television is shifted. Yes, including our new assignments above 200 Mc. But not including the new band at 144-148, the move to which will be the subject of a separate order. The military services find they can release these frequencies to us soon by temporarily retaining sharing rights on a non-interfering basis. Don't rely upon this paragraph for your operating authorization, because there may be changes; but you can get reliable information from night to night by listening to W1AW — which is why the
One word of caution: Despite the definiteness of the FCC allocation of new v.h.f. and u.h.f.
bands, it is our belief that some of the amateur assignments between 200 and 2000 Mc. may be
subjected to further change and we recall that FCC itself said that its higher allocations would be
changed to accord with any international treaties to which the country might become party. So we
advise that you do not risk too much money yet on elaborate apparatus unless it can accommodate
itself to the possibility of small shifts in months to come.

The armed forces are not yet in position to re-
lease any of our frequencies below 28 Mc. While
their traffic loads are considerably reduced, their
network organization still requires as many fre-
quencies as before, it is said. They report that
real relief will come only as bases and camps are
actually closed. They are trying hard and there is
no doubt of the sincerity of their effort, both on
behalf of amateurs and for the various commercial
services whose frequencies they are also using.
It is a question of time, purely. It could be
midwinter before we get DX frequencies again,
but there should be considerably more definite
information available in another month. As we
write, we hear that HB, HK, FY, U and VK amateurs are back on the air on all bands and
probably enjoying the freedom from W interference. What a pity that we’re not there with
them! Yet it is our country that has the largest
and most extended military establishments and
whose communication needs will endure the long-
est, and we must prepare ourselves to wait until
our restoration is reasonably possible. We cannot
demand precedence in reestablishment over all
other radio services; but ARRL is insisting that
we be put back on the
air just as fast as any other
service. Our advice to you is to get your outdoor
work done before bad weather fouls you up, for
we can expect DX before the winter is over. And
for fast information in between the issues of QST,
again refer to WIAW’s broadcasts.

The matter of the 160-meter band is not likely
to be settled finally until about the first of the
year but, for the information of those planning
new stations, you should of course understand
that there will be no assignment for general ama-
teur working in this band. However, the prospect
is that we shall have a nonexclusive assignment
for disaster-relief networks, jointly with other
services, and that the frequencies made available
for this purpose will turn out to be 1750-1800 kc.
It is not definite yet and you should await further
word, but that is what you may tentatively ex-
pect. We recommend to the former 160-meter
‘phone crew, by the way, that they try the 10-
meter band, with emphasis on antenna systems
designed for good ground-wave coverage.

The Rio conference, which lasted most of
September, ended with no actions of direct or
immediate concern to us. We shall have a report
in an early issue from Assistant Secretary Bud-
long, who represented us there. There is now a
new regional convention, replacing the Habana
Convention and establishing an Inter-American
Telecommunications Office, but nothing in this
document directly affects us. The Santiago Ar-
range ment was not revised and won’t be until
after next year’s world conference. No allocations
were changed but there was discussion of future
allocations and all the Americas now embark
upon preparations for the international con-
ference, using the U. S. allocation proposals as the
basis for study. Throughout the world numerous
additional groups are preparing, small confer-
ences are being held, and soon we shall be ap-
proaching another worldwide meeting — where,
among other things, the question of our 21-Mc.
bond will be decided.

Meanwhile we all have much to do and plenty
of opportunity for interesting work. The Hz.
Gang itself is hard at it, planning, writing, travel-
ing to Washington, working in labs. We shall
transmit information and reports to you as
rapidly as possible — technical, operating, regu-
larly. Our postwar world begins to unfold. The
outlook is an entrancing one. Dream yourself up
some plans, OM, and get in on the fun!

K. B. W.

WE GO TO WORK

Thanks to exploding atoms, we now have
our impatiently-awaited chance to sink our teeth
into the sixty-four dollar question: what part of
the tremendous technical development during the
war is going to have a place in amateur radio?
There hasn’t been a sufficient lapse of time to get
a real perspective — nor are the restrictions on
wartime secret information by any means com-
pletely removed — so the answer isn’t obvious.
What is obvious is that so many inviting avenues
are opening up that it’s hard to decide which are
the most promising for the initial plunge.
So far as we can see at this juncture, nothing
that has come out of this war is going to revolu-
tionize amateur communication on the old stand-
by frequencies — at least not in the same sense
that c.w. supplanted spark after World War I.
There will be better equipment, yes; and there
are such things as carrier-shift keying to look into
and appraise from the ham standpoint. There are
immensely interesting and useful developments in
predicting the distances that can be covered on
various frequencies, methods which promise to
make DX work an exact science rather than a
fishing expedition. But these things are in the
nature of refinements rather than fundamental
changes. We haven’t heard, for example, of the
invention of any system that makes it possible for
many stations to work without interference
where only one could work comfortably in prewar
days. With the probability that the amateur
population will increase manifold we badly need
a system of that sort. But it looks as though we’ll
have to find the answer — if there is one — for
ourselves.

Most of the developments of technical interest
are centered in the region above 300 megacycles.

(Concluded on page 110)
Getting Acquainted With the
“Lighthouse” Tube

A Simple Transmitter for the 144-, 220- and 420-Mc. Bands

BY PHILIP S. RAND, * WIDBM

One of the tubes most likely to enjoy widespread use by the amateur in our new u.h.f. bands is the disc-seal type known as the “lighthouse.” It is made in several different types and sizes, but the one to be discussed in this article are manufactured by General Electric and are designated the 2C40, 2C43 and 2C44. These tubes are low-powered types and operate very nicely with a plate voltage of from 350 to 400 at 20 to 30 ma. This represents an input of from 7 to 12 watts, a level which can be readily modulated by anything delivering from 3½ to 6 watts of audio.

Referring to the photograph of a 2C44, the tube is conventional only in that it has an octal base. The wide metal band immediately above the base is the r.f. cathode connection, which is coupled by a built-in 100-µµfd. condenser to the d.c. cathode connection brought out through the Nos. 3, 5 and 8 pins in the base. The cathode pillar extends up to within a few thousandths of an inch of the grid disc (the central metal disc) and has its emitting surface only on the flat end of this pillar. The heater is mounted inside the pillar directly under the cathode surface. The grid disc has a hole punched in its center (slightly larger in area than the cathode surface) across which is stretched the fine mesh of the grid. The plate pillar extends down to within a few thousandths of an inch of the grid, and connection is made at the top.

The lighthouse tube is a normal triode tube with the usual frequency-limiting factors designed out of its construction. Use of short and large-diameter cathode and plate leads reduces their inductance to a minimum, while the grid lead inductance is reduced by making it a disc instead of a single or double wire. The transit time is minimized by the close spacing of the elements. The third limiting factor, inter-electrode capacitance, has been reduced considerably in proportion to the power-handling capabilities of the tube, although the actual values resemble other triode capacitances. Nevertheless, reduction of inductance and transit time results in a tube that handles as well in conventional parallel-line circuits at 420 Mc. as does an HY75 at 144 Mc.

Here is a very practical application of one of the high-frequency tubes developed during the war and now available to amateurs. The tube makes possible three-band operation with conventional pre-war technique in the region between 2 and ¾ meters. A three-band amateur transmitter using the 2C44. The shorting bar on the parallel lines is moved to the proper point and locked, and tuning over the band is accomplished by the home-made variable condenser mounted at the ends of the lines near the tube.


For a cross-sectional view of a "lighthouse" tube, see QST, October, 1944, p. 42.
Another model using the lighthouse tube. This oscillator, with no tuning condenser across the line, goes easily to 700 Mc.

However, for the next amateur band (1145-1245 Mc.) it is necessary to go to either a radial- or concentric-type cavity. The steplike arrangement of the plate, grid and (r.f.) cathode is an intentional part of the design to permit plugging the tube into a cavity. A discussion of cavity construction for the lighthouse tube must be reserved for some future article.

A Three-Band U.H.F. Amateur Transmitter

The lighthouse tube is a "natural" for the 144-, 220- and 420-Mc. bands. Using parallel lines, it is only necessary to change the position of the shorting bar to obtain output on any of the three bands. A simple transmitter of this type is shown in the photograph. The shorting bar is moved to a previously-calibrated point on the lines and locked, and any frequency within the amateur band is obtained by a proper setting of a tuning condenser connected across the lines at the point where they connect to the tube. The antenna coupling loop is connected to the shorting bar so that the two are moved simultaneously.

The circuit is shown in Fig. 1. It will be recognized as the conventional circuit used in most 112-Mc. gear. The only critical component in the unit is $RFC_2$, the grid choke. There is an optimum value of choke for any one frequency, with which maximum output will be obtained at that frequency, but the value shown is a good compromise for the three-band range of this transmitter. The cathode is above ground by $RFC_3$ and $RFC_4$, but these inductors do not seem to be too critical.

The transmitter is built on a 6- by 28- by 1-inch board. The "cold" ends of the ¾-inch rods used in the line are supported by two panel bushings mounted in an aluminum bracket which is fastened to the baseboard. These two panel bushings are of the locking type and make it a simple matter to position the rod properly. The plate rod is terminated at the plate and in a hole in the plate cap. The plate cap consists of a ¾-inch length of ¾-inch diameter brass rod with a ¾-inch hole drilled in the center and a ¾-inch hole drilled in the side. Holes are drilled at right angles to the large holes and tapped for 6-32 set screws. The ¾-inch hole fits over the plate cap of the tube, and the ¾-inch hole slides over the end of the plate rod. The grid half of the parallel line is approximately one inch shorter than the plate rod, to provide room for the grid condenser, $C_2$. The grid end of the line is supported by a small polystyrene post, and the grid socket is made by forming a narrow band of copper around the grid disc of the lighthouse tube and tightening it with a 2-56 machine screw and nut.

The shorting bar for the parallel lines is made of two locking-type panel bushings set in a copper strap. These bushings are tightened just enough to insure good contact and still allow the bar to slide without too much effort. It is imperative, therefore, that the two rods be smooth and straight, although they can be either brass rod or brass tubing. The coaxial-cable connector for the antenna feed line and the antenna loop are mounted to a piece of ¾ inch bakelite bolted to the shorting bar. The antenna loop rides under the lines so that it will not hit the tuning condenser when the shorting bar is moved near the tuning condenser. The size of the loop may vary with different antennas but, in general, it should be...
about 2 inches long and spaced the same as the lines. The coupling can be increased by bending the loop closer to the lines.

The tuning condenser is of the split-stator type with the rotor floating. The stator plates consist of two strips of copper, \( \frac{3}{4} \) inch wide by 1 inch long, formed in two arcs and soldered to the tuning rods (see Fig. 2). The rotor uses a piece of \( \frac{3}{4} \)-inch diameter polystyrene rod through which is drilled a \( \frac{1}{4} \)-inch diameter hole for a bakelite or polystyrene shaft. If desired, the solid polystyrene can be replaced by a \( \frac{3}{4} \)-inch diameter coil form by cementing a disc of polystyrene to the open end of the coil form.

The rotor plate, a \( \text{U} \)-shaped strip of copper one inch square, is formed and then cemented to the polystyrene form. A \( \text{U} \)-shaped piece is necessary because it was found that at 450 Mc, the rotor plate acted as a capacitor plate as it was first brought near the stator plates, but after rotating the rotor still further it began to act as a shorted turn in the field of the lines, thus counteracting the effect of the additional capacity and limiting the tuning range to only a small frequency variation. Two metal brackets with panel bushings are used to support the rotor shaft. It is a good idea to mount the panel bushings in slots rather than the usual clearance holes, so that the shaft can be moved toward the stator plates until the desired capacity range is obtained.

The tube socket is mounted on an aluminum bracket which is screwed to the baseboard. No connection is made to the r.f. cathode connection because the oscillator was found to work better over the entire range that way, although a 300-700-Mc. oscillator mounted on a metal chassis worked fine with the r.f. cathode connection grounded.

Speaking of metal chassis for a line oscillator like this, they can be unforeseen sources of trouble. On one such 12-inch job (the chassis was approximately one-half wavelength long), it was possible to light a 6-watt fluorescent lamp brightly at both ends of the chassis, demonstrating only too well its uselessness as a ground.

### Tuning Up

The tune-up procedure for this oscillator is much the same as for any 112-Mc. oscillator, with the exception that forced ventilation must be used on the tube if anything like the rated maximum input of 20 watts is to be used. As much of the plate heat as possible must be conducted away by the plate rod, and for this reason the connection between plate and rod must be as good as possible from a heat as well as an electrical standpoint. The forced ventilation of the plate can best be obtained by the use of a small electric fan whose blast is directed at the plate connection whenever the plate power is applied. A small blower tube can be rigged up from stiff cardboard and attached to the fan if a regular blower housing is not available.

Assuming all three or four connections are made properly, the rig should oscillate without any trouble, and oscillation can be determined by using a small neon bulb or a flashlight lamp and loop of wire held close to the lines. Grid current is also an excellent oscillation indicator. If no oscillation is obtained, it probably means an incorrect grid choke, and its construction should be checked or modified slightly. To get the best efficiency, particularly on any one band, may require some slight revision of the grid choke or in the value of the r.f. by-pass capacitors while watching the output as indicated by the lamp load and the power.
input as indicated by a plate milliammeter. Tuning up should be done at reduced plate voltage, say around 250 or 300, at which value the loaded plate current should run around 15 to 20 ma., after which the maximum input of 40 ma. at 500 volts can be applied if considered necessary. A 6-watt fluorescent light also makes a good indicator, and with this rig we have been able to light one to almost full brilliancy at 450 Mc.2

A good set of Lecher wires or an accurately-calibrated absorption wavemeter is essential for finding the different amateur bands. Although a wire line is probably the most convenient for the 144- and 220-Mc. bands, a more rigid line for the 420-Mc. band can be made by using 1/4-inch rod or tubing, supporting it in the same manner that the tuned circuit was supported for the oscillator. After the oscillator has been calibrated, a cardboard scale can be added to the baseboard and the positions marked for the three amateur bands. The approximate settings of the shorting bar follow, although it is realized that they will probably differ slightly in other rigs:

<table>
<thead>
<tr>
<th>Distance from Center of Plate of 2C43 to Shorting Bar</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 inches</td>
<td>138–152 Mc.</td>
</tr>
<tr>
<td>8¼</td>
<td>215–230</td>
</tr>
<tr>
<td>2½</td>
<td>418–452</td>
</tr>
</tbody>
</table>

Considerable care must be exercised in moving the shorting bar (and in removing the tube from its socket) because of the possibility of breaking the tube seals.

**The Antenna**

Separate antennas will be required for each band, unless a rhombic or similar broad-band antenna is used. It is highly desirable to use coaxial instead of open-wire transmission line at 420 Mc. (if one has access to the low-loss coax developed during the war) because of the lower radiation losses. An intriguing thing about the 420-Mc. band is the small size of the antenna, and a rather decent system can be built in a small space. One of the photographs shows a four-element beam consisting of a folded dipole, one reflector and two directors, and the antenna is only 13 inches high. The length of the elements and their relative spacing should be adjusted to obtain the highest possible forward radiation as indicated on a field-strength meter.

All elements are made of 3/8-inch diameter aluminum rod secured to the wooden framework by blocks of bakelite. The ends of the folded dipole are bolted together with 6–32 brass machine screws and 1/4-inch brass spacers.

**General**

The 2C43 and 2C44 types perform very well in the v.h.f. region, not only as oscillators but also as neutralized amplifiers and frequency multipliers. For example, a single 2C44 will double from 75 to 150 Mc. and drive a pair of 2C44s in push-pull which in turn triple to 450 Mc., all with conventional L-C and linear circuits.

The 2C40 is a receiving-type lighthouse tube and with the others makes a complete set of tubes for the 200– to 1500-Mc. range. As soon as these tubes and their sockets become readily available on the market, the 420- and 1145-Mc. bands should see considerable activity.

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2 Ratings of the 2C44 are given on page 44 of QST. November, 1944.
3 See QST, August, 1945, page 46.

**"Good News" Department**

**Switzerland**—Amateur equipment has been returned by the Government and amateur activities were resumed on the 80-meter band Sept. 30, 1945.

**Colombia**—Governmental decree of October 9, 1945 authorized amateur operation, on all bands, subject to pre-war regulations.

**U.S.S.R.**—CBS news dispatches of October 12, 1945 stated that activity on all amateur bands had been authorized and that amateurs were not restricted to domestic contacts.

**Australia**—Amateur equipment to be returned by the Government and amateurs have been released from their wartime silence by Postmaster General, according to a report via United Press on October 6, 1945.

**Trinidad**—VP4s may go on any pre-war band, even 7-Mc. 'phone, according to a report from VP4TI, via W2NYC.

**Brazil**—Amateur operation on the 3.5-, 56- and 112-Mc. bands has been reestablished. 14- and 7-Mc. activation is expected shortly.
The opening of the 112-Mc. band for amateur radio has, aside from the pleasure it affords us in being able to engage once again in our favorite hobby, forcibly brought home the fact that u.h.f. radio is growing up. No longer can we operate in the bands above 100 Mc. with little fear of interrupting some other service if we inadvertently get out of the band. Instead we are sandwiched in between other interests in much the same fashion as on the lower frequencies, and our moral obligation to keep our records spotless is as definite as it is below 54 Mc. The recent complaints of amateur interference with aircraft services on 116.1 Mc. (when our limit is 115.5 Mc.) bring out strikingly the fact that many of us are using frequency-determining methods that are too casual (or nebulous!) for modern operation. Imagine anyone seriously explaining why he was operating on 27.4 or 30.6 Mc. before the war and you will see what we mean. The matter will be no less serious when we move to the 144- to 148-Mc. band.

A favorite procedure in establishing one's equipment in a new high-frequency band has been to identify the second or fourth harmonic from one's transmitter on the next lower-frequency band where the frequency is known accurately. This is a simple method when bands are harmonically related to one another, but the new u.h.f. bands have not been allocated this conveniently. The limits of the imminent 144- to 148-Mc. band bear no direct harmonic relation to any of the limits of our other bands (with the single exception of the 4-Mc. limit of the 80-meter band), and the same is true of the 50- to 54-Mc. band. The following paragraphs contain nothing new in band-limit-determining technique, but they describe the methods available to amateurs at the present time.

Lecher Wires

Lacking an accurately-calibrated absorption-type frequency meter (which might be a homemade affair resulting from considerable pre-war foresight or the manufactured article built by several instrument companies), the simplest and least expensive piece of frequency-determining equipment is a set of Lecher wires. "Lecher wires" is the name given to a two-wire transmission line used for direct wavelength measurement by observation of the distance between maximum current loops of standing waves along the line. The line is a simple thing to build, the single strict requirement that only air dielectric exist between the portions of the line where the measuring is done being an easy one to satisfy. The wires are usually stretched tightly between insulating supports, and a spacing of an inch to an inch and a half is about right for 150 Mc. and lower. The line must be at least one wavelength long, to insure the existence of at least one full half wavelength, and the current loops are found by using a "shorting bar" which can be slid along the line to vary its effective length. The longer the line is made, in terms of half wavelengths, the sharper will be the readings that are obtained, because of the more rapid phase shifts present in the longer line.

A practical Lecher-wire system has been described recently, and it should not be necessary to repeat all of the constructional details here. The Lecher-wire assembly should be built in more or less permanent form, although it is quite feasible to stretch the line temporarily along a wall or a large plank laid on the floor. A permanent system is probably best constructed along the lines of the reference article, by constructing a T beam of two pieces of one-by-two-inch wood at least eight feet long and supporting the wires from insulators fastened to brackets at the ends of the T beam. This type of construction has the additional advantage that it provides a guide for a carriage on which the shorting bar can be mounted. The shorting bar should be a piece of brass or copper sharpened almost to a knife edge. The wire can be any bare copper wire larger than No. 18.

The frequency of a transmitter can be checked by loosely coupling the Lecher wires (by a hairpin loop at one end of the line) and finding two spots on the line where shorting the line causes an increase in the plate current of the transmitter. The distance between these two points on the line bears the following relation to the frequency:

\[ F_{Mc} = \frac{5906}{\text{Distance (inches)}} \]

If the distance is measured in meters, the relation is

\[ F_{Mc} = \frac{150}{\text{Distance (meters)}} \]


In many cases the change in plate current will be too small to observe on the plate milliammeter, and a small loop of wire and flashlight lamp coupled to the transmitter must be used as an indicator. Then when the shorting bar is placed properly the lamp's brilliance will be reduced. For maximum accuracy with this method, the indicating lamp and the Lecher wires should be coupled as loosely as possible consistent with any indication at all, because of the possibility of "pulling" of a self-excited oscillator. No such care is necessary with a power amplifier excited by an isolated oscillator. For low-powered rigs, where coupling a flashlight lamp will result in too much pulling of the frequency, it may be necessary to use an absorption-type wavemeter using a crystal detector and milliammeter indicator. Many of the low-powered rigs will be transceivers, and the frequency check can be made in the "receive" position with the technique used for any superregenerative receiver.

Checking a superregenerative receiver with Lecher wires consists of advancing the regeneration control from the "off" position up to the point where the receiver just starts to superregenerate, with the Lecher wires loosely coupled. There will be found points on the Lecher wires where shorting the line will reduce the hiss in the receiver, and these represent the current loops along the line. In the case of a transceiver with no regeneration control, it will be necessary to couple in the Lecher wires until an indication is obtained. Except in the case of a transceiver which is oscillating too hard in the "receive" condition, it will be possible to get accurate indications.

A word of caution might well be repeated here concerning transceiver operation. Most transceivers do not transmit on exactly the same frequency to which they are tuned in the "receive" condition, with the result that two operators working each other with transceivers very often "walk" across the band during a QSO in steps of new equipment. However, the pre-war amateur with low-frequency equipment will most likely resort to the use of harmonics from his low-frequency gear for checking frequency in the 50- and 144-Mc. bands. It is, however, the accurate checking of the fundamental frequency of the harmonic generating oscillator that is the important thing. If, for example, one is using the harmonics from a crystal in the 3.5-Mc. band (and thus anything from the 36th to the 42nd harmonic), the error in measuring the frequency at 80 meters is multiplied by about 40 at 144 Mc. Depending upon the accuracy of calibration of a crystal and the circuit in which it is used, a crystal can vary perhaps 2 or 3 kc. at 80 meters and thus could be in error 100 kc. or more at 144 Mc. This is, of course, unimportant to the amateur willing to stay within 400 or 500 kc. of the band edges, but it should be borne in mind by anyone with a desire or tendency to "crowd the edges" that it is not sufficient to accept the nominal frequency of a crystal when using its high-order harmonics for accurate checking.

Harmonics for Frequency Checking

The preceding method of frequency checking is the most convenient for the amateur without any low-frequency gear because it requires a minimum of new equipment. However, the pre-war amateur with low-frequency equipment will most likely have to resort to the use of harmonics from his low-frequency gear for checking frequency in the 50- and 144-Mc. bands. It is, however, the accurate checking of the fundamental frequency of the harmonic generating oscillator that is the important thing. If, for example, one is using the harmonics from a crystal in the 3.5-Mc. band (and thus anything from the 36th to the 42nd harmonic), the error in measuring the frequency at 80 meters is multiplied by about 40 at 144 Mc. Depending upon the accuracy of calibration of a crystal and the circuit in which it is used, a crystal can vary perhaps 2 or 3 kc. at 80 meters and thus could be in error 100 kc. or more at 144 Mc. This is, of course, unimportant to the amateur willing to stay within 400 or 500 kc. of the band edges, but it should be borne in mind by anyone with a desire or tendency to "crowd the edges" that it is not sufficient to accept the nominal frequency of a crystal when using its high-order harmonics for accurate checking.

![Diagram](image_url)

**Fig. 1** — Harmonics of oscillators in the 1.7- to 2.0-Mc. range with harmonics in the 2-meter amateur band.
but if the fundamental frequency is below 14 Mc. it is highly advisable to use Lecher wires for a rough check to insure operation within the band. In the case of a super-heterodyne receiver, Lecher wires can be used to check the frequency of the local oscillator if the i.f. is low enough to bring the oscillator within the range of the Lecher wires. Some experimenting will be necessary to get the proper coupling between the Lecher wires and the local oscillator.

When the band limits have been established accurately on the receiver by the harmonic method, the receiver can be used to check the transmitter frequency if the transmitter is low-powered and the receiver is remote enough to preclude the possibility of the transmitter blanketing the receiver. However, it is at best an unsatisfactory method unless the amateur band falling in the 144-Mc. band.

The serious u.h.f. amateur will, of course, not be satisfied until he has a good secondary standard for measuring frequencies in the region above 50 Mc., and the references in the bibliography are recommended for ideas along this line.

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--- B. G.


Extended-Range Television Reception

A Receiving System for Weak-Signal Areas
In Three Parts—Part I

BY MARSHALL P. WILDER, * W2KJI.

Fig. 1 — Cross section showing the signal path between the Empire State Transmitter and the author’s home in Berlin, Conn. The receiving antenna is approximately 1000 feet below the line of sight.

It is usually taken for granted that reception of television broadcast programs is confined to the area in which the signal can be received over a substantially line-of-sight path. For reliable, day-after-day reception this is no doubt true. However it does not mean that those who live outside the normal service area have to go without television entirely — not, that is, if they are willing to take the extra pains necessary to make the most of the signal that does penetrate the outlying regions. While it is not to be expected that reception always will equal that obtainable within a stone’s throw of the transmitter, the fact is that the entertainment quality can be high for a surprising percentage of the time. At least that has been the writer’s experience at a location in Berlin, Conn., almost 90 miles from the Empire State transmitter and well below the line of sight. Consistent reception of WNBT (51.25-Mc. picture carrier, 55.75-Mc. sound carrier) has been obtained over the path 1 shown in cross-section in Fig. 1, a result which, while naturally dependent upon atmospheric conditions, has been made possible by a receiving system that includes a high-gain antenna as well as a receiver of advanced design.

Beginning with the December, 1937, issue the writer published a series of articles in QST, “Introducing Modern Electronic Television to the Radio Amateur.” During the intervening eight years the art has progressed considerably, and standards of good engineering practice have developed both as a result of action taken by the Federal Communications Commission and by the industry as a whole. For instance, modern television calls for a receiver capable of quasi-single sideband reception (type RA) as indicated in Fig. 2.

The picture reproducing tube and associated deflection circuits should be capable of linear deflection of the beam at a frequency of 15,750 traces per second horizontally, and 60 traces per second vertically. The rate of horizontal deflection of the return trace of the beam is approximately five times faster than the trace time. The return trace

This chassis contains the video amplifier, limiters, automatic frequency control synchronizing circuits, vertical and horizontal deflection circuits, and the d.c. power supply. Layout of components is described in the text.

The author of this article has been getting good television reception for a considerable proportion of the broadcasting time at a location nearly 90 miles from the nearest broadcaster and a thousand feet below the line of sight. This is a description of the equipment with which it is done.

*Electronic Division, Remington Rand Inc., Middletown, Conn.

1 For the method of constructing such a map, see P. S. Rand, “Choosing U.H.F. Sites,” QST, September, 1945.


QST for
time of the vertical deflection is approximately twelve times faster than the trace time. A total of 525 lines is traced in one-thirtieth of a second. Interlacing is accomplished by dividing one complete picture or frame into two "fields," each forming a 262½-line picture scanned in 1/50th second. The lines of the second field fit in between the scanning lines of the first so that a 525-line picture is achieved, although alternate lines are separated in time by 1/60th second. At the end of the first field, when the scanning beam has moved only a half line across the bottom of the picture, the beam is returned to the top of the picture to finish the line. Because the beam is moving down the picture (as a result of the continuous vertical deflection) at the same time that it is moving across, this process places the last half line above the last half of the first line of the first field, the displacement being just the width of one line. The lines of the second field thereby are automatically placed between the lines of the first as the scanning continues. The reason for interlacing two fields is to achieve a picture interruption rate of sixty times a second rather than thirty, thereby achieving a decided reduction in picture flicker. The brighter the picture, the higher the interruption rate has to be to avoid annoying flicker. An interruption rate higher than approximately thirty-five fields per second is not noticeable at ordinary levels of picture brightness. To insure against the development of noticeable flicker as pictures are further increased in brightness, an interruption rate of sixty fields per second has been established by the Federal Communications Commission.

The principal requirements for a receiver operating under the conditions encountered when signals must be received over non-optical paths are a good inherent signal-to-noise ratio, ample gain, and a method of synchronization which is as insensitive as possible to the upsetting effects of local interference such as automobile ignition. For the most part the circuits in the receiver to be described follow designs which will be fairly familiar to those who have kept in touch with television development, hence the discussion will be concentrated on those aspects that are particularly useful for weak-signal reception.

Two unusual features of this receiver are the means for synchronization, employing the flywheel or electrical inertia type of circuit, and electronic regulation of the d.c. power. A noise limiter is an important element in the receiver. The description to follow covers the units furnishing power, synchronization, beam deflection, video signal amplification, noise limiting, and low-frequency restoration. Fig. 3 is a block diagram of the receiver.

A.F.C. Synchronization

Aside from band width, horizontal and vertical resolution depend on the accuracy of synchronization as well as the intensity of the noise impressed on the kinescope grid. This is especially true when signals are weak or the noise level is high. If methods of synchronizing other than automatic frequency control are used there are often conditions when horizontal resolution is reduced, regardless of the pass band of the receiver. A report based on an original paper by Wundt and Fredendall, prepared by the television section of RCA Laboratories, Princeton, N. J., for the Radio Technical Planning Board, Panel 6, Television Committee 2, describes an automatic frequency-synchronizing circuit. This circuit will not follow sudden changes in the synchronizing pulse repetition rate and is recommended for all receivers operating at or near the fringe of television service areas. The repetition rate, line by line and field by field, is held rigidly at the broadcasting station. At the receiving point any spurious pulses such as those generated by auto ignition or other local interference will not cause loss of synchronization unless the rate of

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The interfering pulse is very near that of the picture sync pulse for an extended time, a very unlikely coincidence. The synchronizing circuit employed in this receiver, shown in block form in Fig. 4, is essentially the type described in the RTPB report.

Fig. 5 is the detailed wiring diagram of the video, synchronizing, and deflection circuits. Referring to this figure and to Fig. 3, the tuner chassis transmits the composite video-sync signal from the second detector via a cathode follower to the grid of \( V_a \), where it is amplified and passed on to the noise limiting diode, \( V_7 \). \( R_{109} \) sets the voltage on both plates of \( V_1 \) to allow the video to pass through, along with the synchronizing pulses. \( V_1 \) clips off noise pulses to the top of the synchronizing pulses.

It will be noted that compensation for high-frequency losses in the plate circuits of \( V_8 \) and \( V_7 \), including the grid of \( V_8 \), is accomplished by an inductance, \( L_a \), in series with the load resistor, \( R_8 \), for \( V_7 \). Further high-frequency compensation is effected by \( C_2, R_2 \). Two stages of video amplification are used instead of one, to permit greater freedom in design, noise limiting, and simpler high-frequency compensation. The output tube, \( V_8 \), is a video power output tube capable of supplying 75 volts peak-to-peak to the grid of the kinescope with a passband of 4.5 Mc. Series peaking is employed.

The video signal is supplied from the video output tube, \( V_8 \) through \( R_{12} \) and \( C_8 \) to the cathode of tube \( V_9 \) (Block No. 1, Fig. 4). The high value of \( R_{15} \), in combination with the low voltage applied to the plate of \( V_9 \), results in saturation of all signals except the tips of the synchronizing pulses.

It is a feature of this type of synchronizing circuit that the wave form need not be sharply defined; that is to say, considerable high-frequency content can be lost without affecting the quality of synchronization. It will be noted that the input to \( V_9 \) is through a series resistor of not less than 10,000 ohms, a decided advantage in retaining high frequencies on the grid of the kinescope.

The second triode section of \( V_9 \) inverts, amplifies and clips off the top of the sync pulses to a common level. Both the vertical and horizontal pulses are fed to the grids of \( V_{16} \) (Block No. 4) and \( V_{17} \) (Block No. 5) via \( RC \) components designed to separate and apply essentially horizontal pulses to the grid of \( V_{16} \) and vertical pulses to the grid of \( V_{17} \). The purpose of \( V_9 \), in the horizontal deflection case, is to apply signals of equal amplitude but opposite polarity to \( V_{16} \) (Block No. 6), a diode bridge-type phase discriminator. At the same time a portion of the sawtooth appearing in the plate circuit of the output tube, \( V_{11} \) (Block No. 12), is fed back to the bridge through \( C_{14} \). These two voltages, one from \( V_{16} \) and derived from the received signal, and the other from the plate circuit of \( V_{11} \) and generated
Fig. 6 — Wiring diagram of regulated power supply for the video and sync circuits.

locally, are compared in $V_{14}$. If there is a phase difference, a bias will be developed of a polarity which, when applied through the d.c. amplifier (Block No. 8, one-half of $V_{12}$) will cause the blocking oscillator $V_{12}$ (Block No. 10) to slow down or speed up until the voltage output of the phase discriminator is essentially zero. When this is achieved exact synchronization will be maintained. Constant hunting back and forth is prevented by the RC filter $R_{29}, C_{19}$.

A similar action takes place in the vertical deflection circuits. The vertical synchronizing pulses are inverted in $V_{11}$ (Block No. 3) so that a pulse of opposite polarity can be applied to a double-diode phase discriminator, $V_{15}$ (Block No. 5). At this point vertical pulses derived from the vertical output tube $V_{16}$ (Block No. 11), are mixed with them so that the resulting voltage is either positive or negative depending on whether the locally-generated pulses are leading or lagging the received pulses. In $V_{14}$ (Block No. 7) this voltage difference is amplified, and in $V_{16}$ (Block No. 9) the amplified voltage difference is employed to speed up or slow down the local oscillator. When the local oscillator is operating at the same frequency as the received pulses, the voltage difference is essentially zero and complete synchronization is effected. Small sketches accompanying each block indicate the approximate wave forms to be observed on a cathode-ray oscilloscope.

**Power Supply Circuits**

The beam in the picture tube is deflected by a magnetic deflection coil from power developed in conventional deflection circuits, but controlled as to frequency by the automatic frequency synchronizing circuit outlined above. To avoid hum bars in the picture or ripples along the edges, an electronically regulated source is required.

Fig. 6 is a circuit diagram of such a power supply. This circuit passes all current through the four 6Y6's from plates to cathodes and the internal resistance of the tubes is varied by the potential on their grids. Any fluctuations on the grid of $V_{16}$ will be applied in opposite phase to tubes $V_1, V_2, V_3, V_4$ to restore the potential of the power supply to a constant output voltage which can be set over a narrow range by $R_{102}$. In order to have a reference point of rigidly fixed voltage two VR150's are used. The arm of $R_{102}$ is set so that the grid of $V_6$ is approximately 5 volts more negative than its cathode.

![Circuit Diagram]

**Fig. 7** — Circuit diagram of high-voltage power supply for the picture-reproducing tube.

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A circuit diagram for the high-voltage power supply is given in Fig. 7. Too much emphasis cannot be placed on the personal danger involved when dealing with the high voltage required in a television receiver. High-voltage sources of power resulting from rectification and filtering of either high-frequency oscillators or fly-back voltage developed in a horizontal output tube are to be preferred whenever it is possible to obtain components. Unfortunately such transformers and other components were not available and a conventional high-voltage supply of prewar design had to be used.

A 12AP4 or 9AP4 is recommended for use in this receiver. However, if a suitable deflection yoke is employed the 7CP1 and the 9JP1 can be used without essential changes in the circuit. Most of the writer’s experience has been with the 7CP1.

The average brightness of the picture is controlled by $R_8$ in the cathode circuit of the kinescope. The average brightness of the picture is controlled by $R_8$ in the cathode circuit of the kinescope.

Bottom view of the video-sync-deflection chassis. Insofar as possible, small parts such as resistors and paper condensers are mounted on terminal boards, with cabled leads to tube sockets and other chassis-mounted components.

Left - The 7500-volt power supply for the picture-reproducing tube is built in a metal cabinet separate from the other chassis units.

Right - The rectifier tube and filter condensers are visible in this bottom view of the high-voltage power supply.

