QST

devoted entirely to amateur radio

In this Issue—
DX Contest Highlights
Directive Antenna Design
Midget I. F. Equipment

may, 1937
25 cents
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326 Elm Street, Buffalo, New York
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THE new 10 meter "Super-Pro", introduced only last month, has already been acclaimed by experienced amateurs, professional operators, engineers, and advanced experimenters, as a truly superior ultra-high frequency receiver.

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Say You Saw It in QST — It Identifies You and Helps QST
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All appointments in the League's field organization are made by the proper S.C.M., elected by members in each Section. Mail your S.C.M. (on the 16th of each month) a postal covering your radio activities for the previous 30 days. Tell him your DX, plans for experimenting, results in 'phone and traffic. He is interested, whether you are an A.R.R.L. member or your QST at the newsstands; he wants a report from every active ham. If interested and qualified for O.R.S., O.P.S., or other appointments he can tell you about them, too.

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The American Radio Relay League, Inc., is a non-commercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

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

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

Inquiries regarding membership are solicited. A bona fide interest in amateur radio is the only essential qualification; ownership of a transmitting station and knowledge of the code are not prerequisites. Correspondence should be addressed to the Secretary.

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THOUGHTFUL amateurs occasionally ask us where we imagine amateur radio will be ten years hence, or fifteen. It is a large order for a mere human, isn't it?

However, a few fundamentals seem to stand out. The world's needs for radio frequencies increase. Some day the point will be reached where non-essential services must give way to those for whom the use of radio is imperative. When that time is reached, will amateur radio have become a non-essential service? That day is too far distant to say with accuracy what we must do, but one point seems clear: it will depend upon what we have made of ourselves.

When the amateur's position is summarized to-day it is found most satisfying in its content of public service. We are the makers of the art of to-morrow, the suppliers of the personnel and many of the ideas that will carry onward the radio work of the next few decades. We are the reservoir of trained operators and technicians. We supply the communications in emergencies. Our public-service record to-day is positively superb and no one can question the value of the institution of amateur radio to-day.

To keep our place in the sun we must continue to serve society. We must be sufficiently adaptable to change the nature of that service to meet changing social needs. We do not know what those needs will be. That is why we say that our future is in our own hands—it depends upon our ability to continue a flow of contributions so valuable in the needs of that day that there will be no question of the essential nature of the amateur service.

At this moment, unquestionably the amateur's greatest service is emergency communication. That is why we feel so strongly that every amateur ought to be prepared to aid his community in times when normal communication fails and the dependence is upon amateur radio. To pay the piper for DX chasing, rag-chewing, the sport of contests and other angles of ham radio which are largely the indulgence of a hobby, every one of us ought to make some contribution of service. The greatest respect in which we can so serve to-day is during emergencies. We think it will be so for quite a few years to come. When we are prepared with plans, gear and personnel to do a vital job that nobody else can do, no one can deny the essential nature of the amateur service.

THE technique of radio marches on but every new operator has to master the whole story of operating. He inherits the apparatus improvements of his predecessors but he must traverse the long rough path of learning how to employ them. Last year's new amateurs, after a period of awful dumbness, become reasonably proficient operators. This year's have a long route yet to go. Much of the interference is caused by unskilful operating and is therefore unnecessary. The chief contribution of unnecessary QRM is made, it seems to us, by too-protracted calling. Why not a brief call and then a listen-in? Maybe the other fellow has picked you up already. If so, he'll answer at once, only too grateful that you didn't keep him waiting by continuing the call another two minutes. If he doesn't reply, you can call him a bit more, again pausing to listen. If he's answering someone else, you'll perceive it and can stop. If he's still "by," you can give him another brief shout.

This doesn't begin to treat the subject but it does tackle the chief factor, too-long calls. The use of break-in of course would provide a better solution. Reams have been written about it but its use is still all too infrequent. But the practice of punctuating calls with brief changeovers to listen a moment is almost as good, so far as calling itself is concerned, and requires no alteration of apparatus. It requires no cooperation by the distant operator. It is also perfectly applicable to 14-Mc. and 28-Mc. DX work, phone and c.w.

Please, fellows, can't we have some of this punctuation? Brief blasts of "three times three" or perhaps better "five times two," then a quick listen. It will save a lot of rumpus.

WE'RE certainly ashamed of the fellows who deliberately worked outside the amateur bands during the DX Contest. Doing so deliberately at other times gives amateur radio a black eye and the offender an excellent chance of a pink slip. Doing it during the Contest compounds these offenses with the additional one of taking unfair advantage of the rest of us. It is plain cheating at a game of skill, and we must say we have no patience with it. We hope the F.C.C. can hang these lads as high as kites. Those who have cheated deliberately can expect no sympathy from us.

We call the attention of those who are inter-
ested in working as close to the edges of bands as
is safe, but staying on the proper side of the fence,
to an article in this issue on the construction of a
very simple and inexpensive 100-kc. oscillator.

Intelligently handled it will be a reliable index to
how far one may go and still be safe. It will
prevent accidental transgressions and therefore
is eminently worth owning.

K. B. W.

Priority
A True Story

By H. W. Castner,* Will E

BEFORE the advent of radio the dictionary
defined “priority” as “the quality or privi­
lege of preceding something else.” The
word was adapted to radio communication and
methods devised to make it possible to get im­
portant traffic across without delay, but to-day if
you can get 1-kw. input to give about 95% output
and if you test persistently during the evening
with all kinds of squeaks, squawks, blasts and
groans and if you call CQ at least twenty-five
times and then sign your call at about 90 w.p.m.
and make it so that no one can read it, you will
probably get “priority” on your channel—for a
time at least. This procedure is by far more effec­
Uve during floods and all disasters where life and
death are concerned.

Well, anyway, my story this time relates to a
“priority” message just after the War and take it
from me, brothers, if you did not suspend traffic
in those days when you heard one of them things,
you would receive something a little different
than an article in QST relative to QRM of QRR,
etc., etc.

When President Wilson decided to go over to
Europe and fix it so that our creditors would
h11 1n1re to pay up in the future, there was much
ado in Navy Radio. My headache was executive
duties for the C.O. at NBD and my old shipmate
Fred Schnell (W9UZ) was a chief on the presi­
dent’s ship. Suffice it to say that all ships and
stations were primed to offer the utmost in service
to the Commander-In-Chief.

Although time has dimmed the memory of
actual arrangements used to indicate distress
during the war, I can still remember the tempo­
rary arrangement of a series of S’s used about as
follows:

SSSS Sighted a Sub.
SSSS SSSS Sighted and pursued.
SSSS SSSS SSSS Sighted, pursued and fired
upon.
SSSS SSSS SSSS SSSS Sighted, pursued, fired
on, hit and sinking.

Of course the number of groups constituted
priority, and it is of passing interest to mention

that it was often necessary to leave a two-group
guy to answer a three, etc. Nothing had priority
over a four group.

At the time of our story many such arrange­
ments were still in use, and it was a similar call
that caused us at NBD to jump right out of our
pants.

Night had fallen, over a stormy sea. Some con­
cern was had on various weather forecasts in the
vicinity of the great ship carrying the President of
the United States. As the night wore on, every
man on every ship and station had an “ear to the
ground.” We put on a continuous watch on wave­
length “J” (600 meters), and the operator on
No. 1 spark watch continued up to his neck with
the usual traffic on a QSH schedule with various
ships. QSH then meant sending paid traffic or
Government traffic in groups of ten messages and
then QSL all, or a check challenge if necessary, or
a repeat. At the Chatham, Mass., RCA station
this minute is R. K. Elliott. We called him “RK”
for two reasons. First, those were his initials, but
of more importance was that that was all he
could say if you sent a bunch of traffic at any
speed and asked QSL. If some of you fellows who
think you can operate could have tried one of
those tricks with continuous traffic for four hours,
you would have broken out all over with goose
pimples.

The old typewriter carriage was banging back
and forth on this night with old reliable RK
walking it right to ‘em, when in rushed a traffic
chief waving his arms and hollering like heck,
“We have a four-group priority from the Presi­
dent’s ship! Get him—get him!”

The poor guy that was QSO NBD may be still
trying to get a QSL for all I know, but this is once
when he didn’t get “RK” from Elliott. A hush
came over everybody and everything at the sta­
tion as old NBD put on the whole 5-kw. and
blasted a snappy call on 600 meters. At the “K”
breathless operators stood tense and frozen for
what seemed hours, when from far across the
great expanse of stormy sea, clear and distinct,
came the “R”—the call—the preamble—the
address—and then this message:

“Please send the President’s bathrobe on next
mail packet.”

*Damariscotta, Maine.
Post Mortem—1937 DX Contests

THE Battle of the Beams is over! The power companies have untied their overload relays, the tube manufacturers are working overtime to fill the orders for replacements, and small children have been introduced to gaunt, bearded men with a "No, that isn't the boogie man. That's papa. He was in the DX Contest."

Yes, reference is being made to that little cataclysm, that apparently innocuous but actually mad tussle referred to in the preliminary announcements as the 1937 International DX Contest. The March lion whistled, whined, and groaned during the c.w. portion of the contest from March 6th to 14th, and reared up and roared during the 'phone contest from the 20th to the 28th. Nothing was spared during the conflict. Bands bulged, bottles blazed. Wrists grew weary and tonsils tender. During the c.w. contest the bands were a kaleidoscope of beautiful bands set on a background of chirpy d.c., rectified a.c., rough a.c., raw a.c., and a few things that never were identified. Electron-coupled oscillators flitted through the bands, seeking an opening for a possible contact before moving on to possible more fertile fields. The 'phone contest was more cooperative: everyone would open up to call the same station, then quiet down until another DX station called CQ, resulting in a surge-like effect that was a beautiful thing to listen to (if you weren't in the contest!).

Everyone is in agreement on but one point. However much they may argue about good/poor operating, good/lousy signals, or long/phased/rhombic/rotatable directional antennas, they will all agree that there was more DX per kilocycle per hour than during any previous contest. You'll agree, too, that conditions must have been better than ever before when you see some of the scores.

It is no easy matter to get the high scores at this early date. It is exciting in itself to watch the calendar and see the deadline for copy coming closer and closer, with each day bringing in a new score that tops yesterday's high. Understand that the scores to be given have been collected by various means, that they are subject to some revision after cross-checking and confirmation. Some will suffer because they counted Scotland (GM) as an additional multiplier, or counted Puerto Rico and the Virgin Islands as separate countries. Some will find that their computation was slightly in error. And some will be eliminated because they were caught operating outside the band! Yes, the fellow that obeyed the rules is going to be recognized, and the ones who stepped over the line in an effort to take an unfair advantage will be disqualified.

While some of the off-frequency operation was accidental, there is no doubt that a great deal of it was intentional. So if in the final Contest writeup you find that Joe Doaks down the street is not listed among the high scorers, although he told you his score was umpty-ump, you know the reason why.

The C.W. Contest

AS WAS the case last year, a station outside the United States and Canada garnered the greatest number of points. Yes, you've
The 7- and 14-Mc. coils are in place, and by changing coils the transmitter can be operated on 3.5 and 28 Mc. The tube line-up: 53 p.p. oscillator, 6L6 buffer, 801 buffer, 100TH buffer-doubler, 250TH buffer-doubler (used only on 10 and 20 meters), and p.p. 250TH final.

Some of you fellows who were in the contest don't realize how easy the whole thing was. Not that it was easy to raise the stations or fight the QRM, but at least you didn't have the handicap of working in the same office as the highest scoring station, having him tell you each morning of the DX he had worked and that you had always thought was just a misprint in the Call Book. Clark Rodimon, "Roddy" of W1SZ, managing editor of QST and the guy that this very minute is hollering for this copy, guessed it. K5AY, whose signal rocked through the States day and night, ran up some 256,997 points during the 38 hours he was on. Operated by J. A. Wilson, ex-W2BXU, K5AY worked 1618 stations and had a multiplier of 53 out of a possible 56 for a four-band operation! That averages over 18 QSO's per hour, which is some operating in any language! Phased antennas were used on the higher-frequency bands, giving good coverage of the States. The power? 200 watts input to a 211 final.

And there you have the formula for top score in a DX Contest: mix one good operator with some good antennas, set him down at a receiver and any kind of a transmitter, throw the bug weights away and wait for the contest to start.

Last year's high scorer came in a very excellent second this time. XE2N gathered together some 201,520 points with 150 watts input and operation on five bands. He bemoans the fact that more stations did not get up on 160 to grab off the additional multiplier. W6ITH reports that K6CGK had 165,000 points, which would place the Hawaiian station third highest. The fourth highest score reported is from another station utilizing five bands: K7PQ ran up 162,968 points by working 1058 stations. He worked W6GRX on five bands. His only regret in the contest is that the bookkeeping involved almost takes all the pleasure out of it. However, there are plenty of contestants who would have suffered that way gladly!

Other high scores were from K5AC (who wasn't competing), 185,000; PA0AZ, 90,285; and G6NF, 79,288.

Some of you fellows who were in the contest don't realize how easy the whole thing was. Not that it was easy to raise the stations or fight the QRM, but at least you didn't have the handicap of working in the same office as the highest scoring station, having him tell you each morning of the DX he had worked and that you had always thought was just a misprint in the Call Book. Clark Rodimon, "Roddy" of W1SZ, managing editor of QST and the guy that this very minute is hollering for this copy, turned in the highest score of any W/VE station. That is, of course, if someone else doesn't come along with more than 116,665 points.

Burning a hole right through four bands, and digging out weak ones that many passed over, Roddy worked 255 stations in 68 countries, with a multiplier of 147. We're a little proud of the guy, even if he did make the other contestants around the office (including the writer) look like tin-
eared beginners. The input used was around 650 watts into various combinations of wires, including a rhombic that had more major lobes than some of us heard signals.

So close behind W1SZ that it isn't even funny, and national high scorer (HQ stations are not eligible for awards), comes a West Coast station, W6CXW, operated by Henry Sasaki, of Long Beach, Calif. W6CXW needs no lengthy description; he is well known in DX circles 'round the world. Always well up in the scoring of any contest, this is the first time he has been national high station, and the first time a W6 has gained that honor since W6BAX smoked out everyone back in 1930. Considering the fact that East Coast stations have a better opportunity to pyramid multipliers by 3.5-Mc. working of European countries, we think that the achievement of W6CXW is all the more outstanding, and his score of approximately 115,000 looks very pretty in any history book. The only definite thing we know about his work so far is that six different antennas were available, at the flick of a switch! We will have the complete data on his work in the final contest writeup.

Into second place comes W2AIW, to redeem the honor of the East Coast, with a score of 105,223. Running 800 watts on 28 Mc., and a kilowatt on the other three bands, W2AIW worked 253 stations and had a multiplier of 139. Two antennas were used: a 14-Mc. array and a 3.5-Mc. Zepp for all-around operation.

Just to add insult to injury, the next highest score comes from another W6. This time it is W6GRL, at Ventura, Calif., whom you recall was the highest W6 last year. He knocked over H4,464 points.

Other high scores: W4CBY, 91,574; W9TB, 75,565; W6FZL, 75,208; W6JSO, 72,000 (approx.); W8FJN, 69,328; W6GRX, 66,600; W4AH, 61,530; W6LEC, 57,120; W1ME, 58,304; W2GRG, 50,537; W1TS, 50,700; W1BF, 50,537.

The highest Canadian score so far is that of VE2AX, whose 60,420 points will most likely make him the highest-scoring station in his country. VE2AX says that many stations were fooled by harmonics, a concrete example being the 7-Mc. harmonic of FM8AD when the Martinique station was on 3.5 Mc. Of course, VE2AX might have been hearing the harmonics of the 3.5-Mc. W stations calling FM8AD on 80, so we won't press the point. But it's worth thinking about.

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The 'Phone Contest

W OPERATORS in the 'phone portion of the contest are thankful for several things. Primary, of course, was the fact that they didn't have to drag their contacts out of the QRM belt that was our 'phone band.

(Continued on page 89)
A 100-Kc. E.C. Oscillator for Frequency Checking

By Don H. Mix,* WITS

WHILE casting about for a simple means of checking the frequency of an e.c. oscillator transmitter, particularly when operating near the edges of the bands, the use of a 100-kc. oscillator was suggested. The advantages of a calibrated oscillator operating at this low frequency are at once apparent. To check the frequency of an oscillator operating at 100 kc. it is not necessary to set up elaborate calibrating apparatus nor is it necessary to use a crystal, for the frequency of the oscillator may be set by beating one of its harmonics against one of the many broadcast signals of stations operating at exact multiples of 100 kc. These signals are commonly available at all but a few of the twenty-four hours at most points in this country and Canada. The b.c. signal need be only strong enough to make identification possible. Once set, the oscillator provides accurately calibrated signals every 100 kc. from 100 kc. upwards in frequency.

An oscillator of simple construction requiring but a few inexpensive parts is shown in the photograph. Referring to the diagram, Fig. 1, an ordinary 2.5-millihenry r.f. choke is used for the inductance, the cathode tap being placed between the first and second "pies." This inductance will tune approximately to 100 kc. with a capacity of 0.001 µfd. A 100-µfd. midget variable condenser is connected across the fixed mica condenser to give a tuning range of approximately 5 kc. at the oscillator's fundamental frequency. Maybe we were lucky—considering usual commercial tolerances on ratings,—but in the gadget pictured, with a choke and fixed condenser picked at random from stock, the oscillator hits 100 kc. with the 100-µfd. condenser at half scale.

The base and panel are made up of two small pieces of one-sixteenth inch aluminum although any available sheet metal which will not bend or spring too easily may be used. The panel is four by five inches and the chassis four by five by two inches. All parts except the 24A tube, grid condenser and leak and fixed and variable tuning condensers are mounted underneath the chassis. While a simple knob might be used for the tuning control, it is much easier to obtain an accurate setting of the oscillator with a vernier dial.

First calibration is quite simple providing only that at least two b.c. stations operating on multiples of 100 kc. may be heard. In most cases it will not be necessary to connect the oscillator to the b.c. receiver. In our case a good beat note was obtained with the oscillator several feet away from the b.c. receiver. The procedure of setting the oscillator to 100 kc. is as follows: First, tune in a b.c. signal at a multiple of 100 kc. such as 700, 800, 900, or 1000 kc., etc. Be sure of the identity of the station, since a difference of one channel (10 kc.) will mean an error of about 250 kc. at 14 Mc. Reduce the beat to zero, being very careful of the adjustment. For greatest accuracy, listen for the slow beats on modulation. Now tune the receiver to a second signal at a multiple of 100 kc. If the oscillator is operating at 100 kc., it should zero beat with all signals at exact multiples of 100 kc. If the oscillator is not operating at 100 kc. it may be adjusted to zero beat with the first signal but at the same setting will not zero beat with other signals at 100-kc. multiples. In this case, capacity or inductance must be adjusted. As a matter of fact, if any beat note at all is obtained, it will probably be the correct one since the nearest other frequencies which would produce a beat with a signal at say 700 kc. would be 116.6 or 87.5 kc. which would require an appreciable departure in capacity or inductance from the correct values.

(Continued on page 114)

A Modulator for the Low-Power
Five-Band Transmitter
A Metal-Tube Audio Unit Using Class-A 6L6 Output
By George Grammer*

In discussing the low-power transmitter described in December 1936 QST\(^1\) it was pointed out that one of the design features was that of providing for plate modulation for radiotelephony. The present article is concerned with the description of a modulator primarily intended for working with that transmitter, although it can also be used for modulating other 30-watt input rigs or, with slight modification, as a driver for a higher-power modulator.

In recent years it has become natural to think of Class-B whenever plate modulation is under consideration. This is understandable enough, because Class-B audio amplification offers the opportunity for getting large amounts of audio power at less expense than other systems. For low power levels, however, recent developments in beam tubes have again brought Class-A amplification within the economical price range, partly because it is now possible to get more power at low plate voltages and partly because fewer coupling transformers are required. The smaller variations in plate current with voice input also simplify the power-supply requirements because poor voltage regulation is less serious.

These various factors of cost, power output and simplicity of design were given due consideration in planning the modulator unit pictured herewith. The audio power output necessary for modulating the 30 watts input to the final stage in the transmitter is 15 watts; a pair of 6L6's can deliver this output readily when operating purely Class-A. An important factor is that no driving power for the grids is needed to obtain this output; this eliminates one cause of distortion, permits dispensing with a special coupling transformer, and avoids the necessity for using a driving stage having considerable power output.

The number of tubes required in the speech amplifier naturally enough is a function of the gain needed for the particular microphone used. It seemed reasonable to us to assume that the owner of a low-power transmitter—since low power is used chiefly because it is inexpensive—naturally would think first of economy when considering a modulation system. Fortunately the less expensive types of microphones also are the ones which give the highest output, so that fewer speech amplifier stages are necessary. Carbon microphones, because they are obtainable at lower cost than any other types, therefore seemed the logical choice, and on looking into the microphone situation it was found that a double-button model could be purchased practically as cheaply as the single-button type. The double-button type is preferable because the push-pull arrangement reduces distortion.

The output level of the low-priced double-button microphones is such that two speech stages before the modulator give more than ample gain. It might even be possible to use only one, but the extra stage adds little to the cost of the audio section and provides a conservative factor of safety. The tube line-up used in the practical modulator consists of a 6C5 first stage, a 6N7 second stage, and a pair of 6L6's in the third and final stage. The circuit diagram is given in Fig. 1.

Circuit Details

Referring to Fig. 1, the microphone works into the conventional input transformer. The small numbers on the input connections refer to the

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*Assistant Technical Editor.

1—"An Inexpensive Five-Band Low-Power Transmitter," QST, December, 1936.
terminal numbers on the type of transformer specified in Fig. 1. Terminals 3 and 4 are joined together and grounded; Nos. 2 and 5 are the microphone button connections. The gain control, $R_1$, is connected across the secondary of the microphone transformer. Its rotor connection goes to the grid of the 6C5.

In the 6C5 stage, $R_2$ is the cathode bias resistor and $C_1$ the cathode by-pass condenser. $R_3$ is the plate load resistor and $C_2$ the plate by-pass condenser. $R_{12}$ is a plate decoupling resistor.

To get push-pull output for the 6L6's in the final stage, the second tube, the 6N7 double triode, is used as a phase inverter as well as a voltage amplifier. The output of the 6C5 is fed through $C_9$ to the grid of the first triode section of the 6N7; the plate of the same section is coupled through $C_9$ to one 6L6 grid and part of the voltage developed also is fed to the grid of the second triode section of the 6N7 through $C_7$. Not all of the audio voltage is used for this purpose; $C_7$ is tapped down on the first-section plate load resistor so that the actual audio voltage applied to the second-section grid is the same as that applied to the first-section grid directly from the 6C5. The first-section plate load resistor actually consists of two resistors, $R_6$ and $R_{14}$, in series; the values of these resistors have been determined experimentally to give the correct voltage for the second-section grid and should be followed carefully. $C_4$ is the plate by-pass condenser for the first triode section of the 6N7 and $R_{12}$ a plate decoupling resistor. $R_7$ and $C_4$ are the plate load resistor and plate by-pass condenser for the second triode section. $R_9$ and $R_{10}$ are the usual grid-leak resistors, and $R_5$ is the 6N7 cathode resistor. This resistor preferably should not be by-passed, since some negative feedback helps to equalize the outputs of the two triode sections and thus stabilizes the performance.

In the 6L6 stage, $C_5$ and $C_9$ are the grid coupling condensers and $R_y$ and $R_{10}$ the grid leaks. A semi-variable resistor, $R_{14}$, provides cathode bias for the 6L6's. The actual value of cathode resistance in use is about 165 ohms, a setting determined experimentally to give optimum performance. The plates of the 6L6's are connected to a push-pull output transformer, $T_2$. The screens are by-passed by $C_4$. To provide appropriate voltages for the various tube elements, a voltage divider consisting of $R_{15}$ and $R_{16}$ in series is connected across the "B" supply.

It is rather important that the circuit values be duplicated exactly if optimum performance is to be secured. In this connection, two rather important points should be observed: $C_4$ must be at least 8 µfd. to avoid hum troubles, and no decoupling resistor should be used in the plate circuit of the second triode section of the 6N7. In the original circuit arrangement tried, a decoupling resistor installed in this position was found to cause motor-boating rather than cure it, while a rather strong hum was eliminated by replacing a 2-µfd. condenser used originally at $C_4$ with an 8-µfd. unit.

CONSTRUCTION

The photographs show the construction of the modulator. Referring to the general view, the microphone transformer, $T_1$, is mounted at the
left front corner of the chassis and the output transformer, T2, at the rear right corner. The 6C5 is directly behind the microphone transformer; between the 6C5 and T2 is the 6N7. The two 6L6's are at the front of the chassis at the right. The gain control is at the left-hand edge of the chassis.

The bottom view shows how the various parts are placed under the chassis. The volume control, R1, has the microphone switch, Sw, mounted on it so that when R1 is turned to the zero position the microphone circuit is opened. The three plate by-pass condensers, C2, C3 and C4, are mounted on the chassis near the upper center in the photograph; the similar condenser at the upper right is C4, the screen by-pass.

The 6C5 and 6N7 sockets are at the lower left in the bottom-view photograph. The various condensers and resistors are placed as closely as possible to the tube socket prongs to which they connect, use being made of insulating lugs wherever necessary. The plus “B” connections for these two stages are brought to a multi-lug strip on which the decoupling resistors also are mounted. This strip is visible in the photograph just above the two tube sockets. The cathode resistor and cathode by-pass condenser for the 6C5 are just below the sockets. Power supply leads are brought through a 4-wire cord which terminates in a lug strip near the bottom center in the photograph. The voltage divider resistors R15 and R16, and the 6L6 cathode resistor, R14, are along the right-hand edge. All ground connections are made directly to the chassis.

The chassis is of light steel measuring 11 by 7 by 2 inches. Round holes are cut out to permit the transformer terminals to project through for “upside-down” mounting. A three-terminal connection strip is mounted on the side of the chassis near the microphone transformer to make connections to the microphone cable. A similar two-terminal strip is mounted on the rear edge for output connections from T2. When used with the transmitter described in the previous issue, the pair of terminals on T2 intended for a 5000-ohm load should be used. The connections marked “Output” in Fig. 1 should connect to those marked “Mod.” in Fig. 1, page 13, December, 1936, QST, the “Q” terminal on the transformer connecting to the plus “B” side on the transmitter. This is the only connection between the two units.

TESTING AND OPERATION

The power supply used with the modulator is identical with that described in December QST for the transmitter. Under full load the output voltage will be approximately 380 with an 83-V rectifier. The total “B” current taken by the modulator should be approximately 140 milliamperes with no sound input to the microphone, and should rise to about 150 ma. at full output on speech. This test should of course be made with the transmitter connected and operating, since the plate current to the 6L6’s will not rise if there is no load on the modulator. If the current is more or less than 140 ma. with no speech input, the resistor R14 should be adjusted to obtain the correct current value.

Before attempting to use the modulator directly on the transmitter it is a good plan to test it on a resistance load, using a 5000-ohm, 25-watt resistor connected across the output terminals. A pair of headphones may be tapped across about 500 ohms of the resistor, if the resistor is of the type having a sliding tap, or a second resistor of a few hundred ohms may be connected in series with the load resistor to form a voltage divider across which the headphones may be connected. It is not advisable to connect the phones directly across the load resistor because the audio voltage is too high for safe operation. With another person speaking into the microphone in a normal tone, the gain control should be advanced to the point where distortion just begins to be perceptible, then retarded to the point where no distortion is apparent. Under these conditions the total “B” current taken by the modulator should vary about as described above. The headphone test also will readily uncover hum, noise, or other troubles, although if the specifications are followed carefully the performace should be entirely satisfactory from this standpoint. The

A VIEW UNDERNEATH THE CHASSIS OF THE MODULATOR UNIT
A description of the layout is contained in the text.
Air-Wave Bending of Ultra-High-Frequency Waves
A Review of Recordings and Observations Made on Various Frequencies Over 100-Mile Indirect Paths

By Ross A. Hull*

In Two Parts—Part One**

This article is an “absolute must” for every amateur who has the slightest trace of interest in the ultra-high frequencies. In spite of its length, it is actually a very-much-clipped outline covering observations made by Mr. Hull in the two and a half years of spare time that he has devoted to this particular u.h.f. job. A paper covering all the detailed technical phases of the work has been prepared and a summary of it presented at the annual joint meeting of the International Scientific Radio Union and the I.R.E. at Washington. The complete paper will probably be printed for distribution in scientific circles during the summer.—EDITOR

There are still many phases of amateur radio that we know very little about. One of these—and a particularly engaging one—is the behaviour of u.h.f. waves at distances beyond the line of sight. For many years we suffered from the erroneous impression that there was nothing left of the signals beyond the horizon. With frequencies slightly higher than 30 Mc., it was assumed, the ionosphere became quite useless as a medium for bending the waves back to earth, and that without this bending there could be no signals beyond the line of sight. But early experimental work showed that the signals did not stop precisely at the horizon; that they could be detected slightly beyond this point. An explanation was readily available. It had been known for many years that light waves take a curved path through the lower atmosphere and are spread behind obstructions through the phenomena of diffraction and refraction. Computations showed that u.h.f. waves actually should not travel in straight lines across the surface of the earth but that they should bend in a curve having a radius of approximately four times the earth’s radius. Somewhat similar computations had been used long before to show that, because of this bending of electromagnetic waves in the atmosphere, the sun is visible for at least two minutes and twenty seconds after it has actually passed below the horizon. These computations are also used in astronomical work to correct for the apparent positions of celestial bodies.

The Mechanics of Bending

Before we get too deeply into observations of this bending business, perhaps it would be well to digress long enough to review a few general ideas as we see them to-day. In very simple terms it can be said that we would have no bending of radio waves if it were not for the fact that their velocity varies in the different media through which they pass. All we need, to make a wave front headed out for space bend back to earth, is to have an atmosphere (or stratosphere) in which the make-up is such as to increase the velocity of propagation the higher the wave front goes. This condition is satisfied most of the time for the lower frequencies because of the existence of layers of increasing ionization far above the earth’s surface (the ionosphere). These gradients of ionization, however, are very rarely steep enough or low enough to bend u.h.f. waves back to earth. That they do bend u.h.f. waves back once in a while is fairly well established by the several instances of signals being heard and communication being established over distances of 1000 miles and more. The Ionosphere, as we ordinarily consider it, may be the responsible agency. On the other hand, on these instances the bending may occur in the recently-discovered very low layers of ionization. In this discussion, however, where we are to talk exclusively of a brand of bending that gives us signals at 50 or 100 miles, we believe firmly that we can forget ionization and look to other sorts of gradients in the very lowest reaches of the atmosphere—in the very same air in which birds (and men) fly.

In this part of the atmosphere we know that the velocity of the upper edge of the wave front is increased, for instance, if it is travelling into a region of increasingly low atmospheric pressure (which it ordinarily does) or into a region of increasingly high temperature, or into a region of steadily decreasing water vapor content. These gradients of pressure, temperature, and humidity do exist and do cause bending of waves at long distances. The bending is downward but, owing to the normally much greater spread of the ionosphere, the amplitude of these bending effects is considerably less than those caused by ionospheric gradients. In practice the only effective layers of ionization are those encountered either by birds in flight or by the aurora borealis. These bending effects are not of the same importance as those which result from the density changes in the lower atmosphere. These lower atmosphere gradients are of the utmost importance to the long-distance radio amateur, and we are going to devote this last part of this article to a discussion of these gradients and their effects of bending waves at long distances.
sorts of conditions all provide a negative gradient in the index of refraction of the atmosphere; and a decrease in the index of refraction results in an increase in the velocity of propagation. Under ordinary, clear, settled weather conditions these requirements are partially satisfied in the lower atmosphere. The pressure drops off with height and the water vapor content decreases also. During most of the day, unfortunately, the temperature drops off sharply with height above ground (the condition we don't want). The result, as shown both in theory and practice is a slight bending of five-meter waves in a trajectory or path having a radius of curvature of about four times the earth's radius. Result—we can talk to points slightly beyond the horizon.

VARIATIONS IN "AIR WAVE" BENDING

But this atmospheric condition is by no means a stationary one. Once the sun has set on our sample clear day, the temperature of the surface air begins cooling. By midnight we may well have a gradient that gives a steady increase in temperature for the first 2000 feet above ground. At that time we have all factors tending to increase the velocity of the upper part of the wave front and as a result we have much stronger u.h.f. signals beyond the horizon. Such night-time increase in signal level we will later show to be a very real effect, particularly in the summer when the day-to-night temperature contrasts are so great.

This sort of stable clear weather condition is, as it happens, the condition that ordinarily provides the least bending of all. It generally coincides with the prevalence of what weather men term Polar air. Let an air mass from the tropics drift across this Polar air and we have a set-up in which the temperature may increase irregularly all the way up to eight or ten thousand feet. The result is now a relatively tremendous bending and very intense signals beyond the horizon. Another result is the formation of clouds at the level where the warm and cool air mix and, later, rain. Naturally an almost infinite number of other atmospheric conditions may exist, with the temperature, water vapor and pressure gradients doing all sort of unexpected things. They all reveal themselves, we hope later to show, in changes in the order of bending and consequent variations in signal level.

All of this, of course, is based on what we now know about bending in the atmosphere. It was far from clear to us a few years ago. We had a picture of u.h.f. propagation but only a very meagre one; no long distance signals because the ionosphere was ineffective; good signals only along the line of sight; weak signals immediately beyond the horizon, possibly resulting from diffraction and refraction, and a rapid falling off beyond that.

FADING OF U.H.F. SIGNALS

In 1931, Jouaust reported some experiments made with five meters in France between stations slightly beyond the line of sight. The signals were found to vary in strength and this fading was considered to be the result of slow changes in the makeup of the lower atmosphere—particularly in the gradient in the temperature of the air immediately above the earth's surface. This observation (we believe it to be the first on record) that u.h.f. waves were subject to fading received very little notice at the time and nothing much more was done about it until 1934, when RCA engineers reported observing weak fluctuating signals beyond the horizon. Then G. W. Pickard and Dr. C. F. Brooks began consistent observations of the variations in five-meter signals between the Blue Hill Observatory, Seabrook Beach, N. H. and Mt. Washington, both paths extending somewhat beyond the horizon.

The first real jolt to our own understanding of u.h.f. behavior was had in August 1934, when communication was more or less accidentally established.

THE ULTRA-HIGH-FREQUENCY EQUIPMENT INSTALLED AT A FARMHOUSE ON THE OUTSKIRTS OF WEST HARTFORD

The relay rack carries most of the power supply gear, the voltage regulators and crystal-controlled receivers for 60.6 and 61.5 mc. Other equipment includes the 41-mc. crystal-controlled converter (using an HRO as the i.f. amplifier), an S.I.G. receiver for general observation of ham signals and superregenerative gear for 60, 112 and 224 mc.

between West Hartford and Boston—a 100-mile path of not one horizon but five with a radius for the clearing ray path of but six tenths of the earth's radius. Here, obviously, was an order of bending far beyond our wildest expectations. More important still was the observation that the signals from these Boston low-powered stations held steadily at very high levels for many hours at a time on some occasions while on others they would either be subject to violent slow

variations or be absent entirely. Naturally, there was a mad scramble to provide an explanation. It seemed obvious from the beginning that the ionosphere had nothing to do with it. This conclusion seemed reasonable since the lowest signals were invariably had during the day with strongest signals in the early hours of the morning. Then, the fading was much slower than that experienced on the lower frequencies. Further the periods of very highest signal level invariably accompanied those atmospheric conditions which resulted in rain. There was nothing in any of the observations to suggest a relationship with the ionosphere. On the other hand, it was difficult to explain the performance as being the result of diffraction from the intervening ridges of hills. Such a phenomena would not allow such variation in signal strength and would certainly not permit the signal to drop out entirely. But by the same token, it was almost equally difficult to reconcile the very high signals with estimates based on current refraction calculations. Indeed, calculations clearly showed that we should have no signals at all. The favorable location of the West Hartford station—on a small hill 180 feet above the surrounding country and 320 feet above sea level—did not offer a solution since

there still remained the five horizons to be bridged even to reach favorably located stations in Boston.

A RECORDING PROGRAM STARTED

In any event, the problems involved led to the institution of a program of recording which has resulted in recording receiving equipment being in operation continuously for the last two years. Hourly tone transmissions on 60.5 Mc. were made available by Dr. Brooks of Blue Hill and these were recorded photographically at West Hartford during 1935 and the first few months of 1936. A super-regenerative receiver was used in conjunction with a 12-element directive antenna. The set-up was such that only qualitative observation could be undertaken. Nevertheless, the recordings, studied in conjunction with airplane soundings of the lower atmosphere made at East Boston and Mitchell Field, L. I., proved invaluable in substantiating the belief that the signals, in spite of their high average level, resulted chiefly from refraction in the lower atmosphere and that the enormous variations in signal level were the result of changes in the stratification of the air so frequently found in the atmosphere itself but so infrequently given attention in previous studies. The product of the first few months' work was the basis of a paper read before a scientific group in Washington in May 1935 and published in revised form in June 1935 QST. The one observation considered to be of importance was not that u.h.f. waves were bent beyond the horizon (that was old stuff) but that the bending could so frequently be of such an unexpectedly high order as to bridge a 100-mile path with intervening ridges of hills 1000 feet high, and to put down a field on many occasions as strong as one would normally expect along an unobstructed line-of-sight path.

THE EARLY CONCLUSIONS

The observations reported in this first paper were made chiefly in the winter months and they resulted in this statement, "It appears that an extensive sub-normal temperature lapse-rate anywhere in the regions between 300 and 2600 meters (Continued on page 78)
Havana

While the international conferences, such as Madrid and Cairo, set a world standard, rearrangements and special agreements concerning “continental” frequencies may be made at what are called regional conferences. The last such conference in this region was at Havana in November.

In March last, representatives of the United States, Canada, Mexico, and Cuba met in Havana for a preliminary discussion. They adopted numerous resolutions but none of them is yet binding: they were adopted only as a basis for discussion at the real conference which will be held in November, when twenty-three nations of North & Central America will be invited to participate. Much of the work of the conference will relate to broadcasting. Amongst the matters that interest amateurs will be the following:

1. Changing our 1715-2000-kc. band to 1750-2050 kc., so as to provide expansion for the police service. We would give up 35 kc. at one end and gain 50 kc. at the other end. Since 1715-1750 kc. is not harmonically related to any of our other bands, it should make no difference to us. In fact, since we would gain 15 kc., there would be some net profit on the transaction, even though a signal occupies a little more space at 2000 kc. than at 1700.

2. Reaffirming all the important amateur bands as available only for assignment to amateurs in the North & Central American region.

3. A proposal by Cuba that the Latin-American countries be permitted to use 7000-7100 kc. for ‘phone. The northern countries would continue to employ the entire band exclusively for c.w. The universal W/VE feeling is that this is a c.w. band, so this threat may be serious. The answer may lie in the report that the Cuban amateurs want this provision to permit daylight work, where 4 Mc. has insufficient range and 14 Mc. too long a skip. If confined to daylight hours, it might not be so bad.

4. An arrangement permitting intercommunication between all types of stations during emergencies.

These are all proposals for discussion in November, and are not yet actions. The League expects to be represented at the November conference.

Cairo

Some of the proposals of other nations for the Cairo Conference are now coming out. We have seen a few items. Japan proposes that all amateurs be limited to a power of 50 watts in the antenna, in order to reduce interference. Australia, proposing carrying allocation up to 150 Mc., suggests retaining the 56-60-Mc. band for amateur and experimental stations, as now provided internationally, and giving us an additional such joint assignment from 120 to 130 Mc. Sweden proposes, amongst other things, the assignment of 1560-2785, 2810-2900 and 2930-3605 kc. to the mobile and fixed services, primarily maritime radiotelephony; and 3605-3635 kc. to aircraft. These proposals cover our entire 1.75-Mc. band and the first 185 kc. of our 3.5-Mc. band. In the case of the frequencies below 2000 kc. the Swedish administration may be talking only of an arrangement for the European region, but the Madrid table provides only one general allocation for all the world for frequencies above 2000. Belgium proposes the elimination of the 1.75-Mc. amateur band, the reduction of the 3.5-Mc. band to 100 kc. and the reduction of the 14-Mc. band to 200 kc. While her first two proposals may be intended only for the European region, she does not so state, and of course her proposal to halve our 14-Mc. band is a frontal attack. Italy proposes reducing the 7-Mc. and 14-Mc. bands in Europe, although permitting them in other regions to continue as they are. She would give European amateurs only 7200-7300 and 14,300-14,400 kc., assigning the other portions of those bands to the fixed and broadcasting services.

These proposals are, we suppose, indicative of what we amateurs shall have to combat at Cairo. As soon as the Book of Proposals can be studied thoroughly, a complete enumeration of the proposals affecting amateur radio will be published here.

Canada

Canadian amateur regulations are effective on the first of April of each year, and are then continued without change for a solid year. Last April 1st the Canadian reg's were reissued for another year without change from the previous year. Canadian General Manager Reid in January obtained expressions from the affiliated clubs and the S.C.M.'s of Canada, and from many active amateurs. One thing that United States amateurs watch with particular interest is the Canadian regulation concerning 14-Mc. 'phone. This question received particular study in this year's Canadian examination and Mr. Reid reports that, from the replies received, a large majority in Canada are in favor of keeping the 'phone allocation in its present dimension

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and in the center of the band. The government at Ottawa has therefore continued the arrangement for another year.

Age Limit? There is a bill before the House Committee on Interstate & Foreign Commerce, H. R. 5376, which would amend Section 303 of the Communications Act to require that all licensed radio operators, including amateurs, be twenty-one years of age or over. It was introduced by Congressman Richard J. Welch of the Fifth California District, San Francisco, on behalf of the A.R.T.A., the labor union of commercial radio operators. It was not intended to cover amateur operators but does so just the same. The League has immediately taken steps to secure the exemption of amateur radio if this bill is enacted. The F.C.C. is not in favor of such an age limit on amateurs and, so far as we are aware, neither is anyone else. Obviously it would have a very serious effect upon us, for, although our average age is about twenty-five or twenty-six, many of us are under twenty-one. The League has asked to be heard when hearings are held on this bill and meanwhile has filed a brief with the committee.

Licensed Operators The Congress recently enacted an amendment to the Communications Act giving the F.C.C. authority, under certain unusual circumstances, to modify the usual requirement that every station must be operated by a licensed operator. The change was enacted primarily for the relief of experimental stations engaged in ionosphere research. A rumor has been going around the country that this bill was sponsored by the A.R.R.L. The League has been in no way connected with it, and it has no effect upon amateur radio. It does not apply to stations for which licensed operators are required by international agreement, as is the case with amateur radio. The Madrid regulations require that the operators of amateur stations be examined both as to technical capabilities and as to the ability to send and receive code. The F.C.C., even if it wished to, which it does not, could not relax the requirement on amateur operation that operators must be licensed.

Changing Address When an amateur station is moved, the filing of an application for amendment of the address of the station license does not in itself authorize the amateur to engage immediately in "fixed" operation at the new address. This may not be done until the amended license is received. In the meanwhile (up to the date of expiration of the license) the amateur may engage in portable operation at the new address, but before doing so he must notify his Inspector of his intention so to do, and he must sign the portable designation. Quite a few amateurs have got into trouble on this score recently, apparently believing that they were authorized to operate as usual, once they had filed application for amendment. Don't forget that this may be done only in portable status, and that that requires notifying the Inspector.

Harmonic QRMs The London short-wave broadcasting station, GSD, operating on about 25 meters, is being interfered with in Canada frequently by the third harmonics of American 'phone stations operating between 3900 and 4000 kc. This station carries the Empire broadcasting of the B.B.C. and is much listened to in Canada. There seems to be a considerable amount of third-harmonic interference from 'phones. All 'phone amateurs would be well-advised to check their emissions for third harmonics and eliminate them if any are found.

Hq. On Air There are fifteen licensed amateurs on the A.R.R.L. headquarters staff. In addition to WlA W, these amateurs operate twelve active home stations (soon to be thirteen), and two without stations at the moment are inveterate experimenters. Interest divides, as it does in any typical amateur group, between the various bands and between traffic, DX, u.h.f. work, experimenting, and rag-chewing. Some of the gang is to be found on, almost any old time. Always psed CU, OM.

The Cover WE GRABBED the picture in QST's Lab this month, not only because Jim Lamb and his gadgets made a swell shot but because we wanted to draw attention to a new story of his scheduled for next month's issue. The story is the outcome of hundreds of hours of development and measurement work and has to do with "Full-Range Selectivity." It discloses ways and means of obtaining continuously adjustable selectivity in the superhet all the way from the highest we can use for c.w. to the broadest required for 'phone—a range of over 100-to-1. It's another basic advance in our practical communication technique.

Post Mortem—1937 DX Contest (Continued from page 11) Another helpful item was the fact that the DX stations were easy to pick up after a call, most of them being easily recognizable by their accents. Disappointing, however, was the rather poor performance of the 28-Mc. band, which seemed to have acquired a sort of "don't care" attitude after having been jammed with kilowatt after kilowatt in the c.w. contest.

A minor thrill for us around here was the re-
ception of the scores. At first glance, it looked as though W1SZ would repeat his performance, and top the 'phone test with 28,594 points. Then W4CBY, with W4DHZ at the mike, sent in a score of 31,356, and that looked awfully good. Then when W2UK said he had 39,000 points we were certain we knew the highest station, until W4AH told us about his 43,333 points. But we were totally unprepared for the score of W9ARA, which came through just as we started to write this report. Robert Henry, W9ARA of Butler, Mo., worked 250 stations for a score of 45,367! Twenty-three countries were worked on 10 meters, and 38 on the 14-Mc. band. Complete details are lacking, but a rotatable "signal squirter" was used for an antenna. Much credit is due this station because of its location in almost the center of the country.

So there you have the story. We can't be certain that W9ARA is the highest station, because it is a little too early, but it looks very good. High West Coast score (to date) was submitted by W6ITH, who had 23,085 points. Incidentally, you'll find a photograph of W6ITB's rig in the Sweepstakes story. The second highest West Coast score we've heard of is that of W6BAY: 14,000.

Unfortunately, time prevented our obtaining any foreign scores. However, we have it from several sources that KG6MVV had approximately 63,000 points, which should make him high-scoring foreign station. KG6MVV is well known for his amazing signal on 28 Mc., and we understand from W6ITH that during the contest the Hawaiian station worked all possible districts (14) on ten, and 12 of them on the twenty-meter band. VK2GU, who has the most consistent 28-Mc. 'phone signal on the East Coast of any VK, is reported to have made 27,000 points. Other scores were: W3CRG, 21,276; W2IXY, 16,164; W2CBQ, 18,576; W0BEZ, 15,640; W0YGC, 15,414; W2DSB, 13,846; W6AM, 11,696; W4DCQ, 11,036; W6EJC, 10,362.

GENERAL

Taken as a whole, the 1937 DX Contests were the most successful staged. Unlike the contests of only a few years back, so many contestants made WAC time after time and on different bands that it is useless to recount them all individually. More countries were worked than ever before. More bands were brought into play than ever before. More . . . And yet, stations still persist in the same old time-wasting and unsporting activities of rough notes, inexcusable key-clicks, and just plain poor operating. The more frequent use of QIHM, QLM, etc., would be a great help.

However, worse than ever before was the amount of out of band operation. We have heard many comments on the unfair tactics employed by some to gain a slight advantage. Fortunately for our argument, the highest scoring stations operated legally at all times. But two scores, of 104,742 and 104,380, had to be disqualified because of out-of-band operation! No doubt others will have to be disqualified also, but these two were almost certain third and fourth place stations (not counting W1SZ). And that's the sermon for to-day.

To all those who helped so willingly in compiling these early scores, we give our sincere thanks.

—B. G.

DX Competition Policy

THE A.R.R.L. has a double responsibility in connection with supervision of its operating activities. First there are competition rules. In fairness to all it is necessary to see that individuals abide by the rules of the game. After all it is no achievement at all to win or surpass, or accomplish results, DX or otherwise, by unfair means. It is sporting to abide by contest rules; unethical and unfair to break rules. Regulations for activities or sports of any kind have to be enforced by an umpire. Whether accident or intent is responsible for "hitting a foul" or deciding whether the pitch was a ball or a strike, it is the umpire's responsibility to call the play—to make a decision in the interest of fairness to the players. No game demands higher standards of sportsmanship than amateur radio. In our national and international competitions of annual fame, A.R.R.L. is the umpire.

But A.R.R.L. has a second and deeper responsibility to the amateur service that goes beyond the interest of the players in the game alone. A.R.R.L. goes to bat for the amateur service in both international and national representation of that service. "Amateur radio" stands or falls in the conference halls where domestic and inter-

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national regulations, legislation or agreements on matters of communication are made, by its respected public relationships. Its record of splendid public service, training value, and all constructive aspects established by amateurs are positive factors; the standards of frequency observance, the record of cooperation and satisfactory relationships with other services, the number of operators violating as compared to the number observing regulations with care—these things count powerfully when examined. On the record, and from the facts may be fashioned strong arguments "for the amateur," or for our adversaries, as the case may be. So it is the first duty of your A.R.R.L. to so conduct amateur affairs that a shining record may be presented and the facts may all have positive rather than negative force. We are glad to say that through A.R.R.L. efforts, the amateur service has a top notch record. The burden of this story is that we must keep it that way and that the League intends to discharge all of its obligations to the fraternity fairly and honestly as it has ever done. Your A.R.R.L. is respected in Washington, and Ottawa. Its spokesmen in scheduled conferences for the early future (the next important North American and world conferences concerning frequency allocation are to be at Havana and Cairo) must continue to have a clean slate for the amateur service, that they may point without fear to the record of present and past amateur operating.

In A.R.R.L.'s 9th International DX Competition there was a tendency toward increased off-frequency operation and other violations. This is the case in point. The off-frequency record has been one of diminishing proportions for a number of years and disqualifications have been less numerous, until this recent history, a pleasant enough record indeed. Perhaps the record has looked so good that precautions have been neglected, by some operators. Hams (too trusting) have depended on other hams being in the band, and matched them kilocycle for kilocycle, hoping to work at the absolute limits of the bands. Or some have deliberately worked outside. At any rate some stations were heard scores of kilocycles off frequency! Factors of safety must be allowed for crystal temperature drift or tank tuning. Even an oven is not absolute insurance unless checks are made. Several frequencies of oscillation for one crystal, transmitter parasitics, one must check for all if certainty in adjustment is to prevail. Our contest rules set a time limit but did not penalize any operator for taking all the time necessary to check with accurate markers, WWV, W9XAN-W6XK s.f. transmissions, broadcast station harmonics, etc. Frequency measuring equipment is more reliable, abundant, and inexpensive than ever before, so we must state our belief that too much haste, too small a factor of safety, too little operating distance from the right side of a band edge, too little use of QMH and QML-type operating may have something to do with the contest difficulties.

DISQUALIFICATIONS

To combat this trend, in line with past practice, A.R.R.L. Official Observers in the United States and Canada were asked to do as much special monitoring of the bands as possible during the contest period. A firm policy has been observed this year of barring from QST mention in preliminary and final DX contest reports, and from awards, any operators checked in a violation by two or more Observers with standards of known and sufficient accuracy. We are going to "hew to the line" to the extent of listing the stations that have been so checked by receipt of a satisfactory weight of evidence against them. The Wouff-Hong and the Kellyswitch were designed by T.O.M. for just such emergencies that threaten the fair name of our amateur radio service. All amateurs should be grateful and thankful to the individual observers who cooperated in keeping our hobby self-regulatory. In addition, letters from participants indicated that a great many of those A.R.R.L. checked in the U.S.A. also received notices of violations direct from the F.C.C. so that we have a double check on the accuracy of our Observers' work. Our evidence is concrete. Of course a single F.C.C. citation, if we know about it, is more than enough to disqualify. In two instances where F.C.C. discrepancy citations
were admitted by letter we respected the honesty and good intentions of the writers but, in fairness to others, felt we had to list the calls. In no case where stations have been reported in violation by official sources so that it is a case of violation beyond any reasonable doubt do we believe that that operator rates favorable contest publicity in QST, since whether the trouble was caused by carelessness, accident or other reason the result is the same in adding to the record of amateur violations, and is therefore against the best interest of all amateurs. We personally sympathize with unintentional offenders. It is our painful duty to umpire, however. The lesson is that greater care must be observed.

Our listing of stations observed out of the bands includes a number of foreign as well as W/VE amateurs, in accord with the policy stated in an Official League Broadcast released at the beginning of the contest. We regret the necessity of this listing, and we appreciate that many other stations besides those listed may have been missed inadvertently that were equally at fault. A consistent policy that reduces possible criticism of our off-frequency operating at international conferences, however, requires amateurs of all countries to observe their assigned bands. We are glad to report that there was not the required weight of evidence to disqualify any VK's, G's, ZT's or ZL's, which doubtless means that more careful frequency observance is the rule in those countries. One strong station was reported by an observer as breaking a point to point public service station badly so that a message had to be repeated eight times to get through. If such stations besides those listed may have been.

In earlier years the DX testing and competition required amateurs of many a past DX contest to work a lot of stations to get the results he needed to earn his DX points. Today, with so many stations being heard, it is not necessary to work as many stations to get DX points. However, we must still be aware of amateurs who operate off-frequency and are not willing to correct their mistake.

The following are deemed ineligible for DX-scoring lists, or awards, in the March 1937 DX competition in accordance with the above policy.

W1BEQ W1BUX W1DC* W1FJN W1GLF W1HP W1IL* W1JR W1NJS W1NFE W1PL W1RY W1ZB.
W2AZL W2AZN W2BDZ W2BYP W2DZA W2GD W2GUP W2GYX W2HEN W2HXI W2HW W2KAN W2YV.
W3BOP W3BZE W3DF V3EFY W3EH W3EMM W3EQ W3ET V3FQW W3FQZ W3FSC W3GAP W3GHB* W3GKO W3QM.
W4AGI W4AUU W4BQO W4BSJ W4CRZ W4DCZ W4DTR.
W5ASG W5DQD* W5EM W5FAS W5FBN.
W6AZC W6BYB* W6CUTZ W6D7B W6HB W6HT W6ITU* W6JJ W6JHH W6KGD
W6KRI* W6KUR W6LZV W6MHH W6MKL W6MTC W6NKR W6NYA W90EH W90HN
W6TT W6WG.
W7BD W7DZX W7EK W7ESM W7FMD W7FTU W7JL W7VQ.

(Continued on page 118)
A Universal Exciter With Variable-Frequency Crystal Control

Combining Reliability and Convenience in Relay-Rack Construction

By James Millen,* W1HRX

In recent years the trend in both amateur and commercial transmitter design practice seems to be toward the treatment of the exciter as a separate unit. During the past year or so, much progress has been made in the design details of exciter units with a view toward increasing their reliability, compactness, universal applicability, ease of band-shift, and vernier control of frequency adjustment.

In the unit described herewith an attempt has been made to consolidate the desirable features of several exciters described in recent issues of QST, and to incorporate some of the newer types of components only more recently available, to form a complete unit having the following characteristics:

- An effective, dependable circuit
- Variable frequency control
- Pre-tuned band shifting
- Compactness
- Universal application
- Ease of construction
- Relative low cost of component parts

The Circuit

Though many amateurs favor a Tri-tet oscillator, we have been partial to a triode crystal oscillator with triode doublers, using tubes such as the 53 or 6A6, as originally developed by W1CTW.1 This system has been described so often that details are scarcely necessary here.

In some layouts, such as used in another recent transmitter employing a variation in the original circuit, a material simplification of the circuit wiring is secured by criss-crossing the functions of the two tubes; half of the first 53 is the oscillator, half of the second 53 is the first doubler; then back to the first 53 for the second doubling and then on to the second 53 again for the final doubling. In this instance, however, the neater arrangement is secured by wiring the triode sections in straight sequence, rather than by "criss-crossing."

Another circuit detail which, while neither new nor original is yet seldom seen in amateur equipment, is the method of using a dummy plug for switching the d.c. meter from one circuit to another, rather than the more general practice of conventional jacks with a plug-and-cord connected to the meter.

By using 6-prong plug-in bases for the pre-tuned tank circuits it is possible to have an independent link-coupling winding on each output tank and to connect all of the corresponding socket terminals in parallel across the output terminals. In practice it will be found advisable, for quick band shift, to have additional tank circuits fitted with the output coils for those bands upon which the exciter is to be operated, insomuch as the loading of the link circuit appreciably changes the tuning of the tank coil being used in the output stage, as against the tuning of that same tank coil when the output winding is

open and the stage is being used as a doubler. If, however, the slight additional time required to re-tune the tank is of less importance than economy, then, of course, the one unit can be made to serve double duty by means of a slight retiming operation.

Even at 28 Mc. with such a circuit ample output is obtained to drive a 35T, RK37 or a similar tube as a buffer operating on the final frequency; which, in turn, can fully drive most any final amplifier that can be legally used on the amateur bands. The exciter output will also provide ample excitation for pentodes of the RK-20 type without an additional buffer.

Those many 28-Mc. stations that have been QSO W1HRX on Sundays during the past December and January may be interested to know that the r.f. portion of the transmitter used comprised this exciter driving an RK37 buffer which, in turn, drove a pair of RK38's. The complete assembly, shown in the photo, is in actuality but a relay-rack mounted version of an earlier base-mounted single-unit transmitter that time had proved to be extremely satisfactory.

VARIABLE FREQUENCY CONTROL

It is an easy matter in the design of such an exciter to use a multiplicity of fixed crystals and a selector switch. With present QRM conditions it is frequently more desirable, however, to be able to make a relatively minor shift in frequency in order to avoid an objectionable heterodyne, and for this purpose the value of the variable air-gap holder with low-drift tunable type crystal cannot be too strongly emphasized. The usefulness of such an arrangement increases materially with increasing frequency for, while the frequency of the unit with constant output is of the order of but six kilocycles in the 3.5-Mc. band, this same unit has a range of over 50 kilocycles in the 28-Mc. band!

FRONT VIEW OF THE EXCITER UNIT WITH THE COILS REMOVED

The dial in the center is the crystal gap control for varying frequency. A dummy plug is fitted into the four jacks for meter switching. Between the jacks at the left is the pilot light and between those at the right is the on-off toggle switch.

THE COIL ASSEMBLIES

The FXTB exciter tank units of the special 6-prong type were chosen in order to provide ample contacts for the output link circuit as well as to make possible the use of the special isolantite sockets designed primarily for plug-in coils rather than tubes. In addition to the shield can and the R39 plug-in base these units comprise an Isolantite plate upon which are mounted two double-spaced midget variable condensers, completely isolated from each other so that they may be used in series, parallel, or any other combination desired. To the bottom of the Isolantite plate, directly under the condensers, is fastened an R39 coil form. The photo of the disassembled units shows this arrangement. The Table gives full data for winding the coils.

In the 28-Mc. output unit only one of the dual tuning condensers is used and even that is set at a relatively low value of capacity. At the lower frequencies the two condensers in each unit are connected in parallel. By such an arrangement one condenser is roughly set and then a fine adjustment made on the other, which facilitates accurate tuning.

One of the contact pins is used for grounding the shield. This connection to the shield can be made most easily by means of a soldering lug between the shield and the base (located where it will be gripped by one of the screws) and connected to the pin by a bus-wire jumper. In soldering a screw is used to hold the lug in proper position, and when soldered the shield can be removed at will without breaking the connection. The lug should be of the shakeproof variety, so that there

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However, the trend, among most amateurs at least, is away from the home construction chassis, cabinets, and other such metal units requiring considerable shop facilities if a really first-rate final appearance is to be had. On the other hand, the amateur who uses a commercial foundation unit still has all the fun of circuit development and experimentation, and, at the same time, secures a piece of finished equipment that he is proud to display.

The foundation unit was originally designed to be as versatile as possible. In our application it is mounted behind a standard relay rack panel, in which is cut and mounted a hinged door. This door, of course, is not entirely necessary, and, from a purely performance angle, may well be dispensed with. Furthermore, there is, of course, (Continued on page 68)

**CONSTRUCTION DETAILS**

The metal chassis unit around which this exciter has been constructed is a standard commercially available component but may be readily home-constructed by the more ambitious amateur. Often a smooth lug will not bite through the oxide film on the aluminum surface.

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**REAR VIEW OF THE UNIT WITH THE BACK AND THE DUST COVER OF THE CONTROLS REMOVED TO SHOW THE WIRING**

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**FIG. 1—FOUR TUNED CIRCUITS WITH TWO DOUBLE-TRIODE TUBES ARE USED IN THE EXCITER CIRCUIT. THE TRIODE ELEMENTS ARE DIAGRAMMED SEPARATELY FOR CLARITY**

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**COIL TABLE**

<table>
<thead>
<tr>
<th>Band (Mc.)</th>
<th>$L_1$</th>
<th>$L_2$</th>
<th>$L_3$</th>
<th>$L_4$</th>
<th>$L_5$</th>
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<tbody>
<tr>
<td>Coils</td>
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<tr>
<td>L1, L2, L3, L4—Plate coils in shielded units (see coil table).</td>
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<tr>
<td>L5—Output link coil (see table).</td>
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<tr>
<td>C1, C2, C3, C4—Two 35-µfd. ultramidget tuning condensers in parallel except for 28-Mc. (Included in National FXTB coil units—see text).</td>
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<tr>
<td>C5, C6, C7—100-µfd. mica condensers.</td>
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<tr>
<td>C8, C9, C10, C11—0.01-µfd. mica condensers.</td>
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<tr>
<td>R1, R2, R3, R4—10,000-ohm 2-watt grid-leak resistors.</td>
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<tr>
<td>RFC—2.5-millihenry r.f. choke (National Type R-100).</td>
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<tr>
<td>M1—0–50 d.c. milliammeter (Trip-limit).</td>
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<tr>
<td>The crystal is a special Hollister type in a National Type CHV Vari-Gap crystal holder.</td>
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</table>

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**QST for**

26
How Would You Do It?

Announcing the Prize Winners in the Third and the Problem for Fifth in the Series of Practical Problem Contests

This problem contest business is turning into a tremendous success. The solutions may not be setting the world afire but at least they are giving us an insight into human ingenuity which we only glimpsed before.

There is really a wonderful spirit on the part of our contributors all along the line. We feel quite certain that many genuinely valuable contributions will be brought to light before we get through. Of course, this third contest was no slouch! Indeed, we consider that the two winning papers are genuine honest-to-goodness contributions.

Walter Van B. Roberts, W3CHO, rings the big bell this time with a scheme for varying the link coupling without sloppy wires, movable coils, or mechanical attachments to the tanks themselves. It is a glorious example of the virtue of extreme simplicity.

O. K. Blackburn, W9MB, wins by a thin hair the second prize from George A. Bonadio, W5OMM. Both provided similar solutions. W9MB's paper got the extra vote. The remaining pile of contributions contained much of interest and almost all of the schemes suggested were perfectly practical. Most of them, however, involved complex mechanical structures and none of them, in the opinion of the judges had quite that clean-cut simplicity and practicability that characterized the winning scheme. Without more fuss, therefore, we hand them to you.

Variable Link Coupling

By W. Van B. Roberts, W3CHO

Link coupling between tuned circuits is a widely used arrangement offering a number of advantages, perhaps the most important being that the coils may be located quite a distance apart. However, with simple link coupling it is not easy to vary the coupling between push-pull coils without upsetting the symmetry of the arrangement unless, for example, a special coil form is used that permits the link to be moved symmetrically with respect to the coil. Even this requires mechanical moving parts made up to suit the particular job. The arrangement to be described is offered as giving the desired ability to vary the coupling without any moving parts except a single movable clip.

Fig. 1 (a) shows a pair of coils coupled by a link having a total self-inductance \( L \) and negligible resistance. It can be shown that this arrangement is identically equal to that of Fig. 1 (B) which is a pair of coils having direct mutual inductance between them, the coils of Fig. 1 (b), however, having inductances somewhat smaller than those of Fig. 1 (A). Fig. 1 (B) also indicates the exact values of the equivalent inductances and of the equivalent mutual.

Let us suppose that \( M_1 \) and \( M_2 \) and \( L \) are so chosen that the resulting coupling is somewhat greater than desired. The problem then is to find a convenient way to reduce this coupling, preferably without changing \( M_1 \) or \( M_2 \) since this would involve moving the link turns relative to the coils, which is not easy to do if the link turns are to be kept at the low radio frequency potential points of the coils.

From Fig. 1 (B) it will be seen that the effective mutual between coils can be decreased by increasing \( L \), a fact that suggests Fig. 1 (C) as a simple means for reducing the coupling. In Fig. 1 (C) we have merely an ordinary link coupling with a small series inductance added and provided with a clip connection so that more or less of it may be included in the link circuit. The

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the extra coil is entirely out of the link circuit, it is important to design the link to have a sufficiently large value of \( \frac{M_1 M_2}{L} \). This brings up the matter of the number of turns at each end of the link. Let us suppose that we have one turn at each end to begin with. What will be the effect of increasing this to two turns at each end? First of all, the mutual at each end will be doubled so that the product of the two mutuals will be increased four times. But at the same time, the self-inductance \( L \) of the link circuit will be increased. If, for example, \( L \) should thereby be quadrupled, there will be no increase in the effective coupling. In actual practice, however, there is always some self-inductance in the conductors connecting the two link coils together, and also if the two link turns are spread apart a little from each other, then even the inductances of the link turns will not be quadrupled by doubling the number of turns. Hence, in practice increasing the number of turns at each end will increase the effective coupling especially if these turns are not too tightly bunched together. The necessary number of turns in any particular case must be determined by experiment, although in many cases the minimum number is probably known from previous experience.