Chassis Arrangement
A top view of the d.c. power supply, video amplifier and limiters, automatic frequency control synchronizing circuits, and vertical and horizontal deflection output circuits is given in one of the photographs. The tube in the lower left-hand corner is the first video stage, $V_6$. The next tube above is the noise limiter, $V_7$, followed along the chassis edge by $V_8$, the video output tube. Two VR150s, $V_{21}$, $V_{22}$, and a 6SJ7, $V_5$, regulating the d.c. power supply, complete the line of tubes along the edge. The second row starts with the horizontal phase-inverter tube, $V_{16}$, followed by the d.c. restoring sync separator, $V_9$. Next in line is the vertical-pulse phase inverter, $V_{17}$, followed by two 6Y6s, $V_1$ and $V_2$, part of the d.c. regulator. The third row begins with the horizontal discriminator, $V_{14}$, the vertical and horizontal d.c. amplifier, $V_{13}$, the vertical phase discriminator, $V_{15}$, and the other two d.c. regulators (6Y6s), $V_3$ and $V_4$. The fourth line of tubes starts with the horizontal blocking oscillator, $V_{12}$, followed by the vertical oscillator, $V_{10}$, and the vertical output tube, $V_{18}$. The two 5U4G rectifiers, $V_{19}$ and $V_{20}$, are above. The last line of tubes consists of the 807 horizontal output tube, $V_{11}$, and the 6X5 damping tube, $V_{19}$.

The large cans contain transformers and are adjacent to the tubes with which they operate.

(Concluded on page 118)
An A.M.-F.M. Transmitter for 50 Mc.

Combining Crystal and V.F.O. Control in the New Six-Meter Band

BY E. P. TILTON,° W1HDQ

The new band at 50-51 Mc. will not require a different approach in transmitter design — the familiar double-double-amplify system still can be used — but it is no longer possible to multiply from ham band to ham band. Until the new crystals become available a v.f.o. offers an easy way out. Here’s a transmitter that combines crystal, v.f.o., f.m. and a.m. — just about everything you’ll need when 50 Mc. gets the green light.

In prewar days it was customary to make one exciter unit do for operation on all bands. In view of the harmonic relation then existing between the low-frequency ends of all the bands, this was not too difficult a proposition, even for those contemplating work on 56 and 112 Mc., but now that harmonic relation stops at 28 Mc. some other approach is in order for the v.h.f. worker. Some exciters which give output on 28 Mc. can be made to work on 50 Mc. also, but the difficulty of attaining this end indicates that a separate exciter for 50 Mc. and higher is the simplest way out.

By designing our tuned circuits to cover a little more than the range required for six-meter operation, we are able to generate power over a range which will be useful in tripling to the two-meter band as well. Even though multistage design is not contemplated for the higher frequency, a source of r.f. having reliable frequency characteristics is mighty handy in finding the band and in lining up transmitters and receivers to be used there, as anyone who has hunted for 144 Mc. will testify. Thus our v.f.o. grid circuit is made to tune from 12 to 13.5 Mc., the range from 12 to 12.35 giving us the 144-Mc. band, and 12.5 to 13.5 the 50-Mc. band. Crystals for this range soon will be available from several manufacturers at moderate cost. The common oscillator plate circuit tunes to the second harmonic of this range, or from 24 to

Front view of 50-Mc. a.m./f.m. transmitter. The r.f. section of unit occupies the left-hand portion of the chassis. The VR-150, 6SA7 reactance modulator, and microphone transformer are at the right. Note neutralizing capacity wires at the left of the 815.

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27 Mc. Because amateur communication by means of frequency modulation is still in the experimental stage, it is often desirable to make quick changes from a.m. to f.m. in order to compare results with the two modes of operation. This is accomplished by using two separate oscillator tubes with a common plate circuit, a switch being provided to close the cathode circuit of whichever oscillator is desired. To prevent any possibility of accidental frequency modulation when amplitude is being used, a three-position switch is employed, giving us a front-panel choice of crystal or v.f.o. control, or v.f.o. with f.m.

Stabilising the V.F.O.

Stability under changes in supply voltage is attained by the simple expedient of supplying the v.f.o. screen from a VR-150. The screen voltage is held at 150 when the plate voltage is varied over a range from 150 to 600 volts. The cathode current to the oscillator, measured in J2, remains practically constant when the plate voltage is varied over this wide range, and the total frequency shift is only a few hundred cycles. With variations in plate voltage which would result from even the most severe line-voltage fluctuations, the frequency shift in the oscillator is only a few cycles. It is thus not necessary to resort to expensive and complicated regulated power supplies to obtain entirely satisfactory v.f.o. stability.

Of course, fluctuation in supply voltage is only one of several sources of v.f.o. instability. We must also guard against excessive tube and component heating, variations in circuit capacity due to non-rigid mechanical design, and interaction due to improper placement of components. In this design, oscillator input is held to less than

![Wiring diagram of 50-Mc. a.m./f.m. transmitter.](https://example.com/wiring-diagram.png)

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C1 - 0.01-µfd. 400-volt paper tubular.
C2 - 0.001-µfd. mica.
C3 - 8-µfd. 400-volt electrolytic and 0.005-µfd. mica in parallel.
C4, C5 - 500-µfd. mica.
C6, C7, C8, C9, C10, C11, C12 - 0.002-µfd. mica.
C9 - 100-µfd. midget variable, screwdriver adjustment (Hammarlund APC-100).
C10 - 100-µfd. and 50-µfd. in parallel (Sickles Silvercap). See text.
C11 - 100-µfd. mica.
C12, C13 - 50-µfd. variable (Hammarlund MC-50-M).
C14 - 50-µfd. mica.
C15 - 35-µfd. per section, split stator (Hammarlund MCD-35-MX).
Cm1, Cm2 - Neutralising capacity. See text.
R1 - 0.5-megohm volume control, switch type.
R2 - 750-ohm, ½-watt.
R3 - 50,000-ohm, ½-watt.
R4, R5 - 0.35-megohm, ½-watt.
R6 - 5000-ohm, ½-watt.
R7, R8 - 0.1-megohm, ½-watt.
R9 - 5000-ohm, 5-watt.
R10 - 250-ohm, 1-watt.
R11 - 15,000-ohm, 1-watt.
R12 - 15,000-ohm, 5-watt.
R13 - RFC4, RFC5, RFC6 - 2.5-m.h. r.f. choke (National R-100).
RFC7, RFC8 - 2.5-m.h. r.f. choke, end mounting (National R-100-U).
J1 - Open-circuit jack.
J2, J3, J4 - Closed-circuit jack.
S1, S2, S3 - 3-position, 3-contact rotary switch (Malloy).
S4 - Switch on deviation control, R1.
T1 - Single-button microphone transformer (Thordarson T-83A78).
T2 - 6.3-volt, 4-amp, filament transformer.
L1 - 8 turns No. 18 tinned, ½-inch diameter, 1-inch length, on National PRJ-2 form.
L2 - 10 turns No. 14 e., ½-inch diameter, spaced one diameter, air-wound.
L3 - 4 turns, No. 14 e., ½-inch diameter, spaced one diameter, air-wound.
L4 - 5 turns each section, No. 14 e., ½-inch diameter. Adjust spacing for best transfer of energy. See text.
L5 - 5 turns each section, No. 12 tinned, 1½-inch diameter, spaced one diameter.
L6 - 2 turns No. 14 e., 1-inch diameter, swinging link. See photos and text.
L7 - 35 turns, No. 24 d.c.a., close-wound on 9/16-inch diameter form (National PBF-3).
Under-chassis view. At the lower center are the v.f.o. grid coil and associated components. Over these are the crystal and cathode circuit for the 6AG7 crystal oscillator. At the upper right are the inductively-coupled doubler plate coil and final grid coil. The coil and condenser at the lower right comprise the plate circuit which is common to both oscillators. The doubler plate tuning condenser is at the far right.

Choosing the Tubes

Several types of tubes were tried in the v.f.o., and it was found that there was little choice between the 6F6, 6V6 and 6VGT. All showed similar freedom from drift and had practically the same output, but the 6F6 had a slight edge in the matter of frequency shift when the plate circuit was tuned through resonance. The 6AG7 was good in this respect, but was rejected because of its greater tendency to microphonics. The 6AG7 was used for the crystal oscillator, however, because of its low output capacitance, it being desirable to keep the total capacity across the common oscillator plate circuit to the lowest possible value.

The same tubes were tried in the doubler stage, and again there was little difference in performance, so the 6V6 was used because it is readily available. As the final stage is very easily driven it is unnecessary to push the doubler hard, or to strive for maximum efficiency at any point in order to get adequate drive to operate the final stage at full input. The doubler screen is also supplied from the stabilized source, and input to this stage is about the same as that to the oscillator — namely, about 5 watts, with a plate voltage of 300.

For the final stage, low overall cost and simplicity of design dictated the choice of an 815. An 832 or 829 might have been used, in which case neutralization might have been avoided — and somewhat higher output attained, in the case of the 829 — but neutralization presented no difficulties, and for most v.h.f. workers the considerable difference in cost would not be made up by the slight improvement in performance. An 829 would be a likely selection for tripling to 144 Mc., however.

Mechanical Details

The transmitter is built on a standard 10 X 17 X 3-inch chassis, and all components except tubes, crystal and the final-stage output circuit are mounted below the deck. An experimental model was made using a 7-inch chassis, but much better circuit layout and accessibility were obtained with the larger base used in the final model.

Viewing the unit from the top front, the microphone transformer and 6SA7 reactance modulator are at the right front, with the VR-150 at the rear, adjacent to the antenna coupling assembly. The crystal, crystal oscillator, and v.f.o. are grouped near the middle of the chassis, with the doubler and final tubes at the left.

The front panel is a standard $8\frac{3}{4} \times 19$-inch crackle-finished masonite unit. The v.f.o. tuning dial is centrally placed, with the oscillator and doubler tuning condensers at the left, and the a.m./f.m. switch and deviation control at the right. The final plate tuning knob is above the v.f.o. dial, at the left, and the swinging-link adjustment at the right. Jacks, from left to right, are J4, J3, J2 and J1.

R.f. wiring is of No. 16 and 18 tinned wire, with other circuits being wired with No. 18 "push-back." Needless to say, r.f. leads should be made as short and direct as possible, though the balance of the wiring may be arranged for neatness.

Two wires may be seen protruding through the chassis close to the 815. These are neutralizing "condensers," labeled $C_{n1}$ and $C_{n2}$ on the schematic diagram. They consist of two pieces of No. 14 enameled wire, soldered to the grid prongs of the 815 socket, crossed under the chassis, and brought through the chassis and held in position by two small isolantite feed-through bushings (Millen 32150).
Tuning Up

Adjustment is simple and straightforward. The tuning range of the v.f.o. should be checked first. This may be done with only the two oscillator tubes in place, and the a.m./f.m. switch on the v.f.o. position. The oscillator plate condenser should be tuned for maximum r.f. indication in a neon bulb adjacent to Ls, and the frequency checked in a receiver having a fairly accurate calibration for the region around 12, 24, or 48 Mc.

The size of the v.f.o. grid coil, L1, is extremely critical, and if some pruning of this coil is to be avoided it would be advisable to make the 50-mfd. section of C10 an adjustable padder condenser, such as a Hammarlund APC-50, which can then be adjusted until 12 Mc. appears at about 90 on the v.f.o. vernier dial. The high-frequency limit, 13.5 Mc., should then come at approximately 10, giving a spread of about 18 divisions for the 144-Mc. band and 54 divisions for the 50-Mc. band.

Operation of the crystal oscillator may next be checked. With a 100-ma. meter inserted into J3, and the a.m./f.m. switch on the "crystal" position, adjust the crystal-oscillator cathode tuning, C6, until the current dips sharply, indicating oscillation. This control should be set at the point which gives the lowest cathode current consistent with easy crystal starting. Cathode current should be similar for both oscillators — about 20 ma.

The doubler stage may then be tested by installing the 6V6 and 815 tubes, leaving the plate power off the 815. A meter having a 10-ma. range should be used to measure the grid current in the 815, at J3. The current should come up to about 6 ma. when the spacing between L3 and L4 is optimum, though this is more than is actually needed for satisfactory operation of the 815.

Next the position of the neutralizing wires can be adjusted. The 815 plate tuning condenser, C30, should be rotated slowly, meanwhile watching the grid current for any variation. The position of the neutralizing wires should be adjusted until there is no sign of fluctuation in grid current as the tuning condenser is rotated. A length of wire extending about one inch above the metal ring on the 815, at a position about ½ inch from the glass envelope, should be sufficient. If this should be inadequate, small tabs of copper or brass can be soldered to the ends of the wires to make additional capacity to the tube plates. These tabs were incorporated in our experimental model, but were removed when the wires alone were found to suffice. The neutralizing capacity, however small, was found to be necessary in both models in order to secure completely stable operation.

Power may then be applied to the 815 plates, while noting the cathode current as indicated on a 200-ma. meter plugged into J4. The dip at resonance should bring the current to about 50 ma. with no load. A 25-watt lamp connected across the swinging link terminals should then give a full-brilliancy indication when the link is adjusted for maximum coupling. This is with 500 volts applied, which should be used only after it has been determined that everything is functioning properly. If trouble is encountered, further tests should be made with reduced voltage to avoid damaging the tube.

When the rig is put on the air, the full 500 volts at 100 ma. may be used for f.m. or c.w. operation. For plate modulation, the voltage should be reduced to about 400 for maximum tube life, even though the tube plates may show no color at the higher voltage.

For frequency modulation, the 6S7A reactance modulator provides the simplest possible means of obtaining the desired swing in frequency. It may be operated with a single-button microphone plugged into J1, or the modulator may be driven from a speech amplifier and crystal or dynamic-microphone set-up which most amateur 'phone stations will have on band. The output of the speech amplifier should then be connected to the high end of the potentiometer, R1. In either case, R1 serves as a deviation control, the swing being adjusted to suit the receiver at the station being worked.

Post Mortem

The experimental model made provision for the use of a parallel line in the final plate circuit, and though it was finally discarded in favor of the coil-and-condenser tank circuit shown, some observations made of the performance of various lines may be of interest here. The first line was made of ½-inch copper tubing 28 inches long, spaced one inch between centers. To conserve space, the line was folded back on itself, the radius at the bend being about 1½ inches. Tuning this line with a small capacity tapped down about one-third of the length of the line from the hot end, the minimum cathode current was found to be 56 ma. Substituting the coil and condenser shown in the photographs brought the minimum current down to 46 ma. Checking the output by means of a lamp load and an exposure meter, it was found that a given amount of output which was obtained with a current of 85 ma. with the line required only 77 ma. when the conventional tank circuit was used. Straight and folded lines of several conductor sizes were tried and some improvement was noted when straight lines of smaller conductor sizes were used, but the difficulty of supporting such lines ruled them out.

The coil-condenser tank had another advantage which was important; it permitted the use of a swinging link which could be controlled from the front panel. When using f.m. or c.w., the 815 may be operated at full rating. When shifting to a.m. it is desirable to reduce the input slightly. The swinging link is also useful as an excitation adjustment, in case the unit is used as an exciter for a high-powered final. No reaching around in back of the rack is required for any adjustment — an important safety consideration.
A Four-Tube Superheterodyne for 144 Mc.

Some Design Considerations in V.H.F. Receivers

BY BYRON GOODMAN,* WIJPE

Here is a high-performance superheterodyne for 144 Mc. that will give anyone a good start on the band. It uses the 6J6 miniature twin triode as mixer and oscillator, and it features a simple tuning system that allows high L-to-C ratios at this frequency.

A superregenerative receiver is often quite satisfactory for v.h.f. operation, but it suffers from certain inherent disadvantages that can only be overcome by a superheterodyne type. It suffers from antenna loading effects which necessitate resetting of the regeneration control while tuning over the band, it is lacking in selectivity to such a degree that it is almost hopeless in a crowded band (this lack of selectivity increases with frequency), and its radiation is a serious source of QRM to other stations up to several miles away. On the other hand, the superheterodyne using a superregenerative second detector requires no resetting of the regeneration control as the band is covered, it is more selective because the superregenerative detector is on a lower frequency, and the radiation is reduced to such a low value that no QRM results unless several receivers are operating in the same room. If suitable tubes are used, the superheterodyne will pick up any signal a straight superregenerative receiver will, and will do it with considerably more convenience and certainty. Any argument that "a superhet is too selective for many modulated oscillators" is only a confession that a lot of modulated oscillators are too broad to be on the air, since a superregenerative second detector at 25 Mc. (where they are often operated) is better than 200 kc. wide at -3 db. points.

During the war many new types of miniature receiving tubes were introduced. Most of these have advantages over the larger tubes at high frequencies and they will undoubtedly find their way into a considerable portion of the future gear built for 50 Mc. and above.

The 6J6, a miniature twin triode, looked like a natural for a mixer-oscillator combination for a 144-Mc. superheterodyne, and the receiver described on these pages was built around that tube. If an r.f. stage had been planned, a different type of tube might have been used for the mixer, but in any superhet with no preselection the best signal-to-noise ratio is obtained with a triode mixer. The 6J6 has a higher transconductance (5300 µmhos) than any other suitable triode and appears to be the best mixer available at the present time.

The Circuit

There is little to be gained by using anything but conventional tubes in the second detector and audio circuits because the signal-to-noise ratio, once established in the input circuit, is not affected if the input stage has sufficient gain. Therefore the circuit, shown in Fig. 1, consists of a 6J6 mixer-oscillator, a 6J5 superregenerative second detector at 25 Mc., a 6J5 audio stage and a 6F6 output stage. No coupling is shown between the mixer and oscillator because the capacity between grid pins on the tube socket gives adequate oscillator injection. Since the 6J6 has a common cathode connection, it is necessary to return the grid of the oscillator portion to cathode, and the grid of the mixer is returned through R1. It might appear at first glance that the mixer is degenerative through R2, but examination of the circuit will show that no signal current flows through R2 because all r.f.

The four-tube 144-Mc. superheterodyne, dressed up in a modern cabinet. The large dial is oscillator tuning, and the small dial and lock is for mixer tuning. The two knobs control regeneration (right) and volume (left).

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returns are made directly to the cathode. The mixer plate is by-passed for signal frequency by \( C_4 \), which also serves to tune the primary, \( L_4 \), of the i.f. transformer. The i.f. transformer is adjustable only in the secondary circuit, since with just one stage there is no tuning requirement other than that the primary and secondary be tuned to the same frequency. If the adjustable condenser were placed in the primary side—which could be done so far as i.f. is concerned—it would not have been physically possible to have so short a return from the mixer plate to cathode for signal and oscillator frequencies. Regeneration in the superregenerative second detector is controlled by \( R_7 \), and this stage is resistance-coupled to the audio amplifier. Audio gain is adjusted by \( R_9 \), and the headphone output can be obtained from \( J_1 \). A switch, \( S_1 \), removes the plate voltage from the second detector and following stages during transmission periods, but plate voltage is left on the oscillator (and mixer) to avoid drift. This is probably an unnecessary refinement, since the local oscillator only drifts 6 or 7 kc. when the plate power is first applied. Most transmitters encountered will drift that much or more.

The circuit diagram shows that inductive tuning of the oscillator and mixer circuits is used, and a word or two is in order as to why we went to this trouble when variable condensers are still available. At low frequencies, leads an inch or two long have negligible reactance and their length is relatively unimportant. However, above 100 Mc., it is almost impossible to get a true lumped circuit of inductance and capacitance between grid and cathode — or grid and plate, in the case of an oscillator — by using a conventional coil and variable condenser, because the reactance of the leads from the variable condenser to the tube becomes high and, further, the tank capacitance is divided between the variable capacitor and the interelectrode capacitance of the tube. The obvious solution is to lump the capacitance across the socket, but this becomes awkward constructionally if a variable condenser is used, so we go to a fixed capacitance and a variable inductance. The inductance is varied by moving a copper vane which acts as a low-resistance shorted turn in the field of the coil. As the vane is moved into the field, the inductance is reduced. No current flows through the insulated shaft supporting the vane, and consequently there is no “jumping” of frequency such as is caused by erratic contact to a condenser rotor. Actually the performance of the oscillator tuning surpassed our expectations, since

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**Fig. 1 — Wiring diagram of the 144-Mc. superheterodyne.**

- \( C_3 \) — 250-µfd. mica.
- \( C_9 \) — 40-µfd. silver mica (two 20-µfd. silver mica in parallel).
- \( C_{10} \), \( C_{11} \) — 10-µfd. mica.
- \( C_4 \) — 500-µfd. mica.
- \( C_6 \) — 100-µfd. mica.
- \( C_7 \) — 20-µfd. adjustable ceramic trimmer (Centralab or Erie).
- \( C_{12} \) — 0.002-µfd. mica.
- \( C_{13} \) — 0.01-µfd. 400-volt paper.
- \( C_{14} \), \( C_{15} \) — 25-µfd. 25-volt electrolytic.
- \( C_{16} \) — 0.1-µfd. 400-volt paper.
- \( J_1 \) — Closed circuit telephone jack.
- \( L_2 \) — 2 turns No. 12 enam., 1-inch diam., spaced wire diameter.
- \( L_3 \) — 2 turns No. 12 enam., 1½-inch diam., spaced twice wire diameter.
- \( L_5 \) — 2 turns No. 12 enam., 1¾-inch diam., spaced to occupy ¾ inch.
- \( L_4 \) — 16 turns No. 22 enam., close-wound on 9/16-inch diam. form.
A top view of the receiver shows the construction of the inductive tuning devices used in the oscillator and mixer circuits. The tubes along the back, from left to right, are super-regenerative second detector, audio and output.

we were able to tune it in and out of zero beat while listening to the oscillator on a v.h.f. communications receiver with an ease and precision comparable to good 7-Mc. performance. If we ever build a communications receiver for 144-Mc. c.w. reception, a similar tuning device will most certainly be used.

When the receiver was first wired, the oscillator plate choke, RFC2, was connected to the grid side of L3 and the oscillator output was erratic and low. Looking up the 6J6 interelectrode capacitances, it was found that the plate-to-cathode capacitance was only 18 per cent of the grid-to-cathode capacitance. Since the oscillator circuit is actually a Colpitts which uses these capacitances for voltage division (and thus excitation control), the plate-to-cathode capacitance was increased by connecting RFC2 to the plate side of L4. The result was a perfectly rational oscillator, and we relate this experience as a tip for experimenters trying new tubes for the first time in old circuits.

Construction

The receiver is built to mount in an 8 by 10 by 8-inch cabinet, but the cabinet is a refinement that is not absolutely necessary. The panel, part of the standard cabinet, measures 8 by 8 inches. The chassis was bent out of ¾ 6-inch aluminum and is 6¼ inches wide and 7 inches deep. A 2½-inch lip is bent down at the rear and a 1¾-inch lip is formed at the front. The front bend is made shorter to avoid the lip at the bottom of the cabinet. The chassis is held to the panel by the two potentiometers (regeneration and volume controls) while a ¾-inch square dural bar bolted to the edge of the 2½-inch lip picks up two screws through the bottom of the cabinet to give a rigid structure.

Black bakelite sockets were used for the audio tubes and a mica-filled bakelite socket was used for the superregenerative detector, just in case there is any difference in performance. The miniature tube socket is the ceramic one made by Eby and others and is heartily recommended over any other type for v.h.f. work. A metal shield to match the socket also acts as a tube lock. The socket is mounted with the No. 5 pin towards the panel. Devising a suitable mounting for the mixer, antenna and oscillator coils bothered us for a while until we picked up some National FWA binding posts and mounted them in National XP-6 polystyrene buttons. These allow the coils to be changed readily for experimental and band-changing purposes. The antenna and loudspeaker leads are brought out to similar posts at the rear of the chassis.

The ¼-inch diameter polystyrene rod used for the oscillator tuning vane shaft is supported at the panel end by the National A dial and at the other by a panel bushing mounted in an aluminum bracket. A friction dial of some kind should be used because the tuning vane is not mechanically balanced. The vane is made of a piece of thin copper soldered to a brass shaft coupling. After soldering the vane to the coupling, the copper was cut roughly in the form of a straight-line-wave-length condenser rotor plate. It was trimmed up later to give something resembling straight-line-frequency tuning, but this is hardly essential. By moving the vane closer to the coil the tuning range can be increased, and vice versa. The tuning vane for the mixer coil is fastened to a piece of ¼-inch polystyrene by small machine screws and nuts, and the poly is fastened to a shaft which is filed flat on one side and tapped for two 6-32 screws. The shaft is part of an ICA No. 1248 panel bearing assembly. A Millen 10050 dial lock working against the small metal dial prevents any undesired change in the position of the mixer tuning vane.

Small bakelite forms for winding r.f. chokes are being made but were not available in the local radio stores at the time of writing, so RFC1 and RFC2 were wound on ¼-inch diameter 1-megohm resistors. A small notch was filed at each end of the resistor to keep the wire in place, and the wire for the chokes was soldered to the leads of the resistor. A 1-watt size was used for RFC2, and a 2-watt size for RFC1. RFC1 was made by mounting a single pie from a 2.5-mh. 4-pie r.f.
choke on a 1-megohm 1-watt resistor similar to that used for RFC1. This may seem like a waste of a good 2.5-mh. choke, but when you consider that you get four good 25-Mc. chokes for the price of one choke and four resistors, it isn't too bad. The easiest way to remove the pies from the ceramic form on which they come is to melt the metal from one end of the choke with a hot soldering iron and then force a sharp ice pick or nail down the hole in the center of the ceramic form until the ceramic splits. The pies can then be removed and one mounted on the resistor with Duco cement.

The i.f. transformer is wound on a National PRE-3 polystyrene form. Two additional small holes, 90 degrees apart, are drilled in the form between the two windings, and one lead of C5 is snaked through to furnish a support for one end of the condenser as well as a tie point for one end of L4 and the isolating resistor R4.

In wiring the receiver, it is convenient to wire the heater circuits first. On the metal tubes, pins Nos. 1 and 2 are grounded to lugs fastened under the screws holding the sockets to the chassis. On the miniature socket a jumper goes from pin No. 4 to the central shield of the socket and thence to a lug under one of the screws fastening the socket to the chassis, on the pin No. 7 side. Some care should be taken in wiring the r.f. components on the miniature socket, to insure short leads. One side of R3, R5, C4, C5 and C1 go directly to pin No. 7. C5 (two condensers in parallel) mounts between pin No. 2 and the binding post supporting the grid side of L4, and C5 is mounted from this post to pin No. 5. C4, C5 and R1 return to the ground lug for the 6J6 heater circuit mentioned above. A small tie point is used at the junction of RFC1 and R5.

The two wires from the antenna binding posts to the posts supporting the antenna coil are No. 14 enameled, and further support is given them by running them through holes in a PRE-3 form.

Adjustment

Checking of the receiver is best done by starting at the output and working toward the input. Connect heater voltage and high voltage to check the superregenerative detector operation. With a speaker or headset connected, advancing the regeneration control should result in the familiar superregenerative hiss provided the volume control isn't turned full off! At this point the 105 volts for the mixer and oscillator can be connected, because the adjustment on C7 should be made with plate voltage on the mixer. With the regeneration control only slightly beyond the point where the hiss starts to be heard, adjust C7 for the point which requires maximum advancing of R7 for oscillation. This brings L2C7 into resonance with L4C4. If it is found that the second detector won't oscillate at one very sharp setting of C7, the coupling between Lr and L5 is too tight. In this event, the coils should be backed away from each other, if possible, or else C7 can be detuned slightly. The former procedure is preferable. In any event, the setting of C7 where the primary circuit pulls the detector out of oscillation should be quite sharp — if it isn't, the setting isn't right. When the detector is oscillating and C7 is not set properly, it is quite likely that the hiss will also contain some unpleasant high-frequency whistles. These give another indication of mistuning (actually they indicate too light loading on the detector) but will clear up when primary and secondary are in resonance. The exact frequency of the i.f. can be checked on a calibrated communications-frequency receiver, if desired, but a frequency check is not essential. With the constants given the i.f. will be around 25 Mc.

Knowing the i.f. makes it a bit easier to adjust the oscillator portion of the 6J6, because an absorption wavemeter or Lecher wires can be used to put the oscillator on the right frequency. If one knows the i.f. and has some means of checking the oscillator frequency, the oscillator can be adjusted to give a tuning

(Concluded on page 108)
I suppose most of us suffer, or enjoy, it is sometimes difficult to tell which, some sort of obsession about our radio gear. For some this may take the form of convenience of operation, such as single-dial control of transmitters; for others it may be antenna efficiency; for still others it may be pushing the DX communications spectrum higher and higher into the kilomegacycles. Such concentration along defined lines is undoubtedly a strong force in the progress of the art, for it drives us to a more intense effort which often leads toward an approximation of ideals which might otherwise appear to be unattainable. In my case, the obsession has taken the form of a receiver which combines the signal "getability" of a first-class communications receiver with the fidelity of a really first-class broadcast receiver. This stems most immediately, I suppose, from the simple fact that the family purse would find it somewhat difficult to sustain the cost of two high-grade receivers, say an HRO or Super-Pro for ham use, and a Scott or Stromberg-Carlson for music. But I believe also that it arises from the innate sense of economy of means shared by most hams who dislike the use of two instruments or tools when one could do the job.

Now at first thought the ideal represented by this objective appears to be incapable of anything but a remote approximation. The characteristics of a receiver for communications purposes and those of a receiver for high-fidelity broadcast reception are not only different but in several aspects diametrically opposed. It would seem that at best one could attain only a compromise which would perform with some adequacy in both fields but which would not be so good in either field as a receiver designed for maximum performance in that field. Although formerly I accepted this generally-held belief, I no longer do so. I believe it is perfectly possible to design a receiver which will do as good a job in both fields as the best receivers available will do in either field. It goes without saying that such a receiver may involve a good deal of complication but not sufficiently more above that required for a top-notch communications receiver to incur a handicap. The receiver shown in the photographs is an example of what can be done along the proposed lines.

In this particular receiver I have compromised somewhat for the simple reason that priority-free junk boxes would not yield quite the necessary stuff to reach the ideal and because, so far as I was concerned, a full solution was not practically justifiable. However, the basic design is there and it would take only minor changes to come close enough to a complete solution so that argument could be reduced to mere abstract quibbling. Moreover, the receiver involves elements which are not found in commercial receivers and which present important performance improvements over the commercial jobs.

**Tube Line-Up**

A total of 21 tubes is employed. However, since three of them are double triodes, actually there are 24 tube circuits, including the rectifiers. By a coincidence there are also 24 controls and switches. That's a lot of tubes and switches admitted, and the complication is justified only by the fact that this is a good deal more than just a receiver, for it provides mike, phonograph and recording facilities as well. Also, it is designed for the highest possible performance. In any case the receiver is not intended for the use of the kids in the family — nor the XYL either, for that matter.

Here is the tube line-up as shown in the circuit diagram of Fig. 1: 1852 r.f. amplifier, 6SA7 converter, 1851 h.f. oscillator, two 6S7Gs as i.f. amplifiers, 6BS meter tube and a.v.c., 6FSG detector and b.f.o., 6T7G noise limiter, 6F5 squeel, 6LSG radio pre-amplifier, 6BS mike pre-amplifier, 6FSG mike-phono mixer, 6L5G tone control and bridging amplifier, 6F8G driver, two 45s as loudspeaker amplifiers, 6L5G recording pre-amplifier, 6V6G recording amplifier, VR150 voltage regulator, 5U4G and 6W4G rectifiers.

The controls are: r.f. trimmer, converter trimmer, main tuning, bandspread tuning, bandswitch, r.f. regeneration, i.f. gain, i.f. selectivity,
crystal phasing, crystal selectivity, a.v.c. switch, noise limiter, b.f.o. switch, stand-by switch, squelch switch, tone control, recorder on-off switch, phono volume, radio volume, mike volume, meter adjuster, loudspeaker on-off and main power switches.

H.F. Circuits

For purposes of description and analysis, the receiver may be broken down into two parts, namely, the tuner, and the audio amplifier. The tuner probably is of greatest interest and widest application; moreover it contains the most novel features — some of them not found in any other receiver so far as I know. Hence it will be taken up in greatest detail. Before proceeding with that, however, I should like to point out that the complete receiver in every detail is out of the junk-box. Not a single new part was purchased. The foundation was the coil assembly; the i.f. transformers and the Vari-tone transformer were taken out of the receiver which has served us for the past eight years. The chassis base and tube shields, one power pack and amplifier, as well as many small parts and hardware came out of a 1932 Scott receiver. The remainder was salvaged from various old receivers and the workshop junkboxes which, through the years, have accumulated a little of everything. Many parts were fabricated on the spot, even the dial scales, the tuning drives, escutcheons, cabinet, panel, and many other parts. The project from design on paper to final tuning up kept me occupied for several months; the actual construction alone consumed the better part of a week, working full time. There were moments when the casual bystander might have marvelled that anyone could call such a process fun!

Most of the problems in a design like this, lie in the r.f. and i.f. ends. There is no difficulty, relatively speaking, in designing an audio amplifier capable of any degree of fidelity desired. So far as the audio end is concerned, the only thing necessary for communications reception, which a high-fidelity amplifier does not offer, is some means of providing, when needed, a narrow pass band which will favor the voice or beat note at the expense of static, heterodynes and other noise elements. This can be provided by incorporating some sort of filter which can be switched in as necessary. There are numerous such circuits available, including the one employed here.

The r.f. and i.f. sections are something else again, for it is here that the conflicts between the demands of communications selectivity and of high-fidelity are greatest. The simplest adequate way of treating an r.f. end for the combined needs of fidelity, and "getability," would be that employed in the SX28 and SX32 in which a single r.f. stage is provided on the broadcast band, where sideband cutting is most serious, and two stages are used on the high-frequency bands where sensitivity and image rejection are most needed. The fanciest method would be that of the Scott receivers where the r.f. stage selectivity is variable.

Unfortunately, neither method was available to me. The best r.f. unit I could find was the Meissner five-band coil assembly in my old receiver which uses only one r.f. stage. There was nothing to do but to hop it up by various means to serve the purpose. A homemade bandspread condenser was added. To improve the image rejection, the r.f. stage was made slightly regenerative by the simple expedient of by-passing the complete cathode resistor, and by putting the leads from the bandspread condenser to the main condenser in such proximity that at maximum gain a little feedback was introduced. This is controlled by the variable cathode resistor, $R_1$. As is well known, regeneration provides image rejection about equivalent to that of an extra r.f. stage.

Almost equally important was the incorporation of panel-controlled trimmers, $C_a$, in the r.f. circuits so that tracking could be adjusted at any

Fig. 1 — Circuit diagram of the 21-tube receiver.

C_1 — Ganged main tuning condensers.
C_2 — Ganged bandspread condensers.
C_a — Air trimmers.
C_e — Selectivity-control condenser.
C_s — Crystal-filter input-transformer tuning condenser.
C_T — A.v.c. time-constant condenser.
R_s — R.f. gain control.
Rs — Selectivity-control resistor.
R_s — I.f. gain control.
R_t — Noise-limiter threshold control.
L — Audio coupling choke.
S_1 — Section of band switch (28 to 0.5 Mc.).
S_2 — Section of selectivity switch.
S_3 — B.f.o. switch.

OST for
point in the tuning range. This combination has resulted in thoroughly satisfactory image suppression. There is no significant image interference below 10 Mc. Above that to 20 Mc., regeneration and exact tracking reduce it to a degree which provides little actual annoyance. Above 20 Mc., with an i.f. of 450 kc., there is no good solution, except a separate converter with a high i.f. The regeneration has some disadvantages, but the total result is r.f. sensitivity and image rejection about as good as that of any commercial receiver I’ve tried.

The bandspread condenser was fashioned from one of the gang condensers in the old Scott by removing plates until only one stator and one rotor plate remained. The bandspread provided is considerably better than recommended in the Handbook. Besides the calibrated scale, there is a 0-100 scale on the bandspread knob, which revolves four times for each bandspread range, thus providing 400 points in each range. The combination of main scale and index scale provide readability down to 10 kc. or less on the 10-meter band and considerably less on the lower frequencies. The 0-100 dial was contrived by cutting out the “second-hand” scale from the old Meissner dial and gluing it onto the knob. The drive for both condenser gangs is of the fishline type employing parts from the old Scott. The old metal-drum scale foundations are used for pulleys and give a smooth flywheel effect.

Both dials are home calibrated on Bristol board. The big escutcheon is made of cracked Presdwood painted black with India ink which gives a nice crystalline finish. The two square meter escutcheons also are made of Presdwood. The meter actually is an old round-case meter, mounted on the back of the panel, but viewed through the square escutcheon.

The sensitivity of the r.f. end is excellent, not only because of the ability to peak all r.f. channels at any point, but also because of the gain obtained. The 1852 is used without a.v.c. to obtain the greatest signal-noise ratio. The mixer is fed a.v.c. voltage and, since a separate i.f. oscillator tube is employed, there is no instability because of the a.v.c. The d.c. voltage to the oscillator is regulated by the VR150. This and the perhaps equally or more important fact that the cabinet contains no transformers, chokes or output tubes to warm it up (these are constructed as separate external units) result in excellent stability. After the initial warm-up drift, the additional drift is inconsequential. As a consequence, no effort was made to introduce drift correction with negative coefficient condensers.

The I.F. Amplifier

So much for the front end. The real thought and work has gone into the i.f. amplifier which has several quite novel features. To attain variable selectivity and variable fidelity, Hammarlund variable-coupling transformers, $T_2$, are used in the first two stages; the third stage has a fixed coupling transformer. $T_3$. The three are so matched as to provide a very sharp curve in the maximum-selectivity position and a very nice flat-top in the high-fidelity position. Both i.f. stages may work at full gain. This is possible because of rather heroic methods to prevent oscillation. First of all, all plate leads are fed through coaxial cable. Second, all plate leads have decoupling chokes and so has the detector output. The chokes are in the round cans in the below-chassis view; they came from the Scott receiver. The cans also contain the plate by-pass condensers, so that no opportunity for radiation is provided by condenser leads. All other by-pass condensers are metal-covered bath-tub types taken from the old Scott or other ancient receivers. There was room for them and they provide additional shielding. In the first stage the cathode by-pass is a bathtub-type 0.5-µfd unit; in the second stage a 2-µfd. (no decimal point). The first stage runs with a minimum bias of a trifle over 3 volts; the second a trifle under 5 volts.

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A. v. c. is applied to only the first stage and the converter because we have no strong signals to contend with here in the mountains and because running the second stage with fixed bias has several advantages. First, modulation rise — a type of distortion which occurs when a tube is operated on the bend of its characteristic — is all but completely eliminated. Second, the a. v. c. action is greatly improved; and lastly, the swing on the S meter is greater. To prevent overloading on strong signals the second stage has a manual gain control, $R_3$. In the city or in close proximity to high-power stations, a. v. c. would have to be applied to this stage or the r.f. stage, or both. Fortunately, in our location, it was not necessary.

**Crystal Filter**

The crystal-filter circuit is somewhat unusual. First, it will be noted that the whole filter circuit can be switched out. There is an excellent reason for this. Fidelity is fully as important in this design as is gain or selectivity. The Hammarlund transformers are balanced to give a very nice flat-top in the high-fidelity position. The addition of the crystal-filter transformers, etc., raises hob with this flat-top. My experiments have proved that this can be corrected only by removing the crystal circuit entirely. Since all of the switching is done at the same r.f. potential and considerable care expended in shielding and placement, there is no instability or loss of gain. In short, fidelity was served at no expense to "getability."

The i.f. transformers provided a range of selectivity from a bandwidth of something less than 5 kc. to over 20 kc. In addition, the crystal-filter selectivity is variable over a wide range and the combination provides any degree of selectivity from about 400 cycles to over 20 kc. The crystal selectivity control, incorporated in $S_2$, is a combination of the two best-known methods and is perhaps the simplest of all. Only one switch section is used for this purpose. (It could be applied to almost any receiver with a few cents worth of parts.)

In the first position of $S_2$ the entire crystal circuit is switched out of the i.f. channel. In the second position, selectivity is broad. This broad response is obtained by inserting a 2000-ohm resistor, $R_2$, in series with the output transformer, as in the Hammarlund receivers. In the next position the selectivity is sharp — that of the crystal circuit alone. In the final position, the selectivity is maximum and is obtained by detuning the output circuit by inserting a padding condenser, $C_4$, in series with the tuning condenser. (This is the method used in the National receivers except that they detune to the low side by using shunting capacitance.) This arrangement makes possible the greatest possible variation in crystal selectivity. The Hammarlund method permits a decrease of selectivity but not an increase over that of crystal alone; the National an increase but not a decrease, although both obtain a greater range by circuit adjustment. The method used here provides variations in both directions, although full use of it is not made in this receiver.

More switch sections and a choice of resistors and detuning capacitances could provide any desired selectivity from that of the tuned circuits alone to the maximum possible with a crystal filter. I used only three positions because the variable i.f. transformers provide an additional range, and the combination more than adequately meets the need. In the broad crystal position, music can be heard sufficiently well for a degree of enjoyment; in the sharpest position the selectivity is beyond the ability of the tuning controls to tune easily and the trimmers need to be used to tune "on the head."

The circuit has another very considerable virtue. First, no switching is done across the crystal; thus no capacity is added and the phasing range is considerable. More important, the gain of the crystal circuit actually is greater with than without the crystal and this compensates for that psychological apparent reduction in sensitivity with the more conventional crystal circuits. The increase of gain is accounted for by the fact that since the output transformer in the high-fidelity positions is tuned to resonance, it is detuned to the high side when the circuit is switched to the "crystal on" positions because the tube output capacitance and the capacitance of the shielded coaxial cable are removed. It is well known that as the crystal circuit is detuned, especially on the high side, the overall gain increases up to a point. The gain is highest in the medium position, lowest in the broad position. In the maximum position the detuning in this instance does not go beyond the gain-increase point so it too profits. This effect, although not intentional, is the result of fidelity considerations but, of course, it is highly desirable. So here is one case where the high-fidelity needs actually increase communications performance. We'll have more later.

The crystal circuit and its associated components are mounted in a heavy steel box fashioned from parts of the condenser shields of the old Scott and can be seen at the front-right of the chassis view. The input transformer, $T_1$, was manufactured from an old Lamb noise-silencer type. Half the turns were removed from the secondary to produce a better match for the crystal impedance. Also the two coils were moved up to within a half inch of each other to provide maximum signal transfer. The primary condenser, $C_6$, is an air type from an old i.f. transformer. The switch is a band-switch from a Midwest. If it weren't a shorting type we would have arranged the circuit so that in the crystal positions the lower end of the output transformer would be grounded. This would have provided an increase in selectivity because, as it stands, the power-supply resistance in series has a broadening effect. But you can't very well switch a circuit from high voltage to ground with a shorting-type switch; so we took what we got, which in any case was sufficient for our purposes.

**B.F.O. and A.V.C. Circuits**

Following the i.f. comes the first 6F8. The top-grid section is used as an infinite-impedance de-
tector for the sake of fidelity. Another means was needed to provide a.v.c. and was found with interesting dividends as we shall see later. Meanwhile, the first dividend comes in the b.f.o. circuit which employs the other section of the tube. The main feature of this b.f.o. is that it can be used with perfect satisfaction with the a.v.c. on.

The reason is very simple: the b.f.o. voltage is injected after the a.v.c. diode and therefore does not affect it. This is not accomplished, however, simply by putting it there on paper; careful construction was necessary. There is no direct connection between the b.f.o. and the i.f. channel; coupling is effected by the close proximity of the elements within the tube. Since the injection is quite weak this way, the b.f.o. tube operates with almost the full 250 volts on the plate. To make sure that the b.f.o. is not fed to preceding stages, the whole detector and b.f.o. sections are shielded. Even the under side of the tube socket and all of the associated resistors, condensers, etc., are contained in one of the cans from the old Scott chokes. This results in confining the injection to the detector stage. Putting on the b.f.o. makes a barely perceptible motion in the very-sensitive S meter — evidence that there is practically no feedback at all.

The results are extremely worth while as any c.w. operator can appreciate. In practice I never find it necessary to shut off the a.v.c., even on the weakest signals, although there is provision for this. It is said that with a.v.c. on c.w. there is an objectionable increase in background noise between characters. This is true if the a.v.c. action is faster than the interval between characters. But if the a.v.c. action is made slow, so that the character interval is shorter than or equal to the time constant of the a.v.c. system, the a.v.c. action never quite catches up with the signal and there is practically no change in gain and thus no increase in background noise, except on extremely slow fists. Since the receiver provides for a slow action, as well as a fast one as will be seen directly, this nuisance does not occur in this receiver and the operation on c.w. is eminently satisfactory. But it cannot be overstressed that the operation of the circuit depends entirely upon successful shielding of the b.f.o. circuit from previous stages. It isn’t too difficult to do at that; in this instance no changes were necessary after the initial installation.

The a.v.c. circuit itself also is unusual. A separate 6B8 is used and its diodes coupled to the primary of the final i.f. transformer. This results in some loading but less than if it were coupled to the secondary and, at any rate, it is not sufficient to make any appreciable difference in performance. The justification for a separate tube, aside from the b.f.o. benefit described above, is this: it is desirable to disassociate the a.v.c. diode from any tube carrying a.f. or i.f. currents because, if it is not, the diode can feed harmonics of the i.f. into the channel via tube capacities, if nothing else, and this will result in "birdies" on frequencies which are harmonics of the i.f.; i.e. 910, 1365, etc. In a receiver as sensitive as this one, such "birdies" can be very strong and annoying, and their reduction or elimination is well worth the extra tube. In this case the "birdies" are just barely auduble at maximum gain at 910 kc. but at no other point. The choke in the detector output leg helps to account for this as well.

A.v.c. is applied only to the mixer and the first i.f. and, in our location, this application is sufficient to give excellent control. A switch, $S_5$, provides a means of varying the time constant of the a.v.c. by changing the value of the filter resistor. In the slow position for high fidelity the constant is about 0.8 second; in the fast position, just half of that. It could be made faster by using a condenser of lower value at $C_6$, but these constants have worked out very well. The a.v.c. can be removed from the controlled tubes, but it is not removed from the meter tube nor from the squelch, thus the meter is usable with the a.v.c. off and the squelch likewise.

The Signal Meter

The pentode section of the 6B8 is used as a meter amplifier and in effect forms a vacuum-tube voltmeter. Since this tube has an extremely flat plate-grid curve, a meter in its plate circuit permits the use of a much more linear scale than usual. Full advantage of this flatness cannot be taken in the "a.v.c.-on" position because the controlled tubes have bending curves and this of course is reflected in the receiver gain. However, the meter can be used with a.v.c. off — that is, not applied to i.f. or r.f. tubes. In this position the linear scale can be employed to full advantage, especially on weak signals, and for field-strength measurements.

I suppose the idea of having the meter operate with a.v.c. off will not at first strike one as of course it is.
revolutionary benefit. However, it grows on one quickly with use. For instance, it is perfect for aligning the receiver. It is well known that receivers should be aligned at maximum gain—therefore with a.v.c. off. In the usual receiver, cutting off the a.v.c. cuts off the meter as well. Not so here. Moreover, a meter is just as handy for measuring signal strength and for tuning without a.v.c. as it is with a.v.c. Finally, with the linear scale, which is easily calibrated from the tube characteristic curves in the tube manuals or with dry cells, it is possible to give much more accurate signal-strength or field-strength reports with the a.v.c. off. Indeed, with the aid of a calibrated microvolter, the meter and the manual gain could be calibrated directly in microvolts. Not having the facilities I could not do so. However, I have incorporated what I call an "X" scale to render more meaning to field-strength reports. On this scale "0 X" is in the middle. Deviations above are calibrated as "2 X", "3 X", "10 X" etc.; those below in "5/4 X", "3/4 X", etc. The signal to be measured or reported is adjusted with the manual gain until it hits "0 X." Any deviation upward or downward, as with antenna adjustment, can then be reported quite accurately as "2 times as strong," or "half as strong," etc. There is a db. scale also, so readings can be given either in "X" or db.

With the a.v.c. off the meter is extremely sensitive. A 25-microvolt signal produces cut-off. The mere peaking of the trimmer will make a variation of 5 or 6 S points. So the receiver makes an ideal meter for antenna adjustments, harmonic-suppression adjustments, etc.

**Noise Limiter and Squelch**

Next in the line-up we have a 6F7G used as a series-diode noise limiter. Any other diode or triode connected as a diode would do. I happened to have this and the filament current was conveniently low, so it was used. The circuit is standard and works very well up to the point where the noise is great enough to affect the a.v.c. considerably. Fortunately, in our location this contingency does not arise often so the additional complication of the Lamb type of limiter was not necessary. The arrangement used has the advantage that it operates as well on power-peak type of interference and even natural static, when it is greater than the signal, as it does on ignition interference. There is a manual threshold control, $R_9$.

The noise limiter is followed by a squelch circuit. To my mind no ham receiver should be without a squelch. The benefit to the nerves alone is worth several times the cost and trouble of incorporating one in a receiver. A 6F5 is used as a trigger tube controlling the 6L5G radio preamplifier. The combination is very sensitive—so sensitive, in fact, that it was found necessary to feed only half the available a.v.c. voltage to the trigger in order to get proper control at maximum gain. The manual i.f. gain control, $R_9$, acts as a threshold control and is set so that any signal above the noise level will trip the squelch. A signal lower than the noise level obviously cannot operate a squelch circuit without tremendously complicated tripping devices. The squelch operates regardless of whether the a.v.c. is on or off. Properly operated, it is a great convenience, not only in cutting interchannel noise, and in break-in operation, but also in other ways. For instance, if two stations are operating on the same frequency intermittently, the squelch can be set to cut in only when the stronger of the two is on.

This completes the tuner section. I believe that so far as it is concerned I have achieved the end of providing both maximum communications performance and maximum fidelity. No sacrifice is made at any point in favor of one or the other. Indeed, as we have seen, the incorporation of elements intended originally to further the fidelity have led to communications-performance improvement. At any rate, the tuner yields the highest quality results for either communications or for high-fidelity listening. In this case, the fidelity is limited to 10 kc. for reasons mentioned later. But it could be extended easily enough to 15 kc. by double-tuning the transformers. Indeed, as it is, a slight amount of double tuning is employed to attain the 10-ke. range, for if single-tuned, the i.f. channel would yield a minimum selectivity of about 8 kc.

**Audio Amplifiers**

The audio end of the receiver probably is of more interest for p.a. than for ham purposes. However, I shall give a brief description. It starts with a three-stage pre-amplifier, mixer, tone control and bridging amplifier. Phono, radio and mike employ separate channels and are mixed before injection into the 6LS tone-control and bridging amplifier. The tone-control circuit employs a UTC "Varitone" transformer and a three-deck switch, shown in Fig. 2, for various sorts of equalization and tone-control effects. In the first position, left to right, we have bass boosting; in the second, treble boosting; in the third and fourth, two different forms of both treble and bass boosting; in the fifth we attenuate all but the voice frequencies; and in the last we attenuate all but 1000 cycles for c.w. use. The potentiometer in Fig. 2 allows 20 db. of compensation in each position. The two last are ideal for communications use and result in a tremen-
dous cutting of background noise. Signals can be read which are deep in the noise otherwise, and thus the effective sensitivity of the receiver is increased greatly. The other positions provide various sorts of equalizations for records, recording and the like.

The 20-db. loss through the tone control accounts for the many a.f. stages. It was felt desirable to provide enough gain so that full output could be obtained with full equalization. I have used this tone-control circuit now for eight years and have found it the most versatile I've ever tried. The headphones and recorder benefit from the tone control, although it might seem that they are hooked up ahead of it.

The output of this stage feeds both the loudspeaker amplifier and the recording amplifier, as well as headphones, without interaction. The insertion of the headphones or of the recording amplifier makes no difference in the quality or volume from the loudspeaker. A separate recording amplifier is used because such an arrangement has many advantages. First, it is possible to record without cutting off the loudspeaker. Second, the recording amplifier can be designed specifically for the application and thus given characteristics tailored to the need. Here, for instance, the arrangement is such that when the loudspeaker output is adjusted to give the desired tone quality, the recorder automatically compensates to produce this result on play-back. This is achieved by giving the recording amplifier about 6-db. bass attenuation as compared to the main amplifier. It was found possible to get this result simply by removing the by-pass condensers and by reducing the input-condenser value to 0.01 µfd. A choke is used in the 6V6 grid because it was available (out of an old GE radio) and also because it provides a simple means of obtaining inverse feedback which, of course, is essential in view of the single-ended beam power stage and the variable load of the recorder. The recording quality is excellent. As a matter of fact, the frequency response with the 6V6 with inverse feedback is better than with 45s without feedback.

The loudspeaker amplifier uses a push-pull driver with a 6F8 and a pair of 45s with inverse feedback operating Class AB. This is the revamped amplifier out of the old Scott. It operates strictly Class A until the output load is about 6 watts; then it begins to draw grid current and operates AB2. The inverse feedback, however, aside from correcting for deficiencies in output-transformer response, cuts the distortion to such a degree that about 15 watts is available before distortion is sufficient to be audibly noticeable.

The speaker, an eight-year-old 12-inch Chaudograph, is mounted in a partition wall of the house providing a tremendous baffle area. As a result, the low-note response is below 20 cycles (that's where our piano leaves off and I can't measure below that!). The high-frequency response is just below 10,000 cycles. The addition of a "tweeter" would provide complete audio fidelity and its lack accounts for the fact that the receiver does not completely meet the most exacting high-fidelity definitions.

Since I keep the receiver in my study, I dislike metal cabinets. The receiver is well enough shielded not to require one, so it is housed in a wood cabinet to match the room paneling. All controls are calibrated in the commercial manner with pen and ink.

**Performance**

So much for description. How about the performance? From the fidelity angle, the performance, if not perfect, is entirely adequate to reproduce faithfully all programs received at our location. The overall frequency response is from under 20 cycles to just under 10,000 cycles. Aside from merely arithmetical fidelity, the acoustic fidelity is really excellent. Both voices and music are reproduced with great naturalness and brilliancy.

Some might quibble that unless the high-frequency range is extended to 15,000 cycles the receiver is not truly high fidelity. This, in a receiver designed for a.m. listening, is a pure abstraction. At least in our location no station delivers a signal with that audio range and the expenditure of extra funds and the additional complications necessary to achieve a perfect response would be rather pointless. However, nothing but the cost of higher-quality transformers and speakers stands in the way of attaining such a response.

As for the communications end, the receiver (Concluded on page 114)
Crystal Control in the New Ham Bands

How to Get to the 144-, 50- and 21-Mc. Bands with 1.75-, 3.5- and 7-Mc. Band Crystals

BY JOHN HOLMBECK, * W0KZ0

It is well known by now that the FCC table of proposed amateur frequencies includes some higher-frequency bands which are not in even-harmonic relationship with the lower-frequency bands, and yet they are frequencies at which the use of crystal control may be desirable.

A little meditating and consequent doodling with figures discloses some interesting conclusions which should prove useful to a lot of us in solving frequency-control problems in the proposed new amateur bands around 21 and 144 Mc. Three major problems which have been worked out by the author are those of getting crystal control on the 144-Mc. and 50-Mc. bands and using any crystal in the 7-Mc. band for control in the proposed 21-Mc. band, all making use of crystals now in the 1.75-Mc. band.

The 144-Mc. Band

Since the new 144-Mc. band is not related to our lower-frequency bands by convenient harmonics, crystal control with crystals useful also in other bands looks a little messy, but by applying a little fourth-grade math and some superhet theory, a multitude of solutions and practical possibilities make themselves evident. So let's see what we have.

First, the maximum practical fundamental frequency of most crystal cuts is in the vicinity of 10 to 12 Mc. To obtain a rough estimate of the number of times we must multiply our crystal frequency to hit that band, let's divide 144 by about 10, giving us 14.4. This is not a very convenient number for frequency multiplying but it is very close to 16 which is an ideal number. So, dividing 144 by 16 we get 9 Mc. and by dividing 148 by 16 we get 9.25.

The next problem is that of getting to 9 Mc. with crystals now in other bands without changing their frequencies. By delving into superhet theory we find the statement that if two alternating voltages of different frequencies are applied to a non-linear impedance, the result is not only the two original frequencies but also their sum and difference, and we can select any one of the four we wish by an appropriate tuned circuit. In words of one syllable, this means that if we feed two frequencies into a mixer tube, we can get their sum and difference from the output.

We also want to find a use for those 1.75-Mc. crystals. If we combine the output of a 2-Mc. crystal with that from a 7-Mc. crystal, we can get to 9 Mc. and a 2-Mc. rock combined with a 7250-ke. slab will give us 9.25 Mc. Thus, by means of a couple of quadruplers we can hit the edges of the 114-Mc. band. Another advantage of a 2-Mc. crystal is that its harmonics are very useful for band-edge spotting. The following list will show examples of a few possible combinations and their results.

Crystals

<table>
<thead>
<tr>
<th>Crystal Frequencies</th>
<th>Output Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 kc. + 7000 to 7250 kc.</td>
<td>144 to 148 Mc.</td>
</tr>
<tr>
<td>1950 kc. + 7050 to 7300 kc.</td>
<td>144 to 148 Mc.</td>
</tr>
<tr>
<td>1915 kc. + 7085 to 7300 kc.</td>
<td>144 to 147.44 Mc.</td>
</tr>
<tr>
<td>1750 kc. + 7250 to 7500 kc.</td>
<td>144 to 148.8 Mc.</td>
</tr>
</tbody>
</table>

Of course, you can work out plenty of others to suit your own crystals. The block diagram of Fig. 1 may be of some help in getting the idea.

With these combinations, it is obvious that our 7-Mc. crystals are as useful as ever for 7, 14 and 28 Mc. and, we hope, for the 21-Mc. band. Besides that, our 1.75-Mc. rocks are good for operation in the 3.5- and 7-Mc. bands, which gives us even more possibilities. Two 1.75-Mc. crystals can be used by quadrupling one into the 7-Mc. band before feeding to the mixer and a doubled 3.5-Mc. crystal will do as well. Using two 160-meter crystals, with certain combinations of them, by exchanging their places, another spot in the 144-Mc. range is available.

Excellent frequency stability can be had by using crystals with opposing temperature coefficients, since drift of one may be used to compensate somewhat for the other one. One good combination is an X-cut on 40 (negative temperature coefficient) and a Y-cut on 160 (positive temperature coefficient). Since the cycles-per-degree-per-megacycle drift of a Y-cut is about four times that of an X-cut, and since the "margcycle" factor of the X-cut is about four times that of the Y, it all cancels out nicely.

50-54 Mc.

Several combinations will give crystal control in the 50-54-Mc. band. For instance, the edges can be reached by using 3.5- and 4-Mc. crystals in conjunction with a 2-Mc. slab. The sums will be 5.5 and 6 Mc. of the 50- to 54-Mc. band is the 9th harmonic which may be reached by tripling twice. Other combinations are shown in the table on the following page.

* A.P.O. 218, % Postmaster, New York.
The 21-Mc. Band

Now for using more of our 40-meter rocks in the 21-Mc. band for which we are hoping. By tripling from 40, if the new range is 21 to 21.5, only crystals from 7000 to about 7166 will hit the band, and a lot of us have crystals higher than that. Going back to grammar-school math, we find that if we want to get to the new frequency by quadrupling, we must start between 5250 and 5385. The following table and the block diagram of Fig. 2 will show how it is done a lot faster than verboze rambling.

<table>
<thead>
<tr>
<th>Crystal Frequencies</th>
<th>Output Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 kc. + 7250 to 7300 kc.</td>
<td>21 to 21.2 Mc.</td>
</tr>
<tr>
<td>1850 kc. + 7200 to 7300 kc.</td>
<td>21 to 21.4 Mc.</td>
</tr>
<tr>
<td>1915 kc. + 7155 to 7230 kc.</td>
<td>21 to 21.5 Mc.</td>
</tr>
<tr>
<td>1725 kc. + 7000 to 7185 kc.</td>
<td>21 to 21.5 Mc.</td>
</tr>
</tbody>
</table>

It will be noted that the 1915-ke. crystal is useful in obtaining complete coverage of the 21-Mc. band, and almost complete coverage of the 144-Mc. band as well, when used in conjunction with existing 7-Mc. band crystals. Also, in heterodyning to 21 Mc., use is made of crystals above 7165 kc., while straight tripling makes use of those below 7165 kc.

The proud possessor of a v.f. crystal is in a good spot. If he gets to 21 Mc. by tripling — assuming he can shift 5 kc. at 7 Mc., his shift is 15 kc. at 21 Mc., but if he beats back to 5.25 and quadruples, he can shift 20 kc. Of course with this system, 80 and 160-meter crystals can be used by multiplying down to 40 before feeding to the mixer.

Frequency Modulation

These examples are intended only to give you ideas you can work out in detail yourselves. Another handy use for the heterodyne idea will be in f.m. Here is the reason. At the present time, reactance-tube modulators are the most practical for ham work, and the less deviating the oscillator has to do, the easier it is to keep it linear. So, if we want to get enough deviation in the output frequency, we’ve got to multiply the output of the oscillator frequency several times. However, since it is also easier to get a given number of kilocycles deviation of the oscillator at the higher frequencies, it is to our advantage to both heterodyne and multiply.

Thus, if we beat the f.m. oscillator with a rock to get a lower frequency and we still do not disturb our deviation, then we can multiply more times to hit a given band. Also by using a crystal which drifts in the same direction as the modulated oscillator, the frequency stability is greatly improved.

The dope is not intended to be the complete story; it’s just to remind us of a few practical possibilities of the heterodyne principle. Good use can be made of receiver tubes which are designed to be mixers. Tubes like the 6K8 make good oscillator-mixers, or a 6N7 may be operated, both oscillators feeding into a 6L7 or 6SA7. The use of low power required by these tubes presents the advantage of low crystal current which means less temperature drift. The disadvantage of needing a lot of power amplification and frequency multiplication can be overcome by using the new television tubes with their excellent power gains. Coil switching is no difficulty with the small parts permissible, in fact tuned circuits can be switched right along with the crystals or the use of a Pierce oscillator will save a lot of grief.

There is another point to be welcomed by the e.w.-v.f.o. bug. It is highly undesirable to key a self-excited oscillator, but for break-in work we can’t have the oscillator or its harmonics fall on the spot where we want to copy. So if we beat a rock against an e.c.o. we can keep the e.c.o. off the low-frequency oscillator makes the mixer an isolating amplifier for straight-through operation when desired for simple frequency multiplication.

While crystals whose harmonics fall in the new ham bands undoubtedly will be available to those who wish to construct crystal-controlled equipment, nevertheless it is interesting and useful to know that standard-band crystals may be used, through the new bands may not be in direct harmonic relation to the crystal frequency. This article shows some combinations which may be used to control by the heterodyne method.

### Crystal Frequencies

<table>
<thead>
<tr>
<th>Crystal Frequencies</th>
<th>Output Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 to 7.3 Mc. - 2 Mc.</td>
<td>5 to 5.3 Mc.</td>
</tr>
<tr>
<td>7 to 7.3 Mc. + 1.75 Mc.</td>
<td>8.75 to 9.05 Mc.</td>
</tr>
<tr>
<td>7 to 7.3 Mc. - 1.75 Mc.</td>
<td>5.25 to 5.55 Mc.</td>
</tr>
<tr>
<td>7 to 7.3 Mc. - 4 Mc.</td>
<td>3 to 3.3 Mc.</td>
</tr>
<tr>
<td>7 to 7.3 Mc. + 3.5 Mc.</td>
<td>10.5 to 10.8 Mc.</td>
</tr>
<tr>
<td>3.5 to 4 Mc. + 2 Mc.</td>
<td>5.5 to 6 Mc.</td>
</tr>
<tr>
<td>3.5 to 4 Mc. - 2 Mc.</td>
<td>1.5 to 2 Mc.</td>
</tr>
</tbody>
</table>

### Multiplication After Mixer

<table>
<thead>
<tr>
<th>Output Frequencies</th>
<th>Mixer Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 to 53 Mc.</td>
<td>(5) (2)</td>
</tr>
<tr>
<td>52.5 to 54 Mc.</td>
<td>(3) (2)</td>
</tr>
<tr>
<td>55.5 to 54 Mc.</td>
<td>(5) (2)</td>
</tr>
<tr>
<td>50 to 55 Mc.</td>
<td>(4) (4)</td>
</tr>
<tr>
<td>53 to 54 Mc.</td>
<td>(5)</td>
</tr>
<tr>
<td>50 to 54 Mc.</td>
<td>(4) (4) (2)</td>
</tr>
</tbody>
</table>

### Output Frequencies

<table>
<thead>
<tr>
<th>Output Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915-Kc. OSC</td>
</tr>
<tr>
<td>MIXER 5.25 TO 5.305 MC.</td>
</tr>
<tr>
<td>QUAD- RULER 1165 TO 7300 Mc.</td>
</tr>
<tr>
<td>OSC 21 TO 21.5 Mc.</td>
</tr>
</tbody>
</table>

#### Fig. 2 — Diagram showing the heterodyne arrangement which may be used to obtain crystal-controlled output at 21 Mc. from 2- and 7-Mc. crystals. Cutting off the low-frequency oscillator makes the mixer an isolating amplifier for straight-through operation when desired for simple frequency multiplication.

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**November 1945**
Mobile with the 5th Armored Division

BY MERTON T. MEADE, * W9KXL

Erase those pictures of racks of Super-Pros, of neat rhombics and V-beams, of clean-shaven operators in neat uniforms busy with their bugs and mills. We're going out into the shootin' war! We are going to ride with an armored division on the move!

We have become part of Combat Command Team B of the Fifth Armored Division and in this fast moving column one vehicle always catches the eye of any radio man. That's the truck with many antennas and with a power unit trailer bouncing along behind. It's another of those famous SCR-399s.

The vehicular markings show this set to be assigned to the 145th Armored Signal Company. This is a spare set, to be sent where the need is the greatest. Its job is to maintain communications when the higher powered sets fail to get through.

Our vehicle looks out of place moving along between the tanks, scout cars, half-tracks and low-along “peeps.” The 399 looks naked and helpless. But inside, there's a sense of security as the walls deaden much of the noise of travel and of battle. Inside, a radioman feels at home, here he is in familiar territory.

But there is no over-confidence. The dial lights are blacked out, the green and red pilot lights are painted over until only a pin point of light remains. For night operation we throw a switch and automatic switching is in effect. When somebody opens the door, off go all lights, a homemade blackout gadget, simple but effective.

Meet the crew. Up in front are the driver, T/5 Meyer and the crew chief, T/Sgt. Thachuk who also handles the .50 cal. machine gun while on the move. In the insulated shelter at the operating positions there are three men: T/3 Meade, W9KXL, T/5 Mitchell and T/4 Guyberston, who has only recently joined this crew. This is a veteran and experienced radio crew.

We move out and drive towards Munster. Behind us lies the Rhine and burning and flattened Wesel. Behind us are hundreds of road miles since the break-through at St. Lo. Hundreds of miles and thousands of messages.

We are driving fast and it is impossible to copy messages on the operating table. We put our message book on a copying board held between the left elbow and hand, and attempt to copy as

*145th Armored Signal Company, APO 255, c/o P.M., N.Y.C.
we sway and bounce with the truck. If necessary, we can use a leg key strapped above our right knee. But we continue to use the fixed table key. We don't hold on to the key but hold our hand slightly above it and swoop down on it with a swift motion born of practice. Occasionally the key eludes us when the traveling is rough and we muff a character or two. We send solid and heavy.

We come upon the burning city of Munster. A hidden 88, attracted by our antennas, fires almost point blank at us. Jerry took too long a lead and the shell screams by a couple of feet ahead of us. An enemy machine gunner fires low, and misses. We do not tarry long enough to let him correct his range.

The weather is bad but Meyer gets us through many soft spots. We bog down once and a tank pulls us out. We are getting out of the range of most of our protective fighter plane bases. The weather grounds more of our planes and the German planes get bolder and more numerous. The weather is better to the east, where the jersies still fight back.

Communications with the Division Headquarters is becoming poor. At night we are often the only set in the Combat Command in contact with Division. One of the operators who handles our traffic back there at Hq. is T/4 Talty, W9TXO, of Des Moines. His prewar neighbor and buddy, T/3 Silverstein, is also back there operating in the Corps net.

At night, the QRM is terrible but we stick with it. There's a brief chance to switch to voice, but a German jammer soon hits us. But it's the incidental QRM rather than the enemy jamming that gives us the biggest headaches.

We have reached the Wesser. Here we shift to the headquarters net of Combat Command A and we are on the move again.

Past Hannover, past Brunswick, we keep moving most of the time. Our columns weave back and forth, by-passing some resistance points, crushing others. We take "impossible" roads to smash the flanks and rear of the retreating Germans.

QRM has grown worse. Every net in every Army system seems to be operating. The distances are such that at night our weak ground waves must compete with more distant but stronger skywaves. Several times we shift to other nets to clear urgent "must" traffic.

Inside the 399 there's a bedlam of noise. Two receivers are whistling on c.w., and another carries the f.m. voice net. The clicking of the key and the turning wheels of the cipher machine add to the confusion. Tempers grow short, our eyes are red from lack of sleep. We're awfully tired of "C" and "K" rations. We copy and decode combat traffic and the operators are busy, even on the move. One is operating, another is working with the codes and ciphers, the third man handles f.m. traffic, and acts as a runner on temporary halts. He gives and takes messages from the message-center peeps on the fly. The fourth man handles the .50 caliber machine gun, which speaks out loudly every now and then. German planes are frequent and unwelcome visitors.

When we finally stop for the night we arrange two-man watches and take our turns in getting several hours of sleep. By now we are so accustomed to copying code in an exhausted semi-conscious state that it is often hard to get to sleep. We lie there automatically copying code coming from our vehicle or one of the neighboring half-tracks.

Morning comes and we are on the move again. At Bismark we suddenly are aware of just how deep we have penetrated into Germany. We keep on, competing with the Second Armored Division for the lead in the race for Berlin.

Communication with Division Hq. goes sour, so they send out a relay station. Communications smooth out but the relaying cuts our traffic-carrying capacity in half. The Urgent and Priority traffic is cleared, but the routine stuff piles up. We soon have direct contact again, and as always, our net is busy. We handle much traffic normally routed over other nets. Ours is the only net that can now maintain consistent contact between Division Hq. and the Combat Commands.

We keep moving up. Near the banks of the Elbe River we meet stiff opposition. We stop for an afternoon and put up an extra antenna. Now we clear the hook of that backlog of routine traffic. Out come the small gasoline stoves and water cans. We wash, shave and have some hot coffee. The day is sunny and many planes are buzzing around and they bear swastikas! We are attacked a dozen times but we meet them with a curtain of fire. Six jersies go down in flames. One crashes in the middle of our bivouac, its guns firing to the last. Out of the vast explosion and flames comes one of the large engines bounding over the ground like a giant rubber ball. Miracu-

(Continued on page 114)
ELECTION NOTICE

TO ALL Full Members of the American Radio Relay League residing in the Delta and Midwest Divisions:

You are hereby advised that no eligible candidates for alternate director of your respective divisions were nominated under the recent call. By-Law 21 provides that if no eligible nominee be named, the procedure of soliciting and nominating is to be repeated. Pursuant to that by-law, you are again solicited to name Full Members of your respective divisions as candidate for alternate director thereof. Please see the original solicitation published at page 23 of August QST, page 21 of September QST, which remains in full effect except as to dates mentioned therein: Nominating petitions must now be filed at the headquarters office of the League in West Hartford, Conn., by noon EST of the 20th day of December, 1945.

Voting will take place between January 1st and February 20, 1946, on ballots to be mailed from the headquarters office the first week of January. The new alternates will take office as quickly as possible after February 20, 1946, and will serve for the remainder of the 1946-1947 term. You are urged to take the initiative and file nominating petitions.

For the Board of Directors:

K. B. WARNER, Secretary

October 1, 1945.

ELECTION RESULTS

This is election year in six ARRL divisions. In the Pacific, J. Lincoln McCargar, W6EY, and Elbert J. Amaranites, W6FBW, respectively the director and alternate, were the only candidates nominated and have been declared reelected for 1946-47. Exactly ditto was the case of the Southeastern, where Director William C. Shelton, W4ASR, and Alternate William P. Sides, W4AUP, carry on.

Balloting for director is occurring in the Atlantic, Dakota and Midwest Divisions. The Delta Division has a new director. Ray Arledge, W5SIL, was not a candidate for reelection and the sole nominee was declared elected without balloting. He is Dr. George S. Acton, W5BMM, dentist, of Plain Dealing, La. Doctor Acton is ORS, 00 and A-1 Op., and was active in AARS.

EXAMINATION SCHEDULES

The schedule of FCC amateur operator examinations for 1945, published on page 21 of our January issue, is necessarily altered in some spots by the recent change of Government offices to the five-day week. FCC offices are no longer open on Saturdays and whenever examinations at a district office were originally scheduled for that day a change has now occurred. In other cities, where exams are given by traveling inspectors, they will sometimes continue to be held on Saturdays.