The usual plug-in coil arrangement for a push-pull coil having three plug terminals for the coil itself, and two more for the link turns may well be used. The link turns might be composed of heavy wire covered with spaghetti and wound between turns of the tank coil. As for the decoupling inductance to be inserted in the link circuit, this might be wound on any kind of fixed or plug-in coil form and would preferably be made of bare wire sufficiently heavy and well spaced, to permit easy clip connection to any turn. The size and number of turns is best determined by trial, although as a guide it is obvious that the total inductance of the decoupling coil should be several times that of the rest of the link circuit in order to be able to reduce the effective coupling to a considerable extent. The rest of the link circuit should be made of heavy insulated wire, preferably twisted together to keep its inductance low.

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Continuous Variable Link Coupling

By O. K. Blackburn, W9MB

The simplest and most obvious solution to our hero’s latest problem is the division of the link into two parts with variable inductive coupling

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Problem No. 5

Our hero is making grand progress with his new rig but he is determined to take time out, before it is quite completed, to build himself an inexpensive operating table to serve, as he modestly puts it, “as the nerve center of the entire installation.” He is not much of a carpenter and his woodworking tools are rather inadequate. He demands that the ideal design for his requirements would have to be a fairly simple structure. He would be floored, for instance, at the idea of building a layer of drawers. But in spite of its simplicity, the creation must provide him with a thoroughly practical and completely comfortable operating position. There must be room for his standard superhet receiver and its external power supply, a loudspeaker, a small monitor, the usual key, microphone and control switches. There must be some sort of accommodation for message blanks and messages, for miscellaneous notes, for pencils, for the log and call book. There must also be room for the plug-in coils and other miscellaneous gadgets which ordinarily make a junk pile out of so many operating tables. All of these things are usually stacked on the top of a perfectly plain table, but our friend has seen enough arrangements of that sort to feel strongly that the effectiveness of his operating work, the general appearance of the station and his own personal comfort could all be aided if he only had the design of a really well-considered “nerve center.”

The exact shape and size of the present equipment to be mounted on the bench do not enter the picture since, without much doubt, new—perhaps bigger, perhaps smaller—equipment will take its place long before the furniture is worn out.

Sketches of the proposed bench are required. All important dimensions should be included.
Ultra-Midget Equipment for the Ultra-High Frequencies

A Complete Transmitter and Receiver for Personal Wear

By Jack Wagenseller,* W3GS

THE writer was called upon to design and construct one of the smallest practical ultra-high frequency transmitters that could be conceived. It had to be small because it had to fit into a man's coat pocket, since the purpose for which it was to be used necessitated that it be completely concealed in a person's clothing, antenna, microphone, batteries and all.

A similarly small receiver was also required, but its design is quite simple as compared to the transmitter.

A dozen uses to which a small transmitter of this type can be put immediately suggest themselves. However, it might be mentioned confidentially that the apparatus described was designed and constructed for a duly licensed amateur engaging in a so-called "magic act" where the person with the concealed transmitter interviews people in the audience and a partner on the stage with the concealed receiver apparently "knows all the answers." The exact details as to how this is carried out will be left to the imagination of the reader. The units also have no end of usefulness for novelty remote pickups in which the announcer can walk around in crowds and large gatherings.

The complete transmitter measures only 4-by-4-by-2 inches and weighs only 1 3/4 pounds. A complete set of batteries for operation of the transmitter weighs only 2 3/4 pounds. These are carried in a specially constructed belt which fastens around the waist. Two Burgess type X30FL midget 45-volt "B" batteries are used for supplying plate voltage. Four small flashlight batteries are connected in series for a filament supply of 6 volts, and a small 4 1/2-volt analyzer type battery is used for supplying microphone voltage. The "B" batteries mentioned will provide approximately 30 hours continuous operation. The filament batteries must be more frequently replaced and have sufficient capacity for approximately 5 hours continuous service. The flashlight batteries are to be preferred for filament supply since they are economical and easy to obtain. A small container was constructed for these cells in order that they may be quickly and easily replaced. The four cells are held in place and automatically connected in series in

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this container by means of spring brass contacts.

The receiver is exactly the same in size as the transmitter but slightly lighter in weight, weighing only 1 1/2 pounds. The battery supply for the receiver is exactly the same as that for the transmitter except that the small microphone battery is, of course, not required in this case.

Most of the constructional details will be furnished on the transmitter since this is by far the more difficult of the two units to construct. A regular Hartley circuit is used with a 955 acorn tube as a self-excited oscillator. This is plate modulated by another 955 acorn tube operating in Class-A. Sufficient audio power is developed to modulate the oscillator adequately even when talking quite some distance from the microphone. Either a single- or double-button carbon microphone may be used, but the single button will, of course, be more sensitive with the limited amount of gain available in the modulator.

If it were not for the ultra-midget microphone transformer and ultra-midget modulation choke, the construction of a transmitter this small would be next to impossible. These units measure only 1 3/8 inches square by 1 1/2 inches high, and weigh only 5 1/2 ounces each. The microphone transformer will accommodate either a single- or double-button microphone. These units are standard and are readily obtainable.

If it were not for the ultra-midget microphone transformer and ultra-midget modulation choke, the construction of a transmitter this small would be next to impossible. These units measure only 1 3/8 inches square by 1 1/2 inches high, and weigh only 5 1/2 ounces each. The microphone transformer will accommodate either a single- or double-button microphone. These units are standard and are readily obtainable.

Since it would be practically impossible to construct the transmitter in one piece, to make construction and assembly easy the unit is built in two sections each separately assembled and wired as completely as possible. The two sections are then placed in the cabinet and the few remaining connections joining the two units are made. The oscillator section is constructed on the top shelf and the modulator assembly constructed on the bottom section. A general idea of the parts layout can be obtained from the accompanying photos. On the top shelf, left to right, are the tank tuning condenser, tank coil, antenna condenser and tube. On the bottom shelf, left to right, are the output choke, tube and input transformer. Fixed condensers, resistors and r.f. chokes are placed where space permits. Battery leads are brought out in a four-wire cable with a midget male cable connector on the end. The battery belt is wired with another four wire cable with midget female connector on the end. Microphone and antenna circuits terminate in small tip jacks.

The receiver is constructed in more or less the same manner as the transmitter. The detector section is constructed on the top shelf and the audio stage on the partition and bottom of the cabinet. The only transformer used in the receiver is a midget audio transformer such as is used in midget broadcast receivers.

An antenna approximately 40 inches long is used for full power output in the 56-Mc. band. However, for very short distances such as in the "magic act," a non-resonant antenna as short as 18 inches may be used with good results. With the non-resonant antenna, the useful transmitting range is approximately one block and with

(Continued on page 188)
A Versatile Oscilloscope Using the 913
Including Linear Sweep, Amplifier and Sine-Wave Audio Oscillator, Adaptable to Both Amateur and Servicing Requirements
By Herbert W. Gordon, WIIBY*

An extremely useful, if not essential, part of the modern amateur station is the cathode-ray oscilloscope. Its advantages as a measuring device, particularly in connection with checking transmitter performance, have been previously described at length. It is not the purpose of this article to "compete" with contemporary stories on the whys and wherefores of the oscilloscope, but rather to give constructional details of an oscilloscope having a high degree of flexibility which makes it readily adaptable not only to the usual amateur measurements but also to receiver measurements and other uses to which the cathode-ray tube can be put.

In the design of equipment the amateur must always take into consideration two items: cost and purpose. The introduction of the 913 cathode-ray tube has helped considerably in bringing the cost of an oscilloscope within reach of a large number of amateurs. When purpose is discussed, the considerations become more involved. At the outset, it may be said that amateurs interested only in checking percentage modulation and making routine transmitter adjustments need but build the fundamental circuit around the 913. A 60-cycle sweep (or one taken from the modulator) is all that is needed, and the filament and plate power may be secured from the receiver power pack.

For a wider range of usefulness, however, a more elaborate arrangement must be used. A linear sweep is essential, for instance, for the study of audio-frequency wave-forms. Likewise, the incorporation of an amplifier in the oscilloscope not only is a necessity for the inspection of voltages too low in themselves to give a good pattern on the cathode-ray tube screen, but also increases the flexibility of the instrument by permitting the reduction of too-large voltages to a value suitable for the 913 deflecting plates. Third, in testing audio amplifiers a source of audio-frequency voltage of good waveform, controllable in amplitude, is always a necessity, and the inclusion of such a generator in the oscilloscope itself is a decided convenience. Finally, when these elements are combined with a switching system which gives real flexibility, a piece of equipment with a wide variety of applications results.

The complete circuit diagram of the oscilloscope, with power supplies, is given in Fig. 1. In all, there are eight tubes, including the 913. The linear sweep circuit utilizes an 885 gas triode and a 6K7 as a current limiter in the conventional circuit. A 6N7 double triode is used as an audio-frequency oscillator in the sine-wave circuit previously described in QST. The resistance-coupled amplifier uses a 6J7, readily cut in and out of the circuit by a switch. In the power-supply end there are three high-voltage supplies, two from one transformer. Half-wave rectifiers, with Type 1V tubes, are used for the oscilloscope and sweep circuits. The supply for the 6J7 amplifier and 6N7 oscillator uses a 5Z4 full-wave rectifier with a resistance-capacity filter.

Constructional Details
The entire unit is housed in a black-crackle metal box measuring 14 by 8 by 7 inches, provided with the usual chassis to fit inside. All parts

*77 Oxford St., Hartford, Conn.

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are mounted on the chassis and panel to facilitate construction and removal. Because the space between the top of the deck and the top of the cabinet is limited, it is absolutely necessary to use metal tubes except as indicated. Glass tubes of the 57 and 6A6 type won't fit.

It is well to check the values of all parts before placing them permanently in position. Since the oscilloscope is used to show up flaws in other devices it must be flawless in itself. RMA standards, when adhered to, are good but too often error enters into the manufacture of items, causing trouble later.

The general arrangement of parts is shown in the top view. The three transformers across the rear of the chassis are (from left to right in the photograph) the power transformer for the amplifier, \( T_1 \), the synchronizing transformer, \( T_2 \), and the power transformer for the 913 and sweep circuit, \( T_3 \). Between \( T_1 \) and \( T_2 \) is the 5Z4 rectifier; the two 1V rectifiers are between \( T_2 \) and \( T_3 \). The 913 is centrally located above the chassis; to its left in the photograph are the 6J7 amplifier and the 6N7 audio oscillator. To the right of the 913 are the 6K7 current limiter and the 885 gas triode. The various switches and controls are of course mounted on the panel. Nothing is critical about physical layout except that if r.f. is to be applied to one or both sets of deflecting plates the leads which carry the r.f. to the plates should be isolated from the other wiring and parts.

The transformer \( T_2 \) is one made by Kenyon especially for the 913. It is small physically and serves admirably. Since the 913 consumes negligible plate power, the transformer's current-carrying capacity is small, hence the bleeder across the power source must be high in resistance to prevent overload. The values recommended take
approximately one milliampere. Because of voltage buildup in the condenser-input filter of the high-voltage supply, two 8-µfd. 400-volt condensers are wired in series to prevent possibility of breakdown. A new type of compact condenser is now available, which helps materially in the space problem.

The 913 tube is mounted on a piece of electralloy cut to the dimensions given in Fig. 2 and bent as shown in the top-view photograph. An Amphenol socket makes it easy to shift the position of the tube so that the deflecting plates can be lined up to give really horizontal and vertical displacement. The whole mounting is fastened to the chassis with wing bolts so that removal is easy should it become necessary to replace the tube.

The use of several different colors of push-back wire and a consistent coding for the colors helps in the connection of switch leads, potentiometers, and other parts. Cabling the wires gives the job that commercial appearance. The liberal use of spaghetti, rubber grommets and bakelite mounting strips is recommended. If the parts are mounted either vertically or horizontally and the wiring made as neat as possible, the oscilloscope will be easy to service.

CONTROLS

In the order of their appearance in the panel view, the controls in the top row from left to right are:

1. Sweep amplitude control, \( R_{24} \). This control varies the width of the pattern when, as normally used, the sweep voltage is applied to the plates giving horizontal deflection.

2. Amplifier gain control, \( R_{1} \). When the amplifier is in use, the height of the pattern is controlled by the setting of this resistor.

3. Intensity control, \( R_{15} \). This control should be adjusted for suitable pattern brilliance and need not be touched thereafter during a given set of measurements. In general, the intensity should be as low as possible since the pattern will be most sharply defined under these conditions.

4. Focusing control, \( R_{17} \). Adjust to give uniform spot or line thickness, making the line as fine as possible. There is always some interlocking between settings for intensity and focus, so the two controls should be adjusted back and forth to give the most sharply-defined pattern.

5. Audio oscillator feedback control, \( R_{5} \). This control changes the generated frequency to some extent, and also affects the purity of the output wave-shape. Once set to give the nearest possible approach to a sine wave (as judged by comparison to 60 cycles, for example) it may be left alone.

6. Synchronizing control, \( R_{11} \). Used to lock the sweep-circuit frequency to that of the signal under observation, or to a sub-multiple of the signal frequency.

In the bottom row, the controls from left to right are as follows, continuing the numbering started above:

7. Coarse sweep-frequency adjustment, \( Sw_{6} \). By selecting condensers of different capacities in the 885 relaxation-oscillator circuit, this switch changes the sweep frequency in roughly harmonic steps. The total frequency range is approximately 4 to 21,000 cycles per second. Lowest frequency will be found with the largest condenser cut in circuit, and vice versa.

8. Fine sweep-frequency adjustment, \( R_{13} \). For adjustment to desired frequency between the coarse steps provided by \( Sw_{6} \).

9 and 10. Input switches for deflecting plates, \( Sw_{a} \) and \( Sw_{b} \). By means of these switches, either set of plates can be connected to (a) sweep-oscillator output, (b) either of the external binding posts marked “horizontal input” and “vertical input,” (c) amplifier output, (d) off. It is therefore possible to reverse the horizontal and vertical deflections, thus shifting the pattern by 90 degrees, at an instant’s notice, as well as to use either pair of plates for the sweep voltage or the voltage being scanned.

11. Audio oscillator output control, \( R_{5} \). The oscillator on-off switch, \( Sw_{9} \), is mounted on this control.

12. Synchronizing transformer switch, \( Sw_{4} \). This control selects the transformer ratio from the several available with the particular type of transformer used. Not really essential, but may be desirable when an exceptionally large voltage is applied to the “synchronizing input” terminals. Normally, the switch is set so that the whole transformer secondary is in use.
The left-hand toggle switch between the two rows of controls is the a.e. on-off switch, Sw. That at the right is the amplifier output switch, Sw1. This switch connects the output of the amplifier either to the deflecting-plate selector switches or to the primary of the synchronizing input transformer. Ordinarily it is left in the deflecting-plate position.

The large number of controls gives a high degree of flexibility, not only in the measurements of external signal sources which may be made, but also in internal connections.

OPERATION

To get into operation, first set the focusing and intensity controls, R17 and R18, at maximum and close the line switch, Sw5. Sw9 and Sw7 should be set to the “off” position, marked “X” in Fig. 1. After the tubes heat, a luminous dot should appear in the center of the screen. The intensity and focusing controls may then be manipulated to make the dot small and sharp and of suitable brightness.

Next, connect the output of the sweep oscillator to the horizontal plates by setting Sw7 (or Sw6, whichever may be connected to the set of plates actually giving horizontal deflection) to the appropriate tap. The dot should change into a line extending across the screen horizontally. To change the length of the line, adjust R24. If the sweep-frequency switch, Sw6, should happen to be set at the low-frequency end of the scale, there will not be a continuous line but a slowly-moving dot. The remedy is to increase the sweep frequency.

Now apply the signal to be observed to the “vertical input” terminals and connect Sw9 to the same terminal (“Y” in Fig. 1). If the signal amplitude is of the order of 25 to 50 volts r.m.s., a pattern of usable size should appear on the screen. To get a stationary figure, connect the signal source also to the “synchronizing input” terminals (a direct connection between the two sets of binding posts on the oscilloscope is all that is necessary) and adjust the synchronizing control, R11, to lock the sweep circuit to the external frequency. Adjustment of Sw9 will determine the number of cycles that appear on the screen; with the oscillator on the same frequency as that of the signal one cycle will appear, on harmonics only part of a cycle, and on sub-harmonics a number of cycles depending upon the ratio of signal frequency to oscillator frequency. For example, with the sweep oscillator on 200 cycles locked by a 1000-cycle signal under observation, five cycles will appear on the screen.

Operation of the audio oscillator is quite simple. With the constants given, the frequency will be approximately 1000 cycles per second. The frequency may be varied slightly by adjustment of Rs, although if this control is advanced too far the tube may go out of oscillation. After a tone to the liking of the operator is found this control need not be touched. Incidentally, a key in series with a headset connected to the “audio output” terminals makes a splendid code-learning set.

In checking an audio amplifier, the output of the audio oscillator should be fed through a twisted line to the input of the stage being studied. Checking the output with phones or with the oscilloscope permits excellent comparison. For this test it is easy to shift from the oscillator itself to the output of the stage under observation merely by flipping the deflecting plate switch.

By increasing the audio amplitude control one can see where distortion starts. If this control is calibrated in terms of volts, audio gain measurements are easily made. Distortion from grid overloading is readily apparent, the pattern flattening on the positive half-cycle and lengthening or cutting-off completely on the negative half-cycle, depending upon the grid bias.

(Continued on page 118)
The 1936 Sweepstakes
Seventh National QSO Contest Results

By E. L. Battey,* W1UE

6,946 QSO's!! That's the total of the 660 operators reporting scores in A.R.R.L.'s Seventh All-Section Sweepstakes Contest! It was a "QSO fiesta" with plenty of contacts for all, a grand party, thoroughly enjoyed both by high and low scorers. Like each of its predecessors the seventh SS "hit the spot."

The '36 SS contest layout was changed somewhat from previous years. Rather than the old "nine-day" plan, activity took place within two 33-hour week-ends, each contestant being allowed to operate any 40 hours out of the 66. A second change reduced the former "complete message exchanges" to merely an exchange of "message preambles." This speeded up the contest considerably. Each preamble contained all the essential details needed for each QSO. The "check" portion consisted of the RST report of the station worked, the doing away with the necessity of giving signal reports separate from contest exchanges. These changes in "operating time" and "exchanges" were received with widespread favor, many claiming they made the SS "better than ever." One feature that kept competition "razor sharp" was the procedure of making the preamble numbers correspond with the number of the QSO's. It was always pleasing to note that the other fellow's numbers were only up to 50, while yours had already passed the 100 mark . . . or, similarly, what a shock it was to see another operator's numbers running higher than yours—and how you dug in to cut down his advantage!! Some fun.

THE WINNERS

Certificate awards are being made to the winners in 68 of the 69 League sections. Entries were received from every section except Alaska. Separate awards were offered to the C.W. leader and the 'Phone leader in each section. 67 C.W. awards are being made. The following are winners in their respective sections: KAIUS W1APU W1BN W1BPT W1BYP W1EZ W1ED W1RY W2EMX W2FFG W2HJK W2HES W3EHW W3FMY W3FTK W4DMH/5 (now W5GEA) W4DCD W4CYC W4DTR W4ECH W4ECN W5CPB W5DGP W5DQD W5EGP W5FPD W5KC K6JPD W6FRN W6HTW W6TJY W6IZE W6IMR W6KFC W6MVK W6SN W6TT W7CRH W7DP W7EK W7ESM W8BYM W8CXR W8EMW W8GQB W8KUN W9AWP W9CBF W9ELL W9FFU W9LLW W9MGV

W9ITH—WORKED ALL SECTIONS ON TWO-WAY RADIOPHONE

D. Reginald Tibbatts, W6ITH, P.A.M./O.P.S. is the first operator to succeed in working all A.R.R.L. Sections within the duration of any contest. He worked all 69 in the two week-ends of the 1936 Sweepstakes and he worked them all on two-way phone! He made contacts on 6 bands, 112, 50, 28, 14, 3.9 and 1.75 Mc. His station equipment is as follows, looking at the photo from left to right: The first rack contains ultra-high frequency equipment and remote relaying gear. The second, more ultra-high equipment on 2½ and 5 meters, together with patch panels and power supplies. The third contains a telephone switchboard for remote and local lines, bridging amplifiers, power level indicators and the frequency standard. The fourth rack contains the exciter stages and amplifier stage of the largest transmitter. Line-ups: 6L6, 6L6, 100TH, p.p. 50T's these feed the large middle rack, which contains a pair of Elmac 500's in push-pull. This outfit runs 1000 watts on any band from 160 to 5 meters. The next rack, or sixth from the left, contains the modulators for the 500T's, four 150 T's in push-pull parallel Class A prime. The high level speech tubes which push the 150T's are below, together with power supplies. The next rack contains a high fidelity broadcast receiver with power supplies, amplifiers and miscellaneous equipment. The eighth rack contains a complete 3.9 and 1.75 Mc. phone, band switched and running about 100 watts to a pair of 10A's push-pull, modulated by another pair in Class B. This transmitter is complete in itself with power supply. The last rack on the right is a complete 50-Mc. transmitter using a pair of 100TH's in the final, modulated by another pair in Class B. This transmitter runs 500 watts on either 28 or 26 Mc. and is crystal controlled from a 6L6, 807, 35T exciter unit. The operating table shows a Sargent Model 21 receiver, speech amplifier gain controls and modulation indicator, calibrated in percentage modulation for each transmitter. The key button unit provides for seven frequencies on 28 and 14 Mc. and four frequencies on 3.9 and 1.75 Mc. Antennas are also switched from the operating position. Many antennas are used, directional diamonds and simple half-wave matched impedance types.

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W9NUF W9RQM W9TJF W9TYF W9UBB W9VKF W9VOD VE1FB VE3DR VE3ACS VE4GE VE4OC VE4SF VE5QP. 12 'phone awards are being made to the following: W3AWH W5BXM W5BZR W6BWG W6ITH W6IWI W6JSS W8EVP/6 W8OIZ W9ATP W9LLV W9PWI. Congratulations to all!

OUTSTANDING SCORERS


ALL SECTIONS WORKED

In every Sweepstakes contest since No. 1 participants have been trying to work all 69 sections within the period of the competition. In the '36 SS one operator succeeded in accomplishing this noteworthy feat—Reg Tibbetts, W6ITH, who worked them all by two-way radiophone. Such records don't "just happen"... the operator makes them happen! Station W6ITH had both excellent equipment (see photo!) and an operator who knew how to use it. By using the right band at the right time, and by using all 'phone bands (1.7, 3.9, 14, 28, 56 and 112 Mcs.) he brought the honor to his station. Congratulations. Reg. Bill Lippman, W6SN, worked all but two sections on 7 and 14 Mc. C.W. W8AQ worked 66 sections, W3BES 64, W1TS W9KEH 63, W6KFC W8BTL W9ELL 62, W4CDC W4YC W6MVK W8BYM W8OFN W3BES W8OFN W9RCQ 61, W1EZ W6 QTM W7 EK W9FU W9RSO 60.

53 operators worked 200 or more different stations. W3BES, leader in stations QSO'd (403), worked 31 of 10 stations per hour. In the '35 SS he averaged 6.3 per hour and at that time it didn't seem possible to better such a performance! W3CHH with 317 stations averaged about 8 QSO's per hour and W1EZ (301 stations) worked them at nearly as rapid a rate! Others lost no time in rolling up the contacts include W1INF (opr. Hal Bubb) and W9ELL with 241, W6KFC and W9KEH 278, W3EHW 277, W9RCQ 276, W8LLW 275, W9TWF 273, W5KC 267, W1BFT 266, W8RBN 263, W8QUS 259, W8AQ 257, W6HJT 254, W8OFN 252, W9FFU 251, W8KUN 249, W9HJK 245, W8SN and W9RSO 243, W6MVK and W8BYM 242, W4YC W240, W8BXR and W7EKB 238, VE2DR 235, W1BVP 233, K5AC (two oprs.) 226, VE3AM 224, W2BXM, W6ITH and VE3JT 223, W9NUF 221, W3FQZ 219, W2FGG 217, W1UE and W2PY 215, VE4GE 214, W9VKF.
Two hundred QSO's in a 40-hour contest represents at least 5 QSO's each hour. The QSO's must have been flying thick and fast during the SS!

RadioPhone Participation

Phone scores were submitted by only sixteen operators. Of these, twelve have already been listed as certificate winners. The highest scoring voice operator is W6ITH, 30,774 points. Ernie Thelemann, W9ATP, La Suer, Minnesota is in second place with a score of 4278-87 stations in 38 sections worked on the 28, 14 and 3.9 Mc. bands. In third place is Richard Hyde, W9PWU, Arvada, Colorado.

Using the 1.7, 3.9 and 14 Mc. bands he worked 45 stations in 23 sections, 3071 points. Other phone scores include W9NWW 2475 (41 stations, 22 sections), W6EVP 1543 (43 stations, 18 sections) W6IWU 866, W5OIZ 745, W5BZR 689. W8EVF was operating portable in Nevada and was the only operator to submit a score from that section.

Club Winners

The gavel trophy, with engraved sterling silver band, offered to the club whose members submitted the highest aggregate score, goes to the Frankford Radio Club (Philadelphia, Pa.). The scores of seven participants in this club total 109,524!! FB, Frankford! The runner-up is the Merrimack Valley Amateur Radio Association (Concord, N. H.); 96,488, followed by the Egyptian Radio Club (E. St. Louis, Ill.), 65,944; Montreal Amateur Radio Club, 57,739; Wichita (Kansas) Amateur Radio Club, 56,801; Houston (Texas) Amateur Radio Club, 56,691; Milwaukee Radio Amateurs' Club, Inc., 51,965; Oakland (Calif.) Radio Club, 50,884; 100 Watt Club (Modesto, Calif.), 45,987; Queen City Amateur Radio Club (Toronto), 32,208; Saskatoon Amateur Radio Club (Sask.), 31,407; Bridgeport (Conn.) Amateur Radio Association, 29,749;

W3FMY, VE3DA, W1BEF, W1BWF, W1HYF, W3BGD, W6NCO, W9HEO, W23KT. Awards are made only in clubs having three or more reporting participants. If any club finds that it actually had three participants, but no award has been made, we shall see that credit is given upon receipt of a list of the club members taking part.

May, 1937

37
TRANSMITTING TUBES USED

The type '10 is still a mighty popular tube. In the 1933 Sweepstakes approximately 28 percent of all contestant's used a single type '10 in the final stage of their transmitters and 10 percent used two type '10's, total 38 percent using type '10 tubes. Three years later, in the 1936 S8 we still find approximately 32 percent of all participants using type '10's! The following approximate percentages show the transmitting tubes in the final stages of transmitters used by operators in the 1936 Sweepstakes:

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single '10</td>
<td>16.6%</td>
</tr>
<tr>
<td>Single '10</td>
<td>15.2%</td>
</tr>
<tr>
<td>Single &quot;50 watt&quot; (63A, 211, 242, etc.)</td>
<td>11.7%</td>
</tr>
<tr>
<td>Two type '46's</td>
<td>6.3%</td>
</tr>
<tr>
<td>Single RE-201</td>
<td>5.7%</td>
</tr>
<tr>
<td>Single 801</td>
<td>3.1%</td>
</tr>
<tr>
<td>Two type '45's</td>
<td>2.5%</td>
</tr>
<tr>
<td>Two 801's</td>
<td>2.3%</td>
</tr>
<tr>
<td>Two type '46's</td>
<td>2.5%</td>
</tr>
<tr>
<td>Single '52</td>
<td>2.1%</td>
</tr>
<tr>
<td>Single '45</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Dozens of other type tubes and combinations were used to a lesser degree. Among the more common types following the above percentages are found single T55, single '49, two "fifty watters", two '52's, single 50T, two 6L6's.

(Continued on page 84)
A Medium-Power Transmitter Especially Designed For 28 Mc.

By Edwin A. Ruth, 3rd, W2GYL

With the rapidly increasing popularity of the 28-Mc. band there has come a desire, if not an actual need, among those who have been active on the 3.5- and 14-Mc. bands to get going on "ten." Some of the phenomenal results that have been accomplished in the past few months, coupled with the continued crowding of the lower-frequency bands, have resulted in an attempt to put a great many of the higher powered rigs on ten meters. Not a little bit of trouble has resulted from this activity and, in a great many cases, transmitters that were perfectly satisfactory on the other bands have been found woefully inefficient and in some instances actually inoperative on the ten-meter band.

With these ideas in mind and a certain amount of experience, gleaned from the construction of other medium-powered transmitters that have been functioning very successfully on the 28-Mc. band, it was decided that our own transmitter should have very much more of a commercial appearance than is generally found in ham radio. We decided to start from scratch and provide ourselves with a rig that would run at approximately 300 watts input and in which every stage would be operating below its full power capacity.

Selection of Tubes

It is not generally understood in amateur engineering circles that running tubes to their highest efficiency is productive of a great many serious effects, not the least of which is the excessive generation of harmonics. This point has been very well stressed in W1EAO's article in the February issue of QST. While pushing tubes to their limit may result in more gross watts per dollar, it has the serious advantage of creating a great deal of interference at distant receiving stations in the form of harmonics.

The selection of tubes for the speech amplifier portion of the circuit is more a matter of convenience and quality than consideration for the amount of power developed. All these tubes are being operated well within their rated capabilities. A look at the diagram will indicate that the speech amplifier is of a strictly conventional variety.

Any number of tubes suggested themselves for use as modulators but the convenience provided by the zero grid bias feature of the RK31, coupled with past experience in using these tubes to provide modulation for transmitters running at very much greater input than the 300 watts for which the present unit was designed, led to their selection. In one instance a pair of RK31's, operating in Class B at the rated voltage of 1250, provided enough power to modulate 500 watts input to 140%.

In order to make the construction of the r.f. portion of the transmitter as simple as possible, a plug-in coil band-changing arrangement was worked out which would not introduce undue complications and would, as well, hold the number of neutralized stages to a minimum. The tube line-up ultimately chosen comprises a 6C5 as a straight triode crystal oscillator, a 6L6 as a frequency multiplier, and a pair of 807's as a push-pull buffer stage exciting the 250TH in the final stage.

Although designed with special attention to efficient operation on 28 Mc., this transmitter is also adaptable to the lower frequency bands.
actually required. A direct indication of this abundance of excitation is found in the fact that
the Class-C stage, in normal operation at 300 watts input, is operating at four times cut-off bias
and the measured rectified grid current is 60 ma.

Reference to the rear view shows that the usual step-ladder construction has been avoided. There
are two important reasons for this change. One is that the assembly results in the elimination of
long filament leads. No filament lead in this
transmitter is longer than three inches. The fila-
ments for the RK30’s are supplied by two indi-
vidual filament transformers located directly
above their sockets. The second important result
of avoiding step-ladder construction is to provide
a “chimney effect” for the whole transmitter so
that the heat generated by the tubes rises toward
the top of the case and draws in cool air through
the louvres down near the floor. A distinct departure from usual construction is the inversion of the modulator tubes, which has the effect of putting the tubes themselves in plenty of free space along with a material shortening of the leads.

While it is not apparent from the picture, all of the leads in the final plate tank circuit are provided with heavy terminals which are held in place by bolts and lock washers. This has been found desirable to eliminate the overheating and the melting of soldered connections resulting from the high circulating currents in this circuit. The plate connector, at the top of the tube, has been provided with a large bronze cap which is used to dissipate the heat which develops at that point.

It will be seen that all of the wiring used to couple the various units has been cabled but the photograph does not show that the risers from the power supply chassis up to the various other elements in the transmitter are housed in steel conduit, provided with suitable "L" and "T" connectors at the points of branching off to the various components.

The primary electrical circuits are so arranged that it is impossible to open the rear door of the transmitter without removing the main power plug from its socket. The high voltage stages are wired with Lynch "Giant-Killer" cable.

By the use of suitable sockets and plug-in terminals each separate unit in the transmitter can be removed from the rack with a minimum of effort. As the direct result of this type of construction it is possible to take all of the separate units from the shop, assemble them in the shack and have the transmitter on the air within fifteen minutes.

**IN GENERAL**

Crystal oscillators, in general, have been the pet peeve of a great many radio designers and authors. We doubt that the arguments for and against particular types will ever be settled to everybody's satisfaction. In our case, we have been concerned only with providing ourselves with a crystal oscillator circuit that will accomplish a predetermined result. The circuit that we have chosen functions in an entirely satisfactory fashion electrically, and it has recommended itself to us mechanically for the reason that it requires a minimum number of parts. We make no claim for its being the best type of oscillator circuit but it accomplishes what we want.