Refer now to your January QST and note the following changes for the rest of this year. Where exact dates or places are not shown, information may be obtained from the Inspector-in-Charge of the district. Asterisks (*) indicate that dates are subject to change and should be verified from the inspector. No examinations on holidays. All examinations begin at 9 A.M. except as noted.

B. Love, W9ZRT, a chiropractor and dairy operator of Mandan, N. D.

The Delta Division has a new director. Ray Arledge, W5SIL, was not a candidate for reelection and the sole nominee was declared elected without balloting. He is Dr. George S. Acton, W5BMM, dentist, of Plain Dealing, La. Doctor Acton is ORS, 00 and A-1 Op., and was active in AARS.

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.
STAFF NOTES

To the busy accompaniment of carpenters and half a dozen other kinds of artisans, former members of the Headquarters staff are making their way back to West Hartford from the armed forces and wartime laboratories and the usual hum at 38 LaSalle Road is now a crescendo of activity. Our new laboratories and shops are rapidly taking form. Partitions are being moved and departments shifted to gear us better to the job ahead.

We are pleased to say that Colonel Handy, W1BDI, and Lieutenant Commander Battey, W1UE, have resumed their old desks as Communications Manager and Assistant CM, respectively. Joseph A. Moskey, W1JMY, has returned from the Radiation Laboratory and is now C.D. Assistant for organized operating activities. Miss Lillian Salter, who held the fort during the terminal months of the war, has been named C.D. Assistant for field-organization administration. All that the Communications Department needs now is a few long-distance bands on which to conduct some contests! We are similarly pleased to report the return of Chief Radioman John Huntoon, USCG, W1LVQ, to his post at 38 LaSalle Road is now a crescendo of hum at 38 LaSalle Road is now a crescendo of activity. Our new laboratories and shops are rapidly taking form. Partitions are being moved and departments shifted to gear us better to the job ahead.

An old friend is now introduced as a full member of the staff: Edward P. Tilton, W1HDQ, famed as our nonresident contributing v.h.f. editor for many years past, now joins the ARRL Technical Department to specialize in v.h.f. matters and will continue as QST's V.H.F. Editor. His enthusiastic readers know that that means accurate reporting and pleasant reading.

We regret to announce the resignations from our staff of Clinton B. DeSoto, W1CBD, the editor of QST, and of his assistant, Mrs. Louisa B. Dresser, LSPH. Clint DeSoto has been our editor during the four war years, following twelve years as an assistant secretary of the League, during which his reputation was firmly established as a reporter of amateur events, notably by his history of the amateur movement, "200 Meters and Down." During the war there was full play for his extraordinary talents and your QSTs of the last few years yield evidence of the unbelievable amount of work done in reporting the changing radio scene during the period of technical censorship and of an overloaded small technical staff at Hq. It was principally through his labors, aided by Mrs. Dresser, that you found QST so interesting and helpful during the long years of the war. The editorship is now being resumed by the Secretary.

The names of two more Hq. men who have long been on leave of absence are regretfully dropped from our masthead. James J. Lamb, W1AL, ARRL research engineer and the inventor of the single-signal superhet, has been with Remington-Rand, Inc., on secret war developments since 1941 and has now become the chief engineer of the electronics division and director of electronic research for that firm — at Middletown and So. Norwalk, Conn. Sgt. Vernon Chambers, WLJEQ, of our technical information service, is home from the wars and has resumed development work with Remington-Rand, with whom he was associated on a leave-of-absence basis before being called up.

MARITIME RADIO TEACHERS WANTED

Metropolitan Vocation High School, a maritime high school in New York City, needs teachers for several maritime subjects, including radio. Salaries range from a base of $2148, which increases by annual increments to $4500 maximum. Accepted applicants are first employed as permanent substitutes on a basis yielding about $2280 — plus, at the moment, a war bonus of $350 a year. Minimum requirements are junior high school graduation, nine years of approved maritime experience, age between 28 and 38, 480 clock hours in approved teacher training courses. Latter may be acquired after acceptance while serving as substitute, at nominal fee. Possession of first-class operator license and experience in work with boys, training of cadets, etc., desirable. Interested men should write, with outline of education and experience, to Franklin J. Keller, Principal, MVHS, Oliver, Oak & James Sts., New York 2, N. Y.

LICENSE TERM INCREASED

The Communications Act forbids FCC to issue licenses for a longer term than five years. Amateur licenses for many years have been issued on a three-year basis. Seeing no reason why ham tickets shouldn't have as great a life "as the law allows," ARRL suggested to FCC that an increase in the term for postwar licenses would save them some licensing work and be a convenience to us. The Commission approved the idea on October 3rd when Section 12.28 of our regulations was amended to read:

12.28 License term. Amateur station licenses are normally issued for a term of five years from the date of issuance of a new, renewed, or modified license.

and operator licenses were similarly treated by the adoption of a new section:

12.38 License term. Amateur operator licenses are normally issued for a term of five years from the date of issuance.

November 1945
This does not extend existing licenses. It means simply that when FCC gets set up to issue new pasteboards, postwarwise, they will all be for five years instead of three.

NOTICE TO MEMBERS DISCHARGED FROM THE MILITARY SERVICES

The requirement of continuous membership in the League for eligibility to ARRL offices has been waived for members serving in the uniform of the United States. See particulars on page 39 of QST for July last. Those desirous of taking advantage of this arrangement are asked to claim the right when renewing membership, stating the beginning and ending dates for their military service.

S. Kruse, assistant electrical engineer at the Bureau of Standards, begins in QST for November, 1920, his report on the “BuStans-ARRL Tests of Short-wave Radio Signal Fading.” This installment describes the stations and the method used. Operation was on 250 meters, with a distance to the average observer of 400 miles. Results will be reported in the next installment. . . . A. L. Groves, our indefatigable correspondent at Brooke, Va., reports an almost complete absence of signals from near-by stations for a week in October, yet 5ZP came in very QSA night after night from a thousand miles. What has been happening?

The League has grown to the place where it needs a full-time traffic manager. J. O. Smith, 2ZL, who has brought us splendidly so far, has resigned with the gratitude of all ARRL men, to give way to Fred H. Schnell, our Chicago city manager, who has come to Hartford as our first paid traffic manager. . . . The resignation of Harry C. Gawler, popular first-district inspector, comes as a big surprise; he is being succeeded by Charles C. Kolster whom we welcome from Chicago, where he has given the amateurs splendid cooperation. . . . Harvey Mitchell Anthony, head of the Department of Applied Electrical Engineering of the Muncie (Indiana) Technical High School, has been elected to the ARRL Board of Direction. . . . Herb Walleze of SBQ has been appointed District Superintendent for his district. . . . Charles A. Service, jr., 3ZA, has found it necessary to resign as Division Manager, Atlantic Division, and has been succeeded by Charles H. Stewart, 3ZS. . . . John Clayton, manager of the Delta Division, reports that “W. L. Barrow of 5EA was laid up with a stroke of lightning which knocked his station completely out.” . . . Frederick E. Terman advises from Stanford University that 6SR and 6AE have joined forces and will operate a joint station under the call 6AE, Mr. Franklin signing JF and Mr. Terman FT. . . . Maine held its first convention September 15th, with 250 present under the chairmanship of Asst. Div. Mgr. H. W. Castner. On its editorial page QST stops temporizing with i.o.w. and comes out flatly for straight c.w. — which is what we have secretly had in mind all along in advocating tube transmission. Receivers must be improved: it is hard to heterodyne the high frequencies we use and we must have vernier tuning and shielded cabinets to avoid hand-capacity effects. . . . NSF is reported heard in Bristol, England, and there have been numerous reports from ship operators several thousand miles away. But who really has the long-distance record, anyway?; “just what constitutes the supreme amateur DX record for approximately 200 meters?” . . . We propose that amateurs assist the police in helping recover stolen automobiles. At certain hours of the day, each of us could transmit data obtained from our local police, describing stolen machines, and we could all copy that information and telephone it to our own local police. This would be a fine thing for all concerned except the thief. It would be the first time that amateur radio stations would be put to a real practical use all over the country.

In “Correspondence,” Boyd Phelps describes the fan antenna at 9ZT. He particularly emphasizes the desirability of having all current paths the same length. When this is done, the antenna tunes just as sharply as did an older antenna of two vertical wires — contrary to the experience of other amateurs. The editor invites comment, there being a dearth of data on aerial design.

W2MQB, writing in the Crystal Ball Department this month, tells of his plans for phonograph recording and playback equipment in his ham shack. Don’t’s idea is very timely and brings to mind the tantalizing question of the availability of recordings of ham signals before we closed down on Dec. 7, 1941.

Let’s hope that somewhere there are many recordings of “hot nights” on 20 and 40 meters and that someone caught snatches of that elusive 56-Mc. DX. Did anyone think ahead far enough to record the signals from those very rare and never-to-be-forgotten DX stations, some of which were manned by operators now silent forever? How about a platter cut on 40 meters during the peak of a Sweepstakes contest, or on 80 during an ORS party?

Information on the availability and location of such historical recordings will be compiled at ARRL Hq., upon receipt of data from you fellers who were smart enough and who possessed the equipment to record ham signals during the pre-war years. Drop us a line, and give us the dope. Just mark it “Phonograph,” c/o ARRL Hq., and we’ll do the rest.

44 QST for
Improved Driver Stages for Class-B Amplifiers

The Cathode-Follower as a Power Amplifier

BY ELLIOTT A. HENRY, W9FEN

The versatile cathode-follower lends itself admirably to overcoming the performance limitations of conventional driver stages for Class-B audio amplifiers or modulators. The advantages of the cathode-follower power amplifier are: practically perfect regulation, large damping factor, low distortion, and wide frequency response. Design principles, typical examples, and additional applications are discussed.

While cathode-followers have found wide application in video-amplifier design and as impedance-changing devices, little attention has been given to their use as power amplifiers in audio work. For applications involving reactive or variable loads this type of amplifier is ideal. Typical of this type of load is the dynamic loudspeaker or the load presented by Class-B amplifier grids. The most important characteristic of the cathode-follower power amplifier is its practically perfect regulation. For normally-used tubes the regulation is in the order of 5 per cent with any load between full load and no load. Of almost equal importance is the high damping factor. The effective damping across the primary of the output transformer is approximately equal to the reciprocal of the grid-to-plate transconductance and normally is in the order of a few hundred ohms. Reduced harmonic distortion and increased frequency response also result from the 100-per-cent inverse feedback. The increased frequency range is interesting in that it is possible to get an equal or better frequency range with very cheap transformers than may be obtained with very expensive ones in conventional circuits.

With all these advantages, it is only natural to look around for the "catch," and there is one. This "catch" is the high input voltage required. As all of the output voltage is in the grid-cathode circuit and therefore out of phase or bucking the input voltage, the input voltage must always exceed the output voltage. This is another way of saying that the voltage gain of the stage is always less than unity, the power output is unaffected by the 100-per-cent feedback. All that is necessary is to supply a higher driving voltage.

Basic Operation

Since several excellent articles on cathode-followers have recently been published in QST and other magazines, the discussion to follow will be concerned primarily with power-amplifier applications of cathode-followers and will deal with basic design theory only where such theory is necessary for the proper understanding of these applications.

For an explanation of the amplifier characteristics referred to above, let's examine Fig. 1. This is the simplest type of cathode-follower power amplifier. In this circuit R1 is used to supply additional bias since the d.c. resistance of the output transformer primary is generally too low to provide adequate bias. Condenser C1 is of such a value that its reactance is negligible at the lowest frequency. If this is so, then the cathode impedance, Zk, will be the primary impedance of the transformer T1. This impedance will, of course, be a complex impedance, but over the mid-frequency range may be considered as resistive. Assuming that a signal in the mid-frequency range is applied, on the positive half of the cycle the grid is driven positive which increases the plate current. This current flowing through the cathode impedance will produce a voltage drop making the cathode more positive with respect to ground. With respect to ground, the grid and cathode voltages are in phase. The effective driving voltage, however, is the voltage between the grid and cathode, labeled \( E_g \), and, since \( E_{in} \) and \( E_{out} \) have the same polarity with respect to ground, they are effectively in series across the grid-to-
...explanation for the high damping factor obtained.

The resistance is unchanged and must be matched.

Secondary in accordance with formers are not necessary. Second, it offers an...frequency response. However, in the cathode-circuit, that for maximum power output the plate...result of the feedback action, the effect is similar in this type of amplifier. The apparent impedance...simplifies one problem in that special trans-

Application of inverse-voltage feedback does not change the plate resistance of the tube but, as a result of the feedback action, the effect is similar to that resulting from a change in plate resistance. This is important for two reasons. First, it tells us that the same load impedances should be used in a cathode-follower power amplifier as would be used with the same tube or tubes in a conventional circuit where the load is in the plate circuit; that for maximum power output the plate resistance is unchanged and must be matched. This simplifies one problem in that special transformers are not necessary. Second, it offers an explanation for the high damping factor obtained in this type of amplifier. The apparent impedance looking into the tube is:

\[ Z = \frac{R_p}{\mu + 1} = \frac{1}{G_m} \]  

This impedance is effectively in shunt with the primary of the transformer and is reflected to the secondary in accordance with the impedance ratio of the transformer. For example, a 6L6 operating with 250 volts on the plate and screen has a damping resistance of 22,500 ohms, while the same tube used as a cathode-follower has a damping resistance of only 166 ohms.

**Pentode or Beam Tubes**

Thus far the discussion has been devoted to the use of triodes. Pentodes or beam tubes also may be used and are even superior to triodes. Their use requires an additional provision to keep the cathode and screen at the same a.c. potential so that true pentode operation may be secured. In a conventional amplifier the screen grid is bypassed to ground, as is usually the cathode. The screen therefore is maintained at a constant d.c. potential above the cathode but they are both at effective a.c. ground potential. The input signal then causes the plate voltage to vary up and down while the cathode and screen voltages remain fixed. In a cathode-follower circuit, however, the plate voltage remains constant and the cathode rises and falls in accordance with the input signal. Thus, if true pentode operation, and as a consequence full power output, is to be obtained, the screen grid must be made to rise and fall with the cathode. Two methods of accomplishing this are shown in Figs. 2 (B) and 2 (C). Fig. 2 (B) makes use of a special transformer, \( T \), with a third winding, labeled \( S e c. \). This winding has the same number of turns as the primary, \( P r i. \), and is connected so that the screen and cathode voltages are in phase. It can be readily seen that if \( S e c. \) and \( P r i. \) have the same number of turns, there will always be a fixed voltage difference between the screen and cathode. This voltage difference will be equal to the d.c. voltage applied to the screen. The condenser \( C_1 \) is added to make negligible any variation in the transformer construction and to insure zero phase difference between the two voltages. Its value should be large so that the reactance is small at the lowest frequency. In Fig. 2 (C) the same

![Fig. 2 — Single-ended stages with cathode coupling.](image)
thing is accomplished without the use of a special transformer. In this circuit the condenser $C_1$ again is connected between the cathode and screen and the choke $L_1$ is used to provide a low-resistance path for the screen d.c. while presenting a very high impedance to the a.c. Condenser $C_1$ again has a low resistance and the same result is obtained as with the special transformer. $L_1$ may be quite small in size but should have a reasonably-large inductance.

**Single-Ended Stages**

Four types of single-ended cathode-follower power-amplifier circuits are shown in Fig. 2. No provision for d.c. bias is shown since this may be added in a similar manner to that shown in Fig. 1. Fig. 2 (A) uses a triode and has been fully covered in the foregoing discussion. Although Figs. 2 (B) and 2 (C) are shown using pentodes, the circuits are equally applicable to beam tubes. The difference between these two circuits is the manner in which true pentode operation is obtained. The gain and power output is the same for both. Since tube data usually give the transconductance instead of the $\mu$ for pentodes, the following formula is to be preferred in calculating the gain of single-ended pentode or beam-tube cathode-followers.

$$A = \frac{G_m Z_b}{1 + G_m Z_b}$$  \hspace{1cm} (4)

How this knowledge of the gain is made use of will be covered in more detail in the design section which follows. Fig. 2 (D) utilizes a single-section high-pass pi filter as the coupling network. Again a pentode has been used for illustrative purposes, although a beam or triode tube might be used as desired. The gain is calculated from Eq. (4) and $Z_b$ may be assumed to be equal to $Z_L$. In designing this coupling network, $F_s$, the cut-off frequency, is chosen to be slightly lower than the lowest frequency it is desired to pass, and the capacity of $C_b$ is given by

$$C = \frac{79580}{F_s Z_L}$$  \hspace{1cm} (5)

while the inductance of the chokes, $L_b$, may be determined from

$$L = \frac{0.14916 Z_L}{F_s}$$  \hspace{1cm} (6)

where $C$ is in microfarads, $L$ is in henrys, $F$ is in cycles, and $Z$ is in ohms. This circuit, usually used in push-pull, is illustrated in Fig. 7 and is to be preferred in very high-power installations and wherever the utmost in quality is desired. Any transformer used to drive a Class-B audio stage is required to have very-low leakage inductance to permit the high currents to flow. Also it must be designed to have considerable extension of the low-frequency range to prevent the magnetizing current from absorbing so much of the power from the driver tubes that there is insufficient power left to supply the peak demand of the Class-B grids. Transformers meeting these specifications are very large and expensive. The circuit in Fig. 7 overcomes this problem by eliminating the transformer and substituting the symmetrical pi filter. Leakage inductance is eliminated and the chokes may be of a reasonable size. This circuit has been included more as a point of interest and not with the expectation that it will find much application in amateur transmitters.

**The Input Transformer**

Before getting down to practical circuits and design data, a practical method of supplying the high input voltage to the cathode-follower without resorting to high plate voltages should be discussed. The wide frequency response of the cathode-follower can be preserved throughout the amplifier by having several cathode-coupled stages in cascade. The overall gain then will become essentially the gains of the transformers but the number of required stages will be increased if the same overall voltage gain is to be obtained as with a conventional amplifier. From the standpoint of “understandability” in communication work, the wide frequency response is neither necessary nor desirable. A frequency range of about 200 to 3500 cycles generally is conceded to supply the greatest intelligibility. This is leading up to suggesting the use of an input transformer with a high step-up ratio and one whose primary is driven from the plate circuit of the preceding stage. Transformers with large step-up ratios usually have low-inductance primaries, to keep the cost and size down, so the use of such a transformer as suggested will probably mean that the overall frequency response will be down about two or three db, at 200 cycles. This seems to be a logical solution, since the number of stages is kept to a minimum and our low frequencies, which waste power and add nothing to the “understandability” of the speech, are eliminated. Fig. 3 illustrates an extreme case where two transformers might be used to secure high step-up ratios by connecting the primaries in parallel and the secondaries in series. However, this will not be necessary unless it is desired to use some old transformers from the “junk box” which happen to have low turns ratios.

**Push-Pull Stages**

The push-pull versions of the circuits in Fig. 2 are shown in Figs. 4, 5, 6, and 7. Fig. 4 uses a pair of 6N6Gs to represent the triode-type of cathode-follower. The 6N6G actually is two triodes con-
nected in cascade in one envelope but may be treated as one tube for design purposes. Fig. 5 is an example of the use of beam tubes, such as the 6L6 or 6Y6, with a standard-type Class-B input transformer. These two circuits are the most practical and a step-by-step design will be made for each. The use of the push-pull cathode-follower stage modifies the gain formulas given in Eq. (2) for triodes and Eq. (4) for pentode or beam tubes. The gain formula for push-pull triodes is given by

$$A = \frac{\mu Z_k}{Z_k (\mu + 1) + 2 R_p}$$

For push-pull pentodes or beam tubes the gain formula becomes

$$A = \frac{G_m Z_k}{2 + G_m Z_k}$$

In these equations, the value of $\mu$ or $G_m$ is for one tube, while $Z_k$ is the total impedance, cathode to cathode.

This modification of the formula is necessary to allow for the plate resistance of both tubes. Beam tubes again are used in Fig. 6 and the special transformer, $T_2$, is used to secure true pentode operation. While there are no transformers of this type on the market of which we know, it is expected that there may be before too long.

**Design Procedure**

The design procedure for the triode cathode-follower stage in Fig. 4 starts with the selection of the Class-B input transformer, $T_2$. If the Class-B stage is assumed to be a pair of 805s, the peak load represented by their grids will be approximately 5000 ohms across half of the secondary, and since the correct load for the 6N6Gs is 10,000 ohms, plate to plate, a transformer with an impedance ratio, primary to one-half the secondary, of 2 to 1, or a turns ratio of 1.41 to 1, will be required. The tube manual supplies the information that the 6N6Gs will deliver 8 watts of power across this 10,000-ohm load. The peak voltage delivered across this load will be

$$E_{\text{peak}} = 1.41 \sqrt{WR} = 1.41 \sqrt{8} (10^4) = 400 \text{ volts}$$

The next step is to determine the required peak input voltage.

$$E_{\text{in}} = \frac{E_{\text{out}}}{A} = \frac{400}{0.91} = 440 \text{ volts peak, grid to grid.}$$

The final step is the selection of the input transformer, $T_1$. If we use a pair of 6C5s for $V_1$, an output of 150 peak volts is readily obtained with an input of about 15 volts. Therefore transformer $T_1$ should have a minimum step-up ratio of 1 to 3. The voltage amplifier driving the 6C5s is left up to the individual preference of the constructor. The condenser $C$ should have a low reactance in order to keep the plate impedance to ground low; 30 to 80 µfd. would be entirely satisfactory.

This circuit certainly has a minimum of components and the voltage step-up of the input transformer has eliminated the need for any additional stages resulting from the loss of voltage gain in the cathode-coupled stage. The effective damping resistance, $R_d$, across the primary of $T_2$ will be

$$R_d = \frac{2 R_p}{\mu + 1} = \frac{48000}{58 + 1} = 813 \text{ ohms,}$$

or about half of that of a pair of 2A3s used in the conventional manner. The damping resistance of beam tubes is considerably lower than that of triodes, when both are used as cathode-followers.

The circuit of Fig. 5 might be used to drive four 805s in push-pull parallel. In that case the peak load across half the secondary of $T_2$ would be 2500 ohms and the recommended plate-to-plate load for the 6L6s operating Class A with 270 volts on the screen and plate is 5000 ohms. Therefore the impedance ratio of the transformer again would be 2 to 1, primary to one-half secondary.
It would have to be capable of handling the additional power. Referring to the tube manual, we find that these tubes will deliver 18.5 watts into the 5000-ohm load. The peak voltage will be
\[ E_{\text{peak}} = 1.41 \sqrt{WR} = 1.41 \sqrt{(18.5)(5000)} = 430 \text{ volts}. \]

The voltage gain, given by Eq. (8), will be
\[ A = \frac{G_mZ_k}{2 + G_mZ_k} = \frac{(0.0055)(5000)}{2 + (0.0055)(5000)} \]
\[ = \frac{27.5}{29.5} = 0.93, \]
the \( G_m \) being 5500 µmho or 0.0055 mho. The peak voltage across the grids then will be required to be
\[ E_{\text{in}} = \frac{E_{\text{out}}}{A} = \frac{430}{0.93} = 462 \text{ volts}. \]

If a pair of 6C5s is used again as the driver delivering an output voltage of 150 peak volts, the minimum turns ratio of the input transformer should be 1 to 3.08 or a standard ratio of 1 to 3.5. An input transformer with a higher step-up ratio may be used with the consequent increase in voltage gain. The values of the chokes \( L_1 \) and the condenser \( C_1 \) are not too critical. The principal requirement is that the reactance of the condenser be low and that of the choke high. A value of 12 to 20 µfd. for the condenser and 30 or more henrys for the choke will be satisfactory. This value of inductance should be readily obtainable in a small physical size, since the d.c. through each choke will be only 8 or 9 ma.

In selecting the cathode-biasing resistor, it is necessary to know the d.c. resistance of the primary of \( T_2 \). The tube manual again furnishes the information that a biasing resistor of 125 ohms is required for the two tubes. But this assumed that all of the plate current is flowing through this resistor. In our circuit the current flows through each half of the primary and some voltage drop occurs in the transformer. If we assume that the resistance of each half of the primary winding is 50 ohms, then of course the total effective resistance for biasing purposes would be 25 ohms and \( R_1 \) would have a value of 100 ohms. The value of \( C \) should be large to keep the plate-to-ground impedance low. As with the triode stage, 80 to 80 µfd. will be satisfactory, actually the higher the better. The damping resistance is
\[ R_d = \frac{2}{G_m} = \frac{2}{0.0055} = 364 \text{ ohms}. \]

**Other Applications**

There are many additional applications for amplifiers of this type. Among them there are two which would probably be of general interest. The first is the use of the cathode-follower amplifier as the output stage of a radio receiver. The loudspeaker presents a resistive load over a very restricted range around 400 cycles and is reactive at all other frequencies with the magnitude of this reactance varying widely. This means that the output tubes work into quite a varying load and rather high distortion results. The cathode-follower power amplifier is an ideal solution, since the voltage output is independent of the load, within a few per cent, over the range from full load to no load, the damping factor is very high, and the 100-per-cent inverse feedback reduces distortion to a minimum. The distortion will be only about 1 per cent of that of a stage with the same components used in the conventional manner.

The second application is in amplifiers for public-address work. Here the number of speakers required may change from day to day or even several times during the course of the day. This requires special matching and this matching must be changed every time a speaker is added or removed and, further, the gain must be readjusted if the volume level is to be held constant. By the use of the cathode-follower, speakers may be added or removed, up to the full load, without changing the volume level or requiring the matching to be changed. This can be accomplished in the following manner.

Assume that the amplifier will deliver 40 watts to a nominal line impedance of 200 ohms. The line voltage then will be 89.3 volts r.m.s. and, as we have seen, will remain essentially constant from full load to no load. If ten speakers of 2000-ohm impedances are connected in parallel across this line, the total impedance of the speakers will be 200 ohms, or full load, and the power delivered to each speaker will be
\[ W = \frac{E^2}{R} \]
\[ = \frac{8000}{2000} = 4 \text{ watts}. \]
If one or more of the speakers is disconnected, the power delivered to each of the remaining speakers will not change, since the line voltage has remained constant. The result is that the amplifier is delivering less power. This indicates that the power output is inversely proportional to the load for any load between no load and full load.

The transformers used are in the low-priced group and the response is down only 2.4 db. at 20 cycles. The high-frequency limit, taken at the half-power point, is 33 kilocycles. This performance would be very difficult to obtain, even with very expensive transformers, in conventional circuits. The 3-db. rise at 12 kc. results from resonance in the output transformer, T₃, and is not objectionable. The resonance peak would be several db. higher in an amplifier with a lower feedback ratio. The overall frequency response can be modified, such as to provide bass and treble boost, in the voltage amplifier stage or stages preceding the cathode-coupled stages. The curve in Fig. 10 resulted when a transformer with a very high distributed capacity was substituted for $T₃$ in the circuit of Fig. 9. Even with the use of this transformer, which would be very unsatisfactory in a conventional amplifier, the frequency range is 20 to 13,000 cycles.

**Summary**

From a general-design standpoint, the most satisfactory tubes to use are those with high values of transconductance and which work into low recommended values of plate load. The high $G_m$ insures better damping and will allow the voltage gain to be closer to unity and therefore the regulation will be better. The use of tubes with lower plate loads will simplify the design in that the required input voltage to the grids will be lower for full-power output and the step-up ratio of the input transformer will be in the range

(Concluded on page 118)
THE CRYSTAL BALL

CONDUCTED BY A. DAVID MIDDDELTON,* W20EN

Many of the 112-Mc. rigs throughout the country must have a built-in combination PPI and crystal ball, because the boys have been working out in all directions and yet they found time to send in some excellent, detailed reports on their crystal gazing. Most of the contributions are worthy of being passed on to the gang and we regret that space limitations do not permit publication of all the ideas submitted.

Here’s the latest dope relayed by us to you from the amateur CIC Rooms of the world.

MORE OF THE SAME—ONLY BETTER, SAYS W9LQE

My crystal ball seems to tell me “not to be the first by whom the new is tried, nor yet the last to lay the old aside.” So the new rig at W9LQE will be an improvement over the old one but it will not be essentially different. The power input, 350 watts, ‘phone, and 400 watts, c.w., will remain. Components will be operated well within their ratings, so that when emergencies arise it will be practicable to operate the transmitter day and night, continuously, if necessary.

I’ll have break-in c.w., satisfactory, noiseless, and as smooth as silk. (I haven’t found the answer to this one, but it will come.) The a.f. and r.f. systems will be in separate, completely enclosed metal cabinets.

BCI will be reduced as much as the state of the art permits. Every possible precaution in the design and operation of the new transmitter and every possible preventive measure will be used to effect this.

As to frequency control, both crystals and v.f.o. will be used. The oscillators positively shall not have too much work to do. A 45-volt B battery will probably furnish their plate voltage.

Crystal control will be used for c.w., because the only way to get a crystal note is to use a crystal. A “pdc” note is good, but it is not and cannot be the characteristic crystal note. The old-timers know this, regardless of the flattering reports the boys give on the notes coming from v.f.o.s. C.w. must be really good, with no clicks, no thumps, no chirps, no yoops, no lag, and with a musical tone as steady as the hills. I want one that sounds as though it were coming from Gabriel’s trumpet and carrying the sock of an A-bomb. I still maintain that it is harder to get a c.w. transmitter to work properly than it is to get a ‘phone rig to work acceptably well. Good c.w. is no cinch.

*B Department Editor.
sarily heavy, will remain in racks and will be relay-operated with their outputs brought to the transmitter in conduit.

"I believe that the proper use of the bands and frequencies therein will greatly outweigh the questionable advantages of 'brute-force high-power.' Therefore, I am determined to lick the problem of how to make a good v.f.o.

"In the past, I never was able to lick the problem of break-in on spot-frequency nets as I never liked the banging in my ears. There must be a way to work break-in without such annoying disturbances in the receiver. I don't mean to just put up with that racket, but to eliminate it!

"My 'phone operation will be of the 'narrow-band' type as I believe that 'broadcast quality' on the ham bands is selfish. I will use a carbon mike with a breast-plate holder in order to keep my hands free to manipulate the controls, or to make notes in the log.

"In my transmitter, I would like to incorporate front panel plug-in coils, similar in fashion to the HR0 or FB7 type of plug-ins. Maybe some coil manufacturer will come out with some workable system of that sort.

"As to the v.h.f. and u.h.f. bands ... when the lid of secrecy is lifted, I hope to be able to delve into the mysteries of these bands. I am holding an open mind on this part of the spectrum, waiting without forming any prejudices, to see what is in store for us."
OPERATING A RIG FROM THE DARKROOM

Some fellers just never can get enough of their hobbies, so they rig up ways to combine two of them! Comes now S/Sgt. Jesse D. Wheaton, OPLO, who tells how he is going to operate from inside his photography darkroom! There are few minor details, such as logging (maybe with invisible ink, or something) still unexplained, but here is what OM Jesse says:

"Seeing that I also am interested in photography as well as ham radio, I plan to have my shack right next to the darkroom as shown in Fig. 2-A.

"My rig will be all tuned up, and the receiver set on my working frequency. A remote-local switch on the operating table will permit push-to-talk operation in either room. A foot-pedal-operated switch under the darkroom work bench will turn on the rig, and a mike suspended over the bench picks up my voice. A loudspeaker, working in parallel with the one in the radio shack will give me the signals from the other station.

"Fig. 2-B shows one way that the transmitter and receiver relays could be connected. The relays could be either the normal type or the 'push-to-operate, push-to-release' variety."

![Schematic Diagram]

--- Lt. London K. Allbright, W6SLF

LIGHT-HOUSES, BUTTERFLIES AND PLUMBING

Now, you OMs and YLs go right ahead gazing into your pet crystal ball trying to get a look at life on the postwar ham bands but I wore three xtal-balls down to marble size before the Great Swami finally broke through the cranium insulation and delivered the message that provided the first practical step for the days to come. He said, "Lissen OM, the Post Office has a $100 Victory bond that'll put you smack in the middle of any two of those new u.h.f. bands for only $75. What'say?"

With that slick new $100 bond marking the u.h.f. section of the Handbook, the 420-450-Mc. and the 1445-1245-Mc. bands began to have a lot more significance. Of course, the first love, 40 meters, will have my call punching through it now and then, and a rig to handle that has been lined up for months, but what about u.h.f.?

In looking over some of the recent tube announcements, the light-house tube strikes a promising note. Also, the "butterfly" circuit seems to wrap around the light-house tube. Such a combination, together with a little plumbing, gives one solution to a two-band rig on the u.h.f. The electrical requirements for the tuned circuits call for a few pieces of coaxial cable about 4 inches long which are going to make the dimensions quite practical, in size and on the pocketbook.

The receiver problem seemed a bit more complicated at first, but one of the recently announced tubes and the plain "butterfly" solves that difficult problem. A superhet using a light-house tube, or a 6E4, as a regenerative 1st detector giving an i.f. of around 20 Mc. looks quite feasible. From the i.f. on, ordinary tubes will handle the job. The wide tuning range possible (Continued on page 118)
Waves and Wave Guides

The microwave field that was so fruitfully explored during the war is characterized not only by strange-looking devices, but as well by new ideas and a new language. New, that is, to those who were not exposed to microwave equipment in wartime, those whose experience has been confined to the region half-jokingly, half-scornfully dubbed "d.c." by the explorers above 300 megacycles. Now that we amateurs have microwave bands of our own to exploit, we'll have to extend some of our concepts of how things work. For example, for years we've dismissed electromagnetic waves as something that obviously had to exist if there is to be any radio communication, but hardly a subject to be worried about in detail. But in the microwave region waves are contained in the station equipment itself as well as in the space between the transmitter and receiver. We can't ignore them any longer.

Wave Representations

There appears to be no really satisfactory way of representing an electromagnetic wave in an ordinary drawing. This is not surprising, because a wave has no physical substance. The "conventional" representations usually are plots of mathematically-expressed properties of the wave, and bear no more resemblance to the actual wave than a sine curve does to the alternating current it is supposed to describe. However, we do have a satisfying mental picture of electrons moving through wires, and are so accustomed to the relationship between the sine curve and current intensity variation with time that the absurdity of visualizing alternating-current flow in caterpillar-like convolutions along a wire hardly ever occurs to us. Yet it is only too easy to form an equally-absurd picture of a wave - lacking even the electron, intangible though it is, to tie things down. But, having nothing better, we are compelled to stick to the various conventional forms of representation, continually keeping in mind that these forms are not to be taken literally but must be properly interpreted.

Everyone who has done a little reading on radio knows that an electromagnetic wave in space consists of traveling fields of electric and magnetic force. The two fields are separate but not independent, and go through identical variations with time when viewed at a fixed point in space. In the case of a "pure" wave, or one involving only a single frequency, these time variations follow a sine curve; hence we draw (as in Fig. 1) the same curve to represent them that we use to show the variation with time of an alternating current. In the case of the alternating current, the ordinate above the zero axis commonly would be labeled "plus" and that below "minus," to indicate that the current is flowing in the positive direction whenever the curve is above the axis and in the negative direction whenever the curve is below the axis. That is, each time the sine curve passes through the axis the direction of current flow reverses.

As applied to a wave, Fig. 1 says that the field (either one, electric or magnetic) exerts its force in some unspecified direction whenever the curve is above the axis and that this direction is reversed whenever the curve is below the axis. The curve does not show the actual direction; it has no means of doing so. By definition, the direction of an electric field of force is the direction in which a small positive charge would move when placed in the field; similarly, the direction of a magnetic field is the direction in which a small north pole would move in the field.

Let us assume that we have a field which at some instant such as A on the time scale starts from zero and increases in intensity, the direction - it might be south, for example - being indicated by the fact that the curve is below the axis. The intensity reaches a maximum at a later time X, then dies away until at a still later time B it has dropped to zero. During all this time the direction of the field is still south. After reaching zero the field again begins to grow, but this time the direction is just opposite - north, in this case. The intensity increases until time Y, then dies away again until at time C it has once more returned to zero. However, during the time interval between B and C the direction always was north - unchanging until the curve once more dropped below the axis beyond C.

This is a basic point that must be grasped before one can hope to form a clear mental picture of the wave. Since the time element is important, it may help to consider the drawing in a slightly different way. Imagine the sine curve as moving at constant speed toward the left - the whole curve, not simply a point traveling along it like a car on a roller coaster. If we select the intensity ordinate at the left as the observing point, then the height of the curve as it cuts across the or-

![Fig. 1 — Sine-curve representation of intensity variations in a wave field with time, at a fixed observing point.](image-url)
dinate will be the relative intensity of the force, measured from the zero axis. When a zero-intensity point, such as A, reaches the ordinate the direction reverses and the intensity increases with time in the opposite direction. What we see as the curve moves by is a continuous change in intensity (and, periodically, a change in direction), a change which has nothing to do with height except that the height of the curve represents its value. The curve itself definitely is not a picture of the wave.

When the intensity variations have gone through the whole gamut of possible values, one cycle has been completed and the whole thing starts over again. Each succeeding cycle is exactly like the first since we have assumed a wave of constant frequency. If the curve moves at constant speed, then, it will move the same distance during each cycle, hence the familiar relationship between speed (or, as it is usually called, "velocity of propagation"), frequency and wavelength.

By changing the label on the horizontal axis from "Time" to "Space," as in Fig. 2, we can get a different interpretation from the same curve. Now we assume that instead of making our observation at a fixed point in space and letting time run on, we take an instantaneous snapshot of the intensity variations in the field as they are distributed along a line parallel to the direction in which the wave is moving. If we could make time stand still while we moved along such a line measuring the field intensity, the value of the field at any point along the axis would be proportional to the height of the curve above or below the axis at that point. Again we should find a periodic reversal in direction. However, the curve merely says that the direction reverses; it does not say what the direction is. The distance between any two points having the same direction and intensity is equal to the wavelength of the wave, as shown on the drawing. But obviously the curve does not give an actual picture of the wave — no more than it did with the different label in Fig. 1.

Another form of representation is shown in Fig. 3, with the corresponding sine curve shown above. In this case the intensity is indicated by the closeness of spacing of the lines and the direction by the arrowheads. This form at least eliminates iii space at a fixed instant of time.

Fig. 2 — By changing the label on the horizontal axis, the sine curve can be made to represent intensity variations in space at a fixed instant of time.

Fig. 3 — In this drawing, the spacing between arrows indicates the relative intensity of the field — the closer the spacing the greater the intensity — and the arrowheads indicate the field direction.

find that the same value of intensity and direction exists at every point. Likewise, a similar group of measurements made at various heights over a fixed point on the ground would show the same intensity and direction. In other words, intensity and direction would be the same, at any given instant, at any point in a plane perpendicular to the direction in which the wave is traveling. The wave is called a plane wave for that reason. (Strictly speaking, no wave can be truly plane except at an infinite distance from its source, because radiation traveling in all directions from the source resembles an expanding sphere. However, for all practical purposes the curvature at a reasonable distance from the source is so small that the wave is substantially plane.)

With the interpretation and limitations of the diagrams in mind, it is not too hard to form a picture of the traveling field. This picture becomes more complicated when it is remembered that there are two fields to consider in an electromagnetic wave. However, the second field goes through the same variations as the first; the difference is that the direction of one field always is at right angles to the direction of the other. Further, the directions of both fields are at right angles to the direction in which the wave itself is traveling. If the wave be traveling north, for example, the direction of the electric field at some chosen instant at a fixed observing point might be west, in which case the magnetic field direction at the same instant and same spot would be downward; both these directions are perpendicular to north and to each other. At some later time the electric field at the point of observation will have reversed and will be directed east; at the same instant the magnetic field will be directed upward. Both fields, in other words, always have directions transverse to the direction of propagation. Such a wave consequently is called a "transverse electromagnetic" wave, usually shortened to "TEM" wave.

Waves Along Transmission Lines

The TEM wave is the type found in space and also is the type that travels along a two-conductor transmission line, either parallel or coaxial. In the line case, the electric lines of force extend from one conductor to the other, their direction being at right angles to the direction of propaga-
tion, which is the direction of the line itself. The magnetic lines surround the conductors of the parallel line, and form concentric circles between the conductors of the coaxial line; they are everywhere perpendicular to the electric lines and to the direction of propagation. This is shown in Fig. 4. The intensity of the fields varies along the line at any instant just as in the case of the space wave whose intensity-space variation is shown in Fig. 2, and the intensity varies with time at a given point as shown in Fig. 1.

There are no frequency limitations on such lines; they will carry power at any frequency from d.c. right on up. Of course, if the spacing between the conductors of a parallel line becomes comparable to the length of the wave being carried the line moves into the antenna category rather than operating without losses from radiation, but that is somewhat beside the point of the present discussion.

An Important Principle

In dealing with waves theoretically it is customary to assume that conductors and dielectrics have no losses. Such assumptions greatly simplify the calculations; modifications to take losses into account can be and are introduced afterward to make a satisfactory approximation of actual conditions. If a conductor is perfect (i.e., has zero resistance) then the direction of any electric field at any point is normal to the conductor surface, just enough electrons are drawn to the surface (or repelled from it, depending upon the direction of the field) to produce a charge that will balance the field intensity at the surface. There they are held — "bound" — by the field, and there is no current flow because there is no difference of potential between points along the conductor. Current flows only when the intensity of the field is changing, and the value of the current is just that which corresponds to the electrons adjusting themselves to the new field conditions.

This principle is fundamental in dealing with waves in metallic guides. Consider again the representation in Fig. 3, remembering that this is an instantaneous picture and that the field strength at any point is continually changing as the wave moves along, say to the right. From the previous discussion the lines of force could be visualized as lying in planes perpendicular to the page on which the drawing is printed, each plane marking off a very thin slice of space in which the field is everywhere the same. The same, that is, at a given instant. At any later time, however short the interval, the field strength in the same slice of space has changed, but again it has the same value throughout the slice. Fig. 3 represents Fig. 5 in showing a side view with this method of representation, but includes additionally what might be called an end view of the wave, showing by the uniform spacing of the arrows that the field is uniform both left and right and up and down. Naturally, this can only represent a small section of the wave; actually, the set of arrows should be extended indefinitely to the left and right and their length should be enlarged to any value that the imagination can encompass. Furthermore, it represents only one of the two fields — either one — so the other must be visualized as having the same time- or space-intensity variations, but with its direction always perpendicular to the first and to the direction in which the wave is moving. However, it is easier to deal with only one of the two, and for the moment we are chiefly interested in the electric field.

Now suppose we place a hollow rectangular pipe in the electric field of the wave in such a way that the length of the pipe is parallel to the direction of wave motion, giving us in Fig. 5 an end view of the wave trying to carry on through the open end of the pipe. Remember that the field exists just as much between the lines depicted as on them; the spacing between lines is just an attempt to represent the relative field strength by agreed-upon symbols. The lines of force are perpendicular to the top and bottom of the pipe, hence are in agreement with the principle discussed above. But at the sides of the pipe the
field direction is parallel to the walls of the conductor. And since this means that an infinitely-large current would flow in the side walls, the existence of a wave of the plane type in a hollow wave guide becomes impossible. If it is to fit into a pipe, the wave cannot have uniform field strength in a plane perpendicular to the direction of wave travel. The field in such a plane must be distributed in such a way that the lines of electric force are always perpendicular to the walls of the guide at points where the field touches the walls. Either that, or the electric field at some or all of the walls must be zero.

If a field distribution such as that shown in Fig. 3 could be achieved perpendicular to the direction of propagation, these requirements would be met. However, Fig. 3 must be given a somewhat different interpretation — always we run up against the impossibility of showing on a flat page a continuous four-dimensional phenomenon. We now visualize Fig. 3 as representing not a wave seen from the side and traveling to the left or right, but as a stationary distribution of field intensity in space. The time variations that take place are now simply in the intensity of the field; although the intensity at any point varies with time according to the sine law, the field is always zero at the same spot in space and always has its maximum value midway between two zero locations.

In other words, we might imagine Fig. 3 to be an end view of a new type of wave having fixed maxima and nulls along a line perpendicular to the direction in which the wave is traveling — a sidewise standing-wave phenomenon in space. If we do this, it becomes perfectly possible to fit the wave into the rectangular pipe; all that is necessary is to place the guide so that its side walls coincide with a null, or zero line of electric field, as in Fig. 7. The field at the surfaces of the side walls being zero, no current will flow in these walls.

Standing Waves

No single wave can have this kind of field distribution. On antennas and transmission lines, standing waves result only when there are reflections so that the wave traveling out along the line or antenna meets another wave coming back. In this familiar case the two waves follow exactly the same paths, although in opposite directions, and the length of the standing wave is exactly the same as the length of a single wave traveling along the same transmission line. But if we are to have a sidewise standing wave the reflections must take place from the sides of the pipe; a simple reflection from the far end would give just the same kind of standing wave as on an ordinary transmission line, one that is wholly along the direction of transmission. So waves traveling in pipes must go sidewise at the same time that they move forward.

A simple graphical approach to this requires still another method of depicting the wave. Suppose that the sine curve of Fig. 2 showing the space distribution of the field intensity at a given instant is imagined to exist in three dimensions, resembling corrugated paperboard or a corrugated tin roof. Then Fig. 2 is a view of the edge, and a rough indication of the top view of the curve is given by Fig. 8, where a thin line represents a null, a solid heavy line a positive maximum and a dashed heavy line a negative maximum. Keep in mind that the lines in this method of representation are not lines of force (that is, they do not show the direction of the field) but simply mark the regions in space where maxima and nulls exist. We are looking down on the wave in much the same way that we can look down on ripples in a stream from the vantage point of a bridge. The direction of travel is perpendicular to the lines of maxima and minima, just as the direction of travel of water waves is perpendicular to the "ridges" in the water. The distance between any two adjacent lines in the direction perpendicular to them is a quarter wavelength, between any two alternate lines a half wavelength, and so on.

Now suppose we use this method of representing the electric fields of two waves traveling at some angle to each other, as in Fig. 9. We can imagine one wave as moving from upper left to lower right and the other from lower left to upper right. Then there is a series of straight lines, XX, YY and ZZ, along which the field strength always is zero because the positive maximum of one wave always is met at that line by the negative maximum of the other, giving a net field of zero. The same cancellation is true of intermediate values in corresponding parts of the waves. (A water-wave analogy of this phenomenon can be found, too; nearly everyone has observed the standing waves that exist on the surface of a pond when two sets of traveling waves intersect at an angle.) A metallic conductor such as the side wall of a rectangular pipe could be placed along any of these null lines without causing any disturbance.

The two waves combine to form a resultant single wave, just as two forces combine to form a single resultant force. And since the waves are assumed to have equal amplitudes, the resultant wave travels along a line bisecting the angle between them, from left to right in the case assumed in Fig. 9. Note that the null lines likewise bisect the angle between the directions of travel of the two waves; in other words, the null lines are parallel to the direction in which the re-
ultant wave propagates. This being the case, the side walls of a rectangular pipe can be placed along any pair of these lines and the wave will travel through the pipe.

Along a line, such as AA, perpendicular to the direction of propagation the field intensity will vary from zero at the null lines to a maximum just half-way between any pair of lines. This is indicated by the fact that the same type of maxima intersect midway between the null lines; for example, between YY and ZZ the negative maxima add together along the line AA. Thus we obtain — as a standing wave — the type of field distribution shown in Fig. 3 as an instantaneous picture.

Fig. 8 — The representation at the bottom shows, by alternate light, heavy and dashed lines, the locations of nulls and maximum in a “corrugated sheet” sine wave when viewed from the top.

Two possibilities are shown in Fig. 9. If the side walls of the guide are placed at YY and ZZ the stationary electric field distribution as measured along AA will go through one variation from zero through a maximum and back to zero; that is, through one “half-period” variation. The term “half-period” is used intentionally in preference to “half-wave” for reasons which will become clear in a moment. If the side walls are placed at XX and ZZ, the stationary field as measured along AA will rise from zero through a positive maximum, back to zero, then through a negative maximum and finally back to zero again. This is a “full-period” variation, or two half-period variations. Any number of these half-period variations can exist, provided the side walls are separated the proper distance to accommodate them.

In a way, building up a picture of wave propagation in a guide in this fashion is putting the cart before the horse, because we have assumed two waves and then put the side walls of the guide at the locations dictated by the necessity for having zero electric field at these walls. The two waves in a guide are separate waves in the same sense that the outgoing and reflected waves on a transmission line are separate. In other words, the second wave is simply the first after reflection from a side wall of the guide. The reflected component cancels the primary component at the wall — that is, the electric field is reflected with a reversal of phase — because, since the lines of force are not perpendicular to the conductor, this field must be zero at the surface of a perfect short circuit. This is true whether it be the short at the end of a transmission line or the wall at the side of a hollow guide. Fig. 9 is a means by which a picture of the locations of the zero-field lines can be formed with a minimum of complications. But it is also a true picture of what happens when a wave is introduced into the guide; reflections occur all along both side walls since both are equally exposed to the incoming wave, and the total effect is the same as though two separate waves actually were present. Since the angle of reflection is equal to the angle of incidence, the direction of propagation is straight down the guide.

The physical spacing between the null lines depends upon the wavelength of the two waves or components and the angle between them. Obviously, if the wavelength is made longer or shorter, leaving the angle fixed, the null lines will be farther apart or closer together, respectively. This merely corresponds to changing the scale in Fig. 9. But if the angle between the wave directions is varied, the spacing between the null lines will increase as the angle is made smaller. When the angle becomes zero degrees the two waves merge into one and the spacing between null lines becomes infinite, which is simply another way of saying that a single wave component cannot exist in a guide.

When the angle between the two wave directions is 180 degrees the waves again merge, but the resultant wave is then simply traveling crosswise in the guide and there is no propagation through it. In this limiting case the distance in which the field goes through a half-period variation is the same as a half wavelength in space, since the direction of wave travel is the same as the direction in which the distance across the guide is measured. The side walls cannot have any closer spacing than this; anything less would be

(Closed on page 180)
WERE you caught off base too? The sudden ending of the war, and the unexpected reactivation of the 112-Mc. band in essentially its prewar form, found a large part of the country's v.h.f. population without the means to get going quickly, and many of them away from home. That first week or so was a hectic period, but it didn't take long for things to get rolling.

By Labor Day there was a definitely prewar sound to the 112-Mc. band in most of the populous areas along the East Coast, in the area around the Great Lakes, and in many of the cities of the Pacific Coast. It was a haywire beginning, generally; there was little time for refinements in that first mad rush, and the gear would only be in use for a short time anyway, in view of the conversion to 144 Mc. to be made within a few weeks. It was strange, too, at first, to find that you couldn't always remember names; it was hard to know just what to say, after years of inactivity, or, at best, the use of the stilted forms of WERS or military communication; but all those who took part in those first nights of activity stored up memories of an experience that will stay with them for many a day.

Credit for the first DX reported goes to Art Laverty, a recent licensee, who, with W4HVL/9, operating from an elevated location near St. Charles, Ill., worked SCM W9EGQ, Gary, Ind., a distance of about 60 miles, on the night of August 28th. They were using a 15-watt mobile job and a 4-element beam. Other contacts included W9PK, Downers Grove, Ill.; W9MAT, La Grange; W9CYT, Evergreen Park; and W9MVZ, Gary.

On September 2nd, W9YQC/8, operating mobile from a bluff overlooking the Lake, near Benton Harbor, Mich., worked W9DUT, and W9EGQ of Gary, Ind., and W9BAY, Chicago Heights; and W9FCN, La Grange, Ill.; the distance being around 75 miles to the Illinois stations. W9YQC/8 and W9FCN both used crystal-controlled 815s at 30 to 50 watts input and 4-element beams. W9EGQ has 14 watts input to an 807 doubler, and an eleven-tube superhet, which gives excellent results, especially on weak-signal reception of stabilized rigs.

W9PK, Downers Grove, Ill., reports 34 stations worked between August 22nd and September 10th. Jack has a stabilized rig using an 815 in the final at 30 watts input, and a four-element horizontal array. The polarization question, as always, is a problem in the Chicago area. Most stations are using verticals, but the advocates of horizontal polarization are gaining ground.

W8CVQ, Kalamazoo, Mich., was heard in both Chicago and Gary on September 4th. This distance of 100 miles or more is the next mark for the boys to shoot at, and W9EGQ reports that W9BAY has heard Indianapolis WERS signals on several occasions — a path of some 200 miles.

Labor Day week-end provided the East Coast with its first taste of inversion DX, with conditions hitting the peak on the night of September 5th. It was a typical late-summer session, and numerous contacts were made between stations in Rhode Island, Massachusetts and Connecticut, and those in New York, New Jersey and Pennsylvania. W1KOE, Wakefield, R. I.; W1BJE, Westport Harbor, Mass.; W1PP, Madison, and W1JLK, Tolland, Conn., were working into the second and third call areas. Contacts beyond 100 miles were numerous, and several nearing the 200-mile mark. W1KOE worked W2COK, Staten Island, N. Y.; W9BBD/2, Eaton, N. J.; W3BES, Glenisle, Pa.; and W6SGX/3, 8 miles west of Philadelphia, a distance of close to 200 miles.

WILLL, Hartford, still doing business at the same old stand, heard many signals from beyond the normal range, including W1KGE, Darien, Conn.; W1LWE/2, Glen Cove, L. I.; W1LUD/1, Mt. Greylock, Mass.; W1BJE and W1KOE; W3AC, mobile; W3BES; and W2OEN/2 at Speculator, N. Y. Your conductor was in the throes of his first postwar DX that night, operating from a 1000-foot elevation near Somers, Conn., where he yelled himself hoarse at various W2's — to no avail.

W3ELI, Norfolk, Va., writes that most call areas are represented by stations working portable in that vicinity. By late September, the following were being heard: W1LVN, W2DOR, W3ELI, W3IKE, W3HWT, W3NT, W5HNU, W6IQL, W7FAE, W8BUJ, W8VGO, and W9AWL, as well as numerous others who had not been identified. Army planes in the vicinity, calling Washington, more than 150 miles distant, on 116.1 Mc., sounded like rather good DX for that frequency, even though they were at 9000 feet.

W9BBD/2, Eaton, N. J., reports 39 stations worked up to September 10th. He is using an f.m. exciter driving an 815 at 75 watts input, and a vertical folded doublet. A 400-watt final for a.m. or f.m. is in the works. Checks on f.m., with stations equipped to receive it properly, have resulted in excellent reports; but a.m. has to be used most of the time for maximum readability in the superregenerative receivers generally in use. We have no direct reports of activity from the West Coast, but we understand that Twin Peaks, San Francisco, is taking its customary beating, and the mountains back of Los Angeles have already seen plenty of mobile and portable activity. W6OVK, formerly of Tucson, Ariz., is in San Francisco, and rarin' to go; but his gear is spread out over various parts of the country (a commonly heard complaint) and his pet receiver, an a.m. f.m. job with 5- and 30-Mc. I.f. channels and separate converters for the various v.h.f. bands, has been lost in shipment.

W7GSJ, Whitefish, Mont., writes that he ex-
MANY novel means of getting in touch with fellow hams have been mentioned in these columns; here is an addition to the list. STK3C Edwin Thaiss painted his call, WSPCS, on the back of his dungaree shirt and “worked” these calls:

- Thaiss painted his call, WSPCS, WSWBT, W9AOP, W9BNJ, these columns; here is an addition to the list. STK3C Edwin Thaiss painted his call, WSPCS, on the back of his dungaree shirt and “worked” these calls:

- Adams, R/Mc, Portsmouth, Va.
- Costs, R/Mc, foreign duty
- Drinkard, R/Mc, Galveston, Texas
- Godward, CRT, Baltimore, Md.

ARMY — AIR FORCES

- ex-LRG, Glinka, Pvt., Scott Field, Ill.
- JIIN, Katsanos, Sgt., foreign duty
- KIBX, Bowler, T/5, Greenhoro, N. C.
- 1MBC, Tox, S/Sgt., foreign duty
- 1NBD, Copley, Lt., Honolulu, Hawaii
- 2JBN, Kearsarge, Sgt., Tampa, Fla.
- 2HAO, Ayrault, S/Sgt., foreign duty
- 2HGX, Zemek, Capt., foreign duty
- 2BQW, Roseville, Sgt., Golfport, Miss.
- 2HL, Mitchell, Maj., foreign duty
- 2NMS, Brinkmann, Cpl., Tucson, Arizona
- 2OMG, Gillimany, Pvt., Trux Field, Wis.
- 2NRM, Rush, Cpl., foreign duty
- 2RTH, T/5, foreign duty

ARMY — GENERAL

- 1LT, Borden, Pvt., Aberdeen Proving Grounds, Md.
- 2IJL, Fowler, T/5, foreign duty
- 2NQ, Les, Capt., Camp Beale, Calif.
- 3MS, Young, Sgt., foreign duty
- 4VQ, Hunt, Capt., Pine Camp, N. Y.
- 5FMG, Lee, Capt., Camp Beale, Calif.
- 5KUS, Maddux, Sgt., foreign duty

MERCHANT MARINE AND MARITIME SERVICE

- 1BBQ, Nash, Mrks, match, INCE, Deck; 2LMS, Csn, Deck, 3WQ, Tom, Clerk, 4NP, Do, Weather, 5NQ, Mrks, Match, foreign duty
- 1ULQ, Sheehan, Pvt., Aberdeen Proving Grounds, Md.

Lt. Ray Long, W5ERM, Signal Corps, believes in “fraternizing.” Here he is, near Altkirchen, Germany, kneeling with a German “friend.” The enemy was just across the Sieg river at that time.

COAST GUARD

- 1AIN, Levallee, Lt, Baltimore, Md.
- 2HSB, Naegel, CSM, Arverne, L. L., N. Y.
- 2NDQ, Branden, Lt., foreign duty
- 3JS, Getch, CSM, foreign duty

Coast Guard

- 1AIN, Levallee, Lt, Baltimore, Md.
- 2HSB, Naegel, CSM, Arverne, L. L., N. Y.
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- 2NDQ, Branden, Lt., foreign duty
- 3JS, Getch, CSM, foreign duty
Not until the shooting was over were these hams able to get together in Wiesbaden, Germany, for the purpose of having this photo taken. Left to right, front row: T/Sgt. Snyder, W3HTX; Capt. Dietrich, W6FTO; Lt. Clifford, W9SYO; T/Sgt. Bridge, W6MXH; T/Sgt. Juring, W9YTO. Second row: T/4 Goldbach, W2CIJ; T/3 Phillips, W8VJG; T/Sgt. Double, W8GZF; T/Sgt. Curley, W8MPA; T/3 Leupold, W9TFQ; T/5 Hall, W9UAL; T/4 Thompson, W3DRQ; T/4 Farnsworth, W9GOG; T/Sgt. Morris, W2KHP.

November 1945 61
For heroical achievement in action in Germany last February, Pfc. Carl L. Luske, Jr., of the 744th Light Tank Battalion, received the Bronze Star medal.

Carl was serving with the 744th Light Tank Battalion at that time.

He hails from Stratford, Conn., and graduated from the United States Naval Academy in 1943.

Luske, a native of Bridgeport, Conn., was born on March 3, 1925.

He is a son of Mr. and Mrs. C. L. Luske, Sr., Bridgeport, Conn.


24-HOUR TIME

72 Bowler St., East Lynn, Mass.

Editor, QST:
I suggest and strongly urge that the ARRL adopt and use the 24-hour clock system. It has the advantages of simplicity, and no AM and PM appendages. It surely should be pointed out as a sensible and progressive move for better operating efficiency in amateur operating. One can keep in mind the number of hours off Greenwich Civil Time, and thus quote GCT during DX contacts, which would be a courteous gesture.

— Harold W. Ryall, W1NKW

A REPORT FROM IE SHIMA

Editor, QST:
Well, now it can be told. . . . I’m on Io Shima, just off Okinawa. The island was in the news this year because Ernie Pyle was killed here and also because the Jap planes and envoys stopped here on the original peace mission to Manila to see General MacArthur.

Ernie’s grave is just below me here, in the Island’s military cemetery. The stone, raised by the 77th Div. on the spot where he was hit by the Jap machine gun bullet, is also nearby.

I got in on the Jap peace mission deal, and was plenty busy for a while, as that was one event that had to go off without a hitch. My control towers handled the planes in and out, and coming in. I was on duty in one tower while my C.O. stood the main trick at the other tower where the Jap planes landed. I had the satisfaction of copying the message sent by the Jap pilot in halting English, giving us his arrival time at Io Shima.

The Jap planes showed evidence of a hasty very streaked white paint job. One could see the red suns beneath the green crosses, too. I got some pictures of the planes both arriving in the air, and after they got on the ground.

When the envoys returned from Manila a few days later in one of our deluxe C-54 airliners, and changed to their Jap Bettys here I was again fortunate to be in on the deal. This time I had to know a few facts for tower clearance, and so I jeeped right down the strip to the Jap plane and talked with the Jap pilot at the cabin door of his plane. One of the envoys acted as interpreter for me. The paper that I gave the Jap pilot to write both Jap and Arabic figures on is a highly prized souvenir of the occasion. I said “hello” in Japanese to the pilot at one point and he gave me a smile and a salute in return.

Thought you’d be interested in this. I enjoyed it when it happened.

— Lt. P. M. Cornell, SC, WBEFW

LSPHs REPORTED ENTHUSIASTIC

BY W9PHB

W. Pacific Area

Editor, QST:
Just a few comments from the other side. Now that the war is over and the new frequency allocations are known, wherever you go you find the boys designing their future rigs. I have observed that some of the most enthusiastic ones that I have met, are the boys licensed since Pearl Harbor.

— Clayton C. DeWitt, W9PHB
A Challenge. Activities of the War Emergency Radio Service will terminate November 15th. As a temporary wartime service, designed to fill a wartime need, WERS, with the assistance of many non-amateurs, served its purpose admirably well. It was a vital and important part of our civilian defense. We must be forever thankful that the emergency communications facilities it developed and maintained in continuous readiness were never needed during actual enemy action against our land. But the fact stands that there did exist throughout the nation a highly efficient organization prepared to render invaluable aid if the need had arisen; and the men and women who worked so unselfishly to make WERS a success are to be commended for their untiring and ceaseless efforts.

But what of the future? The job of furnishing emergency communications in times of disaster traditionally has belonged to the radio amateur for more than a quarter-century. Indeed, we have come to accept disaster preparedness as an obligation; and our past performances in times of emergency have demonstrated clearly the seriousness with which we have accepted that obligation. Currently we hear the questions asked: Will the amateurs step in promptly and pick up where WERS leaves off? Will they do the job in peacetime as effectively as WERS did in wartime? These queries constitute a challenge to amateur radio’s ability to organize for this vital work. It has been and still is a big job. Can we measure up to the requirements?

ARRL will sponsor and broadly direct a postwar emergency preparedness program. The success of such a venture, however, depends on the energies put forth by individual amateurs in the field. None of us can undertake such a task alone or in small groups. The cooperation of all civic-minded amateurs is essential. The goal of the prewar ARRL Emergency Corps remains our slogan: AN AMATEUR RADIO EMERGENCY STATION IN EVERY COMMUNITY! That should be our minimum requirement for organizing to do an effective job when the low-frequency bands are once more available. Our more immediate objective is to have ready local v.h.f. networks wherever possible, and particularly in areas of large population.

Details of a complete emergency plan are being worked out at Headquarters. QST will carry full information in the near future. Meanwhile, every amateur who possesses equipment capable of operation on 112 Mc., and the proposed band 144-148 Mc., is urged to contact his Section Communications Manager (address listed on pages 4-6 in each issue of QST), ARRL Emergency Coordinator if known, or local radio club, to learn how he can be of assistance in present organizing. In addition, we suggest reference to the Operating News Section in October QST for supplementary information.

Participation in fifty-odd major communications emergencies since 1919 has contributed as much or more than any other single factor to the glorious history of accomplishment in amateur radio. Here is a golden opportunity to win additional public respect. In the true spirit of amateur radio let us now prepare to carry on our traditional responsibility to community and nation. Act now!

Amateur Radio Clubs. Since V-J Day we have been extremely gratified to note increased interest in the formation of new clubs. In order to help these clubs get started on the right foot we have available to organizers of new amateur associations, literature containing suggestions for organizing, keeping up interest, courses of study, sample constitutions, etc. These mimeographs may be procured, free of charge, by directing request to the Communications Department.

In addition, the League will grant affiliation to any amateur radio society having at least 51 per cent of its licensed amateurs also ARRL members that indicates its willingness to cooperate with the ARRL in its objectives. Affiliation must receive the approval of the Director of the Division in which the club is located. The necessary forms to start affiliation proceedings will be forwarded, upon request, to any existing amateur radio association.

Numerous affiliated radio clubs, inactive during the war, once again are coming back to life, and these will be returned to our active files and mailing lists upon receipt of information concerning activities in which the club is participating, and return of the questionnaire which we will send to the organization. Let’s hear from all active associations, affiliated or not. We’ll try to help as much as possible with suggestions for the rebuilding of the organization.

Press Schedules. Radiotelegraph transmissions of press information provide excellent practice for anyone desiring to improve his code copying ability. A revised list of commercial press schedules is now available upon request to Headquarters. Many of the schedules listed are subject to change without our knowledge and we would appreciate hearing of any such changes or additional stations noted. Please give the call, time (GMT), frequency (kc.), origin and speed. QST will continue to publish revised and supple-

November 1945
September Hurricane Finds Miami
WERS Ready

Once again WERS has come through, this time in the hurricane which struck Miami on September 15th during which WKNW, Dade County, Florida, proved that a well-trained emergency system is a valuable asset in any disaster.

Our WERS set-up for hurricane emergency allowed for ten district headquarters stations to cover the county and to work directly into the control station on the roof of the fifteenth story Technical Vocational Building; a Ford Red Cross mobile disaster unit with a rack and panel m.o.p.a. and superhet receiver; and a number of privately-owned mobile units running from three to twenty-five watts to dispatch to emergency locations and to work over the devastated area with the mobile disaster unit as a subcontrol. Operation was to begin as soon as the wind subsided enough to permit an operator to get his emergency location. Those not needed at home were to man control in order to protect equipment against possible damage and to keep everything in order so that we could get on the air as soon as possible. Another unit was assigned to be set up at Red Cross Disaster Headquarters previous to the storm.

The day before the blow, Callahan, Unit No. 63; Mennt, No. 80; Paup, WTRD; Hall, W4FVW, No. 30; Selaigne, W4VV, No. 30; Bumpus, W1DFY, No. 14; Marvin, No. 45 and Bryan, ex-W4AI, wrestled a 750-watt gas-driven generator and other equipment up to the penthouse and set up for emergency operation.

Following the emergency plan, control was manned Saturday, September 15th, with Callahan as chief operator, while Ed Doff, W4CPC, No. 68, set up in District Three headquarters. Our regular emphasis was to get in touch with the Red Cross Headquarters and secure on the roof to be erected as soon as was practical. W4VY set up No. 68 at Red Cross Disaster Headquarters and Bliving, W4AEW, No. 35, as chief operator, manned the units with Richards, W1JTF and Coxe, W4CNB, as assistant operators and Verma and Arline Delling to handle phone lines.

While the wind was blowing at about seventy miles an hour, Petru, No. 12, Paup, and Mennt climbed to the roof of the penthouse to get the antenna up and secure it from the high wind. This antenna blew away three times during the evening and finally not enough of it remained to be of any use. Operation was carried on with a coxial-fed extended Zepp indoor but this antenna was so inefficient that our range was cut to ten or twelve miles. At five-thirty the commercial power went off and the station went on emergency power. In the meantime, things were buzzing at Disaster Headquarters. South of us all lines were down and radio was the only means of contact. Soon the phone line to Jackson Memorial Hospital went out and Ray Russell, No. 32, was dispatched to that location. Within fifteen minutes this important link was re-established and continued to operate during the evening.

Shortly before 10 p.m. the Disaster Unit, No. 30; Bumpus, W1DFY, No. 14; Selaigne, W4VV, No. 30; and Conley, W4HNL, No. 46, were started toward Homestead. In the Disaster Unit with Hall, W4FVW, we had Mrs. Beatrice Vines, executive director at Headquarters, and Bryan, ex-W4AI, as assistant in charge of organized operating activities. All hands will join with us at ARRL in heartiest congratulations to "Ed," "Ev," and "Joe" upon their records of faithful service to our country. Theirs was a contribution of which we may be justifiably proud. Welcome home, fellers!

—E. M. S.
November 1945 67

This picture shows some of the men responsible for the success of the Mercer County WERS net. Left to right, front row: E. Hinisky, W4HDE; S. Bob, W4WAE; E. Sanborn, W4FRE; L. Campbell, W4QCN. Back row: A. C. Heck, W3GEG, radio aide; Mike Barbat, Wm. Fleckenstein; Sidney Kappell. Other active members not shown are: Dick Reed, W8JUI; Jim Catron, now at Penn. State College; Dikeon, W8VUI; Robert H. Morgan, W8VNL, and Paul Trice, W8QHS.

By this time civilian defense in this area was taking an interest in radio communication, so the WERS net control was established at its headquarters. However, the arrangement proved to be a failure simply because of the location of the group. The collaboration of these two nets is noteworthy. The system proved to be a failure simply because of the location of the location underground, which was shielded by girders, metallic material, and high tension lines. Tests were carried out, but the inadequate facilities for uhf antennas proved to be a problem. Too little cooperation from civilian defense authorities proved that the net control would have to be relocated in order to maintain a more efficient organization.

Operating problems were not as bad as anticipated, although there were, and still are, only two experienced traffic men in the net. Others learned the procedure quickly. To speed up procedure, radio drills in traffic handling was one of the “musts” of each drill session. To further improve traffic handling a channel for i.e.w. operation was put into use. Although there is no rag-chewing, radio communication with our neighboring State, Ohio, proved to be an incentive to all stations of the WKXV net. Signal reports as far distant as eighteen miles are exchanged between the Mahoning County, Ohio, and the Mercer County nets. Exchanges of practice radio traffic has been made on many occasions. The cooperation of these two nets is noteworthy. Definite channels have been established as not to cause undue interference with each other.

We at WKXV can justly be proud of our net. We have gained through experience and profit by our mistakes. We have solved the mysteries of the ultra-high frequencies. We have proven to ourselves that we can face the task of helping out in whatever emergency arises. And those of us who are new in the amateur radio game feel that radio will be an integral part of our peacetime national life.

— Ernest J. Hillman, W8JUI, Assistant Radio Aide, WKXV

Affiliated Club Honor Roll

The following clubs are additions to the “ARRL Affiliated Club Honor Roll” which appeared in the July, 1945, issue of QST, on page 57:

Amateur Radio Club of Seattle, Wash.
Frankford Radio Club, Pa.

BRIEF

Each amateur is urged to inform the secretary or other club officer of the radio club in his vicinity of his future plans to enable the club to start peace time activities as soon as possible.

WERS of the Month

Mercer County, Pa.

One of the hardest tasks in organizing a WERS unit in any one place, it was found, was to convince some of the city officials that the possibilities of a radio system could extend beyond the range of civilian defense. The negative attitude of the city administration proved to be the beginning of Mercer County’s radio system. The radio amateurs of the County decided it was high time the officials were shown what radio activity could mean to a community. Therefore, with the help of a further radiation these boys nominated a leader to act as radio aide for an intended radio net.

In October, 1942, a special meeting of all leading amateurs, servicemen, and radio enthusiasts gathered at the Mercer County Courthouse to discuss the matter and elect those necessary to form a nucleus of a reliable organization. There was no publicity, no soliciting, and no advertising to get members interested. The few remaining amateurs and interested servicemen who were still at home had one thing in common, to show those who had nothing but double that amateur radio could be put to practical use.

Thus, with the first meeting of this newly-organized group, plans for the administration, organization, procedure, and locations were under way. The radio aids and their assistants immediately began work on filing application forms, mapping locations, and working up some procedure forms for operation of a WERS net. After careful consideration application was made for ten radio units to be distributed throughout the Sharon and Farrell areas. These ten stations have been included in Mercer County WERS ever since its licensing, although there have been new operators. On October 1, 1943, Mercer County was granted a license for ten units, nine composite units and an Abbot TR-4, under the call WKXV, and became the first organized net in Western Pennsylvania. However, while waiting for the application to be approved the boys were constructing apparatus from whatever material they could find available and whatever circuits could be obtained from The Radio Amateur’s Handbook. By the time the license arrived, the units were ready to give the gear its first real test.