(Continued on page 50)

**COIL DATA**

<table>
<thead>
<tr>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>L7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>28 Mc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 t. No. 18 close wound</td>
<td>4 t. No. 18</td>
<td>Split winding</td>
<td>8 t. No. 14</td>
<td>4 t. No. 18</td>
<td>8 t. No. 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length ½&quot;.</td>
<td>2 t. ea. side</td>
<td>1½&quot; dia. link</td>
<td>Link 2 t. at cold end</td>
<td>1¾&quot; dia., length 2¾&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Link 1 turn at cold end</td>
<td>2 t. link winding</td>
<td>2 t. in center.</td>
<td>Link 2 t. end winding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>length and link 1&quot;</td>
<td></td>
<td>length 3½&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>14 Mc.</strong></td>
<td>Same as above</td>
<td>Same as above</td>
<td>10 t. No. 18</td>
<td>7 t. No. 18</td>
<td>10 t. No. 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7 t. No. 18</td>
<td>except 4 t.</td>
<td>on National XR10A form,</td>
<td>Link 2 t. in- side center coil form</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>length ¾&quot;</td>
<td>each side center tap</td>
<td>Length 2½&quot;</td>
<td>link 2 t., cold end</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Link 1 t., cold end</td>
<td></td>
<td>Link 2 t. in- side center coil form</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All wire used is enamel covered.

May, 1937 41
Long-Wire Directive Antennas
Design Methods for "V"s and Rhombics

By Robert C. Graham,* W8LUQ

The more common type of directive array in amateur operation involves a multiplicity of reflectors, directors, phasing elements, radiators, etc., so arranged as to obtain the utmost power gain in a given direction. For obvious reasons these arrays are almost entirely confined to frequencies of 7 Mc. and higher. Moreover, such systems are rarely designed to permit multiband operation and yet maintain the original directivity pattern with reasonable power gain.

THE LONG SINGLE WIRE

The simplest solution to this problem is a long horizontal single-wire antenna that may be harmonically operated. For this case, however,

there still remain the shortcomings of a slight shift in directivity with frequency change, together with a power gain that is not all that might be obtained by other methods. For example, let us assume a wire 6 wavelengths long for 20 meters (396 ft.). To further simplify the explanation let us terminate the far end of this antenna in its characteristic impedance such as a 145-ohm non-inductive resistor (Fig. 1-A). This gives us a non-resonant type radiator and effectively reduces the rear radiation, resulting in a pattern similar to Fig. 1-B. (This diagram represents the theoretical free-space characteristic of the major lobes only.) The resulting directivity and power gain for harmonic operation of this antenna is then in accordance with the table in second column.

THE INVERTED "V"

In 1930 Bell Laboratory experimenters found that a greater power gain was obtainable along the bisector line of the acute angle made by two tilted wires than along the line perpendicular to the bisector as in the method just described, and that good results were obtained when this system was installed in a horizontal plane (horizontal polarization). This arrangement forms the basis for the well-known horizontal "V" (or "Vee" as it is sometimes called). This radiator (Fig. 3-A) when several wavelengths long may be harmonically operated without any appreciable directivity shift and with much greater power gains than can be obtained with the single wire. Moreover, the resulting power gain is greater than can be produced by the usual reflector-director methods involving 2 or 3 elements.

The open-ended "V" as shown is bi-directional—that is, its major directive pattern is to the front and rear along the bisecting axis. Tilting the whole horizontal plane of the "V" will tend to

* Engineer, General Cable Corp., Rome, N. Y.
increase the low-angle radiation off the low end and decrease it off the high end.

Fig. 3-B shows the dimensions that should be followed for an optimum design to obtain maximum power gain for different-sized "V" antennas. The longer-type systems give good performance on multi-hand operation. Angle \( \alpha \) is approximately equal to twice the angle of maximum radiation for a single wire equal in length to one side of the "V".

The "V" can be made unidirectional through eliminating the rear pattern by either of the following two methods:

1. The use of another "V" \( \frac{1}{4} \) wave to the rear to act as a reflector.
2. The termination of the far end of each leg in its characteristic impedance (Fig. 3-C).

The first method is quite cumbersome for amateur practice and restricts correct operation to a single frequency band.

The second method is preferable because the system becomes non-resonant (no standing waves) and is therefore more readily adaptable to multi-band use. However, a serious drawback to this method is the fact that varying ground resistance causes a variation in the terminating resistance. This condition causes reflected losses that may become severe and thereby change the entire action of the system—particularly with harmonic operation.

Should unidirectional properties be the paramount desire it is recommended that an alternate system be used. This brings us to the arrangement of two "V"s placed end-to-end, the system being terminated in its characteristic impedance; in other words, the terminated rhombic.

The "Rolls-Royce" of unidirectional antenna systems, either for transmitting or receiving, is the terminated rhombic, or diamond as it is sometimes called. The unterminated rhombic, which is bidirectional and resonant, will be described later. For the present discussion all reference to the rhombic is in its terminated form. This discussion will also pertain to a rhombic installed in a horizontal plane above ground so as to provide horizontal polarization. (Note: This system also may be constructed in the vertical plane to obtain vertical polarization, which might be of some practical advantage in ultra-high frequency applications.)

It has only been in the past few years that the amateur has made any really practical use of the rhombic \(^3\) and in nearly every case the increase in radiating performance has more than justified the installation. The system was perfected by the Bell Laboratories in the latter part of 1930 chiefly as an improved receiving antenna, and has been in more or less continual use by commercial interests for high-frequency transoceanic service since that time. The rhombic is a direct descendant of the previously-described inverted "V" and represents a radical improvement over that system in operation and performance.

The advantages of the rhombic are so numerous that we can conservatively summarize the matter by saying that it is among the best of all known directive systems—that is, by proper design, greater power gain and directivity may be realized for the rhombic than any other ordinary single or multi-wire radiator. The installation is not complicated—certainly a great deal simpler.
than the “curtain” arrays. By no means the least of its features (probably a major advantage with the amateur) is an inherently broad frequency characteristic.

FIG. 3-B—DESIGN CHART FOR HORIZONTAL "V" ANTENNAS
Enclosed angle between wires versus length of sides.

Excellent efficiency is obtained over a 2 to 1 frequency range, and on some of the larger systems a 4 to 1 range may be obtained with fair performance. On this basis it is advisable from the standpoint of multi-band operation to design the rhombic for a fundamental of 20 meters, which will then permit operation on 10 and 40 meters and in some cases satisfactory performance over the entire group of amateur bands.

RHOMBIC DESIGN

Most of the design data thus far given in various amateur publications have been rather vague and, in some cases, a trifle misleading.

As a remedy for this situation it is intended to offer design information in as “digestible” manner as possible. The general theory of the rhombic 1 will be omitted, but in so doing please do not get the idea that it is just another one of those lucky hit-or-miss systems that “just happened” to work. Some good sound engineering and mathematical principles are involved in the development of the rhombic for which the actual measured results bear out the calculated “theoretical” results to a startlingly close agreement.

First of all, in deciding on a “good location” for the rhombic it is advisable to select as flat a section of terrain as possible, because any tilt in the horizontal plane of the rhombic will lead to distorted effects upon the wave angle. If the ground is sloping it is good practice to construct the rhombic so that its whole horizontal plane is also sloping parallel to the ground. Of course, any inconsequential short sloping sections of the earth may be neglected for all practical purposes.

Next, the rhombic dimensions are worked out from a given set of conditions for which there exists a single optimum design for maximum output.

To obtain maximum output for an “ideal” condition the only given design factor is the wave angle (or angle of radiation) from which is determined optimum height, length, and angle of tilt (Fig. 4). This so-called “ideal” design may be classified into either of two alternative arrangements:

1. The Maximum Output Method, in which the greatest possible amplitude for the wave angle is obtained but not with its maximum radius at the line indicating the given wave direction of the directive pattern (Fig. 5-A).

2. The Alignment Method, in which the major lobe of the directive pattern is symmetrical with the wave angle (Fig. 5-B).

The former permits the greatest possible output whereas the latter, at only a slight sacrifice in output, has the features of a better signal-to-noise ratio for reception purposes together with the requirement of less overall space for the installation.

FIG. 4—THE HORIZONTAL RHOMBIC OR DIAMOND ANTENNA, TERMINATED

The design procedure for either condition is shown in Fig. 6, together with several examples of how this chart may be applied. Wave angles from 10° to 30° are shown in the design charts since it is considered that this is the most useful range.
for practical use. Something in the range of 12° to 25° is probably the best to strive for to obtain overall DX performance. Higher frequency-band operation of a rhombic produces a lower wave angle than the fundamental frequency-band, and vice-versa for lower frequency-band application. The chart shown in Fig. 6 is computed from the following formulas:

\[ H = \frac{\lambda}{4 \sin \Delta} \]

\[ \sin \phi = \cos \Delta \]

\[ l = \frac{\lambda}{2 \sin^2 \Delta} \]

(for maximum output method)

\[ l = \frac{371 \lambda}{\sin^2 \Delta} \]

(for alignment method)

(1) Given Desired wave angle (\( \Delta \)) = 18°.
To Find: \( H, L, \phi \).

Method:
Draw vertical line thru point "a" (18° wave angle—abscissa).
Read intersection of this line on each curve on its corresponding scale.
\( e = \) angle of tilt (\( \phi \)).
\( d = \) height (\( H \)).
\( c = \) length (\( L \)) for ideal case.
\( b = \) length (\( L \)) for alignment case.

Result:
\( \phi = 72° \).
\( H = .81 \) wavelengths.
\( L = 3.25 \) wavelengths (either may be used).

(2) Given Available and effective height (\( H \)) = .7 wavelengths.
To Find: \( H, L, \phi, \Delta \).

Method:
Draw vertical line thru point "f" (.7 wavelengths—abscissa).
Read intersection of this line on each curve on its corresponding scale.
\( g = \) angle of tilt (\( \phi \)).
\( h = \) length (\( L \)) for ideal case.
\( i = \) length (\( L \)) for alignment case.
\( l = \) wave angle (\( \Delta \)).

Result:
\( \phi = 69° \).
\( L = 3.9 \) wavelengths (either may be used).
\( L = 2.9 \) wavelengths (see text).

\[ \Delta = 21° \]

where \( \lambda = \) wavelengths
\( \Delta = \) wave angle (degrees)
\( \phi = \) angle of tilt (degrees)
\( l = \) length of one leg (wavelengths)
\( H = \) effective height (wavelengths)

In the event that the situation arises wherein it is impossible to meet these design requirements for some reason or other (i.e., lack of longitudinal space, height, etc.) there are, fortunately, two compromise design methods that allow operation at only a slight gain reduction over the "ideal" cases just described.

The first compromise method is based on an original given premise of length and height from which is determined the proper angle of tilt and corresponding wave angle.

FIG. 5—TYPICAL VERTICAL CHARACTERISTICS FOR THE RHOMBIC Antenna Obtained by the Maximum Output Method (A), and the Alignment Method (B).

FIG. 6—RHOMBIC ANTENNA DESIGN CHART
The use of the Chart is illustrated by the following examples:

(3) Given: Length for 1 side (ideal case) \( L = 3.0 \) wavelengths.
To Find: \( H, \phi, \Delta \).

Method:
Draw vertical line thru point "m" (3.0 wavelengths—abscissa).
Read intersection of this line on each curve on its corresponding scale.
\( n = \) angle of tilt (\( \phi \)).
\( o = \) height (\( H \)).
\( p = \) wave angle (\( \Delta \)).

Result:
\( \phi = 66° \).
\( H = .81 \) wavelengths.
\( \Delta = 24° \).

(4) Given: Length for 1 side (alignment method) \( L = 2.0 \) wavelengths.
To Find: \( H, \phi, \Delta \).

Method:
Draw vertical line thru point "m" (2.0 wavelengths—abscissa).
Read intersection of this line on each curve on its corresponding scale.
\( s = \) angle of tilt (\( \phi \)).
\( t = \) height (\( H \)).
\( u = \) wave angle (\( \Delta \)).

Result:
\( \phi = 64.8° \).
\( H = .581 \) wavelengths.
\( \Delta = 25.5° \).
For maximum output, Fig. 7 illustrates the procedure to be followed for this set of conditions. This chart is based upon an effective height of \( \frac{1}{2} \) wavelength, which represents a practical value for most amateurs to deal with. For any different height other than the one shown the curve may be plotted from the expression:

\[
\frac{H}{l} = \frac{\sin \Delta}{\frac{2\pi H \sin \Delta}{\lambda} - \frac{\lambda}{l \sin \Delta} - \frac{\tan \left(\frac{\pi}{2} H \sin \Delta\right)}{\tan \left(\frac{\pi}{2} l \sin \Delta\right)} - \frac{\lambda}{\sin \Delta}}
\]

(Note: the solution of this equation for \( l \) in terms of wavelength (\( \lambda \)) may be obtained by the trial and error method.)

The second compromise design method is based upon a premise of a given length (somewhat reduced over the ideal case) and wave angle to determine the remaining optimum dimensions for best operation. Fig. 8 represents the design chart and method to be followed for this condition. Curves for values of length of 2, 3 and 4 wavelengths are shown, and additional curves for any length may be similarly plotted from the relationship:

(Continued on page 78)

![Compromise Design Chart](image_url)

**FIG. 7—COMPROMISE METHOD DESIGN CHART FOR RHOMBIC ANTENNAS WITH FIXED HEIGHT (ONE-HALF WAVELENGTH)**

The following example illustrates the use of the Chart:

**Given:** Height = \( \frac{1}{2} \) wavelength.

**Available length of one leg = \( \lambda \).**

**To Find:**
- Angle of Tilt (\( \theta \)).
- Wave Angle (\( \Delta \)).

**Method:**
- Place straight edge on curve "L" at \( \frac{3}{2} \lambda \) wavelengths (point \( y \)) and draw line XYZ. Read angle \( \theta \) from intersection at point \( X \) (right hand ordinate) and angle \( \Delta \) at point \( Z \) (intersection of abscissa).

**Result:**
- \( H = \frac{1}{2} \) wavelength given.
- \( L = \frac{3}{2} \lambda \) wavelengths.
- Tilt angle \( \theta = 69 \) degrees.
- Wave angle \( \Delta = 21 \) degrees.

**FIG. 8—COMPROMISE METHOD DESIGN CHART FOR VARIOUS LEG LENGTHS AND WAVE ANGLES**

The following examples illustrate the use of the Chart:

(1) **Given:** Length (\( L \)) = 2 wavelengths.

**Desired wave angle (\( \Delta \)) = 20°.

**To Find:** \( H, \theta \).

**Method:**
- Draw vertical line thru point "a" (\( L = 2 \) wavelengths) and point "b" on abscissa (\( \Delta = 20° \)).
- Read angle of tilt (\( \theta \)) for point "a" and height (\( H \)) from intersection of line ab at point "c" on curve H.

**Results:**
- \( \theta = 60.5° \).
- \( H = 0.75 \) wavelengths.

(2) **Given:**
- Length (\( L \)) = 3 wavelengths.
- Angle of tilt (\( \theta \)) = 78°.

**To Find:** \( H, \Delta \).

**Method:**
- Draw vertical line from point "a" on curve \( L = 3 \) wavelengths at \( \theta = 78° \) to intersection of this line on Curve H (point "c") and intersection at point "f" on the abscissa for \( \Delta \).

**Result:**
- \( H = 0.56 \) wavelengths.
- \( \Delta = 26.6° \).
Skip-Distance Calculation*

Rapid Graphical Determination of Secant of Angle of Incidence

By Newbern Smith**

The secant of the angle of incidence of a radio wave upon the reflecting layers in the upper atmosphere is an important quantity in the elementary theory of sky-wave transmission. By simple refraction theory, neglecting the influence of the earth's magnetic field on the ionosphere, a region of given ionization density, which will return to earth a wave of frequency \( f \) at normal (vertical) incidence, will return a wave of frequency \( f \sec \phi \) if incident on the layer at an angle \( \phi \). The critical penetration frequency for this angle of incidence will thus also be greater than the normal-incidence critical frequency by the factor \( \sec \phi \). Furthermore, the evidence indicates that a wave of frequency \( f \sec \phi \) incident at angle \( \phi \) upon the layer behaves in other respects also, such as absorption to a considerable extent like a wave of frequency \( f \) incident normally.

The angle \( \phi \) depends only on the virtual height of the layer \( (h) \) and the distance of transmission \( (D) \) along the earth (see Fig. 1). The accompanying chart, which has been in use for some time at the National Bureau of Standards, provides a simple means of determining \( \sec \phi \) for any distance up to 5000 km. and any layer height up to 500 km. To use, lay a straight edge on the chart passing through the given virtual height of the layer and the desired distance laid off on the distance scale at the lower left hand edge of the chart (increasing distances lie to the left). The

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* Publication approved by the Director of the National Bureau of Standards of the U.S. Department of Commerce.
** National Bureau of Standards, Washington, D. C.

intersection of the straight edge with the vertical line corresponding to the same desired distance on the main distance scale (increasing distances to the right) will give the value of \( \sec \phi \).

For example, a distance of 2400 km. and a virtual height of 300 km. will correspond to a \( \sec \phi \) of 3.07. For this path, then, a radio wave of frequency 15,000 kc. will behave in many respects approximately like a wave of frequency \( \frac{15,000}{3.07} = 4900 \) kc. which is incident normally upon the layer.

If the straight edge and the vertical distance line do not intersect to the left of the "maximum \( D \) for one hop" line, this indicates an impossible case, where the ray would have to leave the transmitter at an angle below the horizontal.

**FIG. 1—EQUIVALENT PATH OF A RADIO WAVE BEING PROPAGATED FROM A TRANSMITTING STATION (T) TO A RECEIVING STATION (R) BY ONE HOP**

The angle \( \theta \) is given by the relation:

\[
\tan \theta = \frac{\sin \theta}{h + r(1 - \cos \theta)}
\]

Distance between ionosphere and earth greatly exaggerated for clarity of representation.

In this case the height of the layer is too small to permit transmission in one hop, and calculations must be made for two or more hops.

The angle of take off (\( \phi \)) of the waves from the transmitter above the horizontal (and angle of arrival at the receiver) may be calculated from the relation:

\[
\phi = 90^\circ - \theta - 222.4
\]

where \( D \) = distance of one hop in km.

\( \phi \) = angle whose secant has been determined

The larger \( X \) is, the smaller are \( D \) and \( \phi \), for a given layer height \( h \). Thus the practical range of a wave for one hop depends largely on the minimum angle above the horizontal at which enough power is radiated to produce a good signal. This minimum usable value of \( X \) depends on the location and antenna structure of the transmitter and receiver, but a practical limit seems to be somewhere around 3° or 4°. The dotted line corresponds to an angle of take-off of 31½°. For effective single-hop transmission, then, the intersection must take place to the left of the dotted line. A point to the right of the dotted line indicates unsatisfactory single hop communication, and in such a case calculations should be made for two or more hops.

IT USED TO be that 80m cw sigs went straight up in the air a mile a minute and bounced off the moon or something and come down gosh knows where in the middle of nowhere somewhere and presumably smacked some kind of a furrier in the eye, and the guy next door to you in Bugtussle, Georgia, that you had the sked with couldn't hear you even a little bit. Skip, they called it. You could call this mug and listen 'til the cows come home and you never would hear him. It turned out later to be that the reason you didn't and he didn't was because you and him wasn't both there a callin' and a listenin' in the right place at the right time and vice versa, but skip was a good alibi while it lasted. When ARRL trunk lines and AARS nets took up spot frequency operation it made monkeys out of these skip hollerers. I'm glad I don't hear that skip alibi no more. I got purty sicka hearin' it.

--- W4IR of the "Dixie Squinch Owl"

New England Division Convention

Providence, R.I., May 21—22

LITTLE "Rhody" has the honor to carry out the traditions of the annual New England Division Convention to be held in Providence, R.I., at the Hotel Biltmore, on May 21st and 22nd, under the auspices of W1AQ, otherwise known as the Associated Radio Amateurs of Southern New England, Inc.

All New England Amateurs are invited to attend a real old time to-day convention, where old acquaintances will be renewed and new friends made. As in the past the program will prove interesting with prominent speakers, a first class banquet and many surprises.

The registration fee is $1.50, banquet $2.00, and a special price for the ladies of $2.00.

Tickets and further information may be obtained by writing to W1AQ, 54 Kelly Ave., East Providence, R. I.
W9SDQ, Indianapolis, Ind.

W9SDQ, Eugene M. Howard, of 837 N. Chester Avenue, Indianapolis, specializes in 14-Mc. 'phone operation, and his signal is a familiar one in the 'phone region of "twenty." The outfit behind the signal is shown in the accompanying photographs.

The transmitter is frame-mounted in two sections, the lower, with two shelves, containing power supplies and the upper the r.f. units. The frame is supported by large casters for ease of movement. The r.f. section of the rig consists of a 53 crystal oscillator-doubler followed by an RK23 buffer stage which in turn drives a second buffer using a T-55. The final stage has a pair of 203-A's in push-pull, operated at 400 watts input. In the photograph the 203-A's occupy the top deck of the rack, while just below are the crystal and driving stages with a small power supply for the 53. On the bottom shelf are two power supplies, one giving 1500 volts for the final stage and the other 1100 volts for the modulator and T-55 buffer. The second shelf contains a 600-volt supply for the RK23; the Class-B modulator also is mounted on this shelf. All grid and plate circuits are metered. Four 7-Mc. crystals are used, three for various frequencies in the 'phone section of the 14-Mc. band and the fourth for c.w. A rotary switch on the panel selects the frequency desired.

The low-level speech equipment occupies the upper part of the small rack at the right-hand end of the operating table. The speech line-up includes a Shure 701A crystal microphone working into a 57, pentode-connected and resistance-coupled to a 58. The 58 is transformer-coupled to a pair of 56's in push-pull and these in turn excite a pair of 2A3's. The latter act as drivers for the Class-B modulator, which uses a pair of 930-B's. The output of the driver is coupled to the modulator grids through a 500-ohm line, the modulator proper being located in the transmitter frame. Power supplies for the speech amplifier are on the lower chassis in the rack.

The receiver is an RME-69, equipped with a noise silencer. A Peak pre-selector, on top of the receiver in the photograph, is used for boosting the gain on the weak signals; it gets its power from a supply mounted on the chassis containing the speech-amplifier supplies.

W9SDQ uses a horizontal Johnson "Q" antenna, a half wave long at 14 Mc.

W8DK, Mt. Clemens, Mich.

Aside from the obvious neatness of the apparatus, one thing we like about the photograph of W8DK is the roomy operating table. The shelf along the rear edge makes practically the whole table available for elbows and papers, yet brings the apparatus within easy reach.

W8DK is owned by Arthur Grolz, and is located at Joy Ranch, Mt. Clemens, Mich. The transmitter, at the right in the photograph, is built in an enclosed iron frame, mounted on rubber-tired casters so that despite its weight (nearly 900 pounds) it can...
easily be pulled out for adjustments or repairs. The r.f. tube line-up consists of a 10 crystal oscillator, a buffer stage with a pair of T-55's, and a final stage using a pair of W.E. 276-A tubes in push-pull. The input to the final is 450 watts. The crystal is temperature-controlled within very close limits. Separate power supplies are used for each stage, the supply for the final amplifier being capable of delivering a kilowatt if necessary.

The transmitter is used chiefly for 4-Mc. 'phone, with speech equipment starting out with an Astatic D104 crystal microphone working into a 6C6 pentode-connected, followed by a 6C6 triode-connected. This in turn drives a pair of 6B5's in push-pull. The speech amplifier is in the metal cabinet toward the left in the photograph; the fifth tube in the row is an 83-V rectifier for the self-contained power supply. The modulator uses a pair of 212-D's.

The receiver at W8DK is an HRO. Auxiliary equipment includes an RCA Oscilloscope and heterodyne and absorption frequency meters.

A Medium-Power Transmitter Especially Designed for 28-Mc.

(Continued from page 41)

One distinct advantage of this type of oscillator circuit is the ease with which a variable-gap crystal may be employed instead of the fixed-frequency crystal. In operating in the 28-Mc. band we use a 7-Mc. crystal. Operation on the 14-Mc. band is also accomplished with a 7-Mc. crystal, more as a matter of convenience. A 3.5-Mc. crystal can be used for 14-Mc. operation by increasing the coil inductance in the crystal oscillator. The 6L6 frequency multiplying stage output is rich in harmonic content and provides ample excitation for the succeeding stage even when quadrupling frequency. It will be noted that the metal shell of the 6L6 is grounded; this prevents some disagreeable effects that occur otherwise.

The 807's in the push-pull buffer stage require no neutralization and deliver high output with very little excitation. It will be seen that this circuit is perfectly conventional in every respect.

The choice of the 250TH for the final stage was made after several other types of tubes, rated at somewhat equivalent plate dissipation, had been tried. Because of the low internal capacity and the high amplification factor of this tube, excitation requirements are relatively low and this results in further simplification of the entire transmitter. More than ordinarily good efficiency in the final stage is obtained, particularly when the transmitter is used on the higher frequencies. It will be seen that the various elements in the transmitter are link coupled and here "Giant-Killer" cable is used for the transmission line between the coupling coils.

The antenna matching network has proved to be very satisfactory and it does not suffer from the inherent disadvantages outlined in W1EAO's article to which we have made previous reference. Naturally, the choice of the antenna is a subject which may well be a complete article in itself, and suffice it to say that good results have been had with two horizontal half-waves in phase on the 28-Mc. band; and a vertical half-wave radiator on the 14-Mc. band.

The line-up in the speech amplifier provides a sufficient over-all gain so that practically any type of microphone may be used. One unique feature of the power supply is that a single transformer, with two secondaries, supplies the plate voltage for the speech amplifier, the modulator and the entire r.f. portion. One of the desirable results is the good regulation obtained under modulation, in spite of the really large job it is made to do.

The recent attention given to the use of Faraday shields between the final tank and the antenna matching networks for the suppression of harmonic radiation have been thoroughly recognized and tried. Their use is suggested as highly desirable. The particular type of shield depends, of course, on the mechanical construction of this portion of the circuit.

Judging by the way they stretch during a DX contest, there must be a lot of rubber in our bands.
Eliminating I.F. Shift—A Heterotone Circuit

How many amateurs have noticed an apparent, shift of i.f. alignment amounting to several kilocycles when the gain control of a superhet was varied? In a receiver under investigation, the input capacity of the i.f. amplifier tubes seemed to change when the bias was changed by the usual variable cathode resistor with bleeder system.

A look at the properties of tubes shows that the effective input capacity is the sum of several fixed capacities and a capacity which is a function of the voltage amplification and the grid-plate capacity of the tube. From this, it appears that a variable-mu tube would have a variable input capacity, since the amplification decreases as the grid bias is increased. The 6K7 has a grid-plate capacity of 0.005 \( \mu \text{fd.} \) and the 6L7 only 0.0005 \( \mu \text{fd.} \), but the maximum gain is nearly the same for both tubes. Therefore, a 6L7 should perform as well as a 6K7 as an i.f. amplifier with the advantages of increased stability and only one-tenth the change of input capacity.

A 6L7 was substituted in the receiver and it proved to be even better than expected. The problem arose: What about the oscillator coupling grid? By connecting it to the a.v.c. circuit, the a.v.c. action of the set was materially improved. Heterotone was tried, coupling into the oscillator grid, with immediate approval.

Fig. 1 shows the modified amplifier and heterotone oscillator. Most values are not critical and are subject to variation depending on the a.f. transformer used in the oscillator circuit. The circuit and values were found by cut-and-try. If the 6C5 does not oscillate, reverse the connections to the primary of the a.f. transformer. The oscillator grid of the 6L7 is connected to the a.v.c. circuit only when the heterotone oscillator is off, in order to maintain a fairly constant percentage of tone modulation. Screen-grid coupling of the oscillator to the 6L7 was found less stable in tone frequency and percentage of modulation than oscillator grid coupling, when the gain control was varied. If the set has one voltage divider to supply all screen voltages, it may be advisable to make changes to keep the screen voltage near 100.

---Wilfred H. Conley, WSCZR

The BH Rectifier for the Ford Coil Plate Supply

For information on the adjustment of the Ford coil plate supply the reader is referred to the article in the June, 1932 issue of QST entitled

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May, 1937
"D.C. Plate Supply from Ford Spark Coils," by Davis. But a few things in regard to the BH rectifier should, perhaps, be brought to attention. The BH tube seems to be more efficient than an 80. Using the circuit of Fig. 2, the output is about as follows: One coil at 6 volts, 6 watts; one coil at 12 volts, 12 watts; two coils at 6 volts, 12 watts; two coils at 12 volts, 20 to 25 watts. The output obtained depends to a great extent on the care used and experience of the operator. It is so easy to get pure d.c., or even x.p.d.c. that it is tempting to adjust the self-excited transmitter for maximum antenna current. The supply should be placed some distance from the rig because the coils cause considerable vibration and their magnetic fields may affect the transmitter meters. The primary current is quite heavy so the coil wiring should go directly to the storage battery, not through common leads which also supply the transmitter tube filament, or else the filament voltage for the transmitter tube will fluctuate when keying. A relay must be used to break the primary circuit of the coils if a bug key is used. In tuning up, not more than 6 volts should be used on the coils. Increase power gradually. Electrolytic filter condensers are cheap, but seem to "leak" until broken in, reducing the output. The old "bootleg" BH, which cost about a dollar, is still in use after four years of service and the recent renewal of coil points put the output higher than ever. Coil points are cheap and should be renewed as soon as the output decreases.

This power supply has been used on a crystal controlled rig with T9 results, but a separate supply for the oscillator and doubler stages is recommended. Both the supplies should, in that case, be keyed so break-in might be used. The power supply in use here weighs about 7 pounds with shielding and cost less than $3. It may be of interest that while operating portable on 3.5-Mc. band, a car radio was in use just under the antenna and about 20 feet from the unshielded coils with no interference whatever.

—Robert F. Valgren, W9ALO

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Modulation Monitoring with the Oscilloscope Having No Sweep Circuit

Fig. 3 shows a simple way to monitor modulation with an oscilloscope which has no linear sweep or amplifier for horizontal displacement. A tuned pick-up coil is connected to one set of plates, while an untuned pick-up coil is connected to the other set. The tuned unit may be a midget tuning condenser and tube socket placed at the oscilloscope terminals where the proper coil may be plugged in. The untuned coil has two or three turns placed near the antenna tank so that it will pick up about the same voltage as developed in the tuned circuit. When the condenser in the tuned circuit is rotated through resonance, a point will be found where a circular outline will appear on the screen. When modulation occurs this circle will increase and decrease in size, giving the appearance of a disc with the unmodulated portion of the carrier appearing as a dark spot in the center. A bright spot in the center clearly indicates overmodulation. Distortion will also be indicated as circular lines more or less illuminated than the rest of the pattern.

—R. E. Patrie, W9CWD

Further information on circular modulation patterns is to be found on page 47, March, 1936, QST.—Ed.

Plug-in Chassis Connections

While rebuilding my transmitter I devised the following method of making the chassis connections to the cabinet wiring and found that
it made quite a neat-appearing job. The plugs used on the chassis are similar to plugs used on coil forms and are mounted on a strip of bakelite which is set over a section of the back of the chassis which has been cut out. The plugs on the bakelite base then fit into plug sockets mounted on bakelite in the back of the cabinet. The wiring to these plug sockets can be cabled or put in pipe according to the desire of the builder. The general idea is shown in Fig. 4.

This proves a quick method for removing the chassis from cabinet or rack for inspection or repair.

---Charles F. Yung, W2GAU

100-kc. Calibrating Oscillator

The circuit of Fig. 5 is used by Charles O. Hecht, W9LSZ, for getting 100-kc. calibrating points. The oscillator uses a 6L6 tube with a self-resonant plate coil, and gives harmonics of good strength at frequencies as high as 30 megacycles. The extremely low-C plate circuit and high-resistance grid leak contribute to the harmonic output.

Dimensions of the plate inductance, L, used by W9LSZ are given in Fig. 5. Its inductance should be such that the plate circuit will be resonant, in conjunction with the self-capacity of the coil plus the output capacity of the tube and the wiring capacity, at a frequency somewhat higher than 100 kc.

Curing Filament Hum

Hum in the receiver caused by leaving transmitter filaments connected during reception is a common complaint. The only sure cure seems to be that of opening the grid circuit in the transmitter during receiving periods. A method for doing this automatically, suggested by Robert Berler, W2EPC, is shown in Fig. 6. W2EPC writes:

"A three-watt neon lamp was purchased and its base was removed from the base of the lamp and then the base was replaced. The 'C' bias lead to the final amplifier is broken at the cold side of the r.f. choke and the lamp is connected in series at that point. The neon lamp can safely pass 65 milliamperes, but if more current is drawn, it is advisable to connect two lamps in parallel."

A Universal Exciter

(Continued from page 65)

May, 1937

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FIG. 5—100-KC. CRYSTAL OSCILLATOR USING 6L6 FOR HARMONIC GENERATION

The inductance L consists of three pi sections, each consisting of 500 turns of 10-strand Litz wire.

FIG. 6—NEON LAMP IN GRID CIRCUIT FOR CURING HUM FROM TRANSMITTER DURING RECEP TION

A three-watt lamp with base resistor removed is used. Where heavy grid currents are drawn, two or more lamps should be connected in parallel.

no necessity for mounting the chassis behind a relay-rack panel, and it may well be mounted in a small cabinet and placed alongside the receiver on the operating table. If the transmitter proper is located some feet from the operating table, such an arrangement is frequently quite desirable, since it makes it possible to QSY quickly without leaving the operating position.

While the present exciter has been designed especially to use the variable-frequency crystal and holder, there is ample room between the two tubes to mount several sockets into which may be plugged a number of standard crystals and holders where several fixed operating frequencies are preferred to the continuously variable range provided by the adjustable crystal.

In the rear view most of the wiring can be seen. There is a handy trick used by commercial companies for wiring jacks that is not generally understood by the average amateur; it is to prepare the leads and solder them to the jack contacts before mounting the jack in place. By so doing, the necessity for soldering in an awkward position is eliminated. It is also possible to skin and tin the wires so that the insulation comes right up to the contact and does so without being frayed or sloppy looking. The jack is then mounted in place, the leads run through the necessary bushings to their proper terminals and, if necessary, re-cut and skinned for soldering to the other pieces of apparatus which are invariably more conveniently located for neat soldering; as are, in this case, the socket terminals.

(Continued on page 70)
Devoted to the interests and activities of the INTERNATIONAL AMATEUR RADIO UNION
Headquarters Society: The American Radio Relay League, West Hartford, Conn.

MEMBER SOCIETIES
American Radio Relay League
Associazione Radiotecnica Italiana
Canadian Section A.R.R.L.
Czeckoslovak Amateur Union
Deutscher Amateur Send- und- Empfangs Verein
Dienst Nederlandsch-Indische Vereeniging Voor Internationaal Radioamateurisme
Irish Radio Transmitters Society
日本アマチュア無線連盟 Japan
Liga Colombiana de Radio Experimentadores
Liga Mexicana de Radio Experimentadores
Magyar Rövidhullámú Amatőrök Országos Egyesülete
Nederlandse Vereniging voor Internationaal Radioamateurisme
Radio Club Venezolano
Radio Club of Great Britain
Radiosender Österreichischer Amateur-Verband
Radio Society of Great Britain
Rede dos Emissores Portugueses
Reseau Belge de Transmetteurs pour l'Europe
Radio Society of the USA
Reseau des Emissores Colombianos
Sverigens Radiosamhälle
T.N.A.V.
Union Schweizer Kurzwelle Amateure
Unión de Radiocomunicadores Españoles
Verein des Kurzwellen- und Fernsehen-Amateurclubs der Schweiz
Wireless Institute of Australia

Conducted by Byron Goodman

C.C.I.R.:
Not all amateurs are familiar with the participation of the I.A.R.U. in the meetings of the C.C.I.R., the technical meetings held during the five-year intervals between international conferences. It is at the C.C.I.R. meetings that the amateur has an opportunity to show what has been accomplished in the way of technical advancement by amateur radio. We will be capably represented at the Bucarest meeting by Messrs. John C. Stadler, VE2AP of Montreal, and James J. Lamb, QST's technical editor, who are busy finishing up their technical studies. They sail from New York on May 4th, will visit the D.A.S.D. at Berlin on May 15th, and will arrive at Bucarest on May 18th, where they will remain until the close of the meeting some time in June. On their return they will visit the R.S.G.B. in London and, time permitting, several other European societies.

The I.A.R.U. is submitting studies on three of the questions proposed for this, the fourth meeting of the C.C.I.R. Question 1 deals with receiver selectivity characteristics, and the amateur contribution shows, among other things, selectivity curves of representative modern amateur communications-type receivers which are in actual use. The fact that amateurs are forced by their overcrowded bands to employ receivers with a higher degree of selectivity than used by other services is clearly shown by this study. It will be remembered that Mr. Lamb's original contributions to the previous C.C.I.R. meeting, on the use of crystal filters, met with widespread interest.

Question 11 treats the use of single-sideband radiotelephony, its application to the higher frequencies for reduced fading and increased communications efficiency, and possible methods of attaining single-sideband communication on the higher frequencies.

The third I.A.R.U. contribution is on Question 16, dealing with the reduction, at the receiving location, of interference caused by electrical installations, or "man-made noise." This presents the "silencer" principles recently described, and should receive the same interest accorded the introduction of the crystal filter.

It is fortunate that amateurs are afforded a chance to participate in these meetings, since we are not only allowed to make our own constructive technical contributions, but also are given opportunity to participate in arrival at interpretations of other questions which might affect our interests.

Map:
A Great Circle Map for British amateurs, and also of some interest to those on the European continent, has been prepared by the "Wireless World" of London and is available through the R.S.G.B. The map is on Pick's Zenithal Azimuthal Graticule, a projection similar to the special type devised for the A.R.R.L. Map of the World. The price is 2/- net.

One thing this map clearly shows is why the G's can work so much good DX. Everything in the world, it seems, is clustered right around them—except for western Oceania. An interesting point is that K6, perhaps the hardest place to work from the British Isles, lies directly over the magnetic North Pole. East coast W's vainly trying to raise elusive J's will heave a sigh of sympathy!
SOME WELL-KNOWN AUSTRALIAN AMATEURS:

Reading in the usual manner, the back row shows VK4AW, VK4RY, VK4UL, VK4WR, and VK4BB. In the front row, VK4GK Jr., VK4AP, VK4YL, VK2LZ, VK4UB, VK4GK Jr.

in Switzerland the U.S.K.A. extends a cordial invitation to visit the society headquarters.

General:

W1GTX forwards the information that the importation of radio parts for amateurs in Denmark is now prohibited. The amateurs in Niigata, previously using J6 calls, have had them changed to J2 prefixes. The 1937 VK/ZL Contest will be conducted by the N.Z.A.R.T. Amateurs in Latvia are licensed to use the amateur frequencies from 28 to 400 Mc. After showing a certain amount of success in these bands they may be allowed permission to operate in the 14-Mc. band. The power used is under 50 watts. The N.A.B.A. (Newfoundland) advises us that they will no longer accept listener cards for distribution, in view of their overloaded QSL Bureau. SWL's should send their cards directly to the Call Book addresses. VU2LK was the first Indian amateur to take the new license examination, according to VU2LK.

QSLS Bureaux:

Following is the list of foreign QSL Bureaux, to which cards can be sent in bulk for distribution in the various countries. Remember, however, that many bureaus now refuse to handle cards and acknowledgements of listeners.
TO-DAY we have a better distribution of interest and occupancy between our several amateur bands than was indicated in the surveys of about two years ago. Recent surveys show that operating interest is somewhat more diversified to-day than it was. More amateurs can work on two or three different bands. Congestion, and utilization of more bands to relieve the situation may have had something to do with it. Technical progress and the wider availability of more flexible and suitable equipment perhaps has been the most potent factor. Better economic conditions that have made the acquisition of more equipment possible have played a part. To-day, also, there is better general appreciation of the relative communicating values, and proper time of use (for optimum results over particular distances) of our different frequencies. The favorable DX conditions on the higher frequencies during this part of the sun-spot cycle have naturally focussed attention on the 14- and 28-Mc. bands.

The long continued good conditions on 28 Mc. have brought about a 584% increase in occupancy and registered interest in that band in a two-year period! Our use of ten meters to-day is about one fifth as great as our use of the 14-Mc. band, however, so it is apparent that this DX territory is still by far the most attractive, since the interference levels are lower, especially if we aim to operate in the whole band, and not confine our work to the low-frequency end.

56-Mc. band work has held continued interest, so that there has been in two years something like a 50% increase in utilization of this territory.

Our four low-frequency bands contain nearly 90% of amateur operating. Comparing occupancy figures of to-day with the survey made some two years ago, an increase of interest in the 1.7-Mc. band amounting to about 22% is shown. 14-Mc. band use has increased nearly 50%. At the same time, decreased registered interest in the 3500- to 4000-ke. band and 7000- to 7300-ke. bands amounting to around 30% and 10% respectively is indicated. This does not necessarily mean that there are fewer stations operating in those bands, since this analysis has been concerned not with the exact amount of occupancy in different bands, but with the distribution of individual interest over all the different bands. A tabulation showing the percentage of all interest represented in each band, as now indicated, and as shown in an exactly similar survey of two years ago, best tells the story:

<table>
<thead>
<tr>
<th>Bands</th>
<th>% Use '35</th>
<th>% Use '37</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>8.06</td>
<td>10.58</td>
</tr>
<tr>
<td>80</td>
<td>42.48</td>
<td>28.06</td>
</tr>
<tr>
<td>40</td>
<td>27.73</td>
<td>26.19</td>
</tr>
<tr>
<td>20</td>
<td>16.19</td>
<td>23.86</td>
</tr>
<tr>
<td>10</td>
<td>.687</td>
<td>4.713</td>
</tr>
<tr>
<td>5</td>
<td>4.16</td>
<td>6.40</td>
</tr>
<tr>
<td>28</td>
<td>.08</td>
<td>.445</td>
</tr>
<tr>
<td>14</td>
<td>.013</td>
<td>.169</td>
</tr>
</tbody>
</table>

The most striking thing is the increase in ten- and twenty-meter utilization. With the exception of the increase in 160-meter interest, it may be said that all the higher frequency bands have gained occupancy, and at the expense of the time spent on the lower frequencies. Two years ago we spoke of 3.5- and 7-Mc. bands as "major interest" bands. The figures show why. The 14-Mc. band to-day must enter this classification if such a grouping is to be made. It is better, though, to look upon the more uniform figures as meaning that more amateurs are to-day able to use more bands with their maximum effectiveness, at the time when these bands are best for the given desired type of communication. We have, of course, a varying degree of protection from congestion with the varying "skip effect" on the different bands. Examining the occupancy in proportion to the width of the various bands, without evaluating this particular factor, shows a very fair degree of uniformity through the 160-80-40- and 20-meter bands—better uniformity than ever in our history. To produce comparable occupancy in the ten-meter region we can stand something like twenty or twenty-five times the present volume of work that goes on there.

Amateurs who find 14 Mc. congested in the busiest or "peak" operating hours have been increasingly going to the 28-Mc. band. This band has somewhat greater width to protect it from congestion. It demonstrates engineering ability to "lick" the problems met in going there. Satisfactory results yield a real return, however. Antenna dimensions make "ten" a fine spot for experimenting with directive radiators and reflectors. Any ham who passed up 28 Mc. in the first section of A.R.R.L.'s DX Competition now knows that he missed a good bet. Portable-mobile...
applications in this hand have been too thoroughly overlooked. Also it is a sound engineering fact that local coverage using 28 Mc. is even more complete and less subject to spotiness and shadows in the local pattern than is 56 Mc. For local applications in emergency control, circuits on this band might avoid increasing the congestion on higher and lower frequency bands. We'll say no more. It should be unnecessary for us to call attention to 28 Mc. as a fertile field for seasonal and regular use, and exceptional DX when conditions are right.

--- F. E. H.

Smithsonian-Roehling Expedition

Truman Smith, W1HQQ, is radio operator on the Smithsonian-Roehling Exploring Expedition, which left Clearwater, Fla., April 1st, planning to return in early July. The ship license, WORG/W1XQY, provides for two-way work with amateurs. WORG operates c.w. on 4100, 5820, 8280 and 16,500 kc. (though W1XQY (phone) and W5C0 (phone) being used on 6625 and 12,862.5 kc. This expedition will visit and explore many places that have never been visited by a scientist and will collect specimens of all sorts. Diving and dredging equipment is included and submarine specimens and under-sea photographic work as well will be attempted. Mr. Roehling's yacht will visit the Isle of Pines, several ports on the south coast of Cuba and Haiti, Port Au Prince, Cape Haitien. Ports on the south coast of Jamaica, Gatun Lake in the Canal Zone, the Pearl Islands in the Pacific, and the Central American coast from Panama to and including Yucatan will be visited. Amateurs are requested to be on the lookout for WORG/W1XQY. Please report reception or contacts to A.R.R.L., for mention in QST.

W9WJ1 (Des Moines, Iowa) handled press into Mason City, Iowa, when that city's communication facilities were disrupted by a snow and ice storm in early April.

March 24th found Aberdeen, Pierre, Huron and surrounding South Dakota towns with disrupted communication facilities due to a severe sleet and snow storm. W9WBU (Omaha, Nebr.) was asked by the telephone company to endeavor to get information from the affected area. W9AVX went to W9UJ's station and together they established a 1.75-Mc. 'phone net with the following stations: W9WWY (Juniata, Nebr.), W9YDF (Bassett, Nebr.), W9LEU (Abbeieron, So. Dak.), W9DUD, WNAX (BC station at Yankton, So. Dak.) assisted by broadcasting a request for any amateur in or around Aberdeen to contact Omaha amateurs, W9BJV (Wartown, So. Dak.) on 3.2-Mc. phone worked cross-band with the "160-meter" stations. A considerable amount of telephone company traffic was handled with the isolated cities.

TVR Flood Net

The TVA (Tennessee Valley Authority) had never given in for short-wave radio. It is significant that in a pressing emergency, without time for cumbersome official machinery to operate, they turned to the hams that worked for them: at Knoxville, W4CXY and Bill Ridinghour, at Atlanta, Gaylord Knight, at Chattanooga, W4CRS, W4CRU and W4CDD; at Muscle Shoals, W4DUD. In Chattanooga the matter was sprung on the boys at 1:30 P.M.; could they get together sufficient radio equipment to go to a strange town and set up a reliable station that could be heard over a 250-mile radius, day and night? The TVA would furnish the car to have a location spotted by the time the truck driver took on too much corn as a pneumonia preventative, and wound up in the ditch somewhere. W4DUD put on an even greater demonstration of the two things that make amateurs valuable in an emergency, namely, initiative and the freemasonry that exists among hams. W4DUD left his home QTH, Muscle Shoals, Ala., with a complete transmitter loaded into a truck and supposed to be following him closely while he drove ahead in his car to have a location spotted by the time the truck could make it to the Memphis area. The truck never got to Memphis; it was cold weather and the truck driver took on too much corn as a pneumonia preventative, and wound up in the ditch somewhere. W4DUD put the matter up to the Memphis hams, and in less time than it takes to tell it, he had not one, but two transmitters at his disposal, with receivers to match and a corps of assistants to help.

The station which the Chattanooga hams set up at Paris, Tenn., was the Net Control Station for what at the time had no name, but which we will call the TVA Net. They operated on a frequency of 4923.5 kc. The majority of work was done on 'phone. The stations in the net were: W4AXO, Knoxville, Tenn.; W6WF-1, Athens, Tenn. (U. S. Forest Reserve Sta.); W4BKG, Wilson Dam, Ala.; W4DUD, Memphis, Tenn. W4U, Chattanooga, Tenn.; W4DRI, Cleveland, Tenn.; W5WU, Steamboat Springs, anchored in Ohio River in and about Paducah, Ky. (the station on this boat used a U. S. Forestry Service frequency of 3185, and worked mostly c.w.); W4CBS, Paris, Tenn., Net Control Station. At W4CBS the net frequency was monitored continuously 24 hours a day, and the roll of the net was called every hour. In addition to keeping in touch with members of its own net, the NCS ran regular schedules with stations abroad the U. S. Engineer Corps stations Yeceno and Cado; with a net to the east of which W4AE was NCS; and with a net of which W4FR was NCS. This "TVA NET" didn't play so prominent a part as some, didn't get the chance to. And because its frequency was off the ham bands, many stations probably never heard it. But it was everlasting ready, and IP the leaves above and below Memphis had gone out, its work would have been spectacular. But the leaves held, and everybody is glad of that.

Cairo Survey Award Won by Faries

The Oakland Radio Club's Col. Claire Foster Award for the individual outstanding work in A.R.R.L.'s Cairo Commercial Occupancy Survey goes to Mr. Walter R. Faries (15 Llanberris Road, Bala Cynwyd, Pa.).

This beautiful memorial plaque was reproduced with the cooperation of the Oakland Radio Club for making the award available to help the program of the A.R.R.L. Cairo Committee in its efforts and program. Congratulations to Mr. Faries on your splendid program of the A.R.R.L. Cairo Committee in its efforts and program. Congratulations to Mr. Faries on your splendid program. Observers' Honor Roll

Cairo Commercial Occupancy Survey

For March 1937

6000-8000 kcs.
Walter Lasak, DE569/G
21,000-21,900 kcs.
W1BMW

May, 1937

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PRIZES FOR BEST ARTICLES

The article by Mr. J. F. Thompson, W4DGS, wins the C.D. Contest prize this month. Each month we print the most interesting and valuable article received that week and the C.D. contest. Contributions may be sent on any phase of amateur operating or communication activity (DX, phone, traffic, rag-chewing, clubs, fraternal, press, etc.) which adds constructively to amateur organization work. Prize winners may select a 1937 QST Handbook, QST Binder and League Emblem, six logs, eight pads radiogram Manks, DX Map and three QST’s, or a combination of A.R.R.L. supplies of equal value. Try your luck. Send your contributions 10-day.

Re Harmonics!

By J. F. Thompson, W4DGS

MOST of my operation is phone and therefore I am interested in improving the ‘phone bands as much as possible and in creating a better feeling toward the ‘phone ham by everyone concerned. Recently I got a new Breiting 12. In tuning around I found hundreds of amateur ‘phone signals in places far removed from authorized amateur frequencies, from 1500 kc. to 4000 kc. Which adds constructively to my operation work. I have sent out over 350 cards, but I have baseline the following only 200 cards.

The harmonies fell into several groups. The largest group of cards went to those stations having harmonics between 7800 kc. and 8000 kc. The harmonies in this group were as a rule clean and sharp. When located, the fundamental, however, was usually broad and overmodulated. Some strong harmonics existed with signals of fine quality and sharpness though. From 4 p.m. to 7 p.m. CST the 7.5-8-Mc. band sounded like another amateur ‘phone band. QRM from Commercials frequently made it a little hard to get the amateur call correct though most of the time the amateur harmonic held complete away. This group of harmonics apparently came from 75-meter ‘phones.

The second group of harmonics was found from 5400 kc. to 6000 kc. This group, though smaller in number, is probably the most dangerous of all the harmonics since they fall in the frequencies allotted to the airways. The signals found were apparently from ‘phones operating in the 160-meter ‘phone band. They were as a rule from one to two S points stronger than the fundamental, and many times the fundamental could not be heard while the harmonic was S8 or better! Almost without exception this group of harmonics was found to be broad and obviously from rigs already radiating a harmonic. Overmodulation increased the difficulty because the S meter would swing widely with modulation.

Another popular group of harmonic frequencies are found around 11,800 kc. Most of these also were 160-meter harmonics. These harmonics were all heard in daylight and from stations more than 500 miles away, much farther than the range of even the most powerful 160-meter ‘phones. Many of these harmonics were poor in quality but strength S9!

Then there are parasites not so numerous but, nevertheless, in the wrong places at the wrong time. One card was sent to a high-powered station with an equally high-powered operator who was heard at 760 kc. in the standard broadcast band. He was over 250 miles away. He answered the card in no uncertain terms, stating that he was not operating at that time. I wrote to the operator at the other end of the QSO and he said that he worked the above station five or six times each week on sked and that he knew the operator personally and that the QSO took place at the time reported. He called me by long-distance telephone and arranged a sked. He corrected it at once in a fine spirit of cooperation.

Another card went to a station whose operator was really pitching one. Everybody was there—including the harmonics—and three of them. One was on another at 11,110 kc. So the drunken remarks had pretty good coverage. Not so good for the goodwill of Amateur Radio.

Another card went to a station heard operating at 7500 kc. He was a W8 and said he was operating in the 160-meter ‘phone band. He was working another W8. During the QSO he said several times that he had had a hard time getting his second harmonic strong enough so that he could raise the 75-meter ‘phone boys in the daytime. I increased not only his second harmonic but also the others.

Harmonics as a rule were noticed from stations whose operators were blowing about their fine equipment or talking not so much for the operator at the other end of the QSO as for their ‘great audience.’ Many of them were from Q9 CQ Hounds. You know the type. The ham that thinks he sounds like Mr. NBC and proceeds to tell the world. Many of the harmonics when modulated caused the S meter to rise. The average harmonic, however, was found to be modulated about 90 per cent. Some were broad and burry on either side. No reports were sent unless the signal strength of the harmonic was S8 or better. They were found interfering with airplanes seeking information from ground stations, ground stations seeking information on the difficulty to the plane in flight. Other harmonics interfered with short-wave relay broadcast stations both foreign and domestic, commercial telephone service and press stations.

It looks like we amateurs are going to have to learn to properly use the frequencies that we already have before we can reasonably expect to get more frequencies. We cannot expect more if we create a nuisance in using frequencies that we already have.

Attention is called to two articles concerning harmonics and their cure appearing recently in QST. The first was ‘About This Harmonic Radiation Problem,’ by W1EAO (February QST, page 22), the second was ‘Electrostatic Shielding in Transmitter Output Circuits’ (March QST, page 19W). All amateurs are urged to read and study both of these articles. The ‘Faraday shields’ explained in March QST are now being widely acclaimed by hundreds of amateurs as the answer to their harmonic problems. Check up on your harmonics and avoid any possible QRM to other services. 160-meter ‘phones should look for (and suppress) harmonics falling between 5400 and 6000 kc. 75-meter ‘phone harmonics fall as follows: 3500-3.550 (VE)—between 10,500-10,650; 3880 (VE)—between 11,650-3000—1000; 11700-12,000 kcs. Airways, Press and Telephone frequencies within these ranges can experience serious interference from amateur harmonics. Let’s prevent it!

G.C.A.R.A. Emergency Transmitter Contest

To promote preparation for emergency communication work the Greater Cincinnati Amateur Radio Association is conducting an Emergency Transmitter Contest for amateurs of the Greater Cincinnati area. The contest started March 19th and will end May 21st. Prizes will be awarded for the best sets submitted. Entries will be judged on neatness, compactness, ingenuity, portability and ease of operation from auxiliary power sources in case of failure of the regular supplies. The power input of the transmitter must not exceed 25 watts. It may be designed for either ‘phone or c.w. No antenna system is necessary, but the antenna tuning device must accompany the submitted transmitter. An entry blank for this contest may be secured from the club secretary or A.R.R.L. Field Day Office of Western Cincinnati. This is an excellent type of activity for clubs and it is hoped many more will take steps to encourage emergency preparedness.

Build that portable or emergency power supply now. Be prepared for emergencies. Don’t miss the pleasures of communication success in the open during the coming months. Get ready for the annual A.R.R.L. Field Day—coming June 19th-20th this year.

* SCM Alabama, 2248 Arlington Ave., So., Birmingham, Ala.

QST for
Coming Hamfests

Abilene, Texas: The amateurs of West Texas are holding a hamfest in Abilene on May 8th and 9th. All amateurs are invited. Registrations fifty cents. For further details see W5EP, William O. Anesley, P. O. Box 602, Abilene.

Milwaukee, Wis.: The 14th Annual QSO Party of the Milwaukee Radio Amateurs' Club, Inc., will be held Saturday, May 15th, 6:30 p.m. CST, at the Milwaukee Athletic Club, East Mason and North Broadway. Central Division Director Mathews, W2ZRN, will be present with latest information on the A.R.R.L. Board Meeting. Tickets: $2.25. Advance tickets: $2.00, obtainable through W9GVL, Chas. O. Meyer, 3720A North 6th Street, Milwaukee.

Williamsport, Pa.: The 1coming Radio Association, Williamsport, invites all radio amateurs to attend its hamfest scheduled for May 15th at South Williamsport Community Hall. Come early—stay late.

Scranton, Pa.: On Sunday, May 23rd, the Electric City Radio Club will stage its first annual hamfest at Hotel Casev, Scranton. Advance registrations $1.75; at the door on the A.R.R.L. Board Meeting. Tickets: $2.25. Advance registrations fifty cents. For further details see East Mason and North Broadway. Central Division Director Mathews, W9ZN, will be present with latest information on their friends, broadcast station engineers, police radio amateurs, etc.

Cleveland, Ohio: The radio amateurs of Cleveland and their friends, broadcast station engineers, police radio operators, radio service men and others have formed a "Shut-in Day Committee" for the purpose of showing their unfortunatetu shut-in friends a good time in the form of an outing. This outing will be held at Puritas Springs Park, Cleveland, on August 1st, Sunday, full day. Everyone is invited: amateurs, their friends, shut-ins and their friends, SWL's and the general public. WSLXV, a member of the committee, advises, "For further information write to John E. 'Pop' Garvey, Chairman, 2141 W. 67th St., Cleveland, Ohio.

VE1DQ, Halifax, Nova Scotia, maintains a regular schedule with VESTV, Nottingham Island, Buffin Land, on 14-Mc, 'phone. This proves a real service since the family of one of the operators at STY lives only one quarter mile from IDQ. Likewise, the latest at VESTV on isolated Resolution Island have found amateur radio a great blessing in talking to their relatives via VE1DQ.

1.75-Mc. DX

Q2DQ worked W1BB on 1.75 Mc. on March 6th and took a contest number from him. W1BB worked both Q2DQ and G2FL on March 13th, exchanging numbers with G2FL. It is hoped that some trans-Atlantic tests on "100" can be arranged for later this fall. Tests on previous years have proven most interesting, with quite a number of hams getting across the pond. Much credit is due G6AA (ex-G2FL) for his work in the '34, '35 and '36 tests and his very complete report on 1936 work, which is being circulated among the stations concerned.

"On January 10th at 1 P.M. P.S.T., I called CQ on 1972 kc. In accordance with the arrangement, W6MBN picked up my signals and put them out on 25 Mc. Looking over the 28-Mc. band I heard W9GND coming back to me on 'phone. Contact was held without a break until signals faded out. W6MBN had his receiver tuned to my frequency through all this and I feel W9GND's signal to MBN via my transmitter. The most interesting part of the whole experiment was when W9GND called CQ. I picked it up, fed it to W6MBN, who put it on the air on 25 Mc. An answer was picked up by me from W2JBF; his 'phone signals were fed to W6MBN, who retransmitted them to W9GND and a satisfactory contact was made."

—W6A/K

Fifty-two days of portable operation have just been completed by W5GJ, operating from a point six miles east of Douglas, Ariz. Close to 100 QSO's were made and over 600 words of messages handled. A schedule with W5EJB was made at noon. The set up proved its complete reliability. Three six-volt babs had to be changed but once in the 52-day period. A 12- to 350-watt dynamotor was used with 47-10 layout. A gig for 7 Mc. Tape run back-and-forth every center-fed and just 18 feet high. When a 48 m.p.h. wind wrecked the tent and whole works, this antenna on bushes but eight feet high brought a report of 84 at noon. Input to final? 32 watts. Starting January 25th Mr. Wainman is operating W5GJ BT 6 from a point near Mesad, Ariz.

W2JBF, Barneget, N. J., has held the following calls during his amateur career: W3BRH, W2ABP, WA4GD, W2EY, W5DPZ.

W9NUF, O.R.S., Chicago, says that W9NWE (see page 71, May 1937) doesn't know what QRM is. He, W9NUF, lives within two miles of the following 69 hams: W9ABU AI DRN DTN EGA ERL ETP FPP PX GRY GRY GRY HCI IFS IUY KF KHA KJH KQX LWJ LKP LWX LXR LXX MOB MR MYB MZT NHT QQM ORX ORX RHE RJW RLPROP RUK SAN SFW SG SGZ SPG TME TFB TAD TRF TTE TGI UBA UHK UTR UYT UYR VCB VCK YDA YES VEF VEF YVB VQB WS WFM WFS WTM.

W6MPK thinks he must have worked three brothers: Ike, Abe and Joe—otherwise W6ZIZY, W1IKE and W6KB.

Any Night! Was It You?

By "Herba"

Time: 9:35 P.M. EST. W-(who?) 57 on the east coast. QSO's six minutes, off six seconds, plays with bug eight seconds, sends five, repeats whole mess six times, and on the ONLY "clear" channel on the 80-meter band. Nice going!

On 600 kc. (long waves to you kids), (1) saying GE to everyone at 10 A.M. Hang over?

On 3810 kc. (.)'s bug being mistaken for his left foot! W(?) with a yard long yooopft into his keyed xtal sign.

On A.A.R.S. Net. (.)'s and others trying to out Mac McElroy and sounding like a J.P. Tape run backwards. Tak tek children, such sendin' in this day an' age.

Of Freq. (Who) CQing for two hours on 3485 kc.

In print. Frank H. Shaw in "Full Five Fathoms," "... it wasn't SOS then—it was PDQ; the international signal that meant distress heralding disaster." Oh, yeah?

To be shot at sunrise (or preferably earlier): (1) These mugs who claim xtal control is more expensive than these lousy self-excited rigs they mess up the hand with. (2) The ditto who knows only one report, i.e. 599X. (3) The expert who can't possibly have a bum note, the fault is always the other fellows receiver. (4) The foney fone that has "all the dope on that" with a bar room tenor's voice, parroting all bits of gab, and with a "handle." Wonder why (who?) is practicing "code" on 80 after claiming to have graduated (?) into an A-I fone hound?

What about it ... was it y o u? Put your own call in each of the spaces above and see if it fits. Should we revive "prehistoric signal" listings, or create a new department like this? If all ham radio operating was patterned after your particular standard, would it rate approbation and public respect? ... or ridicule? Would you lower or raise the average of amateur operating? Do you make any of the above bulls in current operating? Send in examples that you note if you like. But first, why not spend a few minutes "looking at ourselves as others see us" and looking at those Handbook chapters on operating practice and policy. Let's clean up our operating so it becomes impossible to find such absurdities in the game.

May, 1937

59
How's DX?

How:

Ho-ho! What a DX Contest! More countries, more WAC's, more TBYTOC's, more 4BTTOC's, and even 5BTTOC's, than ever before. Antennas played a still greater part than in previous contests, every conceivable type of directive affair having its own faithful followers who swear by it. We've come a long way since the first international contests — imagine the mess we would have been in without crystal control and s.s. superlative.

Let's try to analyze the thing a little. In spite of all of the technical advancements, the determining factor is still Operating. Yes, "operating" with a capital "O." You all know how efficient K5AY's operating was. At least you should know, he worked enough of you! No wasted effort, no lengthy calls or sign-offs, and always on the band that would hand back the greatest returns for the investment. Take any of the high scores: X25N, W6C5XW, W1E2Z, W2AIW. Their signals were good, it's true, but there were others that compared quite favorably, so the laurel still belonged to the fellow with the ability, an intangible little thing that even the gold of old man Croesus couldn't buy. Maybe that's one of the things we like about amateur radio: it's a game where the race goes to the swift, not to the fellow with all of the world's goods at his fingertips.

Still, it would be nice to own enough land to put up several rhombics, and then have a separate kilowatt on each band. . . .

W3JP suggests a simple little maneuver that might help all concerned. If fellows in this country must test their transmitters on the air, they could at least send "VVV" instead of the somewhat prevalent "test." It would make no difference, except that English amateurs send "test" instead of "QG." The real solution, of course, is for everyone to test into a dummy load, instead of radiating their test signals.

Where:

Those of you who missed EL2A need not lose out on a contact with Liberia. The representative of that country is now EL2M, Henry Grimes, Box 72, Monrovia. His signal is reported anything from T3 to T5, but usually around 14-15 kc. However, a self-excited oscillator is used so you may find him down around the high-frequency end of the band. Look for him around 8 a.m., E.S.T. But don't think you worked him on 'phone. That one's a phoney. At least, the real EL2M didn't have a 'phone rig up till April. Thanks W2BA, W1GCA, W1JDO, W8MAB, W9FS, W2XAK . . . .

Speaking of phonies, there were two ZS2A's in the contest this year. But we'll venture to say that the real ZS2A's operating made the fake ones look like a sissy, so there wasn't much chance of confusing the two . . . .

Then there was FK7KW, about whom we know nothing except that the prefix is not assigned . . . .

Also, the real VS1AA (ex-VS2AF) writes to say that anyone who thinks he worked VS1AA between November 9, 1936, and February 7, 1937, was being fooled. You'll know when you work the real one—he never fails to QSL . . . .

Another bootlegger picked out a good call when he used W3SM5N, but the real owner writes to notify us that the station is inactive at present . . . .