W4VV, with mobile No. 30, started south, Gillette, Henke, and Pursell joined them later. Both No. 30 and No. 36 worked control continuously all the way to Homestead. At 7 P.M., our long lost Homestead station, No. 5, was heard at control and direct communication was established. Traffic then moved in both directions until the Homestead Red Cross office closed at midnight. Henke remained in control and operated at No. 5 and the rest of the gang returned to Miami.

On September 18th, W4CNB, with Pursell, Buchnell, Gillette, and Grafe, No. 71, took the truck south and cleared traffic at Goulds, Perrine, and other intermediate points.

On Wednesday, No. 35, minus Pursell but with the addition of W1JIT, again covered this area. During the afternoon the traffic at Goulds, Perrine, and other intermediate points.

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AMATEUR

ACTIVITIES

ATLANTIC DIVISION

EASTERN PENNSYLVANIA — SCM, Jerry Mathie, W3KHS - 3HFO stopped to say hello on his furlough. Sept. 8th in the CREI Building, corner of Park and Chestnut Streets, Philadelphia, with the merchant marine for civilian life - Les again shipped to the Philippines and now needs only that go-ahead signal from FCC to "raise" someone on the 112-Mc. band. 73, Ron.

MARYLAND-DELAWARE-DISTRICT OF COLUMBIA — SCM, Hermann E. Hobbs, W3CIZ - The Washington Radio Club held its first meeting of the season on Oct. 6th in the CREI Building, corner of Park Road and 16th St., N.W., with an election of officers. New officers are: President - Richard M. Houston, pres.; Gordon Walter, vice-pres.; Secretary - William B. Michael, Det. 103rd AACS Sqdn., is stationed at Bound Brook, N. J., and now needs only that go-ahead signal from FCC to "raise" someone on the 112-Mc. band. 73, Ron.

SOUTHERN NEW JERSEY - SCM, Ray Tomlinson, W3SCU - Asst. SCM, Ed. G. Raser, W3ZI; Regional EC, ASQ. OBS appointments have been authorized by Headquarters and a few of the boys already are putting out official messages from Headquarters as they are released. SCM, Ray, has accepted a teaching position at Cranbury, Mo. TVA still is down in Brazil but hopes to return home soon. AAT, the lone station in Halifax, reports that MBZ is a first flt. in ASTO and is stationed in the Pacific. CQF's XYZ is back from Philadelphia hospital and getting along fine. AOE, president of the newly-organized Mercer County Radio Association, writes that the Association has over twenty active members with many more showing great interest. Meetings are held at the local h.q. station. There were twenty-three present at the picnic held Aug. 25th. VNE has returned to Washington, D. C., after a recent leave getting the transmitter ready to go on the air and now awaits the go-ahead signal from FCC and release from the Navy. UMO is running a movie projector for troops in Germany. T/S KX8S writes from Santa Fe, N. M., where he is with S.E.D. Bob holds radiophone first-class and radiotelegraph 2nd-class licenses in addition to his amateur Class A ticket, and hopes to return to State College and resume operation of SYA. NUG sends the following fine report: S/Sgt. MRD recently was discharged from the Army and now has a position of line operator at the local exchange. IOY and NUG have constructed a.c. impedance bridges as a project engineer on a very secret deal. Bill was sent abroad and spent many months doing secret work in England, Africa, Australia, Hawaii, and Alaska. Those enjoying themselves on the 112-Mc. band include ITS, IDY, AXU, and UK. SWF has recently purchased 112 Mc. equipment for the purpose of lining himself up with those of the same wavelength. Aug. 30th, 3DPU paid a visit for the first time in three years and expects to be back soon. SPLA, with the RID in Allegan, Mich., wants news of Eastern Pennsylvania W8s. A swell letter from 3H4L gives some light on the activities of various members of the Beacon Radio Club. 3H4L, who is in the USC on an attack transport, says when last heard 3H4L was in Washington D. C. Lt. Col. 2PF, Signal Corps, has a fine rotary beam perking. The West Philadelphia Monitor, Aug. 15th, reports the formation of the Hamilton Twp. Police Bombing and Torpedo Squad. SCM, Ray, has a new frenc frequency on 80 meters. With its discontinuance on the 112-115.5-Mc. band, much activity was noted around Rochester way. Those heard were: DFN, OGC, PPR, RXQ, JIC, NOL, and MC. Among the DX signals was ECM, who has recently purchased FC2 from Brockport to Kenmore, N. Y. QUQ'S QTH is: Cpl. Norman Miller, Squadron B, 812 AAF, Pope Field, N. C. Norm would like to hear from any of the boys in radar school there. If you Binghamton, N. Y., write to him from them so we can pass the news along. We hear that QOC is back from the wars and has been visiting the gang. The State Guard WERS group got some GI equipment and expects to hold down 20, 40, and 80 c.w. while activated. On Nov. 15th, WERS will leave a great record of achievement which will be a challenge to amateur radio to organize an emergency network able to meet any emergency. 73, Bill.

WESTERN NEW YORK - SCM, William F. Beoor, W8MC - With the opening of the 112-115.5-Mc. band, much activity was noted around Rochester way. Those heard were: DFN, OGC, PPR, RXQ, JIC, NOL, and MC. Among the DX signals was ECM, who has recently purchased FC2 from Brockport to Kenmore, N. Y. QUQ'S QTH is: Cpl. Norman Miller, Squadron B, 812 AAF, Pope Field, N. C. Norm would like to hear from any of the boys in radar school there. If you Binghamton, N. Y., write to him from them so we can pass the news along. We hear that QOC is back from the wars and has been visiting the gang. The State Guard WERS group got some GI equipment and expects to hold down 20, 40, and 80 c.w. while activated. On Nov. 15th, WERS will leave a great record of achievement which will be a challenge to amateur radio to organize an emergency network able to meet any emergency. 73, Bill.
DURING the war, most of us waited with a show of patience for the things we needed or wanted. Right now, we want to know how much longer we have to wait. Amateurs being just like everybody else in this respect, we can hardly do better than to use this page to set forth how postwar things stand here at National.

The strictly amateur receiver, having special coil ranges expanded to cover one amateur band each, is a temporary casualty. The reason is that the amateur frequencies have not been definitely assigned. Prophecy is not among our talents, so Science will have to wait while Law deliberates. We hope it will not be for long, but in the meantime you will have to wait for receivers like the NC-200 or parts like exciter coils.

Many National receivers were accepted as standard by the armed forces during the war with only minor modifications. We think it was a fine tribute to their inherent quality and performance that stock models were able to exceed military specifications, both here and abroad. The British Admiralty used large numbers of HRO’s in key positions, for instance, which were standard even to having amateur bandspread ranges. Stock receivers were not only used but copied, both by our allies and our enemies. This is a story in itself, and we will not go into details now. The point we want to make is that National receivers were comparable to the best military designs when the war started. During the war, constant improvements kept them abreast of the art as it progressed.

As matters stand, we have a group of receivers which are tops by any standard. We do not see any sense in abandoning them just to have new postwar models. As far as the amateur is concerned, they are new models. The HRO may look about the same, but it has been so improved during the war years that it could be called a new design.

The NC-2-40C is a new receiver based on the NC-200. It resembles the 200 in appearance, except for the addition of a separate vernier dial for high precision in logging. Inside the receiver, refinements in circuits and in construction details make the 2-40C a really outstanding performer.

The NC-45 has been so completely overhauled that we have given it a new type symbol. Listed as the NC-46, it is designed to be a high quality AC-DC set. As compared to the NC-45, it has many refinements including a much better AVG and a two watt push-pull output stage.

For the immediate future, these three basic receivers — the HRO, the NC-2-40C and the NC-46 — are the ones on which our production will concentrate. These are the ones you will find on your dealers’ shelves shortly. They will look like old friends, but they will perform like the postwar jobs you have been hoping for.

William A. Ready

presided and FCC Order No. 137 was read and discussed. SWX read an interesting letter from PA0SC relating his experiences during the occupation of the Philippines. Much interest was displayed in the "long line" oscillator for 5 and 23 meters and an "acorn tube" receiver demonstrated by JAV. News on Butler hams reaches us from the East Coast. RWJ and 3GJY recently received discharges respectively. 1st Lt. 4CYC is in the Granite City Engineering Depot, and was killed in the war in the East Coast. RWJ and 3GJY recently received discharges from the Army. Amateurs in localities not now adequately covered by emergency facilities are urged to contact the SCM with regard to EC appointments.

CENTRAL DIVISION

INDIANA — SCM, Herbert S. Brier, W9EGQ — 1IZY is back from Ethiopia, where he ran the Army radio station. Of the 21 WJW 2½ that was shown to be the SCM, many were building new ones. HFV is back at his post at FCC after his operation. FWU is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte. PUB is sweating out another half-point or so before he gets his new station. ARTIC RDC was killed in action in Leyte.

(Continued from page 68)

(Continued from page 78)

OHIO — SCM, Carl F. Wiehe, W8MFP — Toledo reports on a very enjoyable W8RDB WTRJ picnic with about seventy-five present. Attendance at meetings and code classes continues good. Experiments with crystal-controlled 146 Mc. transmitters are being conducted by ARF. PZA reports the usual well-attended and enjoyable meetings at the WTRJ club. The Columbus PZA has quit the WTRJ club because they have no one to talk to. WTRJ club furnished communications service there is. Regular League appointments are going and more are under construction. 8FX, our socc., spent a few days around Rogers City recently and reports that 8PV8 is nearly ready to go on QMN. 8TGR reports that one of his pupils brought home some German equipment, and that TFR saw a serf-c.w. transmitter at a skating rink. EBB reports a great resurgence of amateur spirit around NRL since the return of hams to 112. ZYJ reports that some of his experiences during the three years he spent in North Africa, Sicily, Italy, and England. Capt. WV, of the merchant marine, was home recently. DV is flight radio officer of Pan-American Airlines. CBI reports that VEN has returned to California after a recent visit to Dayton. MFV
ONLY PERFORMANCE PAYS OFF!

It's no photo finish with the new HQ-129-X. This new professional-type receiver is way out in front when it comes to performance. Every feature of the HQ-129-X is the outgrowth of years of building commercial receivers.

Write for descriptive booklet — place your order with your dealer today to insure early delivery.

HQ-129-X $129
AMATEUR NET
LESS SPEAKER

WRITE TODAY FOR BOOKLET!

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT.
writes from the Arctic that he expects to be back in the fall.

Dayton WERS units Nos. 5, 8, 12, 24, and 44 are heard
regularly in Springfield. FNQ reports from Cincinnati that
the&nbsp;75 MHz 8128 transmitter was recently tested. Both 124- and 234-meter rigs were heard. First prize went to
FNQ and Fred Schaber. SDJ and Roland Zimmerman were
second. The rigs were within a 70-square-mile area and were
dommed in the near-record time of 1 hr. 6 min.

The latest QCEN pile-up was attended by a gang of eighty-
eight enthusiastic hams, 73, Carl.

WISCONSIN — SCM, Emil Felber, Jr., W9RH — UFX

A VMA is painting Camp McCoy for an emergency net and
plans to continue teaching code over the air. For
information write to Ted Kennedy, 225 Owen Dr., Madison 5,
Wis. The Four Lakes Amateur Radio Club will meet shortly
by Jan. 1st. VKC for the MRAC. The WERS gang at WMFI has been
returning to the States f,;om Saipan. ACRM ADI is at
Norway. CRE Ted Kercher, USN, K6SNW, ex-

(Continued from page 70)

ideas for improving a bit of audio on whatever the 807s put
out in case somebody wants to hear what his voice sounds
like on 75, 20, and 10. How about a line from Walpolet,
Fargo, Williston, and the rest of the State, 73, Ray.

SOUTH DAKOTA — SCM, Wayne T. Beck, W2CQD — Some of the guns are on 2 3/4 St.
Paul and several are building. The first cross-town contact
was made between MFJ and BHY. GVO puts in a nice sig-
naL from Bald Eagle and OPA is busy building some nice
gear out there and keeping a schedule with GVO meanwhile.

JNC faithfully reports to this column. KRV is with
KBBW at Hutchinson, Kans. JRT, at Eagle Mountain Lake, Tex.,
expects to be released from USMCR in the near future.

SCM, Ormond D. Beattie, W9RDX — Some of the guns are on 2 3/4 St.
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Hudson Division

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KBBW at Hutchinson, Kans. JRT, at Eagle Mountain Lake, Tex.,
expects to be released from USMCR in the near future.
Try—then compare, and you'll agree that this professional receiver is an outstanding value. It is built by craftsmen who specialize in communication equipment. The HQ-129-X has endless improvements which are fully described in an eight-page booklet . . . Write today for complete technical information.

HAMMARLUND
THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT
The proud papa of twin girls. ETS has moved to Kansas from WLH, who has big plans for the future, DJY built a ices, UFL reports that new OBS. More are wanted. KZI got some Chinese money in Scott Field.

...interested in Veterans Hospital. QEF expects JN, CWK, and HUX. 73, Pll, in the Pacilio area, has been taking the 42-lesson course in radio engineering that the Navy gives for its 2/c men, and has turned from overseas on furlough to visit ZUY, his YF. 

OZN, a Signal Corps sgt., is in Linz, Austria, with HSX. FMV has put a 40-foot pole ready to hoist, has arranged schedules with them for OBS, can be called "The Voice of South Omaha." Slit. NYU is in Europe, and purchased a 2½-meter, and other bands when available. QFI is attending State College at Manhattan, where he expects to finish his E. E. course. He worked as electronics test engineer at Boeing-Wichita until V-J Day, Another Boeing QQI is attending State College at Manhattan, where he expectations are for a ham ticket.

Army on Sept. 26th. ZPZ attended CAP camp at Ashland again. CDZ, formerly of Le Mara, Iowa, now of Omaha, made application blank for renewal. The BMS-OUD is in Nebraska, and purchased 40-foot pole ready to hoist, has arranged schedules with them for OBS, can be called "The Voice of South Omaha." Slit. NYU is in Europe, and purchased a 2½-meter, and other bands when available. QFI is attending State College at Manhattan, where he expectations are for a ham ticket.

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BLILEY has the crystals

Post VJ Day production of Bliley acid etched* crystals for FM receivers, Aircraft and Marine radios, Railroad communications equipment and many other applications is proceeding with the same skill and efficiency that marked our wartime operations.

Substantial quantities of these crystals are in the hands of foresighted manufacturers who planned in advance with Bliley engineers for frequency stabilization in their post-war models.

Now, more than ever before, you need the versatile experience of Bliley engineers and craftsmen gained through more than 15 years of quartz crystal engineering exclusively. Whether your requirements are one crystal or a million, you can be sure of top quality—top design—and top performance—in Bliley crystals.

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

Radio Engineers—write for temporary Bulletin Q-26
Daddy of them all

Introduced by Mallory in 1937, the popularity of Vibrapacks* has grown by leaps and bounds. But these "perfect power supplies" didn't spring into existence overnight.

The "daddy" of all Radio Vibrator Power Supplies or Vibrapacks was the Mallory-Elkon "B" Eliminator, manufactured and sold from 1931 to 1933. Pastime receivers designed for use with "B" batteries. Fourteen years of experience! No wonder Vibrapacks have such an enviable reputation for long life, efficiency, and low cost!

Vibrator power supplies provide the ideal source of plate power for receivers, transmitters, direction finders and countless other radio and electronic devices where commercial AC power is unavailable. When you select vibrator power supplies, select the best—Get Vibrapacks, built exclusively by P. R. Mallory and Co., Inc.

Write today or see your Authorized Mallory Distributor for a free copy of Form E-55SE, describing stock types of Vibrapacks. Inquiries are invited from manufacturers regarding special models for original equipment service.


P. R. MALLORY & CO., Inc.
INDIANAPOLIS 6 INDIANA

(Continued from page 74)

Tex. says he plans to get into ham radio after his release from the Army. JES writes that he has been released from the former forces and is looking for a job in radio or TV. According to latest reports, QHJ is headed for the Philippines. APU called by phone to ask about the prospects of getting back on the air. MN has been released from the Navy and is back with the Telephone Company. Don't forget to drop the SCM a line about reappointment and appointment as OES 73, “GO.”

EASTERN MASSACHUSETTS—SCM, Frank L. Baker, Jr., W1ALP—The following has been heard on 122-115.5 Mc. recently: MYE, SS, PI, JHA, IS, MMM, BDO, CBP, EHT, EKT, JLI, HII, JTY, EPE, KDR, MUD, AKD, LYL, HII, JCT, ALP, JNY, NOV, GDT, MUR, MAF, IB, JNZ, FWS, KED, LWT, AWA, BNR, KVO, KKD, KZD, MUI, LOW, NQA, MBB, AEM, AQA, FNR, RHU, MCR, QA, KEL, MUA, NFZ, FA, AOZ, JB, LZW, LFD, LAT, LLI, RD, MJE, KSS, NBC, KCH, MAL, DAN, NV, LBO, LMG, KGJ, MSB, FKB, MCF, DPI, CTW, IN, COX, AFE, AGR, IXL, LJT, IP, HSB, NSS, BB, JBY, MUO, MSK, JZB, FED, 2GGR, LIXX, MXX, SLLI, 61AH, 7JDZ, 8DDW, 9FXD/11DR, 9QMV, AXW, JMP, JDO, BX, KAO, GWE, ORW, EU, WS, EXR, CBW, LBD, MREM, BJF, and LFD. JFS sends in a list of hams on 2345: KER, MNK, TY, AGX, LYZ, NF, NME, IOG, KVQ, AWO, LQK, DIA, HZP, NPM, 1X0, AMT, NVR, 1XJ, LN, KB, MJ, JOY, and NEW. EHT says that the first meeting of the 56 Mc. Minutemen was held at his house with HUO, VT, IN, DA, EKT, and MJ present. A card from Lt. D. T. McKenzie, Sequin, Tex., states that he is going after his license as soon as he gets out of the Navy and is back with the Telephone Company. Don't forget to drop the SCM a line about reappointment and appointment as OES 73, "GO."

WESTERN MASSACHUSETTS—SCM, William J. Barrett, W1AJAH—The Pittfield Radio Club held its second picnic of the year on Sept. 16th, with thirty members in attendance. Among those back on the air are BK4, 12N, JLT, 1JD, LKO, KES, IRE for 2¾. The favorite spot seen to be Berry Pond and Mt. Greylock. Calls heard include 5FPC, 2MR, SWL, 1U, 1NZ, and 2KLM. Two P.R.C. members will be out of circulation: Jack Fitzpatrick has been called by phone to ask about the prospects of getting back on the air. MN has been released from the Navy and is back with the Telephone Company. Don't forget to drop the SCM a line about reappointment and appointment as OES 73, "GO."
The Raytheon type CK1012 full wave gas rectifier was developed to supply the requirements at high rectification efficiency for those applications which require more power than is obtainable with conventional receiving tubes and yet cannot justify the size and expense of transmitting type tubes. In this category are the larger fm and television receivers and small fixed or mobile transmitters.

The CK1012 is contained in an ST-14 bulb, which is the size of a type 80. The emitter can be directly heated—or, under the proper conditions noted below, ionically heated for greater efficiency and elimination of heater windings.

THE TYPE CK1012 RATINGS—FULL WAVE RECTIFIER SERVICE

<table>
<thead>
<tr>
<th>Service</th>
<th>IONICALLY HEATED*</th>
<th>DIRECTLY HEATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Voltage</td>
<td>0 1.75 volts</td>
<td>0 2.00 volts</td>
</tr>
<tr>
<td>Filament Current</td>
<td>0 2.00 amp</td>
<td>0 2.00 amp</td>
</tr>
<tr>
<td>Maximum Peak Inverse Voltage</td>
<td>1200 volts</td>
<td>1200 volts</td>
</tr>
<tr>
<td>Average D.C. Voltage Drop</td>
<td>25 volts</td>
<td>25 volts</td>
</tr>
<tr>
<td>Maximum D.C. Output Current</td>
<td>300 ma</td>
<td>300 ma</td>
</tr>
<tr>
<td>Minimum D.C. Output Current</td>
<td>70 ma</td>
<td>70 ma</td>
</tr>
<tr>
<td>Minimum Starting Peak Voltage</td>
<td>400 volts</td>
<td>400 volts</td>
</tr>
<tr>
<td>Maximum Steady State Peak Anode current per anode</td>
<td>900 ma</td>
<td>900 ma</td>
</tr>
</tbody>
</table>

*This condition is not recommended for rapid intermittent operation

The very rugged construction is ideal for mobile equipment, and the use of an inert gas allows it to operate over a wide range of ambient temperature. No preheating time is required, and consequently full output is obtainable almost instantly. Any tendency to generate noise in radio frequency applications can be minimized by proper filtering and shielding of the tube and associated wiring.

Whether or not CK1012 fits your requirements, it is an example of the advanced engineering and painstaking manufacture found in the entire Raytheon tube line. For best results, specify Raytheon High-Fidelity Tubes for your products.
LIFE-SAVING PENICILLIN salt solution is carefully tested by battery-powered pH meters before it is placed in vials by white-clad technicians at the modern Commercial Solvents Corporation plant. Throughout the entire manufacturing process, rigid pH checks against excess acidity and alkalinity must be maintained while the penicillin is in solution.

FOUR pH METERS, powered by Burgess Industrial Batteries, are employed by Commercial Solvents Corporation on a 24-hour a day basis to assure necessary, uniform product control. Burgess Industrial Batteries are built to meet specific requirements of test and control instruments. Whatever your portable power problem may be, Burgess engineers are equipped to find the answer. Write us today about your needs, or request free, 80-page Engineering Manual on characteristics of dry batteries. Dept. Q-7, Burgess Battery Company, Freeport, Illinois.

PORTABLE POWER PROBLEMS

THIS MONTH—COMMERCIAL SOLVENTS CORP. PENICILLIN TEST

(Continued on page 79)

MONTANA—SCM, Rex Roberts, W7CPY—The Butte Amateur Radio Club held its annual picnic at Basin on Aug. 5th and a good time was had by all. There were thirty-five in attendance with EQM and GNJ and their families camping on the spot the night before. The club has purchased a 300-watt, 110-volt a.c. generator for future portable work. AW, of Custer, was in Glendive recently. The WERS organization in Great Falls still is intact as there are so few licensed amateurs there at present it was felt that a good workable net under regular operation could not be organized at this time. The regular Glacier Park hamfest was held on the west side of the park on July 14th-15th.

OREGON—SCM, Carl Austin, W7GNJ—HAL burned out his 112-Mc. power supply trying to get going, but mentions that FHJ, FKJ, CYT, DDG, BNW, GAN, and CAU/4T/7, the latter two being mobile, are on. E76IC is at the Fiji Islands, New Guinea, and now is on Luzon. The SCM will furnish his address to those who wish to write him. ALJ, who is about 10 degrees from the equator, has a pair of 813s in h.f. final which he hopes to use soon. K6CIB is electrician at Chemawa Indian School, and is applying for a W7 call. GIP is back home dusting off the rig, after many months in Sitka and the Aleutians. He worked with many calls in Sitka, and is now an ensign; AQO is back in London superintending aircraft radio servicing; ILQ, the club station, is ready to go on 7 and 3.5 Mc. The Eugene Vocational School is to have a 250-watt f.m. b.c. station, and Roger will be chief engineer. ALY, who was radio operator on a 4-motored transport in nearly all operations from Port Moresby to Leyte, reported in person recently. AR2Z has finally un-
Fulfilling the Tradition of Collins Quality Leadership

The 21A is a thoroughly developed 5 kw AM broadcast transmitter, and an excellent example of characteristically superior Collins engineering and construction.

Based on sound, well-proved principles of design, the 21A has been completely modernized within recent months. New components of improved design, with longer life and higher safety factors than were previously available, assure reliable continuous operation.

The response curve is flat, within ± ½ db. from 30 to 10,000 cycles. Reduced power to 1 kw is obtained by instantaneous lowering of plate voltages, permitting uninterrupted program transmission.

We will be glad to send you detailed information regarding the 21A, other Collins transmitters, the 12Y remote amplifier, the 12Z four channel remote amplifier and Collins high quality studio equipment. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

FOR BROADCASTING QUALITY, IT'S... 
Collins equipment is sold in Canada by Collins-Fisher, Ltd., Montreal.

The Collins 12Y Remote Amplifier

A one channel remote amplifier for unattended operation from a 115 volt a.c. power source, the 12Y provides the advantages of quick set-up, small size, light weight, high fidelity, simple operation, utmost reliability and low cost. It is practically hum free due to the removal of the isolation transformer, which is in the power cable.
The best of all that's new in home radios

Yes, there will be F-M and A-M Delco home radios... combinations, too... styled to win the eye and engineered to delight the ear...
in console models, table models and portables that cover the range of customer demand. Delco home radios and Delco auto radios will offer the best of all that's new... backed by Delco Radio's long experience in radio building and merchandising... distinguished by the combination of engineering vision and manufacturing precision that made Delco Radio a major supplier of radio and electronic equipment for the armed forces.

ENGINEERING VISION — MANUFACTURING PRECISION

Delco Radio
DIVISION OF
GENERAL MOTORS

BUY VICTORY BONDS FOR A LASTING PEACE
If your new equipment designs include v-h-f, instant-heating, miniature, or medium-power tubes, these abbreviated characteristics will interest you. More complete data are yours for the asking in the new Hytron catalogue. Write for it today.

<table>
<thead>
<tr>
<th>Type</th>
<th>Filament Ratings</th>
<th>Max. Plate Volts</th>
<th>Max. Plate Amps.</th>
<th>Max. Plate Mc.</th>
<th>Description</th>
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<td>3A5</td>
<td>1.4 0.22 Oxide</td>
<td>150</td>
<td>30</td>
<td>275</td>
<td>Low</td>
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<td>6J5GTX</td>
<td>6.3 0.3 Cath.</td>
<td>330</td>
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<td>107</td>
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<td>TRIODES</td>
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<tr>
<th>Type</th>
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<th>Peak Plate D.C.</th>
<th>Peak Plate Voltage</th>
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<td>250 5000</td>
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<td>1000</td>
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<td>1616</td>
<td>2.5 5.0 Voc.</td>
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<td>40</td>
<td>3.5</td>
<td>185</td>
</tr>
</tbody>
</table>

*Both sections of twin triode. #Discontinued; 26Z5 superseded and replaces. tCurrent for full wave.

NOTE: Not recommended for C.W. Consult Hytron Commercial Engineering Dept. for data.
After at your IRC direct to Dept. Na. new Service 82

efficient, precision engineered veterans are credit, IRC's NEW TYPE BTS TORS have a proven record of unquestioned dependability. The exact counterparts of these efficient, precision engineered veterans are now available from your IRC Distributor for use in your new rigs. Only 13/31" long and no bigger 'round than a bump on a wire, this mighty mite has excellent electrical characteristics. Rates a full half watt at 40° C. ambient...350 volts maximum continuous voltage. Power rise at rated load is but 45° C.

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IRC makes more types of resistance units, in more shapes, for more applications, than any other manufacturer in the world.

(Continued from page 78)
wrapped his 125-watt 'phone rig and is frequently seen zipping at the top of a 110-foot line tree in his back yard, IM, back from the Aleutians, called on GNJ/HHH recently. He is teaching radio and teletype in Seattle, 73, Carl.

WASHINGTON—SCM, O. U. Tatro, W7FWID—KFIQ has arranged to return all equipment to its owners Nov. 15th and the City of Olympia will be advised that most of the equipment with personnel will be available for emergency through the local radio amateur of the ORC with such other equipment as will be authorized by the FCC, GBH, KFKEY radio aide, successfully contacted EOP at Angle Lake from Devil Mt., a distance of about 65 miles. The YARC trying to decide whether their 3½-meter gear should be f.m. or a.m. This may be decided at the first postwar club meeting, to be held at CAM's house. Old-timers will have to be careful that clique does not chill the new-comer, reports IICE, EC, 9VUL writes that he soon will be out of the Air Corps as assistant communications technical inspector and will settle in Seattle. RT was in Seattle on leave from the Aleutian Islands, where he was running an ACS Station handling over 1000 messages a day, and will report to a station in Missouri. HAD, in the Navy since the beginning of the war, is the proud papa of a 6-lb. 4-oz. girl. He is now at Corpus Christi, where GVK was for a while, and says he is all set for 21 Mc. HIM is fixing radios aboard a small harbor craft at Okinawa. IAY is back in Tacoma from overseas. IVE reports that EJX will return to Tacoma after a stay in Wyoming. 6SHV is at Fort Lewis and is trying to get on 2½ with an H775. FCD, with his past five years as flight test engineer, says his 8-lb. YL was born July 28th. He is building an oscillator for 2½. IVK says 112 Mc. is tougher than the Police 128. GPZM is with Tacoma police radio. EOP is at Elmira as railway station agent and servicing radios. EHQ demonstrated the new patented "Mann & Sherry" circ. 9YCG is 2nd radio operator and GYK is deck engineer, A. lieutenant, who signs himself O.I.E.O.M., on which 9YCG is 2nd radio operator and GYK is deck engineer. A lieutenant, who signs himself O.I.E.O.M.,
McELROY Tape Pulling Head TPH-400

With an original arrangement that stops the re-wind when the tape pressure wheel is raised. Another novel arrangement admits the tape from any angle from the right which makes for smoother flow, prevents breakage, and permits the tape to come from any level on the receiving table. $45.00.

McELROY Keying Head HED-400

Complete with built-in polarized relay. An ingenious McElroy design places the studs that pull the transmitting tape on the feed drum, not on the Star Wheel in the contact case. The absence of a Star Wheel opening in the contact case assures clean contacts and less headaches for you. $240.00.

McELROY Ink Recorder REC-400

Although smaller and lighter than previous models, it is capable of speeds up to 700 words per minute. The tape holder, which is part of the equipment, may be attached to either the right or back of the case. Operates from either AC or DC by snapping a toggle. $195.00.

McElroy engineers never copy, never imitate. We create, design, build ... we are never satisfied with mediocrity. And we deliver.
### HENRY RADIO is delivering RECEIVERS

We are delivering the following models:

<table>
<thead>
<tr>
<th>Model Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>National NC-240-C, less speaker</td>
<td>225.00</td>
</tr>
<tr>
<td>National One-Ten</td>
<td>56.10</td>
</tr>
<tr>
<td>National HR-6 Sr.</td>
<td>197.70</td>
</tr>
<tr>
<td>Hammarlund HQ-129X, less speaker</td>
<td>129.00</td>
</tr>
<tr>
<td>Hammarlund Super Pro with speaker</td>
<td>318.00</td>
</tr>
<tr>
<td>Hallicrafters EC-1A</td>
<td>29.50</td>
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<tr>
<td>Hallicrafters 520R</td>
<td>60.00</td>
</tr>
<tr>
<td>Hallicrafters 522R</td>
<td>74.50</td>
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<tr>
<td>Hallicrafters 539</td>
<td>110.00</td>
</tr>
<tr>
<td>Hallicrafters SX-25</td>
<td>94.50</td>
</tr>
<tr>
<td>Hallicrafters SX-28A</td>
<td>223.00</td>
</tr>
<tr>
<td>Hallicrafters 536A</td>
<td>415.00</td>
</tr>
<tr>
<td>RME-45 with Xtol, 6 Meter speaker</td>
<td>166.00</td>
</tr>
</tbody>
</table>

Mail, phone, or wire your order. Demand will exceed supply for a few months. Reserve your receiver early. No priority required. No restrictions. You can send $5.00 and pay balance C.O.D. You can trade in your receiver. You can buy on terms. Write for full information. Tell us your wishes. We will help you get the best receiver for your use and will see that you are 100% satisfied. We also have a complete stock of amateur parts, transmitters, etc. Send to us for any amateur apparatus in any catalog or advertisement at the lowest prices shown. Your inquiries welcomed.

### HENRY RADIO

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(Continued from page 88)
GENERAL ELECTRIC offers you the GL-872-A/872 and GL-8008 (identical in design, but with different bases) as low to medium-power rectifier types with an unusually wide range of applications. Here are some typical uses:

- To rectify plate power for the low and intermediate stages of large transmitters.
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- To convert power from a-c to d-c for small industrial equipment, such as electrical testing apparatus, diathermy units, fractional hp motors, etc.

Ratings at the right are conservative. The mercury vapor in the tube assures (1) the ability to pass high peak currents, and (2) a low internal voltage drop. These qualities spell long service-life and exceptional efficiency.

Your equipment will use Type GL-872-A/872 or Type GL-8008, depending on your basing requirements. For further data see your nearest G-E Office or distributor, or write to Electronics Dept., General Electric Company, Schenectady 5, New York.

CHARACTERISTICS of Types GL-872-A/872 and GL-8008

Half-wave, mercury-vapor rectifier tubes, 2-electrode type, with filamentary cathode. Convection-cooled. Cathode voltage and current are 5 v and 7.5 amp; typical heating time is 30 seconds. Approximate tube voltage drop is 10 v. Maximum anode ratings are: peak inverse voltage 10,000 v, instantaneous current 5 amp, average current 1.25 amp.

Type GL-872-A/872, with 4-pin jumbo base, is adapted to much existing equipment which calls for this type of base. The heavy-duty base of Type GL-8008, giving greater pin-contact area, will be found preferable for newer rectifier installations.
With Government regulations eliminated, HARVEY can now fill your needs for radio, electronic, test and laboratory equipment more quickly and efficiently from the finest and largest stocks in our history. HARVEY carries the lines of leading American radio and electronic manufacturers. Their long-promised postwar stock is now available.

These cabinets are rigidly constructed of 1/16" cold rolled steel, with all parts electrically welded. The two sturdy handles are mounted on each side and provide ample ventilation through sides up to 13" x 17". Price $4.95

HEAVY DUTY DESK PANEL CABINETS

8¾'' high x 19'' long x 14⅝'' deep

Ideal for small transformers, public address amplifiers, oscilators, test equipment, etc.

These cabinets are rigidly constructed of 1/16" cold rolled steel, with all parts electrically welded. Louvers provide ample ventilation through sides and back. Top door is mounted with piano type hinges and locks with flush mounted snap catches. Two sturdy handles are mounted on each side and semi-recessed. Black ripple finish. Suitable for standard 8½'' x 13'' relay rack panel or any size chassis up to 13'' x 17''. Price $4.95

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SPECIAL BUY!
We weren’t satisfied to test our hermetically sealed instruments for temperature, humidity and salt spray individually—we went whole hog and combined the three conditions in a beaker of boiling brine. This test, which really exacts more from an instrument than is normally necessary, was conducted for two weeks without failure or permanent error in excess of 1%. The maximum zero shift was .75%, the current sensitivity plus .5%—and the instrument showed no moisture penetration and no leaks as was evidenced by further production vacuum checking.

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Marion Glass-to-Metal Truly Hermetically Sealed
2½” and 3½” Electrical Indicating Instruments
TINY GIANT WITH A HISTORY

Long before the war, the men who design your Bell Telephone System were looking for an electron tube with frequency capabilities never before attained. With it, they could transmit wide bands of telephone messages—hundreds of them simultaneously through coaxial cable—economically, and over long distances.

They developed a tube which set a new standard in broad-band, high-frequency amplification. So minute that its electrode system had to be inspected under a magnifying glass, the tube could amplify either the voices of 480 people talking at the same time, or the patterns of television. Long-distance, broad-band transmission became a commercial reality.

When war came, this tube excelled all others as an amplifier in certain military equipment. It then grew into the 6AK5, one of the great little tubes of the war. Besides producing 6AK5's in large quantities, the Western Electric responded to emergency needs of the Army and Navy by furnishing design specifications and production techniques to other manufacturers, of whom at least five reached quantity production. On every battlefront it helped our ships and planes to bring in radio signals.

Developing electron tubes of revolutionary design has been the steady job of Bell Laboratories scientists ever since they devised the first practical telephone amplifier over thirty years ago. Now tubes like the 6AK5 will help speed the living pictures of television, as well as hundreds of telephone conversations simultaneously over coaxial highways of the Bell System.
They use it effectively, too, these men and women who make up Meissner’s *precision-el*, for many of them have sons, brothers and loved ones on the battle fronts. The photographs on this page show a few of these precisioneers who fight on the home front with precision and electronic skill as their weapons.

**He’s a veteran** back from active service in the Pacific, but he’s still fighting—this time on the home front with the men and women of Meissner. The traditions of precision quality he’s learning here will be a weapon he can use after peace.

**Precision is a family affair** at Meissner. Here a letter from the front lines affects two families, and you can see that it’s good news that will be reflected in the quality of their work when their rest period is over.