But it doesn't pay to think everyone a phoney. No sir! This column was called to task for hazarding that VS7MB fell into the same category as VS7AI, another phoney. It ain't true! Captain M. Biddle, Royal Army Medical Corps, Military Hospital, Colombo, Ceylon, writes a much nicer letter than we do. He says that he operates VS7MB, and it is very much authentic. His 30 watts has only given him a few W contacts so far, but he hopes the W's he did work were not missed by the incorrect utterance in this column. We apologize, and thank Captain Biddle. The active stations over there are VS7AM, VS7FB, VS7WJ, VS7EB, VS7MB, VS7G, and sometimes VS7AE and VS7JC.

Spanish activity continues, W1EZ worked EA3B (7240 kc, T6c) at 2:30 a.m., W8KBJ worked an EA8 on 'phone, and W1FTR worked EA9AI on 7 M, one night at 9 p.m. EA3B said he was in democratic territory in Spain, whatever that is . . . . W1FTR reports a nice 'phone QSO with the yacht Latitude, operating out of Manila Harbor. Depending on the location, either KZYL or KAIYT is used. Frequency in use are 14,036, 14,106, and 14,322 kc. Send your QSL to the yacht via 2 P. O. Box 532, Manila.

Two active French Guiana stations are FY8A and FY8C. We'd give you their frequencies but they don't stay put, jumping all around the 14-Mc band. You can send cards via FY8C, Narolles, Box 48, Cayanne, French Guiana . . . . .

Also, the real VSI.A.A (ex-VS2AF) writes to say that anyone who compared quite favorably. So his W2AIW. Their signals were good, it's true, but there were others that compared quite favorably, so the laurel still belonged to the fellow with the ability, an intangible little thing that even the gold of old man Croesus couldn't buy. Maybe that's one of the things we like about amateur radio: it's a game where the race goes to the swift, not to the fellow with all of the world's goods at his fingertips.

We'd give you their frequencies but they don't stay put, jumping all around the 14-Mc band. You can send cards via FY8C, Narolles, Box 48, Cayanne, French Guiana . . . . .

When:

Remember when the 28-Mc reports used to trickle in? You know, "W2 . . . heard the harmonic of W9 . . . ." and "W4 . . . reports a brief contact with W6 . . . ." Well, that hard-working ten-meter gang is down on 50 Mc., plugging away, and darned if we don't think they're going to do something. You know that G5BY was heard by a W2, of course. ZS1H is on every day at 1600 GMT, and V1K2G is on Mondays and Wednesdays at 7.30 a.m., E.S.T. But the news of the work is reception by W6ITH of JNJ's harmonic, the harmonics from several ZL's and a K6, and several unidentified 'phone carriers! The time: 5:30 p.m., PST. So how's for some of your hard-boiled DX'ers getting down on five with some c.c. power and a good receiver, and giving the thing a chance?

Eighty was during the contest for European and African contacts, at least for the East Coast gang. It's a non-take-down band in the Mid-East District through the contacts of W4APU with Z51AA (5502 kc., T2K), and K6JPD are rather outstanding . . . . If you didn't try the band during the tests you missed nice ones like OE3AH, PST8E, SM7TUC, E14J, G6TE, VY10W, FM8AD, K7FQ, HB9I, and of course the many's F4, D4, and PAO's.

News on ten is the QSO of W6BAM with MX2B, for the first 28-Mc. W-MX work. We hope MX2B will get on often and give more a chance to get Manchester down on 28 Mc . . . .

Ten was anybody's hand during the contest—the West Coast taking away plenty of Europeans from the Eastern fellows, and VK's and ZL's up to S7 and S8 on the East Coast. No one neglected 28 Mc. this time, and it gave them good ones like SV1KE, Y5AA, HK1JW, K7FQ, Y4M4A, FAM4F, H1KN, USNE, Y7UDX, J8F3, J4GT, J3FJ, J4CF, OA4J, VK7RV, VP2AT, and Z6LJR, as well as the less scarce European and South American countries. The forty-meter band turned in a very good account of itself, with a lot of Asia coming through on the East Coast, and Europe on the other side of the continent. The tendency was to stay on 20, with the band staying open practically 24 hours, but those that tried 7 Mc. grabbed off a lot of multipliers, F6EO, G6NF, GM5YQ, G18TE, W8L8D, and many others came through to the WB's. HR1UZ, YV5AO, UX8XH, and VP7NR were choice bits for the easterners.

The 14-Mc band yielded the most multiplier in practically every case, as one would expect. Did you work all of the fellows that were on? H1JFA: GP1-125, K1JW, K11U5; F14AK; YJ1A; CN8MI; Z1KIRG; U9AW; US8E; UX8JR; J8CA; KA1MD; YV5AN; PK1RL; Y98AB; HS1JR; CR7MB, F6F8AD or VP87F? We'll neither did a lot of us, but all of us were on at one time or another . . . .
W8MAH sends in a list, helpful to those who still need Asia for WAC. J2LU (14,260 kc., T9x), J2J (14,275 kc., T9x), JOMH (114.310 kc., T9x); and UP's can be found off the deep end of 14,400 kc. From 8-9:30 A.M. for the Japanese stations, midnight for the Asiatic Russians .... And if it's VK6's you need, W8MAH recommends VK6SA (14,050 or 14,280 kc.), or VK6LLJ (14,130 kc.), around 9 A.M.

Who...

ZUI.T writes to say that he is still convalescing, and cannot stay up as late as he used to. He was sick during the latter part of the S.A.R.R.L. contest, and was running a fever. At that, his best work was exchanging numbers with 38 stations in one hour! .... We regret to report the death of SUIAP, killed in the large seaplane he was piloting between Southampton, England, and Alexandria, Egypt. This turned the wings and the plane crashed near Lyon, France .... GM2BD (14,130 kc.) is looking for W5, W6, and W7 stations each day from 05 to 06 GMT .... W8CNC reports that VK6LLJ (14,130 kc., T8x) needs Mississippi, Vermont, North and South Dakota, Montana, Wyoming, Colorado, Utah, Nevada and New Mexico for WE WERE CURIOUS ABOUT W2HFF DOWN IN NEW YORK CITY BECAUSE HE WORKS AND HEARS SO MUCH GOOD DX, AND WE THOUGHT SUCH A STUNT WAS IMPOSSIBLE IN THE CROWDED METROPOLITAN AREA.

So here it is W2HFF, Liscum Diven, New York City. The receiver is an old model RME90, with a DB20 pre-selector. The transmitter is a 47 oscillator, 6LO's in parallel doubling, and driving a 203A with 275 watts input. The antenna is conventional, and yet he hears and works stuff like PK6AJ, 21BAX, friendly, KAI1MD, JBCD, FT4AH, U6ST, EAKAH, and KAIUS. So there it is. We still don't know the answer. Unless of course, it's the ability of the operator ...

WAS. He comes through best between 3:30 and 5:30 A.M., EST .... To add insult to injury, old 8-watt W5CPT, that low-powered fellow down in Texas, didn't stop in the contest. He made WAC twice during the contest, once on 28 Mc. His WAS total 6 now, his country 37. On a "countries per kilowatt" basis, he'd have most of us looking rather ridiculous. But listen, W5CPT, aren't there times when you wish you had just a little more power? Or do you do it just to make us feel futile?

WAC:

US6E tells us his QSO's that he is in Asia but the I.A.R.U., the international amateur union that issues the certificates, has set up continental divisions that put US6E in Europe. The A.R.R.L. map shows these divisions, if you're in doubt .... Latest 'phone WAC's are to 236AJ, W2HPS, W2X, W1SZ, W2KK, W1CCY, W1FVO, W3MD, WNGZ, W9YGC, SUIRO, W3EMM, W8IMS, and 117KM .... And all the troubles don't happen to W9. Quoting from Amateur Radio, the Australian amateur radio society magazine: "In 1936 the Pilgrim Fathers landed on Plymouth Rock. During the last VK-ZL test many hams wished, when W stations answered a 'CQ Europe,' that the Plymouth Rock had landed on the Pilgrim Fathers!"

---W1JPE

Irish DX Contest

The Radio Society of Northern Ireland is holding a contest during May week-ends for all amateurs in Ireland (EI and GI) and the rest of the world. The week-ends May 7th-9th, 14th-16th, 21st-23rd, 28th-30th will be used. On each period activity will start at 2400 GMT on the Friday and end at 2400 GMT on the Sunday. Only one telephone may be worked on a different frequency band. The aerial numbers

HUNGARIAN DX CONTEST

The first Hungarian DX Contest will be held on the five week-ends of May under the auspices of the National Union of the Hungarian Shortwave Amateurs. Each period starts Saturday at 1400 GMT and ends Sunday at 2400 GMT. Six figure serial numbers will be exchanged, one point for receiving, one point for sending, two points if numbers are handled successfully both ways. The serial numbers will be made up as follows: The first three numbers will be the RST report of the station worked, the last three will represent the number of the QSO; thus, in the first QSO the number might be 579005, in the one hundredth QSO, 579100, etc. On any given week-end the same station may be worked more than once, if on a different frequency band. The same station may be worked on each week-end. Total points to be multiplied by the number of different HA stations worked. QSO's with the same station on a different band counting an extra multiplier. At least one participant in every country, but not more than three, will receive a certificate for his contest work. Each district in the U.S.A., Canada, Australia, New Zealand and the Union of South Africa will be considered as separate countries for purposes of the awards. A complete log, containing data on the transmitter and receiver, list of QSO's (with times, numbers, frequency band, points, etc.) should arrive at the Union not later than August 1st; address: Magyar-ter 6, Budapest, Hungary.

Polish DX Contest

P.Z.K., the Polish Section, I.A.R.U., is holding a DX contest for Polish amateurs and those throughout the rest of the world. The competition starts at 0001 GMT, May 16th, and ends at 2400 GMT, May 30th. Polish stations will give a serial number, which must be received correctly and reported via QSL card. If the number is not received, or incorrectly received, or the QSL card is not sent, the QSO will not count for either competitor. Points will be scored as follows: VE1, VE2, VE3, W1, W2, W3, W4 and W8 claim four points for each complete SP QSO; VE4 and W9 claim five points per QSO; W5 six points; VE5, VE7 and W7 eight each points. Points for 28-Mc. QSO's will be quadrupled. Each station may be worked once only. Special diplomas and a year's subscription to the P.Z.K. magazine will be awarded to the three highest competitors other than those in Poland. A diploma also will be awarded to the highest scorer in each country. QSL cards should be sent to the Polish QSL Bureau, P.Z.K., Lwow, Bielawickiego 6, Poland. Cards received after October 31st will not be considered.

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The Band Daily Mail Trophy presented for the Golden Jubilee London Distance International Radio Contest, which was organized by the South African Radio Relay League, has been won by an American amateur, Mr. Clark C. Rodimon, W1SZ of West Hartford, Conn., U.S.A., with a score of 289.5 points. The competition, which took place during the four weekends of January, attracted entrants from nearly all parts of the world and more than 5000 cards were received from competitors. The trophy is designed in the form of a single silver aerial mast standing on a map of Africa etched on a portion of a silver globe.

The runner-up was W1TW. The certificate winners are as follows: W1SZ, W2CJM, W3CHH, W4AUU, W5EUG, W6DD, W7EH, W8JIM, W9AEH, W2DR, W9VG, VK3MR, VK3RX, VK7CL, ZL1HY, ZL1J, ZL1L, ZS1FL, ZS3F, ZS4UX, ZS5AH, ZT5Z, ZU5G, W6WMB, W5VH, W4WBE, and ZT2Q. The trophy is presented to Clark C. Rodimon, W1SZ of West Hartford, Conn., U.S.A. in place during the four weekends of January, attracted entrants from nearly all parts of the world and more than 5000 cards were received from competitors. The trophy is designed in the form of a single silver aerial mast standing on a map of Africa etched on a portion of a silver globe.

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A.R.R.L. Headquarters Operators
Hal Bubb, "Hal," Chief Opr. WI4W

The following calls and personal items belong to members of the A.R.R.L. Headquarters gang:

WI4L, L. J. John
WI4A, A.R.R.L. Headquarters Operators Club
WI4B, R. B. Beaudin, "rb"
WI4B, F. E. Handy, "fh"
WIC4S, C. R. DeSoto, "de"
WIF4F, George Grammer, "gg"
WIE4H, K. B. Warner, "ken"
WIES, A. A. Hepbert, "ah"
WIGS, F. C. Beeley, "be"  
WIK4C, Vernon Chambers, "vc"
WIF4J, A. L. Budlong, "bud"
WIF4P, Byron Goodman, "by"
WIL4D, Hall, "hah"
WIS4E, C. C. Rodlinmon, "rod"
WITS, Don Mix, "don"
WIUE, E. L. Battey, "ev"

STATION ACTIVITIES

CANADA

MARITIME DIVISION

Maritime—SCM, A. M. Crowell, VE1DQ—EA reports some FB work during the DX contest; he worked GZ2PL on five bands both before and during the contest; he also got an 88 from FARHE on 3.5 Mc. EX had a week's holidays during the contest—stuck a nail in his foot! AX has returned to 14 Mc. with a new rig. AW has been working DX via 14 Mc. BC and XYL are changing QTH, the lather will now operate under her own call. OW, Congratulations, Mrs. B. BV goes home from Halifax week-ends to work the old DX. FQ is getting new rig ready on 14 Mc. after getting fixed up for unlimited 'phone. KW, new traffic man, has been scheduling EY. FO has been trying a Class "B" linear amplifier. Fredericton news via JO: HM has new rig about finished—2A5, pair 2A5's and pair tens. VE8DX, attending college here, has his comm. ticket. AJ is trying to raise a power transformer. AM, local R.L., is working DX on 28 Mc. FX is on 7 Mc. with 47-48-pair 48's. JO has rebuilt using 59 c.e. c.e. and '45 amp.-15 wat. St. John: The Loyalist City Amateur Radio Club, newly organized here, is starting off right by appointing EE as press agent for the St. John gang to handle notes for the S.C.M. FB and thanks fellows! HL has been elected first president of the club. AX, AY, DH and EJ are preparing to hit the air. BA, GO and FK keep 14 Mc. hot, FL cuts out well on 175-150 kc, low-power phone. IG works with 1F with a nice transmitter on 28 Mc. IG does not help the power company much with his 15 wat. CM, FC and FU work 3.5-Mc. e.w. EI is still going strong after the European contacts. GP is building a new modulator. JW is a new ham. JN's junior 3-watt 1.75-Mc. 'phone is very consistent over 100 miles. BF, IE, GE, FL and JN have a nice 1.75-Mc. 'Phone Net. EE is looking for a W5 and W7 for all districts in Canada and U.S. on 3.5-Mc. ‘Phone and Trunk Line Station; the boys will miss that snappy fist at the Montreal end. BF is rebuilding a W5 for the AK-28. LL has been working some real DX on 7 Mc. GO

ONTARIO DIVISION

Ontario—SCM, Fred H. B. Saxon, VE38G—R.'M.'s: VE3AW, DU, GT, MB, QB, TM, WK, VK, P.M.A.: NX, DC (Doc). Jaffray, Dun-las) reports traffic for first time in fifteen years. On March 1st the Hamilton Club entertained 100 hams, gathered together from Beamsville, Dundas, Brantford, Waterloo, Stratroy, Kitchen, London, Collingwood, Mimico, Toronto and Weston. The speaker was Mr. Kreitbourne of Canadian Westinghouse. WP has gone south to Timmins. TM is fast becoming a dyed-in-the-wool 'phone man. DU had three weeks holidays and QSO'd 56 Europeans on 28 Mc. WK has Mac-Key. My thanks to those who submitted logs in the Section QSO contest. I have a record of 55 taking part. AAG gets the 3.5-Mc. crystal for the best log, having 16 T9X and 5 T9 reports for a total of 21 contacts. OT addressed the International Alumni Association for an hour and a quarter on Ham Radio, SS is new O.R.S. in Welland. DH in St. Catharines is after O.R.S. ticket. North Toronto Club had demonstration of just what is possible with 6L6 and 6L6G. AAX, of Rogers Radio Tubes, told the Wireless Association all about the new short-wave station, CFXK, at Aurora, E9 has installed Paradyne radio and is pleased with it. TA has rebuilt. LW has new super. UN has high-power 'phone rig on 14 Mc. UV overhauled receiver and exicer unit. CD is active on 3.5-Mc. 'phone. AGG has an USR on 14 Mc. AU4M has a half-kw. rig ready to go. Wireless Association executive for 1937: Pres., XF; Vice-Pres., SX; Secy-Treas., AEX; Publicity Mgr., ADG; Exe. Comm., Bx, LX, NF and MJ. TO is on 14-Mc. 'phone and c.w. YB is rebuilding whole station from waste basket up. E9 had new crystal for 'phone work at 2674 kc. FT is having ticket endorsed for 3.5-Mc. phone. OI goes well. VE3VW, VY-2 has 211 in final. AFC is in final. AAF is working DX from 14-Mc. phone. VE3AL is now net control for the Maritime Net. DQ has submitted logs in the Section QSO contest. I have a record of 285 contacts on 3.5-Mc. AOX is in final. VE3IV is in final. VE3YF is gone strong on 3.5 and 7 Mc. VE3X is new and vigorous. VE3R, the first VO3 and VE3P is now an active VO3 on 14 Mc. VE3Q is now working 3.5-Mc. and 7 Mc. VE3Y is new and vigorous. VE3S is on 3.5 and 7 Mc. VE3T is now active on 3.5 Mc. VE3W is on 3.5 Mc. VE3U is rebuilding for an hour and a quarter on Ham Radio. SS is new O.R.S. in Welland. DO and VZ are operating R.C.N.V.R. station in Timmins. EM is fast becoming a dyed-in-the-wool 'phone man. JO has rebuilt. WF and VE2W, VE2S, VE2M and VE2R, VE2KE, VE2Q, VE2P, VE2Q and VE2R visited the Cardinal gang. XS is changing to 'phone. VE3IA, VE3IB and VE3IC visited the Cardinal gang. XS is changing to 'phone. UO has new receiver. 32 stations reported a total of 1024 messages handled in the month, which is splendid. This personal message to those of you who do not handle traffic: "Please send me a letter or a postcard on the 15th of each month, reporting news of your station or of your friends." Thanks, guys. 73—CUL.

Traffic: VE3WK 173 SG 165 QK 140 ABW 94 TM 68 3X 55 WX 45 OL 42 DH 27 MA 26 UV 22 AUM 18 XL 17 KM 14 DW 13 CG-GT 12 QB 11 ZE 10 VD 18 SS 8 A5-OH TO-KT 7 CD-MB 6 UO 4 NC-DC-ABC 3 DJ-LI 2. (Jan.-Feb.; VE3AMU 16 MA 15 WX 22.)

QUEBEC DIVISION

Quebec—SCM, Stan Comach, VE3ZG—We regret very much to report that our old pal "Doc" DG has found it necessary to resign the position of Route Manager and Trunk Line Station; the boys will miss that snappy fist at the Montreal end. BF is rebuilding an AE-28. LL has been working some real DX on 7 Mc. GO

May, 1937
has given up his ORS. CO is selling out and rebuilding. IJ
back. KF has built
3.5-Mc, 'phone. HU spent an enjoyable week-end at Hart­
country. LL is visiting the boys across the Mason-Dixon
ford, saw all the tricks at Headquarters and visited Ed
ocore in the tests. CR, DR, BV and LV lost some sleep over
HL, IT, AC, EC, GB, KF and HT are heard regularly on
Mc. HH is using a T-20 final. DR worked a PK for his 73rd
Vancouver and met some of the Winnipeg boys on his way
IB
Front page of the
Trail-Rossland Amateur Radio Club with RL president, AA
ice-pres., and HX secy-treas. Congratulations, gang, and
hope your club will enjoy a long and successful career. The
A.R.R.L. Convention is being held on May 21st, 22nd and
23rd at the Hotel Lowry in St. Paul. Anyone able to attend
this. convention will be assured of a fine time with plenty of
radio club there. On Feb. 18th the St. James Radio Club
put on a display of radio amateur equipment at St. James
Hotel, and K6's. UG has a T20 and plans T55's as final. XB with
59's you have contacted, and you can find out all about it
by writing to the Convention Committee at 1860 Prospect
Avenue, St. Paul, Minn.


SASKATEWAN—SCM, A. J. R. Simpson, VE4BG—Trunk
Line Station GC is still on the job. With a pair of push-pull
'10's RA keeps several schedules weekly, AAW's autenina down; he schedules QG at Waldron, Seek.
NP at Dauphin, Man. and WQW. VE4ABA was a visitor to Winnipeg to have an operation. AFF at Dauphin keeps in
the swim with a '47 crystal, '46 doubler and pair of 250's final. AAI is now C2A for Wings Ltd. at Favourable Lake.
VE4QF is high power. The Mid American-Dakota Division
A.R.R.L. Convention will be held on May 21st, 22nd and
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Avenue, St. Paul, Minn.


MONTANA—SCM, A. J. R. Simpson, VE4BG—Trunk
Line Station GC is still on the job. With a pair of push-pull
'10's RA keeps several schedules weekly, AAW's autenina down; he schedules QG at Waldron, Seek.
NP at Dauphin, Man. and WQW. VE4ABA was a visitor to Winnipeg to have an operation. AFF at Dauphin keeps in
the swim with a '47 crystal, '46 doubler and pair of 250's final. AAI is now C2A for Wings Ltd. at Favourable Lake.
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59's you have contacted, and you can find out all about it
by writing to the Convention Committee at 1860 Prospect
Avenue, St. Paul, Minn.
The Publishers of QST assume no responsibility for statements made herein by correspondents

**Flea-Power**

358 W. Oakland St., Toledo, Ohio

Editor, QST:

I heartily support W1EXZ's suggestion that a portion of the 80 meter band be set aside for flea-power work, although I would like to see a similar section designated in each band. The special sections need not be large, but I suggest that the power limit be fifteen watts.

Not only would this give the low power fellows a chance to get out, but I'm sure the high power chaps who have already worked everything would have a new stimulus to see what they could do with low power. I predict WAC's proudly qualified by their owners as to the small power used.

And it would give those of us who want to build and test low-power emergency transmitters a chance to see what they will do. From personal experience a good distance away from North American QRM I know low-power rigs can get across if only the signals have a chance to be heard.

The biggest thrill I have yet had in ham radio was when VQ8AH in Mauritius told me he had only ten watts input. Yeah, I got thrills out of those QSO's!

Let's spend our dough on the intake end.

-Norman H. Underwood, W3DYM-KA7NU

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2941 Hering Ave., Bronx, New York

Editor, QST:

Today, in most hobbies the "sporting spirit" holds sway. Smaller bore rifles, lighter rods and line are the trend in hunting and fishing. Lowering power is the equivalent in amateur radio.

Every month in QST we read of the accomplishments of low- and flea-powered stations. It seems that a few watts of r.f. will cover any earthly distance. On 80 meters I found that I could easily contact WI-2-3-4-8-9 and VE1-2-3 with 5½ watts input to an e.c. oscillator. Yep, I got thrills out of those QSO's!

How about it, fellows? Why not a more general lowering of power? It doesn't mean rebuilding. All you need to do is couple your antenna to the oscillator or buffer stage of your big rig and fire, but don't be shy about using that full quarter kw. when you feel it necessary.

—Phil Reich, W2HUG

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7509 Boyer St., Mt. Airy, Phila., Pa.

Editor, QST:

... Think it's about time the A.R.R.L. gave special recognition to him who does it with flea power. A good percentage of WAC's are made with more than 100 watts. Why not have a WAC for less than 25 watts, as W1EXZ says, that is low power?...

—Alan P. Buffington, W3EEW

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Editor, QST:

With great pleasure I read about "The Flea Power Association" in QST.

In his article he says those fellows with high-powered rigs are occasioning lots of QRM and therefore the little fellow is always handicapped. I think his idea is wonderful to some extent, but if the hams with low-powered rigs choose the proper time to operate our stations, I think it would work much better.

... I have noticed that operation of my station between the hours 8 A.M. and 11 A.M. is much better. There is not so much congestion and I always get my man. I hope all those boys using flea power rigs will choose the right time and when congestion on the air is at a minimum.

—Francisco Bou, W3ESX

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May, 1937
Editor, QST:

Having closely followed the interesting developments of amateur radio in the 2-Mc. band I wish to attract the attention of experimentally-minded amateurs to a peculiar phenomenon which I suppose not yet well known but worth further study.

When 10-meter stations are at full activity if one happens to tune his receiver on the 20-meter band he is often able to hear many "CQ" transmissions as well as other 10-meter communications coming through quite distinct and strong. The effect was often noticed by the writer particularly on stations located at distances from New York City of about 500 to 2000 km. Usually this happens on c.w. signals, but although not yet confirmed some phonographs have been received in this unusual way also.

The effect has been practically noticed on no other band except 10 meters.

The first thing one would be inclined to recognize as the cause of this strange sub-harmonic type of reception could be some spurious radiation from multiplier stages preceding the final amplifier reaching the antenna system, perhaps with the undesirable and unwanted help of some parasitic coupling in the transmitter itself. There are, however, the following points making this assumption a wrong or at least unsubstantiable one:

1. Many local tests have always given negative results of sub-harmonic reception from nearby transmitters.
2. Many of the sub-harmonics heard possessed the distinctive notes of self-excited rigs for which obviously the above mentioned assumption must be at once rejected.
3. Reception of telephone transmissions. (This point, however, as already noted, needs further confirmation.) There were no faults or tricks in the receiver used and in this regard I must point out the effect was noted on many receivers of different design.

In conclusion I am inclined to suggest the hypothesis that the cause of this sub-harmonic reception is due to an effect of propagation of radio waves (like the Luxembourg or Tellegen effect, for instance). This hypothesis has to be positively validated by other experiments, but in the meantime it will be very much obliged to you if you kindly publish this letter in QST seeking the cooperation of other amateurs throughout the world in solving this intriguing problem.

Pier Luigi Bargellini

More on 29-30 Mc.

Editor, QST:

... After doing a considerable bit of listening and some

Continued on page 68
EUROPEAN DEVELOPMENTS. This page is being written this month in Istanbul, Turkey, and as has often been the case of late, with just time to reach Hartford by “dead-line” if tomorrow’s “Simplon Orient Express” to Paris makes connection with the Thursday sailing of the Bremen from Cherbourg.

So many weeks have slipped by since I was last at the factory in Malden that it seems strange to be writing about things back there — and yet past experience has shown the importance of withholding comment on European radio developments until full investigations in our own laboratories under our own conditions of application have indicated more concretely the possibilities for their future adaptation to amateur radio. Only too well do we remember the claims made for a ceramic high voltage fixed R.F. condenser dielectric with an unbelievably high dielectric constant and low loss factor. On this page many months ago we commented upon our inability even to begin to substantiate the manufacturer’s claims in our own laboratory measurements. Even so, we really have high hopes for some of the things we have seen over here this winter being adaptable to amateur needs in our own country. In particular it seems safe just to mention that the Europeans know how to mold the extremely low loss polystyrol dielectrics even better than we have been able as yet to do under ideal laboratory conditions at home. — But of all that, more later.

2000 PER CENT OVERLOAD. On our many travels we like to visit as many as possible of the amateurs with whom we have talked over the air. In retrospect, the stations we have seen in this way are particularly notable for their ingenuity. There seems to be no limit to the strange and wonderful things that are done to adapt old equipment to new uses. Our most lasting impression along this line is the Class B output transformer used by Lewis Gilmer a year or so ago at W9MTC. Perhaps it struck us the way it did because we compared it with the very correct equipment of Thorn Donnelly’s Lake Bluff Radio Club, to whose select membership W9MTC belongs.

At all events, we found a pair of 203A’s delivering some half a kilowatt of modulation through a little Class B transformer probably designed for not over twenty-five watts. The transformer had been removed from its case, and all leads had been carefully fanned out to separate them as much as possible. The stripped core and coil had been suspended in a large glass beaker of transformer oil. At last reports this contraption was taking its punishment bravely. Of course, the trick was in the generous use of transformer oil which provided convection cooling for the core and coil as well as insulation for the leads. Strangely enough, the speech quality was not at all too bad.

BATTERY MODEL OF THE NC-101X. A new model of the NC-101X specially adapted to operation from batteries was completed just before I left home and is now available from all of our regular franchised dealers. In addition to eliminating the power supply, certain other changes were made to reduce the B-supply current as much as possible. These include the use of series resistors instead of voltage dividers, and the elimination of one output tube (single 6F6 instead of PP 6F6’s). What with one thing and another, the new model requires only 35 MA (at 180 V.) instead of 115 MA. Similarly, to save the A-battery, the dynamic speaker is of the type which gets its field from a permanent magnet. These are the major changes.

JAMES MILLEN

Say You Saw It in QST — It Identifies You and Helps QST 67
A Statement of Policy

For over twenty-five years, Yaxley products have meant progress in radio. And the passing of each year means further advances from the use of Yaxley products as well as those produced by the parent company—Mallory.

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Correspondence Dept.
(Continued from page 66)

QSO'ing on the 28-Mc. band I am beginning to believe the saying that amateurs are slightly demented is true. On the week-ends when activity is at its greatest one can readily reach the conclusion that despite amateur howls about QRM, the gang at large really likes it. Take a listen, OM. A curve drawn of the number of stations per kilocycle looks like a grid voltage plate current curve with 29-Mc. at cut-off and 28-Mc. saturation. And we find by operating experience if you shift to the 29-Mc. to avoid QRM and incidentally stop QRM'ing the gang that is "most piled up," that the number of QSO's per number of calls made, goes down as the frequency is increased.

To my mind the latter feature is most important. Here we have a "new band" that as yet has not frozen into a set routine. Already we find however that fellows will call CQ and then listen over a small portion of the band. These tricks signal that the Caller is going to listen for Calls in a certain part of the band are all right on the crowded and narrow 7-Mc. band. It seems to me there is no excuse for them on a band like the 'phone portion of the 28-Mc. band. Just because a man operates on the other end of the band is no sign he is a social outcast, in fact, he may be doing you a favor by staying off "your" frequency. If a CQ or "general inquiry" is made, the least a courteous operator can do is to take a listen over the whole band.

The other point I wish to make is on the activity in the exclusive c.w. assignment, 29-30 Mc. Do we find the brass-pounders in that huscious megacycle reserved for their exclusive use? We do not. Merely the dots and dashes burp through 'phone QSO's and an intensive search between 29 and 30 Mc. reveals a few commercial harmonics (PCT 29.0 at R5 on the east coast indicates good transatlantic conditions), an occasional foreigner, and a rare W in the ratio of 500 to 1.

A good deal of the c.w. operation in the 'phone band is of that fellows who also operate 'phone. They do not wish to shift frequency and I feel that such dual operation is to be encouraged. However, before we lose that extra megacycle shouldn't it be a good idea to open up this territory to unrestricted use? The present set-up has proven itself unsatisfactory after a full year's trial. As the QRM in the other half of the band is becoming more and more severe as each week passes by it seems that the time is ripe for a change to unrestricted conditions.

D. A. Griffin, WMAOE

Editor, QST:

Suppose you start a list of Calls Heard, 29 to 30 Mc.: March 1st, to 14th, (W9FJR) W6QG.

Boy, ain't that an imposing list of stations heard for many hours of listening on a supposedly active ham band! Old man W9FJR and myself claim that we certainly are a specially-privileged pair of hams—in fact, the only two hams in the world who have a frequency allocation all for themselves. If you don't believe it, we can show any ham our station licenses, which say we are allowed to listen, OM. A fellow who has the nerve to break up his 1-kw. signal. Oh, h - eck.

John J. Michaels, WSFAR

"Lonely Kilocycles"

Editor, QST:

I operated 100-meter 'phone and believe there lies the height of QRM. Contacts on this band are more enjoyable due to the closer personal feeling towards one another. Because of low-power DX and simplicity of equipment and operation this band is becoming brighter in the eyes of the newcomers as well as the old-timers. Naturally this means many more new stations in the same territory and hence much more QRM. What should be done about this situation? Well, what about the c.w. part of the
Here are the facts

More 100% grid-modulated power output from the Type 154 GAMMATRON than from other comparable tubes. The “154” GAMMATRON is particularly adapted to grid modulation because of its low mu and capability of overload. It is the only tube available that has the characteristics capable of giving high efficiency grid modulation with good linearity. It stands alone in this field; there is no comparable tube on the market.

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Send for article by Frank C. Jones describing the HK-154 10-80 Meter Grid-Modulated Phone Transmitter.
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---

Band? Is this band of 85 kc, crowded? I should say not. I think that these 85 kc. are just being wasted. Night after night I have listened and could hear only 5 or 6 c.w. stations. Now why can we not just as well operate phone there and really do justice to those 86 lonely kilocycles? —N. Howard, W14 BY

---

One of Many

Savanna, Ill.

Editor, QST:

Will you please publish my thanks to the gentleman who is using my call op forty and ten and gathering in all those hard-to-get QSLs? I am especially proud of the German card I received a month ago and thanks a lot for the VE2. I have worked several but have been unable to get a QSL. Incidentally, I need Florida, Nevada, Idaho, and Colorado for WAS. A VE5, VE1, or VO1 would also fill a gap in the wall and keep the mosquitoes out.