**He splits thousandths of an inch** as he does his war job. The “know how” that he and hundreds of Meissner *precision-el* have acquired is one more reason why you will be able to depend on Meissner quality after V-Day.

**On the way to battle** are these cartons of electronic war equipment. He sends them off with a smile, for he knows that the work of Meissner’s *precision-el* will help bring his family together again soon.

**“Step Up” Old Receivers!**

These Meissner Ferrocart I. F. input and output transformers are getting top results in stepping up performance of old worn receivers. Special powdered iron core permits higher “Q” with a resultant increase in selectivity and gain, now available for frequency range 127-206. Ask for numbers 16-5728 input, 16-5730 output. List $2.20 each.

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The call of my station is...

The class of my operator’s license is...

I belong to the following radio societies...

Send my Certificate of Membership [] or Membership Card [] (indicate which) to the address below:

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A bona fide interest in amateur radio is the only essential requirement but full voting membership is granted only to licensed radio amateurs of the United States and Canada. Therefore, if you have a license, please be sure to indicate it above.

*The dues are $2.50 per year in the United States and Possessions. All other countries $3.00 per year.

SOUTHEASTERN DIVISION

ALABAMA — SCM, Lawrence J. Smyth, W4GBV— 1100 Hickory Dr., ex-5DRZ, writes that he sits at the radio in Birmingham, waiting for someone to come through on the ham band. HD4, in radio at Corpus Christi, says that DEW also is there. GOX writes from Frankfort that he is working with some high-power stuff, 60 kw. DOS, former SCM, writes that he is on 214 meters with an HY75 molested by an AJ. EOX is there with him. The first guy worked was DRZ/3 and the second was FGU/3. About 40 stations are active there. DOS gives a list of 4s in the electronics division of the Bureau of Ships: AEL, CRP, CYU, ERB, ERK, IDZ, IDB, and IDN. HD4, in Moscow, and HD2, in Naples, are in the American Radio Relay League. HD4 works at Eastern Air Lines there. AUP hopes someone near becomes interested in 214 meters. 73, Vic.

EASTERN FLORIDA — SCM, Robert B. Murphy, W4IF — Our Director, ASR, paid the Miami district a visit recently. We called an "open" meeting of the Dade County Radio Club at which he, as guest speaker of the evening, supplied us with details on what ARRL is doing for the amateur and gave us the low-down on 214 meters. There were sixty to seventy present. SSI, Director of the Delta Division, was a surprise guest. On Sept. 15th and 16th came the opening up of the 2½-meter Hurricane Red Cross net. This net did an excellent job under the able direction of BYF, 1MCP, a m/sgt. at Ft. Myers, and 1MIR, President of the South Florida Radio Club. The following hams now in Miami: 1MIR is an RTIC and comes from No. Haven, Me.; HLD, ex-1L1K, now is a married man. Al Rioux, a member of PAA A & O Flight, was a very active member of the Tall River Radio Club. HLD lives in Lake Worth, and IAC, 1M1X, is there with him. The first guy worked was DRZ/3 and the second was FGU/3. About 40 stations are active there. DOS gives a list of 4s in the electronics division of the Bureau of Ships: AEL, CRP, CYU, ERB, ERK, IDZ, IDB, and IDN. HD4, in Moscow, and HD2, in Naples, are in the American Radio Relay League. HD4 works at Eastern Air Lines there. AUP hopes someone near becomes interested in 214 meters. 73, Vic.

WESTERN FLORIDA — SCM, L.A. Edward J. Collins, W4MS — JV is working on the big rig and looking over the 112-Mc. gear. UW is busy with WCOA and police radio as well as the rig. VR is rebuilding the big rig in the final. QQ is rebuilding the big rig with T-55s in the final. BBQ has taken down the four-element Yaesu and is rebuilding it. DXZ has some "aerons" and is getting ready to break up about 112. DXQ will be our best local DX when he gets perking on 214 as he lives approximately ten miles out of town. AXP is building a power supply for his transceiver and should be active on 112.

(Continued from page 89)
ALL AMATEUR TRANSMITTER CONTEST

Inaugurated by Taylor Tubes

WIN YOUR "DREAM TRANSMITTER" PLUS EXTRA VICTORY BONDS WITH YOUR IDEA OF THE "IDEAL HAM TRANSMITTER"

Here Are the Highlights of the Contest

Entries must be postmarked on or before February 15, 1946—the official contest closing date. Transmitter design in either of two power classes may be entered. Class 1—input power to the final transmitter stage up to 250 watts. Class 2—input power to the final transmitter stage of from 251 to 1000 watts. Contestant must submit entry blank, full schematic diagram and front panel drawing, with sufficient data necessary to build his "Dream Transmitter." Each entry must be accompanied with a 150-250 word statement by the contestant as to why he believes his transmitter design is outstanding and should win. The prize winning transmitters in each power class will be built by the engineering department of Taylor Tubes, Inc., and presented to the winning contestants as soon as practicable after all entries have been judged and the winning designs selected. The Victory Bond prizes in each power class will be presented to the winners immediately after the winning designs have been announced. See the official entry blank for complete particulars.

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Contest Judges


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(Continued from page 90)

soon. AXF is after the OM to have the 14-Mc. ‘phone rig perking in time. HJA wants to see the 112 gang working and then promises to dive all the way in. FHK is getting that FE 7-Mc. rig ready. MS has the oscillator built on the 112 transmitter and a swell receiver built by 7IQJ and 8MJJX. EQR has his transmitter perking swell on 112 and is gathering parts for a receiver. ECT has been loaned a transceiver so we should hear from him about 2 ½. JHP has been dropped in on us and wants to get on 2 ½, GRF, of the CAA, has joined from K6-land. JHP is a visitor from New Orleans. 7IQJ can’t put up the 112 antenna he wants at his QTH but will get something perking. 8MJJX says his receiver will go to 144 Mc. OOS got his 8MJJX rig swiped but the resident QRO has just spoken to commander. 7CSS was a visitor and gave us some good data on 112. IQB is here as an instructor and is planning a real nice rig. 7AQW still is around and we hope he will join us on 2 ½. LUB is here and anxious to get going again. ACB is the proud owner of a SX-28A and is getting on 2 ½. FFE is about talked into getting on 2 ½. BOW is up in W3-land and doing big things. Ex-QA was seen with a new Handbook and looks like he’ll get going soon. JIP will be a sailor and will be remembered as QU in the roaring 20s. BJF still is the spark plug in Panana City. KB wants to get on again but is busy building houses. CVF, in Alabama, says he is thinking about going on 2 ½ but hasn’t heard his QSOs yet. We recently heard what QR’s plans are for getting back on. BSJ has been reported as being in E. Fl. DMW is building a real super-duper receiver. LT. Ex-ZZAO, USN, was a visitor. Let me have your stamped envelopes for those DX QSLs. The Panama Club is 100 per cent ARRL. ACB wants to know how about a 112-Mc. relay net across Western Florida. 73.

SOUTHWESTERN DIVISION

LOS ANGELES — SCM, H. F. Wood, W6QVV — Had the pleasure of a land line call recently from LIB, who was in the South visiting his folks. He tells me that MJF, on the Fomer when she was hit, evidently is all right. PQM, now is in Panama City. LT should make himself heard as soon as the band opens. EGO is looking forward to the bands opening again. JG is another O1 who is ‘arin’ to go. GY is dusting off the rig. The gang told OZB to rebuild or they would buy him a new rig. 7MEI is about talked into getting on 2 ½. 7IQJ and 8MJJX received the Panana City gang have organized the Panana City Radio Club with GTJ as president. Two new hams are coming up in Young and McKenzie. FOX is an Army It. home on leave from Europe, AUV, of Marianas fame, now is in Panama City. 17T should make himself heard as soon as the band opens. CCA, has joined us from K6-land. HVM was a visitor from New Orleans. 7IQJ can’t put up the 112 antenna he wants at his QTH but will get something perking. 8MJJX says his receiver will go to 144 Mc. OOS got his 8MJJX rig swiped but the resident QRO has just spoken to commander. 7CSS was a visitor and gave us some good data on 112. IQB is here as an instructor and is planning a real nice rig. 7AQW still is around and we hope he will join us on 2 ½. LUB is here and anxious to get going again. ACB is the proud owner of a SX-28A and is getting on 2 ½. FFE is about talked into getting on 2 ½. BOW is up in W3-land and doing big things. Ex-QA was seen with a new Handbook and looks like he’ll get going soon. JIP will be a sailor and will be remembered as QU in the roaring 20s. BJF still is the spark plug in Panana City. KB wants to get on again but is busy building houses. CVF, in Alabama, says he is thinking about going on 2 ½ but hasn’t heard his QSOs yet. We recently heard what QR’s plans are for getting back on. BSJ has been reported as being in E. Fl. DMW is building a real super-duper receiver. LT. Ex-ZZAO, USN, was a visitor. Let me have your stamped envelopes for those DX QSLs. The Panama Club is 100 per cent ARRL. ACB wants to know how about a 112-Mc. relay net across Western Florida. 73.

(Continued on page 96)
Announcing
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NEW | TUF-20

"The Tuffy"

It's a High Frequency Triode that can "Take It and Put It Out" on Frequencies up to 1¼ Meters

FOR PORTABLE, MOBILE AND FIXED STATIONS

General Characteristics

<table>
<thead>
<tr>
<th>Fil.</th>
<th>6.3 Volts</th>
<th>2.75 Amps.</th>
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<tbody>
<tr>
<td>Plate Dissipation</td>
<td>20 Watts</td>
<td>Amplification Factor</td>
</tr>
</tbody>
</table>

Inter-electrode Capacities

| G-P 3.5MMF | G-F 1.8MMF | P-F 0.9MMF |

Overall Dimensions

3¾" high • 1½" diameter • Octal Base

Typical Operation

(Oscillator and Class C RF Amplifier)

<table>
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<tr>
<th>Plate Volts</th>
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<tr>
<td>Plate Current</td>
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<td>-60 Volts</td>
<td>-150 Volts</td>
</tr>
<tr>
<td>Grid Current</td>
<td>15MA</td>
<td>15MA</td>
</tr>
</tbody>
</table>

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Due to design characteristics and close control of manufacturing processes, Burlington instruments embody the following advantages:

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Now available for commercial and amateur radio use—light, easily handled, amazing strength, low in cost. Will withstand horizontal and vertical loads at the head as great as 10,000 pounds. In sizes from 3” to 8” diameter, heights from 12 to 125 feet, in 12 ft. sections.

Stays every 25 ft. of height are cockscrew anchored. Hinged base and erecting boom are part of installation, making it easy to raise or lower at any time.

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12 ft. sections easy to handle, positive coupling.

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FREE!
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area. Things are picking up over in the Verde Valley district. SQN reports that RLC has been home on a vacation and now has a TR-4 in his car. LJN has his 2-½-meter rig going, along with SNI. The Tucson gang still holds club meetings. Fifteen attended the last meeting, and after the meeting were served with "foam" by the 25 Club. Those attending included RNB, RMB, JHF, TXM, TJH, OXZ, SLO, GS, 9DZA, and 9QEH. Glad to report that MLL is feeling better. NRP has also been ill. REJ still is in the Philippine area. QWG is on a tanker in the Pacific area. 73, Doug.

SAN DIEGO — SCM, Ralph H. Culbertson, W6CHV — Asst. SCM, Gordon W. Brown, W6APG — Activity on the 112 to 115-Mc. band is increasing rapidly. New calls noted on the band include AA, APG, ELL, EZM, OCH, TFL, UNU, and 5QE/6. QEZ has just returned from the So. Pacific and is en route to New York. MQF, of Santa Ana, visited EOP recently and expects to be on the air shortly. Ted Thomas expects to open The Radio Shack soon and has been lucky in obtaining the services of MHL as manager. QIN has been working some very FB tests with OZII on his 112-Mc. portable mobile rig. EZM reports his 112-Mc. receiver is giving him lots of trouble. The WERS net still is operating on schedules. 2KAT, now in La Jolla, expects to have his discharge soon and plans to make his home in San Diego. ACW was married recently and his XYL is studying for her ham license. RG Y has been very ill but expects to be back at Western Radio soon and says they will have a full line of amateur equipment soon. 73, Ralph.

WEST GULF DIVISION

NORTHERN TEXAS — SCM, Jack T. Moore, W5ALA — BNQ and ISM have left Lockheed to return to their radio businesses. 3JSL, ex-9ZJB, reports that the following amateurs are stationed at Love Field with him and are interested in seeing some club activity in Dallas and Ft. Worth: EZY, 6JRK, 6MFO, 9BQV, and 9ORR. LM reports that the Temple gang are hot and bothered about the ultra-high frequencies and that AMK and GGQ each have a new SX-28A. AMK recently gave a talk on crystals before the Dallas-Ft. Worth section of IRE. LM says that GGQ is cleaning up his Fibber Magee's closet (ham shack) before trying to get the new receiver. LM is going to clean up the old rotary and paint the big mast as soon as his boy is home from the services. AHX, still in the banking business, says that GOS received his E.E. degree from Texas Tech and has been with G.E. at Bridgeport, Conn., since June 1942, and that GMC also received his E.E. degree from the same school and is an ensign in the Navy, stationed near New York City. JGX has departed from Lockheed to work for Dallas Aero Service. 9KJ has left Lockheed but will remain in Dallas. IZU is busy rebuilding his rig, which will be both phone and cw with a pair of 812s in the final working on 20, 40, and 80. Frank sends the following: KJO plans to rework his rig as well as buy a new receiver; HJJ has a good offer to stay in the Hawaiian Islands after he is discharged from the Signal Corps; FCU drops over to Tyler from Longview once in a while and IZU is burned up because ASA does not stop by to see him; EME was in Tyler recently on a Victory holiday from teaching duties at Texas U.; PH is ready to go; he rebuilt his rig in 1941 and got on the air about sundown of Dec. 7th only to have IYJ answer his first CQ and tell him that all hams were ordered off the air; IYJ would like to hear from ASA, EN, EEW, HEJ, IWR, and KHR. Bob Wagner (LSPH) has returned to Dallas after twenty-six months service at New Delhi, India, and has opened up a radio service shop. Bob has just bought an SX-25 and reports that IXD is an operator for Delta Airlines at Meecham Field in Ft. Worth. ILJ writes from Manila that he is anxious for frequency allocation news. Joe says that he enjoyed a recent visit with his old college roommate, IWE, also in Manila, and that HTH is still on Morotai doing radio repair work. PO advises that he is doing radio repair work at camp Maxey, Paris, Tex. HZB, at Hendricks Field, Sebring, Fls., is anxious to get back on the air. HZB sends the following: FRE (HZB's father) is keeping posted on his frequency standards by means of the I.R.E. proceedings. HYE has transferred to the Air Corps. AJG and JCN are working on the 112-Mc. band and report that they have put out official broadcasts. AJG is working for KRLD and reports that IQT and HMII are active on 112 Mc. and RG will soon have his pilot's license. JBD is working in Wichita Falls, ICB has checked out of Lockheed. ILF sends the following dope: ACT is building a new shack over his garage; AKZ is a

(Continued on page 98)
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The Month in Canada

QUEBEC—VE2

From L. G. Morris, VE2CO:

Bill Toomer, VE2HHS, has been working on radar as a commissioned officer with the RCAF. We note with deep regret the passing of Fred Reppetey, 2JH, who died suddenly in Toronto while watching a lacrosse game. Geoff Field, 2BO, arrived back in Canada after more than four and a half years foreign duty with the air force. Another returning is Major Reg. Varee, 2JA, who was seriously wounded overseas. Reg. was awarded the Order of the...
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<th>Model</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>SX-28A</td>
<td>Super Skyrider with crystal, less speaker</td>
<td>$223.00</td>
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<tr>
<td>S-20R</td>
<td>Sky Champion with built-in speaker</td>
<td>$50.00</td>
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<tr>
<td>S-22R</td>
<td>Skyrider Mine with built-in speaker</td>
<td>$74.50</td>
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<tr>
<td>SX-25</td>
<td>Super Defiant with crystal, less speaker</td>
<td>$94.50</td>
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<tr>
<td>S-39</td>
<td>Sky Ranger portable, AC/DC and battery</td>
<td>$110.00</td>
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<tr>
<td>SX-36</td>
<td>FM/AM receiver</td>
<td>$413.00</td>
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<tr>
<td>S-37</td>
<td>V.H.F. FM/AM receiver</td>
<td>$591.75</td>
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<tr>
<td>PM-23</td>
<td>10&quot; FM speaker in cabinet for use with SX-25, SX-28A</td>
<td>$15.00</td>
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**HAMMARLUND**

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<tr>
<th>Model</th>
<th>Description</th>
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<tr>
<td>HQ-129X (with tubes)</td>
<td></td>
<td>$129.00</td>
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<tr>
<td>ASP-210X</td>
<td></td>
<td>$118.00</td>
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<tr>
<td>ASP-210SX</td>
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<td>$118.00</td>
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<tr>
<th>Model</th>
<th>Description</th>
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<tr>
<td>NC-2-40C and speaker</td>
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**RME**

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<tr>
<td>RME-45 and speaker</td>
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<th>Working Voltage</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Wt.</th>
<th>Price</th>
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<tr>
<td>1 mfd.</td>
<td>1500 V. D.C.</td>
<td>2½</td>
<td>1½</td>
<td>1&quot;</td>
<td>4 oz.</td>
<td>.79</td>
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<tr>
<td>17½ mfd.</td>
<td>1500 V. D.C.</td>
<td>3½</td>
<td>4½</td>
<td>3½</td>
<td>3 lbs.</td>
<td>2.75</td>
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<tr>
<td>11½ mfd.</td>
<td>1500 V. D.C.</td>
<td>5</td>
<td>3½</td>
<td>2½</td>
<td>2½ lbs.</td>
<td>1.65</td>
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<td>3 mfd.</td>
<td>1500 V. D.C.</td>
<td>2½</td>
<td>2½</td>
<td>3½</td>
<td>3½ lbs.</td>
<td>1.45</td>
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<td>3 mfd.</td>
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<td>2½</td>
<td>3½</td>
<td>3½</td>
<td>6 oz.</td>
<td>.69</td>
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<tr>
<td>8 mfd.</td>
<td>2000 V. D.C.</td>
<td>4½</td>
<td>3½</td>
<td>3½</td>
<td>3 lbs.</td>
<td>4.75</td>
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<tr>
<td>20 mfd.</td>
<td>2000 V. D.C.</td>
<td>8</td>
<td>3½</td>
<td>3½</td>
<td>5 lbs.</td>
<td>5.25</td>
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<tr>
<td>Special Porcelain Insulators</td>
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<td>..................................</td>
<td>Learning the Radiotelegraph Code........</td>
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THE AMERICAN RADIO RELAY LEAGUE, Inc.
West Hartford 7, Connecticut

(Continued from page 108)

British Empire for his work on radar, Bill Punteny, 2JJ, is now a keen model airplane fan. A. McVicar, 4PH, formerly with the RAF Transport Command, is now located in Montreal. Recent visitors to the metropolis were Jack Paddon, Q2IS, and Val Sharp, 2CR. Bob Priestek, ex-2CX, returned from overseas and is now in Ottawa. Bob plans to go back to B. C. upon discharge. 2AX, 2EM and 2FK have been planning u.h.f. gear. 2BK has been demobilized and has returned to complete his studies at McGill University. Tom Walker, 2BF, is engaged to be married.

ALBERTA—VE3

From W. Butchart, VE4LQ:

VE4IX, Ted Careless, Hackett, Alta., formerly of Bymoor, Alta., visited Edmonton recently, and stayed with VE4Y, Bill Careless. An item in the Edmonton Journal recently stated that Ron Waite and VE were celebrating the birth of a jr. op. Could that be our Ron, 4MR? Possibly? Most interesting news which has come our way in the past month, came in the form of a letter from 5ADD, Stan Jones, ex-4AJH, Edmonton. It seems that he has been doing more than a little globe-trotting during the past two years or so, and I think we'd better spike that rumor that was going the rounds a few months ago to the effect that Stan was with the ECAF at NW Air Command here in Edmonton! He has actually been at sea, and at the time of writing was in the Caribbean Sea aboard a Swedish oil tanker. Stan is wireless officer aboard the tug. He has visited many ports in India, Ceylon, Persia, Australia, etc. During the fall of 1944 he was ashore in Western Australia, where he picked up his 1st Class commercial ticket, and during his stay there noted that the VK hams showed a marvelous spirit of ham hospitality. He had many contacts with the VK5s, among whom were 6NO, 6FL, 6WH, 6SA, 6AZ, 6KG, 6KR and 6JE. Apparently the VK6s were visited by many of the U. S. boys who were stationed in Australia during the war, but VE6s were few and far between.

VE4A, Roy Usher, of Edmonton, has just finished his annual holiday out Vancouver way, but this time sans car! He met quite a flock of the boys, and renewed acquaintances with the 75 meter 'phone gang. Before I go further, has anyone heard of 4AOZ, Slim MacKenzie, of Edmonton, who recently disappeared? It's about time he forwarded his new QTH so that we can tell you where he is going to hang his sky-wire for postwar activity. During the course of a chemical warfare display put on by the U. S. Army for the Reserve Army boys in Edmonton, I managed to meet up with some U. S. Signal boys, and had the pleasure of seeing the "lanards" of the handle-talkie they were using. And speaking of portable equipment, 4AH, Frank Makepeace, of Edmonton and 4VJ, Ken Angus, of Edmonton, both on the staff of CFRN, are very busy these days planning a pack set for portable remote broadcast work.

A small hamfest, complete with eats, was held at CFRN's transmitter shack recently, when 4VJ, 4AH and myself (4LQ) got together for an evening, along with Hector Hill and Larry Fead of CFRN's xmtr. staff, Mrs. Hill, and Mr. and Mrs. Angus (VJ's folks). The boys proudly displayed the new emergency rig of CFRN, which is the work of All and VJ. By the way, 4VJ had a new rig and receiver which he will be needing as soon as the VE6s are allowed back on the air. 4VJ is also taking stock of the situation, and admitted without any hesitation on his part, that he is seriously thinking of throwing a "blooper" together just to see how things sound on the short waves.

4BW, Ted Sacker, of Edmonton, having acquired a couple of good sticks was seen dragging vast quantities of ash cord home the other evening. As reported last month, Ted's enthusiasm is running high, what with a new receiver on the way, and news that the American boys are allowed on 112-Mc. now. Was talking to 4JJL, Jake Allen, R. I., of Edmonton, the other day, and he too is waxing enthusiastic about getting on the air again. Jake, by the way, informed me that 4AO, W. R. Pottle, of Regina, Supervising Radio Inspector for Saskatchewan passed away on the 28th of May last. 4AO was one of the really old timers in the radio game, having been a wireless operator aboard ship back in the old days of spark. As a ham, he has been on the air for years, and will be remembered by all the old gang in Western Canada.

I have noted the progress of 4AEN, Geo. Marion, of Edmonton, in this column from time to time, and now,
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21-11.30
21-11.25
21-11.40
21-11.45
21-11.75

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Kwikheat Iron with choice of 20, 21, 22, or 23 tips—$11.00
Set of 5 tips, consisting of 10, 12, 13, 14, and 15—$6.00

(Continued from page 108)

again, after five or six months with only a dusty letter, Geo. turns up in person, on 58 days leave from HMCS Uganda. He has travelled 75,000 miles in five months aboard the cruiser. Geo. was in on the shelling of Truk, and was within 46 miles of the Jap mainland on one patrol. He had been aboard planes diving at him (fortunately no direct hits), and altogether saw very much in a short time. Questioned as to future activity, Geo. says that he has applied for discharge, and that at the conclusion of this leave he will probably be put back on "Civilian Status" for Geo. He will lose his former job with RCA in Edmonton to return to. In the meantime, he and his XYL are enjoying his leave together, and they have taken an apartment on 115 Street, Edmonton.

When 4AE was in Vancouver scrounging around the various ham rendezvous he met 4GE, Stu Jamieson, of Drumheller, our present SCM in Alberta. Stu just doesn't write letters, and we've had a hard time localising his whereabouts, but Roy says he's a Petty Officer in the RCN and should be back in Alberta some time fairly soon. The Alberta 'phone men will recognize the call 5RV, Vancouver, owned and operated by "Dud" Mesclina. At the time of LQ's trip to the coast in September, 1939, Dud had joined up in the RCAP as radio op. Well, Dud is out of uniform again, and I presume he is back at work in the big radio store in which he was employed prior to enlistment. 4EA gave us the dope on the Vancouver boys, and incidentally, he says that 4ABA, Jack Wilson, of Vancouver, and his sister, Bessie, have been working for Boeing in that city. Bessie was laid off at the time of the cut-back, and Jack is still on the job. The two boys at 8CD, Bob Dunn and Marv Wilson, of Vancouver, are working in the Bank of Nova Scotia, and Marv, out of the Air Force since April, has entered into partnership with another chap in a magnetor sales and repair business. Gordie Badger, 4NU, of Grand synchronized us visit the other day. He has been on holidays from CFGP for a month now, and, as noted last month, was celebrating the arrival of a jr. op. Gordie visited his old side-kick, 4AKK, Bob Lamb, of Edmonton, Calgary, who is with CFGP instead of the Southern City. They made a trip to Banff together, and also out to Strathmore, where CFGP's heap is located. He says that Bob is doing a very FB job as CFGP's technician in Calgary, Geo. made the trip out from Grande Prairie by car, and has left to go back now. His XYL and the jr. op. are leaving by plane this week. The news of 4ABJ's, Art (Schults) Sherwin, of Edmonton, imminent marriage has been made public. Your writer is a personal friend of Art's sister, Bessie, have been working for Boeing in that city. Bessie was laid off at the time of the cut-back, and Jack is still on the job. The two boys at 8CD, Bob Dunn and Marv Wilson, of Vancouver, are working in the Bank of Nova Scotia, and Marv, out of the Air Force since April, has entered into partnership with another chap in a magnetor sales and repair business.

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Four-Tube Superhetrodynne

(Continued from page 80)

boys that both Ottawa and Washington are doing their best to straighten out the situation, but until such time as the ham bands are no longer required by the armed forces we shall have to bide our time, and spend it reeling our rigs and receiving for the grand opening. The meeting, which was attended by 150 hams and hope-to-be hams was presided over by President Alf. Edmonds, ARRL, who opened his remarks with a word of greeting to our ex-service boys.

Several were asked to identify themselves, these being 3AIV, 3FO, 4QA, 3MV and 3XV. They were given a splendid reception and welcome home. Sam Trainer, Jr., 3GT, of the VE Ops Ass'n., was introduced to the meeting and gave an interesting chat on the activities of the organization. He also produced a copy of Radio News of Canada, dated Dec., 1924, which contained an article concerning the origin and activities of the W.A.Q.O. in the early days of wireless. We have certainly made amazing strides since those days in the dim past. The Chairman introduced the speaker of the evening, Mr. Chas. J. Bridgland (Eng. Dept. R.E.L. Leaside), whose paper was entitled "Wave Propagation."

Frank Bowkett proposed a hearty vote of thanks to the speaker, which was enthusiastically endorsed by the meeting. An appeal for subscriptions to ARRL and QST brought forth several applications, and about 20 new members were added to the W.A.O.O. roster.

Officially from the Canadian Radio Operators Association, from their headquarters at Leaside P. O., reports that they have recently published the second issue of 

From A. W. Morley, VE4AA:

Tues Flin Flon Radio Club is in full swing again having got away to a good start early in August. Among those at the initial meeting were 4OB, 4AEQ, 5DV, Howard Beckman (call unknown), as well as several members of the services who are intending to break into the game. News was heard of 4WU who is in the USA, 4AFQ is still overseas with the RCAF. The Club express a keen desire to do a bit of experimenting on the U.F. Thanks for this news.

The future plans of the VE Ops include a headquarters station operating on all ham freq., both 'phone and c.w.

MANITOBA—VE4

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Four-Tube Superhetrodynne

(Continued from page 80)

range from 148 Mc. minus the i.f. to 149 Mc. minus the i.f. In the case of a 25 Mc. i.f., this would be 118 to 121 Mc. The tuning range is adjusted by spacing the turns of L2 and by moving the vane on the shaft. Moving the vane closer to the coil will increase the tuning range but increases the minimum frequency a trifle, and vice versa. If a calibrated 144-Mc. superregenerative receiver or transmitter is available, it can be used as a signal source and the oscillator tuning range can be adjusted without knowing the i.f.

The mixer coil and antenna coupling can be checked by listening to a weak signal (whose weakness is under your control, however), or to ignition noises, and it will be found that best sensitivity will be obtained with quite tight coupling. The mixer circuit will not tune sharply, and it is only necessary to retune it when going from one end of the 144-Mc. band to the other.
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The RADIO SHACK
167 WASHINGTON ST.
BOSTON, MASS., U.S.A.
In this field progress has been rapid and vast — along certain lines. The most spectacular u.h.f. devices are not, superficially, ones that lend themselves to amateur communication. Our problem is one of adapting the basic principles to our own purposes. For instance: Will pulse transmission and visual reception give us longer ranges than more conventional modulation and detection systems? What about pulsetime modulation? Are there possibilities of getting reliable communication beyond line-of-sight by bouncing signals off mountains, or buildings, or clouds — or airplanes? What about the effects of atmospheric refraction — will they be enough greater at, say, 1150 Mc. to make that band much more desirable than 144 Mc.? How can we make satisfactory centimeter equipment in our home workshops and thus avoid the prohibitive cost of the military-type gear?

This is only skimming the surface, of course. There are years of interesting work ahead for the experimenters among us. Here at Headquarters we've initiated a program of investigation into these and similar problems that is going to keep us as fully occupied as the proverbial hen on the hot griddle. It is going to take an enlarged technical staff, more shop and lab facilities. As this is being written we're in the midst of rearranging space, getting equipment together, and polishing off the other necessary preliminaries to going ahead at full speed. But the real job is going to take more than that — it's going to need the active cooperation of every amateur in putting these new bands of ours to work. Only when enough of us get going can we find out what they're good for. That they will be an important part of amateur radio of the future we have no doubt. That future is here, right now, and full of promise, so let's crack it! o.o.

On the Very Highs (Continued from page 59)

pects to be traveling the Great Northern Route to Rochester, Minn., in late October. He is taking portable gear with him, and hopes to work stations en route, and also at Rochester, where he is going for medical attention.

Thus we come to the end of our first postwar batch of activity reports. We also, with this issue, mark the sixth anniversary of the appearance of this column in the pages of QST. It is the last one to be prepared by your conductor in the capacity of a non-staff contributor, for, by the time this appears in print, we shall have moved to West Hartford to take a full-time job as a regular member of the Hq. staff.

If you, the v.h.f. enthusiasts of the country, have found this column of interest or value, it is principally because you have taken the trouble to write to us, telling of your activities and passing along your ideas. For your enthusiastic cooperation through the past six years, we wish to extend our heartfelt thanks. Your help will be of even more value as v.h.f. work assumes an ever-increasing importance in the postwar world of amateur radio — may we count on it?
HERE THEY ARE*

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- Working Portable
- Working Mobile

For High and Ultra-High Frequencies!—Short leads within the tubes and outside the tubes mean FLAT response in these new and interesting bands.

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Emporium, Pa.

Makers of Radio Tubes; Cathode Ray Tubes; Electronic Devices; Fluorescent Lamps, Fixtures, Wiring Devices; Electric Light Bulbs
The small cans are electrolytic condensers. The controls are in a row along the front edge of the chassis. From left to right, they are as follows: horizontal speed, vertical speed, horizontal amplitude, vertical speed, horizontal centering and vertical centering. The control for the noise limiting diode, $V_7$, is between the input and output coaxial sockets on the left edge of the chassis.

In the bottom view of the chassis, the video amplifier occupies the upper left-hand corner. The resistors and condensers for the horizontal sync control are on the card at the upper left, while those for vertical sync control are located at left center. The card in between and at right angles to the first two is for the sync separator and d.c. amplifier circuits. The card above and to the right of center mounts the components for the sweep circuits, and the card in the lower left-hand corner mounts all components for the d.c. regulator circuit. The upper socket at the right-hand edge of the chassis is for deflection power output, and the lower socket is for power output to the tuner unit.

The two potentiometers to the left of the two large paper condensers in the upper left-hand side of the chassis adjust the delay filters in the horizontal and vertical discriminator circuits. The vertical output transformer is in the lower right section of the chassis just to the right of and slightly above the d.c. filter choke mounted on the lower wall.

In the top view of the high-voltage power supply, the bottom of the socket for $V_{18}$, the high voltage rectifier tube, appears between the transformer and the two high voltage condensers. The high-voltage output terminal is in the lower left foreground. In the bottom view, the high-voltage filter condensers are at the top, above the 879 tube, $V_{18}$. Two feed-through insulators for the 879 filament are between the condensers and the transformer. On the lower edge are the on-off switch, pilot light and line cord.

(Part II of this article, covering the intermediate-frequency amplifier and detailed methods of alignment, will appear in an early issue.)

Strays

W2BCN, Bloomfield, often works W2BOV in Newark, New Jersey. W2BCN now lives in the Bloomfield QTH BOV occupied eighteen years ago, and BOV is living in BCN's old Newark QTH. Both ops sign "Joe." It's all very confusion.

W3GSL reports that he recently met HA1S, the w.k. 20-meter 'phone man, working as a civilian in Austria. HA1S said that his 1-kw. 'phone rig had been left in his Hungarian home town which had later been occupied by the Russians.

Obviously HA1S plans to return to the air — he borrowed W3GSL's Handbook!
Pocket Multi-Meter  
**SUPREME Model 542**
Compact. Volt-Ohm-Milliammeter. 24 ranges. 6° square ranges. DC Milliamperes. 0-5/0-50/0-200. AC. 0-60/0-120 VDC: 0-150/0-300. AC. 0-60/0-120. 1-50,000 ohms per volt. 5000 ohms per volt. 1-50,000 ohms per volt. Sensitivity 14.6 VDC: 0-60/0-120. Meters 0-60/0-120. AC. 0-150/0-300. AC. 0-60/0-120. $22.49

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5¼ x 4½. $7.50
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Type 707A. .Net $7.35
A low cost Crystal Microphone. Ideal for the Amateur and P.A. use. Bimorph Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case. Crystal unit is isolated from case.

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114

21-Tube Receiver
(Continued from page 37)
takes no back talk from commercial models and can give points on some features, such as in the b.f.o. and a.v.c. circuits. In a side-by-side test with a Super-Pro in perfect condition, any choice was in favor of the home-built. Even the image rejection was as good, and the tone control enabled the reception of some weak signals not readable with the Super-Pro.

In another test, a high-gain regenerative preselector was hooked up in front. The image rejection was somewhat improved on the 10-meter band, but there was no significant improvement in sensitivity. The signal strength on the meter was greater but the readability was precisely the same. The receiver sensitivity goes well into the tube-noise level and no amount of additional amplification makes any significant difference.

The receiver has every desirable feature standard to communications receivers and several additional ones not found in any other receiver. All in all, it appears to be a very satisfactory solution to the problem of high fidelity with communications performance—so much so that it appears necessary to look for some other obsession!

HAMS IN COMBAT
(Continued from page 41)
ously the damage and casualties are slight. And through all this excitement our operators have been clearing traffic. The air raids have not occasioned even an extra AS in that SCR-399's shack.

In the evening we move out again. It's late at night when we pull to a stop while our artillery pounds a German strong point. The Germans throw some shells our way, but their effort seems feeble in comparison to ours.

Tired and sleepy, we spurn the damp safety of a fox hole and pull our folding cots from the power unit trailer. We just ignore the enemy artillery fire.

In the morning we go again, this time to Stendal. There we see many German prisoners. They wear a white armband and are allowed to wander around town. They'll be gathered up later.

We hear of the death of President Roosevelt but must hear it repeated several times before we believe it.

Our troops are on the Elbe. The bend in the river makes us the U.S. troops closest to Berlin. The Germans have blown the bridges but our engineers are preparing to get us across. Our cry is "On to Berlin." In England our general told us the Fifth Armored would take Berlin and we are ready to back him up. We had felt cheated when we had swung north at the outskirts of Paris and the honor of liberating the city went to others. We were disappointed when our breach- ing of the Siegfried Line, in mid-September, could not be followed up.

We take off a couple of days for preparation.

• We clean the radio equipment and power unit.