Moreover, if he will kindly make his identity known I will be glad to drop around and make the depth of my feelings known in a more touching manner. —Robert Hicks, W9UET

---

Phantom CQ

8577 Germantown Ave., Chestnut Hill, Pa.

Editor, QST:

From Bill Ellsworth, W3FED, comes the following idea: that CQ is entirely unnecessary and superfluous. Says he, why not have a phantom or assumed CQ? A station wanting to send a general call for a rag chew, or what have you, would call "de W3QP de W3QP de W3QP X." It is obvious what is meant, and what a swell saving in time! Directional call would be: "Calif de W3FED Calif de W3FED" or "Calif Calif Calif de W3FED W3FED W3FED." Looks very simple and desirable to me. Just omit the "CQ" entirely and the gang will know what's wanted without it, perfectly.

—Jack Morgan, W8QP

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A Universal Exciter

(Continued from page 55)

Another commercial trick for securing neat wiring is the use of dummy lugs, such as those between the r.f. chokes and the resistors. These handy little gadgets can be obtained from any radio dealer.

While commenting on wiring, it might be well to suggest that whenever a switch is mounted on the panel of the unit, such as the B3-supply switch in this instance, a pair of terminals be located at some handy place in the rear and connected across the switch terminals so that should it be desirable at any time to control the switching by either an extension lead or a relay, it will not be necessary to remove the complete unit from the rack and half-disassemble it in order to delve into the interior to get at the switch contacts. This point is particularly applicable to power supplies, which, sooner or later, you will want to control either directly or by relays from a master switch on the operating table. After all, in our anxiety to get a new transmitter on the air, most of us at first have at least six switches to throw, in various parts of the room, before being able to shift from "send" to "receive." Sooner or later, however, we settle down to at least a brief spell of just plain operating, during which time we all take a little pride in seeing just how quickly we can shift;
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which calls for a single master switch or a “press-to-talk” button.

It will be noted from the photographs that wherever leads are taken through a metal partition a rubber grommet is used. Such practice, while not necessarily essential, in the end invariably pays for itself in the elimination of insulation breakdown at a time when repairs are difficult and inconvenient. Such a grommet is also used in the chassis hole through which passes the flexible drive to the crystal holder.

The standard G.R. jack-top output terminal posts are used, rather than conventional binding posts, so that should this exciter at any time be used with more than one final amplifier for operation on different bands, much awkward work behind the relay rack in shifting leads is reduced to the simple operation of changing plugs.

Long-Wire Antennas

Continued from page 40

\[ \sin \phi = \frac{l - 371 \lambda}{l \cos \Delta} \]

Regardless of which design method is followed the pertinent fact remains that there is an optimum set of dimensions for the rhombic to obtain maximum results under a specific given condition.

Briefly summarizing, with all other dimensions being correct any increase in length causes an increase in power gain and a slight reduction in wave angle. An increase in height also causes a reduction in wave angle and an increase in power gain but not to the same extent as a proportionate increase in length.

TERMINATING THE RHOMBIC

The rhombic, when terminated in its characteristic impedance, becomes unidirectional and non-resonant and should be operated as such to realize the best overall results, either for transmission or reception.

Experiments have shown that a value of 800 ohms is correct for the terminating resistor for any properly constructed rhombic and that the system behaves as a pure resistive load under this condition. Higher or lower values of resistance cause the rhombic to act as a reactive load, thereby considerably reducing the efficiency of the broad frequency characteristic.

This terminating resistor must be capable of safely dissipating \( \frac{1}{2} \) the power output (to eliminate the rear pattern) and be absolutely non-inductive. Such a resistor may be made up from a carbon or graphite rod or from a long 800-ohm transmission line. If the carbon rod or a similar form of lumped resistance is used the device should be suitably protected from weather effects, i.e., covered with good asphaltic compound and sealed in a small light-weight box or fibre tube.

The 800-ohm value of terminating resistance may be substantially lowered by running an equal and parallel-connected wire under each leg of the rhombic. For instance, a distance of about 12 inches separation between two such parallel-connected wires for each leg will permit the use of a 600-ohm terminating resistor. This is of
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THE UNTERMINATED (OPEN ENDED) RHOMBIC

The unterminated rhombic is a bi-directional and resonant system and closely resembles the open "V" in operation and performance. The same design details apply to the unterminated rhombic as for the terminated type. Ordinary 600-ohm tuned feeders are preferable to use for the unterminated rhombic and "V" and may be coupled to the transmitter by the usual parallel- or series-tuned resonant circuits. Matched-impedance lines may be used on these resonant systems by the use of the well-known matching sections or "stubs" but such procedure is not readily adaptable to multi-band work.

If bi-directional properties are desired an open "V" of the same overall length is preferable to the unterminated rhombic. For example, a "V" of 5 wavelengths on a side has a greater power gain than an unterminated rhombic with legs 2½ wavelengths long (5 wavelengths total for one complete side of the rhombic). On the other hand a "V" of only 2½ wavelengths on a side has less power gain than an unterminated diamond 2½ wavelengths on a leg.

The only instance where an unterminated rhombic should be used in place of the open "V" is where it would be impossible to install a "V" of the same overall length due to insufficient dimensions of available space.

To realize the full benefits from a rhombic or "V" some provision should be made to permit the use of the array as a receiving antenna by the incorporation of suitable relay or switching...
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Air-Wave Bending of U. H. F. Waves

(Continued from page 18)

above the surface of the earth is accompanied by a high 60-Mc. signal level over the path. . . ."

In other words, it was concluded that the high signals coincided with an atmospheric condition in which the temperature of the air did not fall off with an increase in height as rapidly as under conditions considered normal for a clear settled day. The observations which had been made prior to the installation of the recorder had indicated much higher signals during the fall of 1934 when temperature gradients were known to have been at least no more favorable than in the winter. We expressed the thought then that "the higher signal levels of the warmer months probably result from the higher specific humidity prevailing during that time." Aside from the splendid assistance given us in this work by Dr. Brooks and his associates at Blue Hill we had at all times the full cooperation of many Boston and New York amateurs, James Millen, W1HRX and Harner Selvidge, W1FQV at Harvard University maintaining regular nightly observation schedules for several months.

GETTING A LONG-TIME PICTURE

By May of 1936, the recording receiver having been running some eleven thousand hours, we had accumulated a great deal more information on the way signals behaved under a great variety of atmospheric conditions and were able to present, in a second paper, the seasonal variations—which showed a very great increase in average signal during the summer—and curves showing the average hour-to-hour variations during the four seasons. These diurnal curves revealed that while the water vapor characteristic was of tremendous importance, its effect in increasing the bending seemed to be dependent primarily on the existence of a favorable temperature characteristic. This was indicated by the fact that the summer day signals were not greatly in excess of the winter signals in spite of the much more favorable summer water-vapor condition. Only at night time, when cooling of the surface air provided the necessary temperature stratification, did the summer signals rise appreciably above those of the winter. Again, during this period, splendid ham cooperation was forthcoming, W1OM, W1NF, W1MJ and others maintaining nightly schedules continuously over a period of six months or so.

All of this work was still qualitative but it definitely clinched, in our own mind anyway, the
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RECORDING ON A QUANTITATIVE BASIS

But to return to our story. By July 1936 we had reached the point where further qualitative observations were considered to be unjustified. The existing transmission and reception equipment, because of various forms of instability, were obviously unsuited for quantitative work and an entirely different line-up was planned.

At about that time, the Yankee Network had begun operation of an experimental transmitter at Squantum, on low flat land on the outskirts of Boston. This transmitter, being higher in power than that used at Blue Hill, and being crystal-controlled, was considered to be a particularly appropriate one for recording. For the West Hartford end, a crystal-controlled receiver was assembled for operation with a Leeds and Northrup recorder, loaned for the work by the Yankee Network. Calibration equipment was provided so that the signal field could be measured in microvolts per meter. Then, with a simple dipole antenna, a program of continuous recording of carrier level was begun in August. This installation has already piled up six thousand hours of operation and is headed for more.

Needless to say, these continuous records proved to be infinitely more informative than the hourly tone signals previously recorded. There was revealed at once a whole series of types of belief that of the few possible agencies, temperature and water vapor gradients in the lower atmosphere were giving us this extraordinarily pronounced bending. Diffraction, we were forced to admit, was probably providing us with a steady sub-audible signal, but the observation that the signals disappeared entirely at times admittedly left us with no better reason to include diffraction in the discussion than the theoretical demand for its existence.

We were handicapped then, as we still are, by the lack of similar observations on the part of amateurs in other parts of the world. An examination of atmospheric conditions at places other than Hartford and Boston shows no reason why equally favorable or perhaps still more effective atmospheric gradients should not exist. Surprisingly, though, we still are unaware of any communication or recording link operating on the u.h.f. frequencies over a comparable path elsewhere. Or should we say, we know of no other set-up in which prolonged observations of signal variations have been related with variations in atmospheric conditions. Obviously, we could make much more rapid progress if recordings or frequent observations were made available in a wide variety of locations. Without any doubt, an organized group of amateur transmitting and recording links located according to some plan in various parts of the country, reporting their daily findings to some centralized office and working with the assistance of the Weather Bureau, could amass a pile of invaluable data which could not be equalled by any other group in existence. We look fondly toward the organization of some such project.
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fading (each one obviously related to the type of air mass prevailing) and the records in general showed all sorts of minor trends and irregular behavior not previously made apparent. In addition, the stability of both transmitter and receiver gave us much more confidence in the recording as an undistorted picture of actual signal variations along the path. Of course, this continuous recording immediately introduced new difficulties. The recorder, turning out some 50 feet of 10-inch wide record each week, soon forged so far ahead of us that we seriously doubted our ability to get enough time to reduce the records to some working form. The hourly tones of the previous work had been measured from the photographic record, mean values being then taken for each day and for each hour of the day. each week—a sufficiently tedious business. With this new program we required a reduction of the recordings in terms of signal level versus percentage of time—a procedure which, when done by hand, takes almost as much time as did the production of the recording itself. The outcome was the development and construction of an automatic record analyzer to be described later. This same device, after having served to reduce all existing recordings, was fitted to the recorder itself so that the signal is now not only recorded but integrated automatically as well.

In addition to the 41-Mc. receiver, two other crystal-controlled receivers (to be described) were provided. One for the Yankee Network 61.5-Mc. station, W1XAC, and the other, on 60.6 Mc., for a new crystal-controlled transmitter installed at the Blue Hill Observatory. These additional receivers, together with a new double-meter photographic recorder, have enabled us to make simultaneous recordings on different frequencies to the tune of some singularly interesting results.

SOME FADE CHARACTERISTICS

This recent phase of the program has brought to light a great many interesting phenomena which, unfortunately, space does not allow us to recount in detail. In general, however, the recordings show that on the three frequencies studied, signals are low and subject to low-amplitude and rapid fading (about one fade per minute) when a fresh air mass of Polar origin prevails over the path during the day. The fluctuations show a definite slowing down toward evening while simultaneously increasing in strength to the early hours of the morning. This high and stable signal is maintained until slightly after sunrise when it again breaks up into increasingly rapid fading while dropping to a lower and lower level toward the middle of the day.

The explanation deduced to cover this behavior is that Polar air has a relatively small water-vapor content and a temperature which...
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<tr>
<th>Model</th>
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NEWARK HAM BARGAIN

Newark Ham Bargains in Plate Transformers and Chokes to Match. These Transformers and Chokes are fully enclosed in silver finish. All Guaranteed. You cannot build that new Rig at a much lower cost.

Manufactured by UTC

20462A - 750-1000 each side of center, AC, at 300 mills. $7.75
20462B - 1250-1500 - center, 300 ma. $7.35
20462C - 3000-2500 each side of center, AC, at 300 mills. $11.95
20462D - 1000-1500 AC each side of center, at 500 mills. $11.95
20462F - Smoothing choke 20 hy. - 200 MA - Lug terminals. $1.75
20462FS - Swinging choke 5-25 hy. - 200 MA - $2.25
20462G - Smoothing choke 20 hy. - 200 MA - $2.25
20462GS - Swinging choke 5-25 hy. - 200 MA - $2.25
20462HS - Swinging choke 20 hy. - 200 MA - $4.40
20462I - Swinging choke 5-25 hy. - 200 MA - $4.40
20462IS - Smoothing choke 20 hy. - 200 MA - $5.50
20462JS - Swinging choke 5-25 hy. - 200 MA - $5.25
20462K - Smoothing choke 20 hy. - 200 MA - $2.65
20462KS - Swinging choke 5-25 hy. - 200 MA - $2.65
20462L - Smoothing choke 20 hy. - 200 MA - $2.65
20462LS - Swinging choke 5-25 hy. - 200 MA - $2.65
20462M - Smoothing choke 20 hy. - 200 MA - $2.65
20462MS - Swinging choke 5-25 hy. - 200 MA - $2.65
20462N - Smoothing choke 20 hy. - 200 MA - $2.65
20462NS - Swinging choke 5-25 hy. - 200 MA - $2.65
20462O - Smoothing choke 20 hy. - 200 MA - $2.65
20462OS - Swinging choke 5-25 hy. - 200 MA - $2.65
20462P - Smoothing choke 20 hy. - 150 MA - $2.65
20462PS - Swinging choke 5-25 hy. - 150 MA - $2.65
20462Q - Smoothing choke 20 hy. - 100 MA - $2.65
20462QS - Swinging choke 5-25 hy. - 100 MA - $2.65
20462R - Smoothing choke 20 hy. - 50 MA - $2.65
20462RS - Swinging choke 5-25 hy. - 50 MA - $2.65
20462T - Smoothing choke 20 hy. - 30 MA - $2.65
20462TS - Swinging choke 5-25 hy. - 30 MA - $2.65
20462U - Smoothing choke 20 hy. - 20 MA - $2.65
20462US - Swinging choke 5-25 hy. - 20 MA - $2.65
20462V - Smoothing choke 20 hy. - 10 MA - $2.65
20462VS - Swinging choke 5-25 hy. - 10 MA - $2.65
20462W - Smoothing choke 20 hy. - 5 MA - $2.65
20462WS - Swinging choke 5-25 hy. - 5 MA - $2.65
20462X - Smoothing choke 20 hy. - 2 MA - $2.65
20462XS - Swinging choke 5-25 hy. - 2 MA - $2.65
20462Y - Smoothing choke 20 hy. - 1 MA - $2.65
20462YS - Swinging choke 5-25 hy. - 1 MA - $2.65
20462Z - Smoothing choke 20 hy. - 0.5 MA - $2.65
20462ZS - Swinging choke 5-25 hy. - 0.5 MA - $2.65

NEWARK ELECTRIC COMPANY
226 W. MADISON ST. Dept. Q
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LEEDS is pleased to Announce their APPOINTMENT—

Western Electric AMATEUR BROADCASTING EQUIPMENT

15 years of honest and faithful service to manufacturer and consumer is again rewarded.

Our appointment as Graybar agents for WESTERN ELECTRIC Amateur Broadcasting Equipment is something to be justly proud of, and we feel certain our friends will respond generously. Anything in Western Electric Amateur Broadcasting Equipment can now be obtained from us immediately.

WESTERN ELECTRIC TUBES

300-A. Class A audio, 12½ watt output. $9.75
304-B. Ideal ultra high frequency triode. 12.50
305-A. 85 watt screen grid U.H.F. .... 38.50
306-A. R.F. pentode — the perfect frequency multiplier ........ 10.80
316-A. Ultra high frequency triode; 7½ w. output on 500 MC .... 10.50
242-C. 100 w. general purpose .... 15.00

633-A. "Salt Shaker" Dynamic mike; broadcast quality at the new low price of .......... 42.50
1002-C. Phones .................. 8.30

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LEEDS World Wide Service to Amateurs
See April issue for many other Leeds specials

Say You Saw It in QST — It Identifies You and Helps QST

THE EFFECT OF TROPICAL AIR

This behavior, of course, applies only to a stable condition in fresh Polar air. Such an air mass becomes rapidly modified by the continued heating of its lower level and by the assimilation of added water vapor. This, as far as the weather is concerned, involves the formation of cumulous clouds and a reduction in that high order of visibility which characterizes fresh Polar air. During this phase signals take on a much more ragged fading characteristic and attain a higher level for a given time of day than previously. This type of air rarely prevails for long in this part of the country and within a day or two one ordinarily expects a low pressure area to come in across southwest part of the country spreading over the Atlantic States a layer of warm tropical air. This circumstance shows itself in the signal recording as a tendency for the minor fluctuations to group themselves in a sort of wave motion, the surges becoming longer in duration and higher in amplitude as the tropical air reaches downward to the surface. By mid-evening on a day when such a tropical disturbance is approaching, the signal will ordinarily have reached a mean level of something more than 200 microvolts per meter, holding this level with very slight fluctuation over periods of an hour or more, then suffering a momentary deep fade. For three or four hours prior to the actual beginning of precipitation, the signal is prone to ride with substantially no variation at a level in excess of 300 microvolts per meter.

The beginning of precipitation is usually accompanied by a complete change in the character of the signal, the change apparently being slow or rapid, apparently depending on the extent to which the area of precipitation covers the signal path. Ordinarily, the change is in the development of very small amplitude and rapid fading which carries the signal to a lower but still fairly steady level. This, however, is not always the case. In several outstanding instances, the extremely high level was maintained for several hours after precipitation had started. The study of conditions surrounding such exceptional cases is, of course, very much a part of the work.
I. F. TRANSFORMERS

tell an interesting story, especially the units which enter into RME — 69 receivers.

Upon intermediate frequency transformer design and construction depends to a marked extent the high frequency selectivity of a superheterodyne.

The coefficient of coupling between primary and secondary determines whether an RME transformer is used in the 1st, 2nd or 3rd stage, in order to obtain the desired results.

Wound in honeycomb fashion, on specially designed machines, thoroughly impregnated and individually tested for proper characteristics before going into the receivers, using the best 10/41 Litz wire — these transformers last indefinitely in any climate.

Write for Bulletin 69

RADIO MFG. ENGINEERS
Peoria, Illinois
A NEW BEGINNER'S RIG USING STANCOR TRANSFORMERS

A 40 watt transmitter for c.w. operation that can be built for less than $40.00... including tubes, crystal and meter. Crystal control... capacitive coupled... only 2 tuned circuits using the new 6L6G and the new Taylor T20. It's one of the simplest and most dependable beginner's rigs ever designed.

FREE Schematic Drawings on Request

STANDARD TRANSFORMER CORPORATION
850 BLACKHAWK STREET • CHICAGO

The 1936 Sweepstakes

(Continued from page 8)

Listen my children, And you shall hear, That "SS" squeak, Still in my ear... -WS6RE

single 150T, single 800, single 804.

CHOICE OF FREQUENCY BANDS

7 Mc. is still out in front as the most used band during the Sweepstakes. 79 per cent of all contestants did some of their operating on "forty" in the '36 SS. 14 Mc. replaced 3.5 as the second most popular contest band, with 50 per cent doing some operating there. 3.5 Mc. is a close third with 48 per cent. While "one-band" operation is not recommended during a contest, some operators chose to stick to their favorite stamping grounds. 22 per cent used 7 Mc. exclusively, 12 per cent remained on 3.5 Mc. and 6 per cent didn't leave 14 Mc. The most popular combination of bands used was 7 and 14 Mc.—22 per cent... followed by 3.5, 7 and 14 Mc.—18 per cent, 3.5 and 7 Mc.—14 per cent, 3.5 and 14 Mc.—13 per cent. 28 Mc. was used by 2 per cent of all participants. 56, 1.7 and 112 Mc. were used by a very few.

Many conclusions can be drawn from the work of the winners. There seems no question that use of several bands pays dividends. 48 per cent of the section winners used the 3.5, 7 and 14 Mc. combination. 33 per cent used 7 and 14 Mc. 1 per cent used 3.5 and 7 Mc. While two winners did succeed by sticking to one band only, they were the exception rather than the rule. It is in the matter of working sections that use of bands is most important. If you pass up the lower frequencies you will miss the more local sections, if you skip the high frequencies you'll find it difficult to get the distant sections. If you plan to enter the SS (or any other contest) get your rig working on all bands and you'll have a better chance of coming out on top.

POWER

The power classifications in the '36 SS were the same as those introduced first in the '35 contest. Operators using 100 watts or less multiplied their basic score by 1.5 for final score. Those using over 100 watts multiplied by 1. It is interesting to note that the number of operators working under each power classification is the same for both '35 and '36—75 per cent using 100 watts or less, 24 per cent using over 100 watts, 1 per cent operating under both classifications. Since operator proficiency is such an important factor in station accomplishment it is almost impossible to arrive at any definite decision regarding high vs. low power. The two operators who worked the greatest number of stations, W3BES and W3CHH, used high power. The third high in number of stations, W1EZ, used under 100 watts. The next high in number of stations, W1INF and W9ELL, used high power. It seems logical to believe that an operator using high power can usually work them faster than one with lower input. The leaders in number of sections worked, W6ITH (69), W6SN...
These A. C. solenoid relays are ideal for remote control of transmitters, for control of crystal ovens, and for any general remote control application except for keying. These relays will not operate in keying service. Silver-to-silver double-break contacts are used throughout.

The maximum contact rating is 10 amp. at 220 v. or 3 amp. at 550 v. The relay coils are wound for 115 volts 60 cycle alternating current. Relays for other voltages can be supplied on special order. Use coupon below.

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Enclosed find money order for $__________ for which please send me, shipping charges prepaid, the following items:

Name:____________________________________
Address:____________________________________

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"STREAM-LINE" POWER HOUSE

(Patent Allowed)

“A Lap Ahead o’ the Field”

Plate Transformers
Swinging (1st Position) and Filter (2nd Position)
Chokes and Modulation Transformers

"STREAM-LINE" in design, appearance
and performance. Radically new design
saves up to 25% in space and weight
on your chassis. All-over housing clamps
core all-round, preventing lamination
hum, shields, protects coils, keeps mois­
ture out. Coils GTC “Pull-Push” mois­
ture-proofed. Ample insulation provides
large safety factor. Ask your jobber or
write for Bulletin 35 and 42 with dia­
grams — FREE!

GENERAL TRANSFORMER CORP.
518 S. Throop Street Chicago, Illinois

LOW POWER ACCOMPLISHMENTS

The records of a few operators who used what
can really be termed “low power” are refreshing
in this game where the common urge is to run the
power up, up, up... W1JAH using a 61A c.c.
oscillator running at 3 wts input worked 48
stations in 19 sections! With a Hartley oscillator
on 3.5 Mc. and a TNT for 7 and 14 Mc., with
inputs of from 9 to 12 wts, WSFDA, veteran of
the low power ranks, made 56,321 points—154
stations, 42 sections; tube used was a “71A, and
WSFDA says the same B batteries were used in
the’35 SS! W1EXX believes in low power—he
ran only 1.75 wts to a 12A But he worked 14
stations in 7 sections in a few hours of operating
... and that is something under present day
QRM conditions. W9VES with 20 wats input
scored 24,048-168 QSO’s, 48 sections. W3LCO
hit 4790 points with 18 wats; 52 stations, 31
sections in 17 hours. 12 wats into a ‘45 TNT on
14 and 3.5 Mc. brought 5501 points to W5JR
(60 stations, 31 sections). VE4CQ had his fun with
2 wats to an ‘01A TNT, working 25 stations in
12 sections. 10 wats brought VE3QB 57 QSO’s
in 31 sections, 5058 points. The possibilities of low
power are too often under-estimated. The reason
that the above champions of low power get results
is that they have confidence in their signals. The
old adage “You’ve gotta make calls if you wanna
get results” is particularly true on low power—
don’t be afraid to make the calls ... you
may be surprised at the DX you can raise. The
practise of calling anything you can hear is a
good one to follow.

SIDELIGHTS

“Would like to tell anyone who thinks contests are a lot of
bunk to get into the SS and see if their operating ability is
really so hot.”— VE4KK. W5ETZ, New Mexico, operated
on one frequency only—14,100 kc., but he made 113 con­
tests in 42 sections. W9WWT, Iowa, stuck to 7030 kc., work­
ing 98 stations in 34 sections. 84 per cent of W9WWT’s 179
contacts resulted from his CQ’s. Add similars: “As hopeless
as the chap who answers a ‘CQ SS’ and expects to get a
ragechew.” Break-in operation was one of the secrets of con­
test success and should be more widely used. A difficult
question: To call that W5 in New Mexico or the W1 in
Vermont, both on the same frequency? Irony: W5EWC
called his fist off at Louisiana all through the contest with no
question: To call that W5 in New Mexico or the W1 in
Vermont, both on the same frequency!? Irony: W9TWC
hit 4790 points with 18 wats; 52 stations, 31
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may be surprised at the DX you can raise. The
practise of calling anything you can hear is a
good one to follow.
ALL'S WELL on the Pennsylvania Lifeboats!

Emergency Radio—Powered by Burgess

When emergencies arise at sea, life saving equipment must be sturdy and reliable.

The S. S. Pennsylvania of the Panama Pacific Line carries lifeboats fitted out with portable RCA emergency radio-telegraph equipment which enables them to contact other ships. Burgess Batteries were chosen to supply the portable power for this apparatus—because Burgess Batteries have proved themselves equal to the strain of long, hard service under the most trying conditions.

Profit by the experiences and tests of skilled engineers. You, too, need dependable portable power. Use Burgess.

BURGESS BATTERY COMPANY
Freeport, Illinois

BURGESS

Say You Saw It in QST — It Identifies You and Helps QST
Mobile Crystal Control
for 5- and 10-Meter
PHONE — CW — ICW

- Single 40 Meter Crystal for All Bands
- 40 and 90 Meter Portable CW
- Complete With Collets 5-10-20 and 40 Meters
- H-F-M TRANSMITTER $48.00

"Type TR-6A6"
- Non-radiating Rec’vr
- 7 Tubes — Jensen
- New 6E6 Unity
- Jensen
- 100% Modulation
- Duplex Operation — PHONE & CW
- Dynamic Speaker
- Phone-CW
- 20 Watt Carrier
- 10 Watt Rec’vr
- PLUG and SOCKET and $39.75

Radio Transceiver Laboratories
8657 — 115 Street, Richmond Hill, New York

NEW Reduced PRICE
NOW Only $27.50

The famous Astatic Non-Directional Dual Diaphragm Dual Unit Studio Model K-2 is now within the purse range of every amateur. Never before has a crystal microphone of this quality been offered at so low a price.

Featuring
The New Astatic PLUG and SOCKET and CABLE PROTECTOR
Furnished equipped with the exclusive Astatic plugging and socket connector, permitting instant inter-change with Astatic D-2 or D-104. Plus the new Astatic Spring Cable Protector which prevents cable breakage at mounting.

Licensed under Brush Development Co. Patents

Astatic Microphone Laboratory, Inc.
DEPT. Q, Youngstown, Ohio, U. S. A.

Pioneer Manufacturers of Quality Crystal Devices
EVERYONE LIKES THE NEW EIMAC 100TH

▲ The "DX" Man
A powerful, clean cut signal on even the highest amateur communication frequencies assures the "DX" man of the greatest possible results from his equipment.

▲ The "Traffic" Man
Two band operation merely by the "flick" of the final tank tuning condenser will appeal to the "traffic" man. Outputs of 150 watts or more from a single 100TH when used as a doubler is just one of the unusual capabilities of this new tube.

▲ The "High Power" Man
The power capabilities of the 100TH are usually sufficient to satisfy the most "rabid" high power man. For those men that must run a "California kilowatt" the use of the 100TH as a buffer or a buffer-doubler leaves little to be desired.

▲ The "Phone" Man
A clean, powerful carrier with a full rounded modulation envelope are readily obtained even on 56 megacycles with the new 100TH. In Class "B" audio outputs of 500 watts may be obtained from a pair of these tubes. An output of 260 watts with 1250 volts may be obtained with the 100TH tubes operating with zero grid bias.

▲ The "Experimenter"
Accidental overloads during adjustment will not harm the 100TH. The 100TH provides a useful tool for the exploration of the following: Ultra high frequency phenomena — Frequency multiplication at a relatively high power level — Class "B" audio work. The ease of neutralization even at the highest frequencies and the freedom of parasitic oscillations are just two advantages of the extremely low interelectrode capacities of the 100TH.

▲ The "Rag Chewer"
The new and improved type of thoriated filament plus tantalum electrodes assures the user of the 100TH of phenomenally long filament life plus complete freedom from failures caused by gas. If you want a transmitter that will "stay put" year after year the 100TH will certainly be your choice.

You Will Like Your 100TH
SEE THIS NEW TUBE TODAY AT YOUR DEALER'S
Only $13.50

EITEL-McCULLOUGH, INC.
San Bruno, California, U. S. A.

Say You Saw It in QST — It Identifies You and Helps QST
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**Wwwt** 15255-55-170-B-40
**Wwxz** 16550-48-116-A-39
**Wwlm** 16550-47-119-A-38
**Wwve** 16500-51-182-B-33
**Wwut** 16499-13-133-A-30
**Wwnq** 16500-50-122-A-35
**Whtf** 13398-44-105-A-33
**Wtken** 12012-44-101-A-26
**Wtly** 15205-49-104-A-33
**Wtgl** 11814-37-113-A-23
**Wfpt** 10840-36-94-A-32
**Wwpb** 10850-36-103-A-24
**Wtcp** 10577-106-100-B-27
**Wbmn** 10018-36-92-A-25
**Wwtd** 9662-44-115-B-35
**Wmfe** 9807-37-87-A-22
**Waag** 8955-45-100-B-22
**Wtck** 7705-35-115-B-36
**Wwiy** 6609-37-91-B-25
**Wwqu** 5673-21-63-A-16
**Wwpt** 5142-07-70-16
**Wwsv** 5351-29-61-A-17

**Michigan**
- **Wsgb** 22665-55-139-A-32
- **Wscb** 13231-4-108-A-15
- **Wscq** 13231-4-127-A-32
- **Wsbc** 8880-37-81-A-23
- **Wsdb** 6450-21-65-A-17
- **Wscu** 3245-21-59-A-15
- **Wsmte** 2989-22-60-B-18
- **Wsmx** 15673-48-B-15
- **Wsms** 1350-19-28-A-10
- **Wspm** 375-9-15-A-4
- **Wspy** 2753-10-61-A-5
- **Wsdq** 144-8-8-4-5

**Ohio**
- **Wsbym** 43554-61-243-A-37
- **Wsaw** 33855-69-237-B-40
- **Wstb** 20815-61-202-A-15
- **Wstt** 23133-62-180-B-31
- **Wsto** 22124-3-172-A-29
- **Wstb** 22189-43-153-A-37
- **Wsmc** 10500-50-192-B-37
- **Wsmn** 18360-51-138-B-49
- **Wsmq** 17150-65-138-A-29
- **Wsmc** 13961-41-115-A-33
- **Wsmj** 15693-45-117-A-33
- **Wsmv** 14369-10-4-35
- **Wsms** 13961-41-115-A-33

**Tennessee**
- **Www** 12072-37-142-A-35
- **Www** 12100-35-122-A-35
- **Www** 12122-30-112-A-35

**Wisconsin**
- **Wbnr** 558-12-17-A-7
- **Wbbr** 2977-8-7-A-8
- **Wbsm** 295-11-8-A-8
- **Wbmg** 45-8-4-A-8

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Why are tubes with SPEER GRAPHITE ANODES better than tubes with anodes of any other material?

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Specialized personal service of genuine value that is not available from other jobbers.

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Complete stock of all amateur apparatus at net prices.

TRADE IN YOUR RECEIVER
All receivers shipped on ten day trial. You need send but $5.00 with order, balance C.O.D. These receivers in stock:

RME-69s Complete.................. $151.20
The new 1937 Breitling 14........ 99.00
The new RCA ACR-155................ 74.50
RCA ACR-175s...................... 119.50
The new 1937 Super Pro............ 238.14
The new Hallcrafters Sky Challenger S-15....... 69.50
Hallcrafters Sky Buddys............ 29.50
Hallcrafters Sky Chiefs............. 44.50
Hallcrafters 1937 Super Skyriders S-11...... 89.50
Hallcrafters Ultra Skyriders S-10...... 99.50
The new Parsons PR-15............. 109.50

TRADE IN YOUR TRANSMITTER
All Collins, Harvey, RCA, RME, Temco, All Star transmitters at net prices. Sold on terms to suit you with two years to pay and 6% interest charges.

HENRY RADIO SHOP
211 North Main Street BUTLER, MISSOURI

**COMPARE THESE FEATURES**

1. "Plug in Jack Terminals" for input and output.
2. Complete variable matching.
3. New modernistic case design.
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7. Double varnished and baked.
8. Moderate price.