(Continued on page 116)
Most of the operators and would-be operators who read QST will recall that Ted McElroy said in the October issue that he was going back to sea (he'd been sailing the North Atlantic during the war) — now to bring back the boys brought "over there" several years ago. I don’t believe there is much more we can tell you about the distributor business he has established. He’d hoped to be here on the job and burn up his typewriter writing letters to guys who wanted to buy Hallicrafters receivers. The gang here hopes that you fellows will still tell your friends about Hallicrafters receivers because the word of a radio operator counts with people on radio sets. We will try to pinch hit for Ted during his five or six weeks’ absence. Send us your inquiries or orders and I promise we'll get them out in good shape.

CODE COURSE

None of us here have seen the old guy work as hard in years as he did in sweating onto a typewriter everything he has learned in thirty years of operating experience. Here, for the first time in the memory of those of us who work with Ted, have we seen him pour everything he has onto a typewriter. We can’t put into words right now the full story of what this new Code Course of Ted’s will do. We won’t try. We’ll simply say that here at last is an opportunity for anyone, anywhere, regardless of age or previous experience, to become a really good operator — and fast.

JUST FOR EXAMPLE

Assuming that the average person will practice several hours the first day, we can tell you — because it has actually worked with three of our girls and four of the men at the factory — we can tell you that you’ll be copying, THAT FIRST DAY, words and sentences at the rate of 20 words per minute. The thing is that ingenious! Ted has taken one-half the alphabet which appears on his Chart No. 1, prepared a practice tape which runs for at least one full hour without attention at the rate of 20 words per minute. And by the time you reach the end of that first roll you’re copying words and sentences containing those thirteen letters at the rate of 20 wpm. You won’t copy twenty full words in one minute. But each letter you write will hit your ears at a full 20 wpm and the space between letters becomes progressively shorter as the rolls go along.

SEND FOR A SAMPLE

At no charge and with no obligation whatever (and we won’t pester you with follow-ups) we'll send you this complete course of instruction so that you can see for yourself what it’ll do. Then, if you decide to go ahead with the job and become a real good operator, AND FAST, you can send us the $25.00 down payment and we’ll send the equipment and first four rolls for first four weeks’ instruction. You then pay $10.00 per month for five months until the full price of $75.00 is reached for the complete outfit.

Frank Bascomb and the boys
We change several faltering relays in our gear. Then, after a couple of nights of good sleep, we are ready to move out again.

We are really disappointed now, as we are not to cross the Elbe. Instead we are to go back to dispose of a German task force whose mission was to cut the communications of our armies. We move out over roads we used in our forward drive. And as usual, it is drive, drive, drive! We often fill our thirsty power unit on the move. The constant battering of our whip antennas by limbs overhanging the road break some of the sections. We replace them on the run whenever we hit a clear stretch of road.

We are sent out to act as a relay station to maintain communications with the infantry. At the designated point we hunt in vain for the rendezvous, but the infantry has moved on. Who are we to defy the roaming German tanks with our radio truck? We grope around in the darkness until we locate a GI outfit and attach ourselves to it. We move away from our intended location but we handle the traffic successfully and without difficulty. At one of the other stations is T/4 Ridnoer, W9KZJ, of Knoxville, Iowa, and another Signal Company ham.

After several days' work we rejoin CCA Hqs. We now can hear the Russian voice stations on our frequencies. We can tell British and German c.w. stations from the procedure used. We don't follow the c.w. procedure used by the Russians.

We are on the Elbe again and have met the British. This is our Division's last mission in the European War. Our ride is over.

Soon we will be relieved and then wait out the official V-Day, the point system and things to come. Our radio truck and crew will return to Division Hq. Other signal company crews will also be coming in with their weary and slightly "dit-happy" operators. Many men swear they are finished with radio operations. Sure! They'll even transfer to the foot infantry. But they will soon be engaged in friendly arguments. Who handled the most messages? What net operated the best? Who was right in certain procedure? Just try and get them out of radio operations and you'll have a battle on your hands.

Out with the other units of the division there are many other operators. Some do not carry as high MOS numbers as many of the signal company operators and they have not had as much radio schooling and practice. But they greatly outnumber us. They are often overlooked, these operators from the infantry, tank artillery, tank destroyer, ordnance, engineer and medical battalions - but radio operating is not a Signal Corps monopoly. There are many fine operators in those other units. Few of the boys can use a bug or copy on a mill. They print rather than use long-hand and are slowed down accordingly. But the amateur 13 w.p.m. test won't bother them, and they have had their baptism of QRM. They do not know much of the hams' lingo, but can give many a ham a lesson on Q signals and operating procedure.
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dial control. Temperature compensation. Automatic
voltage stabilization. Adjustable series-valve-noise
limiter. Flexible crystal filter. Phonograph or high level
microphone pick-up jack. Net.......................... $225
Speaker in matching cabinet, net.. $15.00

HAMMARLUND HQ-129X
Full range .54 to 31 Mc. accurately calibrated. 4 cali­
brated Ham bands and 1 arbitrary scale. Variable selec­
tivity crystal filter. Low drift beat oscillator for code
and locating stations. Antenna compensator. Voltage
regulation. Compensated oscillator to reduce drift dur­
ing warm-up. Automatic noise limiter.
Net.......................... $129
Speaker, net.................... $10.50

Other well-known receivers such as:
- Hallicrafters SX-25... $94.50
- Hallicrafters S-20R... $60.00
- Hallicrafters S-39.... $110.00
- Hallicrafters S-36A.. $15.00
- PM23 Speaker........... $29.50
- Echophone EC-1A........ $29.50

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

ALLIED RADIO CORP., L. M. Dezettel W95FW
833 W. Jackson Blvd., Dept. 27-LL-5
Chicago 7, Illinois. Date.............................

☐ Please ship.................. Model..........................
☐ Enclosed $........... ☐ Full Payment ☐ Part Payment
(Balance C.O.D.)
☐ Send literature on Receivers and Time Payment Plan.
☐ Send Allied Catalog of Radio Parts and Equipment.
Name.................................................................
Address............................................................
City....................................................... Zone..... State..

117
Founded in 1909

RADIO TELEPHONY
RADIO TELEGRAPHY
ANNOUNCING

Courses ranging in length from 3 to 9 months. Dormitory accommodations on campus for men and women students. Advanced students eligible for practical training at KDAC, a 1500 watt broadcast station owned and operated by Port Arthur College. New students accepted each month during year. If interested, write for details.

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PORT ARTHUR
TEXAS

LEARN CODE

Improve Your Sending
G. C. Automatic "KEYER"

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TYPE "A" $25

New, Different, Efficient, Adjustable speed, silent induction type A.C. Motor. In small walnut finished case with carrying handle. Complete with 10 rolls of selected double perforated tape. A wide variety of other tapes available at 50c per roll.

If Your Dealer Can Not Supply You, Write Us

GARDINER & COMPANY
Box 54, Stratford
New Jersey, U. S. A.

Phone, Wire or Write

WHOLESALE
Radio-Electronic Parts
Tubes, Sets and Equipment

R. G. SCELII & CO.
227 Asylum St. Hartford, Conn.
Telephone 2-1144

BRANCH: 84 ELM ST., BRIDGEPORT, CONN.

Class-B Amplifiers

(Continued from page 50)

readily obtainable. Ratios of 1 to 3 and 1 to 4
are common. It is possible to effect further
economics by using a very high step-up ratio and
driving the push-pull stage with a single 6C5.
There is no necessity for by-passing the cathode
resistors in a push-pull stage since the a.c. com-
ponents flowing in this resistor are out of phase
and cancel. The plate supply should be at low
impedance to ground. If this impedance is high,
some a.c. voltage will develop across it, resulting
in a loss of power output and the possibility of
positive feed-back to some of the preceding
stages through this common power-supply
impedance.

Mitchell, "The Cathode-Follower Stage," Wireless World,
April, 1944.

Hanen, "Cathode-Follower Amplifier Design," Aus-
tralian Radio World, October, 1944.

Lee, "Recent Transformer Developments," IRE Proceed-
ings, April, 1945.

Reich, "Features of Cathode-Follower Amplifiers," Elec-
tronic Industries, July, 1945.

Smith, Radiotron Designers Handbook, Chapter Six.


Crystal Ball

(Continued from page 58)

with a "butterfly" tuner is a good answer to the
tuning problem although some tricky mechanical
arrangements still have to be solved.

In looking over the u.h.f. antenna situation it
appears nothing very alarming has developed in
print so far. The outstanding fact is that the
pencil-size antennas are going to be just plain fun
to work with. Those fancy directive arrays the
textbooks illustrate will be right down our alley.
A simple dipole with a window-screen untuned
reflector is a very neat solution to the directivity
problem and with small, light-weight antennas, a
couple of fractional horse power electric motors
will allow squirting the soup either up or down
or left or right.

The behavior of u.h.f. signs in the lower atmos-
phere defies resolution in my crystal ball but if
television signs bounce off of buildings, hills and
clouds, I wonder if we couldn’t "squirt at and
bounce off" a signal from a cloud mass on the
horizon and hop over that "line of sight" limita-
tion.

—William S. Bell, W8IIIN

RECORDING AND PLAY-BACK EQUIP-
MENT ESSENTIAL TO HAM SHACK

One of the "musts" in my postwar ham
shack will be a phonograph turntable complete
with a cutting head and play-back pickup.

Imagine a ham’s surprise when, after turning
the circuit back to me, he hears his own remarks
come back to him. Afterward, I can send him the
record if he so desires. Many hams have little
or no idea how they sound over the air. This
applies to c.w. as well as to ‘phone stations.
(Continued on page 150)
REBUILDING?

A B&W tank assembly with its exclusive double stator tuning capacitor will give your rig new efficiency. The coil assembly mounts directly on the tuning condenser. Tubes may be mounted directly behind. Plate leads will be shortened to a few inches. Built-in neutralizing condensers at the rear permit two short grid leads, thus making a far more compact, more efficient assembly than would otherwise be possible.

And don’t forget the famous B&W Air Inductors. New types! New, improved designs! Ask your distributor today!


BARKER & WILLIAMSON • 235 Fairfield Ave., Upper Darby, Pa.
EXPORT: Lindeteves, Inc. • 10 Rockefeller Plaza, New York 20, New York, U. S. A.

The New Speed·Chek Tube Tester

MORE FLEXIBLE • FAR FASTER • MORE ACCURATE

Three-position lever switching makes this sensational new model one of the most flexible and speediest of all tube testers. Its multi-purpose test circuit provides for standardized VALUE test; SHORT AND OPEN element test and TRANSCONDUCTANCE comparison test. Large 4" square RED·DOT life-time guaranteed meter.

Fast simple operation gives control of each tube element.

New SQUARE LINE series metal case 10\(\times\)10\(\times\)5½", striking two-tone hammered baked-on enamel finish. Detachable cover. Tube chart 8\(\times\)9\(\times\). Simple settings marked in large type.

Model 2413

is another member of the NEW TRIPLETT Square Line

Triplett

ELECTRICAL INSTRUMENT CO. SLUFFTON, OHIO

Additional Features

- Authoritative tests for tube value; shorts, open elements, and transconductance (mutual conductance) comparison for matching tubes.
- Flexible lever-switching gives individual control for each tube element; provides for roaming elements, dual cathode structures, multi-purpose tubes, etc.
- Linevoltageadjustment control.
- Filament Voltages, 0.75 to 110 volts, through 19 steps.
- Sockets: One only each kind required socket plus one spare.
- Distinctive appearance makes impressive counter tester.
I

Unquestionably the year's outstanding contribution to the advancement of wire and radio telegraphy. A thoroughly tested method of Steno-telegraphy arranged for use in wire and radio communication. It's definitely new, completely standard, strictly up-to-date. In addition to changes and additions to previous editions, it contains Radio Code Signals, International Morse, American Morse, Russian, Greek, Arabic, Turkish and Japanese Codes, World Time Chart, United States Time Chart, Commercial "Z" Code, Aeronautical "Q" Code. Miscellaneous Abbreviations used on international wire, submarine cable and radio telegraph circuits. An invaluable aid to every trained and student operator. Price $1.50 postpaid.

LIBERAL DISCOUNT TO DEALERS

THE VIBROPLEX CO., INC.
833 BROADWAY
NEW YORK 3, N. Y.

RF Inductors • RF Chokes • IF Transformers
Condensers • Mica Molded Condensers • Trimmer
Condensers • Miscellaneous Apparatus

The F. W. Sickles Co., Chicopee, Mass.

SICKLES
Electronic Specialties

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RADIO Technician and Radio Communications courses. Register now for new classes starting first Monday of each month. Day and Evening Classes.

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New York 23, N. Y.
Approved under GI Bill of Rights

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WHOLESALE RADIO

2608 Ross Ave. Dallas 1, Texas

Electricity
FOR RADIO AND ELECTRONIC APPLICATIONS

Onan Electric Generating Plants supply electric service for electronic applications and general use, mobile, or stationary. Driven by Onan built 4-cycle gasoline engines, they are of single-unit, compact design and sturdy construction.

Over 250,000
New In Service

D. W. ONAN & SONS
2629 Royalston Ave., Minneapolis 5 Minnesota

Another use of such equipment would be in calling CQ, using a carefully made and perfectly announced CQ record. (A short and snappy one, we hope. — Editor)

Visitors in the shack would be pleased to have a souvenir record of their voice cut while they were actually on the air at your station.

Recordings could be made of the transmission of messages received for a person not in the shack at the time. Imagine Mrs. Joe Jones' delight in receiving a record of her Joe talking from the other side of the world or the country, via ham radio!

These are but a few of the many useful and versatile jobs that recording and play-back equipment could perform in a ham shack.

— Donald A. Miller, ACRM, USN, W2MQB/K4

Technical Topics

(Continued from page 58)

too small to meet the requirement that the field at the walls must be zero. This means, simply, that the guide must be at least a half wavelength wide or the wave cannot get into the pipe. If the guide is exactly a half wavelength wide, the wave can get in but it does not go anywhere. But just as soon as the guide becomes a little more than a half wavelength wide — enough to permit an angle less than 180 degrees between the directions in which the two components of the wave travel — the wave will go through the guide. Or, to look at it from a slightly different standpoint, in a guide of given width there is a "cut-off" frequency — the frequency having a half wavelength in space equal to the width of the guide — below which the guide will not carry energy. Any frequency above the cut-off frequency will get through; the two wave components simply adjust themselves to the proper angle to position the null lines at the actual walls of the guide.

— G. G.

Strays

Last summer the Government of the USSR invited a distinguished group of American scientists to attend the 220th anniversary celebration of The Russian Academy of Sciences.

One of the group was asked to submit a number of purely American publications dealing with non-commercial activities and interests of the American people.

Although the weight of baggage allowed on the plane was strictly limited, a copy of the ARRL Handbook was taken along.

When the various publications were reviewed by the authorities of The Russian Academy of Sciences one of those chosen, for permanent inclusion as part of the library, was the ARRL Handbook.

(Continued from page 118)
ONE OF MANY APPLICATIONS

Astatic GDN Series Dynamic Microphones have many uses and applications. That's why you find them included in countless modern installations such as the airline control and dispatching office illustrated here. When mounted on Astatic's popular Grip-to-Talk Desk Stand with relay operating ON-OFF Switch for remote control of transmitters and amplifiers, as shown, Astatic Microphones are ideally suited to most types of modern communications systems.

"You'll HEAR MORE from Astatic"

THE Astatic CORPORATION
CONNEAUT, OHIO

IN CANADA, CANADIAN ASTATIC LTD., TORONTO, ONTARIO

Precision Methods Followed

BY SKILLED AND TRAINED HANDS

For precision radio communications equipment, precision manufacturing is imperative.

The equipment produced by Wilcox has reached a new standard of perfection for war-time communications and from this vast experience have come many new developments now being incorporated into post-war designs.

Many items in this expanded and improved line are now available, subject to military priorities. Your inquiries invited.

Dual Channel Audio Amplifier


WILCOX ELECTRIC COMPANY, INC.

Manufacturers of Radio Equipment
FOURTEENTH AND CHESTNUT  KANSAS CITY, MISSOURI
It is with deep regret that we record the passing of these amateurs:

W1AHD, Alfred G. White, Ashmont, Mass.
W1AMH, Harold J. Morse, Hartford, Conn.
W2NMJ, Rev. Fr. Kenneth Sullivan, Paterson, N.J.
W5HLF, D. E. Nuckols, Texarkana, Texas
W6OSV, CRE Albert A. Gajewski, San Pedro, Calif.
W8RZB, Pfc. Joseph J. Garard, Toledo, Ohio
W8TID, Wilbur J. stumpf, Bethany, W. Va.
W9VEW, William T. Merriman, Jr., Wil­lard, Mo.
W9ZD, E. B. MacDowell, Kansas City, Mo.
VE2JJ, F. Reevy, Toronto, Ontario, Canada
CMZOP, Mario de la Torre Fernandez, Habana, Cuba
ZL1LH, C. A. Hutchinson, Auckland, New Zealand

FEEDBACK

In the September issue, at the bottom of the right-hand column, page 24, the term 0.004475 should not appear under the radical. Near the bottom of the left-hand column on page 25, the expression for \( X_s \) should be

\[
X_s = \frac{B_p}{G_p^2 + B_p^2}
\]

On page 26 in the same article, left-hand column, the diagonal should not appear in the 11th line, the term being \( 2X_e \). In the expression for \( J \) which appears below the diagram in the same column, the equivalent should be inverted. In the equation for \( L \) which appears below the diagram in the same column, the figure 0.103 in the \( L_e \) column of the chart for two- and three­element arrays should be 1.03.

In the article describing the electronic key, condenser \( C_1 \) in the circuit diagram on page 45 should have a value of 0.5 \( \mu F \).

COMMERCIAL RADIO INSTITUTE

Minneapolis Training Center for 24 Years

Residents Courses Only • Pre-Induction, Broadcast, Service, Aeronautical Television, and Marine telegraphy classes now forming for mid-year term Feb. 1. Literature upon request. Veteran training.

Dept. 8, 38 West Biddle Street, Baltimore 1, Maryland
NEW, Improved VT-73
DESK MICROPHONE

A WORLD-WIDE FAVORITE WITH PROMINENT HAMS FOR QUALITY REPORTS

Stepped up in both performance and styling, the New, Improved TURNER VT-73 is engineered with a rising curvature of response between 500-4000 cycles. Produces more power at intelligible voice frequencies without over-modulation to result in crisper, cleaner signals. Designed especially for quality speech recording, P.A. and ham use. High capacity moisture-proofed crystal has output of —52DB. Range 50-7000 cycles. Finished in rich black crinkle and chrome, with ball swivel head, stand, and 7 ft. cable.

You'll want the VT-73 for your rig
ASK YOUR DEALER OR WRITE
Free Turner Catalog with complete information and prices on all TURNER Microphones. Write for your copy.

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Crystals Licensed Under Patents of the Brush Development Co.

TURNER Pioneers in the communications field Microphones

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We have been appointed a sales agent by Defense Supply Corporation of Government surplus tubes and rectifiers. All are first grade Government tested and inspected tubes—not rejects.

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VT 127A (HF Triode) 8AP4
304 T Type 8BP4
872A M. V. Rectifier 8AP1

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without strain

CHAMPIONS ENDORSE CANDLER WAY

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CANDLER SYSTEM CO.
Dept. 4-N, Box 928, Denver 1, Colorado, U.S.A.
and at 121 Kingsway, London, W.C. 2, England
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 announcement or advertisement containing capital letters be used which would tend to make the advertisement appear more prominent than others of the same nature.

(3) The $1.00 per word rate is exclusive of postage, unless noted in parenthesis (10 cents each).

(4) Remittance in full must accompany copy. No cash or advertising discounts will be allowed.

(5) Closing date for HAM-ADS is the 25th of the second month preceding publication date.

In a column devoted to advertising, no emphasis of any sort will be allowed, nor will any special typographical arrangement, such as all or part capital letters lie used which would tend to make one advertisement stand out from the others.

(1) Advertising shall pertain to radio and shall be of nature of interest to radio amateurs or experimenters in their pursuit of the art.

 Classified columns, the publishers of QST are able to vouch for their integrity or for the grade or character of the products or services advertised.

QUARTZ — Direct importers from Brazil of best quality pure quartz crystals, and also Germany and Czech quartz. A. C. Diamond Drill Carbon Co., 710 World Bldg., New York City.

COMMERCIAL, radio operators examination questions and answers. One dollar per element. G. C. Waller, W5ATV, 650 Highway 22, New Castle, Ohio.

WHY not turn your unused equipment into ready cash which may be applied towards new and better equipment after the war? W5GJQ offers you the best cash prices for communications receivers and test equipment. Write today for large illustrated catalog. Wholesale Radio Laboratories, 744 W. Broadway, New York City.

CRYSTALS available — all types, including 100 kc., 405 kc. and 100 kc. Broadcast and Aircraft given prompt attention. Superior SA components, 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.


Line to single or PG grid transformer. 1 to 10 or 20 turns ratio, Small, shielded, BC quality — $1.00 each. Also 80 inch coaxial cable. electrodes, cathodes, sulfurs, Iowa.

When amateurs are on the air again there will be a complete line of James Knight Precision Crystals for every amateur activity. The James Knights Company, Sandwich, Ill.

Amateur radio license. Complete code or theory preparation for passing amateur radio examinations. Home study and resident courses. American Radio Institute, 101 West 63rd Street, New York City.

Complete radio kits $10.95. Multisetter kits, surplus navy receiving, transmitting, and tubes. Offers details. Radio, 120 Cedar Street, New York 6, N. Y.

Faberradio crystals are now available. Write for prices. Faberadio, Witherspoon, Ill.

Amateur and radio servicemen's supplies, Albert Arnold, W5WX, 111 East 8th St., Amarillo, Texas.

QSLs, order now before rush! Fritz, 1218 Bridgelet, Joliette, Ill.

Write, wire or phone: Bob Henry, W5ARA, Butler, Mo., 24 hour service; new and used receivers, transmitters, test equipment, radio parts of all kinds.


FOR SALE: Utah Kits 22 or 5. Ferguson, 1350 Dennison Avenue, Columbus, Ohio.


ABBOTT DK-2 and cash for MRT-3 or TR-1. Morton Barfield, 2495 Meridian St., Dresher, Pa.

For sale: QSTs; November, 1919 "Lit Off" issue and 1922 to issue. Make offer. Price, W5WHS, 506 Baldwin, Shropshire, Ind.

SWAP pair 813s, or RC-63s for receiver or what have you. Cromwell, W5GWA, P. O. Box 54, La Combe, La.

WESTINGHOUSE generators, inputs 12 v.d.c., 6 v.d.c. outputs 19 v, 400 Ma., 500 v.d.c., 400 Ma. $250.00 or equipment, W2LGT.

CRYSTALS without priority! Prompt delivery of those Eidson fine crystals. Highest quality commercial units available throughout the 100-1200 kc. range. New and reconditioned. Over ten years of satisfaction and fast service! We are as near as your telephone. "Eidson's", Temple, Texas, Phone 3501.

Signal shifter repairs and alignments. Coils, all ironless, $1.00 per pair. Order direct. Seven years experience. Rodgers & Harris, 727 Main Street, Mount Carmel, Ill.

FOR SALE: amateur net prices, new Stancor driver transformers X-4792, 15 watts multimeter, Stancor modulation transformer, X-33903, 75 watts multi-mutch; Stancor filter chokes, 15 henry at 200 ma., C-1811; Stancor plate transformer, 12C-V-1, C.B., at 400 ma., T-235; Stancor coil, 12 inch, T-19765; Johnson 200 FD20 transmitting condenser, 205uf, each section, split section, 2000 volts breakdown — $6.00; Johnson 200 f.d., 35 transmitting condenser, capacitance 202.5uf, each section, split breakdown, $7.00. Used Stancor plate transformer, T-3773, 550-550 at 500 ma., $4.00; Johnson choke 12 H. at 200 ma., $5.00; UTC ST-70 li. transformer 6.5 v. at 5 a. and 0.5 v. at 5 a. $3.00. F. Crane, 2216 South 7th St., Philadelphia, Penna.

FOR SALE: Deluxe transmitter, bandwidthitching 10, 20, 30, and 50 meters, high-fidelity phone and c.w., RCA 813 final; Gray Parzial Deluxe cabinet, 57", eight Simpson meters in National safety panel; National 2" oscilloscope panel. Spearman double deck box (10 x 16) with square box and direction indicator, synchronous motor, continuous reversible rotation, demountable tower. Be & W coils, all bands, all stages for $100.00. RCA transmitter, 813 final; Gray Parzial transmitting condenser, $4.00. Write today.

FOR SALE: Instructograph, electric motor, eight rolls practice and test equipment. All in good condition. S. Rubinstein, 250 East Gun Hill Rd., Bronx 67, N. Y.

WANTED: Instructograph, electric motor, eight rolls practice and test equipment. All in good condition. S. Rubinstein, 250 East Gun Hill Rd., Bronx 67, N. Y.


I W.C. O. Phone transmitters, preamplifier, microphone and tubes for sale or trade for Ektra Leica or Contax with accessories. B. Mitchell (ex-W5FCD), 195 Guilliver, Milton 86, Massachusetts.

SELL Sky Buddy receiver, best cash offer. Strike, W3HIF, 31 North Grant, Wayneboro, Penna.

Radio HAM, experimentals! Quartz crystal kit now available. Complete accessories. Find your crystals at home, complete with plug-in holders, processed quartz blanks, and other accessories. Experience. Inquire now to secure yours at $10.00. (When ordering professional kit, state fundamental frequencies, $4.50) Standard fundamental frequency desired). Selectronics, Inc., P. O. Box 200, Carlisle, Penna.

Spaghetti triple-dipped, $15-16, 18-20, 35 ft. 79¢; red and black resistor kit, 1 watt, 25 for 98¢; 1/2 watt, 35 for 98¢; potentiometers 2 watts, 1/4, 1/10 mega. 39¢. Neutron Electronics Co., 35 Maiden Lane, New York 7, N. Y.

FOR SALE: Complete 7-tube All-Star Senior receiver and peak pre-selector. Good condition. $25.00. Howard Sayres, 6904 North West Bay, Cagio 31, III.


FOR SALE: Meters 3" Weston 500, 100, 200, 300 mls. d.c., 1500 volts d.c. Jewell 5 amp. r.f.; 12-v. d.c.; Triplet 10, 150 volt, 0.6 amp. d.c. $3.00 per each HK5, 220 µµf., $82; 20THV coil. R. Brandt, Star 1, Red Bank, N. J.
A real communications receiver at a sensationally low price

MODEL EC-1A
ECHOPHONE COMMERCIAL

The 1946 Echophone, Model EC-1A, is a 6-tube AC/DC communications receiver of outstanding value. With electrical bandspread throughout its frequency range of .55 to 30 megacycles, BFO for CW reception, and a new automatic noise limiter to suppress interference from automobile ignition, etc., the EC-1A provides genuine communications receiver performance in the lowest price range. Standard 115-volt AC or DC operation; also available for 220 to 250-volt operation.

SPECIFICATIONS

TUBE LINEUP: 1—12SA7 Mixer; 1—12SK7 I.F. Amplifier; 1—12SQ7 Second Detector, First Audio Amplifier and AV/C; 1—35L6GT Second Audio Amplifier; 1—12SQ7 Beat Frequency Oscillator and Automatic Noise Limiter; 1—35Z5GT Rectifier.

CONTROLS: TUNING, BAND SPREAD, VOLUME, BAND SELECTOR, CW/AM, NOISE LIMITER, PHONES/SPEAKER, STAND BY. (BFO pitch adjustment conveniently located on rear of chassis.)

EXTERNAL CONNECTIONS: (On rear of chassis.) Power line cord, phone tip jacks, antenna (doublet or single wire and ground).

PHYSICAL CHARACTERISTICS: The EC-1A is housed in a metal cabinet attractively finished in machine tool gray wrinkle lacquer. The cadmium plated steel chassis is substantially constructed. The PM dynamic speaker is mounted in the top of the cabinet and is protected by special sound projecting louvers instead of the ordinary grill.


FEATURES

1. Frequency coverage, .55 to 30 mc, complete in three bands.
2. Electrical bandspread on all bands with dial indicator.
3. Dial calibrated in megacycles with all important service bands identified.
4. Beat frequency oscillator for CW reception.
5. Automatic noise limiter.
7. Headphones or speaker selected by panel switch, headphones completely isolated by means of phone circuit transformer.
8. AC/DC operation 115 volts or 220 to 250 volts available with external line cord.
9. Good selectivity combined with exceptional sensitivity.
10. Modern 6-tube superheterodyne circuit.

ECHOPHONE
ECHOPHONE DIVISION • THE HALLICRAFTERS CO.
2611 INDIANA AVE., CHICAGO 16, U. S. A.
125
Another item in the Millen line of "Designed for Application" components. Bezel of cast aluminum with black wrinkle finish. Complete with neoprene cushion, green lucite filter scale and four "behind the panel" thumb screws for quick detachment from panel when inserting tube. Mounts in 5" diameter panel hole.

THE NO. 80075 BEZEL FOR 5" CATHODE RAY TUBE

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MALDEN
MASSACHUSETTS

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CONCORD, N. H.
Regardless of the proposed changes in postwar call areas, you'll call for RME communications equipment when planning your new station.

While producing for war—RME and its staff of engineers developed gear that will best serve the amateur or commercial operator during postwar.

Take the new RME 45, for example. It delivers peak performance on ALL frequencies—500 to 33,000 KC. The new VHF-152 is another illustration. To make VHF operation really practical when amateur activity is resumed, the new VHF-152 Converter was designed to fill this need.

Just as RME was the first to introduce an R meter in a receiver, so it has continued to pioneer with the finest first!

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**VHF-152 CONVERTER**

For VHF operation on 28 to 30 MC, 50 to 54 MC, and the new 144 to 148 MC band. At modest cost, the VHF-152 far exceeds any present day method for working these frequencies, through the double detection method.

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HX-100 Socket List Price, $3.30.

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MORE BANDS!
U.S.A. and Canada on November 15th Open
10 and 5-Meter Bands and Four Microwave
Bands; 2½ Shifted; International DX Restored

JUST as this issue of QST is ready for the bindery, and with barely time enough for
us to slip in this extra sheet, the Federal Communications Commission for the
United States and the Department of Transport for Canada on November 9th
have simultaneously announced important actions restoring amateur radio on fre­
quencies above 28 Mc. The actions are effective at 3 A.M., E.S.T., on November 15th.
The FCC action is covered by its Order 130 and replaces the temporary author­
ization of last August under which we operated until Nov. 15th. While it is expected
that by early December FCC will be able to set up the machinery to issue new station
licenses (and begin the renewal and modification of old ones), such facilities are not
yet available. The only action possible at the moment is therefore to continue a
temporary authorization to those of us already licensed. Station licenses that were
valid at any time between Dec. 7, 1941, and Sept. 15, 1942, are validated for another
six months — until 3 A.M., E.S.T., May 15th. (During that time there will be FCC
instructions on how to apply for renewals.) Such stations are then authorized to
operate on a newly-stated group of frequency bands. The action applies to all areas
under FCC jurisdiction except the central, southern and western Pacific areas.
Unfortunately, at the time of releasing the order military clearance had not been
completed for Hawaii and the U.S. island possessions in the Pacific, and they are
excluded. (The prohibition is but temporary and it is possible that it will be lifted
even before Nov. 15th. K6 amateurs should keep themselves informed by listening
to W1AW's broadcasts. Here are our new frequency bands after Nov. 15th:

TEN METERS
The postwar band 28–29.7 Mc. is opened in its entirety to c.w. The portion 28.1
to 29.5 is available for a.m. 'phone (A-3), while f.m. 'phone may use from 28.95 to
29.7 Mc. The 'phone figures are reportedly derived from some FCC postwar planning
and do not represent ARRL suggestions. It is needless to say that 'phone stations
should observe them carefully.

FIVE METERS
We open up temporarily on our old band: 56–60 Mc. is available for c.w., i.c.w.,
a.m. 'phone and facsimile, and 58.5 to 60 Mc. for f.m. 'phone, precisely as before the
war — until March 1st. At that time, subject to further FCC order, television is to
vacate our new band 50–54 Mc. and it will be assigned to us in lieu of 56–60.

TWO AND A HALF SHIFTED
The new band 144–148 Mc. now takes the place of 112–115.5 and no operation
on the latter is now permitted. The new band is available for c.w., i.c.w., 'phone and
fax, and also for f.m. 'phone and f.m. telegraphy. But in some areas part of the band
is still in use for military control circuits, with the result that amateurs within 50
miles airline of Washington, D. C., and Seattle, Wash., are denied the use of 146.5
to 148 Mc. For them the band is temporarily only 144–146.5 Mc. (It is probable that,
when K6 is reactivated, the same thing will be true within 50 miles of Honolulu.)
Let all hands take careful note of these figures and, where indicated, keep clear of
the military portion. Full bandwidth is to be expected in these areas in a few months.

MICROWAVES
We do not yet get our assignments at 220–225, 420–450 and 1145–1245 Mc. They
are temporarily held up because of some conflicts but further news is to be expected
in a few weeks. We do get the remaining four microwave bands,
and they are open to all imaginable types of transmission except pulse, i.e., c.w., i.c.w., a.m. 'phone, fax, television, f.m. 'phone and f.m. telegraphy.

**WAR RESTRICTIONS REPEALED**

The Commission then canceled a handful of its temporary wartime restrictions of unhappy memory. Gone now are Order 72 and its amendments, which prohibited communication with foreign countries, and Order 73 and its amendments, which forbade portable and mobile operation below 56 Mc. Also off the books are Orders 87 and 87-A, which closed us down and took away our frequencies, and Order 87-B which instructed that no further station licenses be issued or modified. The way is thoroughly cleared. We may work foreign DX if we can find it on ten, and we may work v.h.f., u.h.f. and s.h.f. with Canada and Mexico. Huzzah and hooray!

**CANADIAN ANNOUNCEMENT**

The restoration of Canadian amateurs was accomplished by a press statement by the Honorable C. D. Howe, Minister of Reconstruction, who announced that the seven bands of frequencies above enumerated would be placed at the disposal of Canadian amateur radio effective Nov. 15th. Only the over-all band figures were mentioned, with no stipulation of subdivision by types of emission. The band 56-60 was only allocated temporarily, he said, and would be replaced in approximately six months’ time by 50-54 Mc.

“At the outbreak of war, an order was issued suspending the operation of all Canadian amateur radio stations,” the Minister said. “This order has now been rescinded and, effective November 15, 1945, all amateur experimental station licenses which were in force immediately prior to the war are reinstated and will be effective until March 31st next. It is essential, however, that all who hold a 1939 Amateur Experimental Station License must first obtain permission from the nearest Government Radio Inspector before going on the air. Radio Inspectors have likewise been instructed to furnish full information to prospective amateurs.”

The Minister stated that every effort was being made by Canada and the United States to clear other frequency bands for radio operations, particularly the 3.5-4, the 7-7.3, and the 14-14.4 Mc. bands. Announcement would be made at the earliest possible date as to final postwar frequency allocations to amateur stations but in the meantime it was essential that amateur radio operators confine their activities to the frequencies now released.

There were approximately 4,000 Canadian amateur radio operators at the outbreak of the war and the Honorable Mr. Howe paid tribute to the manner in which they had foregone their interesting hobby, in conforming with the governmental order, so as to enable these frequency bands being utilized by the armed forces or other essential war services. “Canadian amateur radio operators have contributed materially to this country’s war effort,” he said. “Most of our amateurs were young men and they responded enthusiastically to the call of their country, especially during the early stages of the war when the Armed Services urgently needed large numbers of radio operators.

“They served at sea with the Royal Canadian Navy and the Canadian Merchant Navy. They served with the Army, the Royal Canadian Air Force and the Government radio services. They also provided the essential instructor personnel for the training of Canadian and Empire airmen under the British Commonwealth Air Training Plan. Many have paid the supreme sacrifice. Several have won high honors for gallantry on the field and a few have risen to the higher executive brackets in the Armed Services. We have just cause to be proud of our amateur radio operators.”

And so, fellows, we take another major step toward restoration. There will be further developments at short intervals. Make it a habit to listen for W1AW, which will always give you the newest news on these matters — Mondays through Fridays at 8, 9 and 10 p.m., E.S.T., on 3555, 7145 and 14280 kc., by special authority of FCC and the special cooperation of the armed forces. Meanwhile, may you find juicy DX on 10 meters, nice bending on 5, and lots of fun with your microwave ideas.

— K. B. W.