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Say You Saw It in QST — It Identifies You and Helps QST
The 1937 Edition of the
RADIO AMATEUR'S HANDBOOK

For four months our technical and editorial groups worked on the revision and elaboration of the Radio Amateur's Handbook for its 1937 edition. Many important technical developments during the past year and sweeping changes in operating technique and methods called for enlargement of the book and rewriting of almost all chapters. Some idea of the extent of the revision may be had from the fact that two hundred new illustrations are included, most of them being prepared especially for this new edition. Special attention has been given to the new developments in noise silencers for short-wave receivers and to the new technical trends in circuit design. A wealth of new material is added to wide fields of transmitter planning, construction and adjustment. The capabilities of the new tubes are exploited to the full in the transmitter designs presented. Extended space is also given to the ever-important subject of antennas, the new ideas in coupling methods being treated in particular detail. The ultra-high frequencies come in for a big share of the space also, new and advanced equipment being detailed to illustrate the newer trends in this rapidly-growing field. As in previous editions full attention has been given to charts and tables of general information for the radio enthusiast; the vacuum tube tables, for example, occupying seventeen pages and being, without doubt, the most complete and detailed tube list ever published. The basic purpose of the handbook is to present a complete treatment of every phase of modern amateur radio from elementary theory through advanced practical application, with emphasis always on ideas and methods that have shown their worth in the field. This new edition, we firmly believe, will fulfill this purpose more effectively than any of its predecessors.

$1 postpaid in Continental U.S.A.—$1.25 postpaid elsewhere
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Station Activities
(Continued from page 64)

HUDSON DIVISION

EASTERN NEW YORK—SCM, Robert E. Haight, W2LJ—EGF continues his good traffic work. GZF is active with A.A.R.S. ISQ made B.P.L. with new rig, BO 5ENI (Doe Gillett) on 3.5 Me. JSL is new R.C.C. member coming thru on 3.5 Mc. CC is on 7280 and 14,370 kcs. UL is back on his 7280 B. GI is new Radioman 1st Class N.C.R. IUA has new 56-Mc. transmitter. JSQ is revamping for 28 Mc. ILD is rebuilding their 14-Mc. rig for ½-kw. 14-Mc. 'phone. JGM is a consistent performer.

New Officers of the Radio Club of Brooklyn now have their new club rooms at 3922-16th Ave. Meetings are held every Friday at 8:00 P.M. The O.T.C.R.A. is having an annual dinner for members on March 29th. All are welcome. FFY is working on relay rack job. FLB has a new 2.5-meter mobile. ESK is in on 3839 and 7046 kcs. with 300 watts. HBC worked EISB on 3.5 Mc. BYX and HHW worked plenty of DX in the contest. BYX was jotted a bit by 1000 volts. AZV has been experimenting with electrostatic shielding in the outside case of his transmitter which was put together by C.C.N.Y. Radio Club: IFS, chief op., IRC, secretary, IY, treasurer. The Radio Club of Brooklyn now has its own club room at 3922-16th Ave. Meetings are held every Friday at 8:00 P.M., code class every Tuesday night at 8:00 and technical sessions Thursday at 8:00 A.M. All are welcome. Don't forget the Long Island Net every night on 3710 kc. at 8:00 P.M. If you have any traffic to unload, listen for DBQ.

Traffic: W2DBQ 756 BKG 51 JL 102 FP 113 BGI 55 BZ 64 5J 44 DQ 46 RI 39 FOD 67 JAP 15 HXT 14 US 13 AD 12 CP-HJT-HGO 11 ESH 10 AHC-CIT 6A 6 HGO-BPK 4 JEG 5 DLR 4 IHT-JOO 2 HAK 1

NORTHERN NEW JERSEY—SCM, Fred C. Rand, W2CM—The N.J. traffic system is now organized for spot-frequency operation with four nets on a spot frequency of 3535, 3650, 3640 and 3850 kc. and a main distribution net composed of the net control centers also operating on a spot frequency. HFB has new superhet receiver. CJX did good work in DX contest. HRN paid visit to League Headquarters. HFT has new 14-Mc. antennas. HXI has worked 43 countries. HTW and GAS are at Stamford, Conn. GGE is planning new transmitter. GVZ has portable emergency rig with dynamotor for operation on all bands. FB! The QSP Club held a dance at Neptune on April 9th. After spending four and one-half years working in V and W stations, EQS finally hooked QWY and then ran wild, working X2N, X2W, W2Q, W2B, W2G, W2X, W2R, W2M, etc. VO1 and FM840 all on 3.5 Mc. with 35 watts input to a 46-fil transistor. GZG has new electric phonograph set-up for entertaining his friends. FFF is working on relay rack job. FLB is back on 1.75-Mc. and other 'phone bands after long absence. JDO is getting out nicely on 56-Mc. 'phone. GYY's new QTH is 300 feet away from GZG and 500 feet from JME—and they're all 'phones with plenty of input. IHX was heard in England on 30, 40 and 80. A certain very nice YL will soon be Mrs. W2DG. Congratulations, Bill, and lots of happiness. The QSP Club has been holding interesting monthly meetings at Elizabeth. All traffic men are urged to attend the O.T.C.R.A., having an attendance contest. There will be prizes. JBI has been doing a swell job with his new 500-watt rig. ICJ is planning to build new transmitter. JUC is new O.R.S. JMX has O.P.S. appointment. HTX has been operating portable at school. Please send interesting news items to your S.C.M. on the 16th of each month.

Traffic: W2GGE 468 (WLNQ 101) BCX 301 (WLNQ 279) BZJ 142 GYZX 117 CGG 92 HCO 70 F6P 69 GMN 68 BZL 55 ECO 50 ENZ 41 HQX 38 HTW 31 HXT 27 LAP 23 HFT 21 CJX 16 ICJ 14 GIZ 11 QM 1 (WLNQ 27)

NEW ENGLAND DIVISION

CONNECTICUT—SCM, Frederick Ells, Jr., W1CTI—Following stations make the B.P.L.: HSX, JXP, AW, TF, IY, and 11th DX Contest. BIH has 350 watts on 3.5, and other 'phone bands after long absence. JDO is getting out nicely on 56-Mc. 'phone. GYY's new QTH is 300 feet away from GZG and 500 feet from JME—and they're all 'phones with plenty of input. IHX was heard in England on 30, 40 and 80. A certain very nice YL will soon be Mrs. W2DG. Congratulations, Bill, and lots of happiness. The QSP Club has been holding interesting monthly meetings at Elizabeth. All traffic men are urged to attend the O.T.C.R.A., having an attendance contest. There will be prizes. JBI has been doing a swell job with his new 500-watt rig. ICJ is planning to build new transmitter. JUC is new O.R.S. JMX has O.P.S. appointment. HTX has been operating portable at school. Please send interesting news items to your S.C.M. on the 16th of each month.

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working DX on 14 and 7 Mc. CJR plans test transmissions on 56 Mc. if he can locate an automatic keying unit. HTS put up an ideal shed to save feeders, but no ice this year! JXR put in band change rig. FVO made W.A.C. on 14-Mc. phone. VB tried a BC receiver without a best one. on 3.5 Mc. DX at night is a definite point because of ill health. Sorry to lose you as R.M., but glad that you can continue with Nutmeg Net work. JTY is interested in bowling. EAO has been appointed as the new chief on the 3.9-Mc. phone band. ARB is active on 28-Mc. phone. GBX keeps CBA on the air on 7 and 56 Mc. JOV has taken up printing as a side line. Sixteen stations reported their traffic at the last Net. BKG, with traffic, is still active on the 3.9-Mc. phone band. ARB is active on 28-Mc. phone. GBX keeps CBA on the air on 7 and 56 Mc. JOV has taken up printing as a side line. Sixteen stations reported their traffic at the last Net.


MAINE—SCM, John W. Singleton, W1CDX—IST is leading in the traffic contest. INW just missed making the B.P.L. Mrs. Swasey (GOJ's mother) took her exam for an operator's ticket on the farmers' net. The P.T.N. 1BR is new member of the P.T.N. IVY is making good use of his new O.R.S. ticket. DHIV is rebuilding for all bands, n.w. and 'phone. KM is new ham in Lewiston. ATA has a good time on DX at night. IYB is having a good time on his 14-Mc. phone. JWR is rebuilding. EZIR is back on 3625 kc.


RHODE ISLAND—SCM, Clayton C. Gordon, W1HRC—JAM, Jim Longworth. IAV has had to call in and error as JHN last report—sorry. CAB has transmission on all bands. 1.75 to 59 Mc., phone and c.w. and has HF-100 on 28 Mc. with 200 watts input. JPF has new 14 Mc. rig. '47 crystals on BVI. JAY has kw. rig nearly done. BDS is on 14-Mc. phone with pair of HF-100's p.p. in final. KOG (Ed. Dolan) at 42 Franklin St., Westerly, is an old timer who has been away for several years and is now back. BIT has gone steel rack and panel finally with HF-100 on 14 Mc. and U.S.S. Vincennes working in Springfield (Home of the Amateur Telescope Makers). IQA has antennas troubles. TJ and GDK schedule.

Traffic: W1IQUE 143 (WILG 287) INU 383 GTN 263 QR 231 (WILG 38) JPF 154 (WILG 84) INT 108 IAY 5 JNO 3 GAB 17 5.

Western Massachusetts—SCM, William J. Barrett, W1JH—J.P.L. is getting to be a habit with JOR—keep it up, Chet! Hock turns in nice total for IOT, and asks anyone who has a rig 30 Mc. to give it a try more frequently. He will be at home in the evenings. How about it, gang? IDG is keeping nice bunch of batteries. BKG spends spare time fooling around 1.75 and 28 Mc. BGZ handled considerable flood traffic. BIV is still in the leg. AFO took a day off to do some FB work in the DX contest.

Traffic: W111WHC 541 BKG 460 FPO 360 MDC 330 HWE 242 BPE 238 ARS 295 HSH 167 AGX 156 EMG 142 BIE 140 BMW 113 JTM 101 QW 66 (CCIC 20) JNU 64 HKK 63 EZP 45 CRC 39 JHN 44 JEP 39 JFJ 34 JID 22 HH 19 JU 84 SMS 10 HXY-DMF (Jan.-Feb.) W1WFCR.

Western Massachusetts—SCM, William J. Barrett, W1JH—J.P.L. is getting to be a habit with JOR—keep it up, Chet! Hock turns in nice total for IOT, and asks anyone who has a rig 30 Mc. to give it a try more frequently. He will be at home in the evenings. How about it, gang? IDG is keeping nice bunch of batteries. BKG spends spare time fooling around 1.75 and 28 Mc. BGZ handled considerable flood traffic. BIV is still in the leg. AFO took a day off to do some FB work in the DX contest.
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FOR the convenience of its members, the League maintains a QSL-card forwarding system which operates through volunteer "District QSL Managers" in each of the nine United States and five Canadian districts. In order to secure such foreign cards as may be received for you, send your district manager a standard No. S stamped envelope. If you have reason to expect a considerable number of cards, put on an extra stamp so that it has a total of six-cents postage. Your own name and address go in the customary place on the face, and your station call should be printed prominently in the upper left-hand corner.

W1—J. T. Steiger, W1BGY, 35 Call Street, Willimansett, Mass.

W2—H. W. Yahnel, W2SN, Lake Ave., Hellen-eta, N. J.

W3—R. E. Macomber, W3CZ, 418 10th St., N. W., Washington, D. C.

W4—B. W. Benning, W4CBY, 520 Whiteford Ave., Atlanta, Ga.

W5—E. H. Treadaway, W5DKR, 2749 Myrtle St., St. Louis, Mo.

W6—D. Casen Mast, W6KHV, 423 East E Street, Ontario, Calif.

W7—Frank E. Pratt, W7DXZ, 5023 So. Ferry St., Tacoma, Wa.

W8—F. W. Allen, W8GER, 324 Richmond Ave., Dayton, Ohio.

W9—George Dammann, W9JO, 319 Sherman Ave., Evanston, Ill.

W9—J. E. Roue, VE1FB, 84 Spring Garden Rd., Halifax, N. S.

W10—C. W. Skarstedt, VE2DR, 236 Elm Ave., London, Ont.

W11—Dr. J. J. Dobry, VE4DR, Killam, Alberta.

K4—F. McCown, K4RJ, Family Court 7, San- terre, Puerto Rico.


K6—James J. Pa, K6LBH, 1416D Lunlilio St., Honolulu, T. H.

K7—Leo E. Osterman, K7BZA, Customhouse, Wrangell, Alaska.

K9—George L. Bickard, K9AR, 849, Manila, P. 0. Box 849, Manila, P. I.

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Say You Saw It in QST — It Identifies You and Helps QST
AVP, BCF visited AVP, EHH has a new "V8," GJY has formed a radio club at Arlington High School, WNU is using the 6G4A on 7 Mc, P1W is operating from the C.G.C. Camp in East Thedford, JVT is a very enthusiastic new amateur.


ATLANTIC DIVISION

EASTERN PENNSYLVANIA—SCM, James M. Bruning, W2EEZ—R.M.'s: 8AHK, 3AQN, 3FOP, 8ASW, P.A.M.: 3EOZ. 3GMK has new 6-tube receiver. 3GQK put the new rig on the air, 3GQK had heard lots of 3GQK during contest. 3GML worked a ZL and a VK on 14 Mc. using R.C.A. Spiderweb as transmitting antenna. 3NEG is now D.N.C.S. of PAZ. 3GLQ is looking for a 3.5-Mc. DX station. 3E5Y is a member of the June Radio Club. 3JFZ is a very enthusiastic new amateur.

Traffic: 3EUP yells "Stop the press!" After three days of radiocontact, 3EUP says he caught a DX phone with his RX-30's and has a fine time Sunday afternoon. 3EON using one watt of power has worked north to Nova Scotia, west to Iowa and five Cubans. 3FJW put up new antennas and within a half hour worked three continents. 3GAU has worked a record number of DX stations in a row. Perseverance pays premiums. 3GEQ sends regards to the gang thru JQE from U.S.S. 8USE, P.A.M.: 8CGU. The Rochester Hamfest drew a large crowd of over one hundred and fifty central and western New York hams. All enjoyed the good food, the fine speakers, the nice prize and many new personal contacts. This Section broke a record this month when three of the boys made the B.P.L. MQX headed this group, closely followed by JTT and AQE. CES, PLA and BJO also had fine totals. KMC is operating aboard the U.S.S. "Gloucester" off San Diego, CA. GWY is testing with WB2 and WB3A for harmonic radiation. FGJ keeps very busy with A.A.R.S. 3FJW operating portable relays for Ithaca. KRY is looking for reliable schedules. O.I.P.S. applicants. LUQ made 57,000 points in the DX contest. AQE has been keeping his schedules from a sick bed. JTT is now working steadily in Erie, Pa., and is on the air only during week-ends. BJO blew his power supply again. QHX and BPG are still strong for D.X. AXC, DX and PUS are rebuilding. TGF is trying to sign up some members for the A.A.R.S. The first QSO with the new rig at GWT was with an African. LFB has moved to Penn Yan, BHE, LGV and NTY were active in DX contest. LGS has a class-A commercial ticket. NWZ cut all the tendons in his right arm last month; Bob has applied for O.R.S. with the call 3VT. 8DNE has applied for O.R.S., 8DIG had to cancel his contest due to pressure of business, and sends 73 to the gang. 3JLW has been busy examining his equipment. 3WQP is working again. NWZ lost nice traffic schedule with LBEF. JMI and BJD are active in DX contest. 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**National Balloon Races and Mile High Air Races**

The National Balloon Races and Mile High Air Races, which were held in Denver, Colo., last season and offered an interesting opportunity for the experienced 56-Mc. operators in the district. The officials in charge of the Air Races praised to the highest extent the work done by amateurs. The radio operators were appointed official judge, two men in each one of the Pylons on the closed course 56-Mc. transceivers, reinforced by equipment built up by the local hams, were used. Base stations were set up on top of the Administration Building at the Denver Municipal Airport. Base stations had 3-5 calls all along, and gave the correct position of each racing plane as it took to the air. The planes raced across the starting line and around the first Pylon. As each plane made its turn at the three pylons, the hams called in base stations and gave their official O.K., and at the same time they made written record of the sequence. As the race progresses, the positions of the planes changed so many times, that an official announcement of the winner's time and speed would not have been possible for several minutes after the finish, had any other form of communication been used. So efficiently did the short-wave radio communication work that official time and speed of the winner was given to the crowd before the last plane finished the race.

Positions for the races: W9ESA and W9MKN at Base Station No. 1 were in communication with W9EPF and W9SKQ in Pylon No. 1 and W9BQ and W9WRA in Pylon No. 2, W9MKN at the same Base Station No. 2 were in communication with Pylon No. 3 where W9UXM and W9FA officiated. W9NWW was stationed at the base stations on one end of a telephone line to A. L. Williams at the announcer's stand. By rotating each day, everyone had a chance to operate one of the base stations.

On July 4th, Col. Roosevelt Turner made a record flight from Denver to Pikes Peak and return, using a Boeing Transport fully loaded. W9DFD and Russell Ramsey located at the airport in Colorado Springs, while W9UIF and W9YAE were stationed at the top of Pikes Peak (with W9KNZ's equipment) where they reported weather conditions to Col. Turner at the Denver Airport and also checked him as he turned around the famous peak. The thermometer stood at 32 degrees and snow was falling at the summit as Col. Turner made his turn and started back to Denver. The report from the hams on the peak furnished a breath-taking description of the record flight which was carried over the network of the National Broadcasting Co. thru KOA. To these Colorado Springs amateurs—orchids for a job exceptionally well done.

The world record for the 550-cubic inch racing ships over a 100-kilometer course, was shattered by Rudy Klink of Lamont, Ill., when he flashed his blue monoplane around the course at a little more than 228 miles per hour. Stationed 31 miles from Denver's Airport, W9MKN and his 3.5-Mc. c.w., rig installed in an automobile, together with W9RFC and C. D. Gualtieri, flashed the official O.K. to W9KFH receiving at the finishing line in front of the grandstand, as Klink made his turn at the north end of the course, the air race announcer was able to tell the crowd that a world’s record was broken, even before the small blue ship came to rest on the Airport.

All newspaper reporters received their information from the amateurs. The times, speeds, and of the many flyers were available to them by records kept by the fellows. A great many of the newsmen as well as officials praised the work of the boys who worked so successfully for the three-day period. W9LNB, Bill Hayes, A. L. Williams, and C. D. Gualtieri proved to be back, with the radio operators, helpers, and everyone used. M. C. Gualtieri took pictures of the bunch, also some very fine pictures of the race. A. L. Williams faithfully handled the job at the speakers' platform that on that end of the telephone line, W9LNB and Bill Hayes gave their time and efforts as relief operators.

It was the first Air Meet in Denver, and a faultless job, the result of all members working together under the capable direction of W9NNW and W9ESA, who worked unceasingly for three months in advance to make the races a success.
methods in the line. The directivity effects and power gain are readily noticed when used for reception. The signal-to-noise ratio is also greatly improved along the major horizontal directive lobe. Many cases have been known where received signals on the usual doublet were so far below the noise level that it was practically impossible to determine that the signal was actually there—but by the use of the “V” or rhombic the same signal was brought up to a good Q5 level.

For rhombics 2 wavelengths on a leg or greater, and for “V”s 4 wavelengths on a side or greater, power gains of 18 to 30 over a single half-wave Hertz are obtainable for the same transmitter power, which makes these systems a veritable “power plant” for low-power transmitters.

A few final hints should not be amiss at this point:

1. In figuring harmonic lengths for the proper length of each side, etc., the following formula will give the result with reasonable accuracy:

   \[ length \text{ in feet} = \frac{492 \times (2K - 0.5)}{\text{freq. (in Mc.)}} \]

   \[ K = \text{number of wavelengths} \]

2. Before this length is correctly determined and cut it is advisable to play safe by using hard drawn or some other forms of “stretchless” wire to maintain the original dimensions.

3. In figuring directions be sure to use a great circle map—the usual straight maps will throw you a long way off on your beam calculations.

Moral: “Be the ham who owns one!”

BIBLIOGRAPHY


How Would You Do It?

(Continued from page 88)
The National Type O Dial is definitely a handsome piece of equipment. The circular-grained, solid nickel-silver dial is 3½ inches in diameter. Numerals and division lines are clean-cut and accurate. The large bakelite knob is well proportioned and comfortable to the hand. For safety, the dial is positively insulated from the hub by a large bakelite boss. Ask to see the National Type O Dial at your dealers.

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32 watts of high fidelity audio for modulation or PA work. Highest quality parts used throughout, UTC, Cornell-Dubilier, IRC, etc. May be used with a crystal, ribbon or dynamic mike, preamplifier not necessary. Tubes used in this kit—QST-6F7-6S5-616 PP, furnished with drilled and punched black crackle chassis and heavy duty solid contained power supply.

Price complete, less tubes $19.40

Kit of RCA Matched Tubes $5.74

able coupling coil assembly may be mounted for front of panel control at a point where it is fairly well isolated from other r.f. fields. The diagram, Fig. 2, gives an outline of the idea which can be varied to suit individual cases. A vernier dial or a small worm gear would make the adjustment easier. This split link can be used to eliminate the last trace of capacity coupling between two tanks by either grounding one or both sides at the point of coupling or by introducing a Faraday shield between the two coils where the link is split. This will not usually be necessary, but it will turn the trick if other methods fail. This variable coupling is also useful for reducing power in c.w. work. The two coils of the “vario-coupler” may be wound on celluloid with No. 18 or 20 cotton covered wire and fastened in place with coil dope. Three turns about 3 inches diameter are suggested for each coil.

Think about these two schemes, gang. They are, of course, just basic ideas. There is still plenty of work to be done in fitting them appropriately into practical installations. But both of them most certainly have a future in practical ham work. Here, anyway, is the next in the series.

Before we pass on to the essential rules and regulations we might ask whether you, dear reader, have a hero in your home. Ours has turned in some problems of general interest so far but before we know it he will have his station completed and be so engrossed in operating that his only real problem will be keeping peace with the family. What we mean is that we should appreciate deeply any list of practical problems that any of you fellows may have bumped against.

Now, the rules:

1. Solutions must be mailed to reach West Hartford before the 20th of the publication month of the issue in which the problem has appeared. (For instance, solutions of problem given in the March issue must arrive at QST before March 20th.) They must be addressed to the Problem Contest Editor, QST, West Hartford, Conn.

2. Manuscripts must not be longer than 1000 words, written in ink or typewritten, with double spacing, on one side of the sheet. Diagrams and sketches may be in pencil, but must be neat and legible.

3. All solutions submitted become the property of QST, available for publication in the magazine.

4. The editors of QST will serve as judges. Their decision will be final.

Prizes of $5 worth of A.R.R.L. station supplies or publications will be given to the author of the solution considered best each month, $2.50 worth of supplies to the author of the solution adjudged second best. The winners have the privilege, of course, of stating the supplies preferred.

—R. A. H.
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**Amateurs using phase-inverting amplifiers, or contemplating using them, will be interested in the June, 1936, issue of the Aerovox Research Worker, which deals with this subject. Because of increasing interest in inversion, additional copies have been printed and upon request will be sent by the Aerovox Corporation, 70 Washington Street, Brooklyn.**

W9SRS writes that a strong but inexpensive antenna rope can be made by treating heavy cotton fish cord, which can be obtained from any dealer handling fish-line supplies. The size used by W9SRS is about the thickness of an ordinary lead pencil. The treatment consists of immersing the cord in two pints of rubber auto-top dressing, using a gallon paint can having a tight-fitting lid. First coil the rope carefully in the can, then pour in the top dressing, cover tightly and let set for at least twenty-four hours.

To dry, pull out the top end of the rope and attach it to a post or tree, walk back with the can and the rope will pull out with no tangling. Stretch tightly and tie the other end to another post and let the rope dry. When dry, the rope will be quite flexible and much stronger than before treating, as well as practically waterproof. W9SRS has used such a rope for over two years, and recent examination indicated that it was apparently as strong as when new.

**A Modulator for the Low-Power Five-Band Transmitter**

(Continued from page 15)

hiss which is characteristic of a carbon microphone is not amplifier noise, of course; cutting off the microphone battery by means of Sw will show how much of the residual background is caused by microphone hiss and how much is generated in the amplifier itself. The latter should be negligible. Occasionally a microphonic tube will cause noise and howling; this can be checked by tapping
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The new National NC-101X was designed for the amateur bands only. Has all the features of the NC-100X, complete bandspread for the 10, 20, 40, 80, and 160 meter bands. With crystal, all tubes, built-in power supply, and 10" dynamic speaker chassis. Net to amateurs $129.00. All other receivers in stock.

FOR AMATEURS ONLY

The recommended button current for the type of microphone specified is 3 to 5 ma. per button, with a maximum limit of 10 ma. Although a 3- or 4.5-volt battery with a 200-ohm potentiometer connected across it could be used to control the microphone current, we have found it satisfactory simply to use a single No. 6 dry-cell battery for the source of microphone current, no adjustment being needed.

The modulator unit always should be grounded, using a connection between the chassis and a good ground connection such as a cold water pipe or the radiator of a hot-water heating system. Such a ground often will reduce hum, and will prevent motorboating and howling when the transmitter is in operation by reducing r.f. pickup. The microphone cable should be shielded, with the shield grounded to the chassis; an unshielded cable is prone to pick up r.f. and cause overloading and distortion, if not oscillation, in the audio amplifier.

When the various tests and precautions described above have been carried out, modulation of the transmitter is simple. The r.f. end may be placed in operation on a suitable frequency and the antenna loading adjusted to make the final r.f. stage take 80 milliamperes, with all circuits adjusted to resonance. Under these conditions the input is approximately 30 watts, with the power supply described in December QST, and the load presented to the modulator by the modulated r.f. stage is for all practical purposes correct in value. If a current indicator such as a low-range r.f. ammeter or a shunted flashlight bulb is used in the antenna circuit, the current should rise slightly—about 10% or so—when the microphone is spoken into. First adjust the modulator gain control so that with normal speaking the plate current is steady under modulation. The correct adjustment will permit attaining 100% modulation on the voice peaks, which is the limiting operating condition.

The modulator design is such that when an attempt is made to secure more than sufficient output for 100% modulation by running up the gain, distortion commences so that no particular benefit is secured. Drastic overmodulation such as can usually be obtained with a Class-B modulator is practically impossible with the Class-A system because the 6N7 driver output flattens off immediately when the 6L6 grids start to draw current—which they do when the 15-watt output is exceeded. This means that distortion starts suddenly and increases very rapidly, a condition which is readily recognized by the receiving operator, and can be checked easily at the transmitter by the use of a listening monitor such as a pickup coil, crystal detector and headphones, or a similar arrangement using a rectifier tube.

For amateurs only.

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The new National NC-101X was designed for the amateur bands only. Has all the features of the NC-100X, complete bandspread for the 10, 20, 40, 80, and 160 meter bands. With crystal, all tubes, built-in power supply, and 10" dynamic speaker chassis. Net to amateurs $129.00. All other receivers in stock.

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The modulator unit always should be grounded, using a connection between the chassis and a good ground connection such as a cold water pipe or the radiator of a hot-water heating system. Such a ground often will reduce hum, and will prevent motorboating and howling when the transmitter is in operation by reducing r.f. pickup. The microphone cable should be shielded, with the shield grounded to the chassis; an unshielded cable is prone to pick up r.f. and cause overloading and distortion, if not oscillation, in the audio amplifier.

When the various tests and precautions described above have been carried out, modulation of the transmitter is simple. The r.f. end may be placed in operation on a suitable frequency and the antenna loading adjusted to make the final r.f. stage take 80 milliamperes, with all circuits adjusted to resonance. Under these conditions the input is approximately 30 watts, with the power supply described in December QST, and the load presented to the modulator by the modulated r.f. stage is for all practical purposes correct in value. If a current indicator such as a low-range r.f. ammeter or a shunted flashlight bulb is used in the antenna circuit, the current should rise slightly—about 10% or so—when the microphone is spoken into. First adjust the modulator gain control so that with normal speaking the plate current is steady under modulation. The correct adjustment will permit attaining 100% modulation on the voice peaks, which is the limiting operating condition.

The modulator design is such that when an attempt is made to secure more than sufficient output for 100% modulation by running up the gain, distortion commences so that no particular benefit is secured. Drastic overmodulation such as can usually be obtained with a Class-B modulator is practically impossible with the Class-A system because the 6N7 driver output flattens off immediately when the 6L6 grids start to draw current—which they do when the 15-watt output level is exceeded. This means that distortion starts suddenly and increases very rapidly, a condition which is readily recognized by the receiving operator, and can be checked easily at the transmitter by the use of a listening monitor such as a pickup coil, crystal detector and headphones, or a similar arrangement using a rectifier tube.

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The new National NC-101X was designed for the amateur bands only. Has all the features of the NC-100X, complete bandspread for the 10, 20, 40, 80, and 160 meter bands. With crystal, all tubes, built-in power supply, and 10" dynamic speaker chassis. Net to amateurs $129.00. All other receivers in stock.

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The recommended button current for the type of microphone specified is 3 to 5 ma. per button, with a maximum limit of 10 ma. Although a 3- or 4.5-volt battery with a 200-ohm potentiometer connected across it could be used to control the microphone current, we have found it satisfactory simply to use a single No. 6 dry-cell battery for the source of microphone current, no adjustment being needed.

The modulator unit always should be grounded, using a connection between the chassis and a good ground connection such as a cold water pipe or the radiator of a hot-water heating system. Such a ground often will reduce hum, and will prevent motorboating and howling when the transmitter is in operation by reducing r.f. pickup. The microphone cable should be shielded, with the shield grounded to the chassis; an unshielded cable is prone to pick up r.f. and cause overloading and distortion, if not oscillation, in the audio amplifier.

When the various tests and precautions described above have been carried out, modulation of the transmitter is simple. The r.f. end may be placed in operation on a suitable frequency and the antenna loading adjusted to make the final r.f. stage take 80 milliamperes, with all circuits adjusted to resonance. Under these conditions the input is approximately 30 watts, with the power supply described in December QST, and the load presented to the modulator by the modulated r.f. stage is for all practical purposes correct in value. If a current indicator such as a low-range r.f. ammeter or a shunted flashlight bulb is used in the antenna circuit, the current should rise slightly—about 10% or so—when the microphone is spoken into. First adjust the modulator gain control so that with normal speaking the plate current is steady under modulation. The correct adjustment will permit attaining 100% modulation on the voice peaks, which is the limiting operating condition.

The modulator design is such that when an attempt is made to secure more than sufficient output for 100% modulation by running up the gain, distortion commences so that no particular benefit is secured. Drastic overmodulation such as can usually be obtained with a Class-B modulator is practically impossible with the Class-A system because the 6N7 driver output flattens off immediately when the 6L6 grids start to draw current—which they do when the 15-watt output is exceeded. This means that distortion starts suddenly and increases very rapidly, a condition which is readily recognized by the receiving operator, and can be checked easily at the transmitter by the use of a listening monitor such as a pickup coil, crystal detector and headphones, or a similar arrangement using a rectifier tube.
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HANDY TO USE

The most interesting feature of the new LOG BOOK is the incorporation of spiral binding. This permits the book to be folded back flat at any page, requiring only half the amount of space on the operating table and making it easy to write on. The log-sheet has been redesigned by the Communications Department so that there is space provided for recording the number of messages handled and QSL's sent and received. General log information (prefixes, etc.) has been brought up-to-date. The LOG BOOK price has been reduced and is now 35c per book, 3 books for $1.00, postpaid.

FOR PRESTIGE

The radiogram blank is now an entirely new form, designed by the Communications Department to comply with the new order of transmission. All blocks for fill-in are properly spaced for use in typewriter. It has a strikingly new heading that you will like. Radiogram blanks, 8½ x 7¾, lithographed in green ink, and padded 100 blanks to the pad, are now priced at 25c per pad, postpaid.

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Radiogram delivery cards embody the same design as the radiogram blank and are available in two forms — on stamped government postcard, 2c each; unstamped, 1c each.

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Cuts
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in Half
Simply press lever—
machine does the rest

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compact. Large contact
points. Black japanned
base. A low priced key
with world famous
Vibroplex quality.
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A 100-kc. Oscillator
(Continued from page 18)

Probably the best stations to use for checking
purposes are those on the clear channels 700 kc.
(WLW), 500 kc. (WBAP-WFAA) and 1000 kc.
(WHO). These stations are receivable over most of
the country for the greater portion of the
twenty-four hours. All broadcasting stations are
required to maintain their frequencies within
plus or minus 50 cycles, and most of the larger
ones such as those mentioned above do consid-
erably better. WLW, for instance, can be relied
upon to be within a few cycles of 700 kc. so that
with care in setting the oscillator on this station
the harmonics can be taken to be accurate within
a kilocycle or so at 14 megacycles. Still more
accurate settings can be obtained by using WWV's
transmissions on 5000 and 10,000 kc., the
schedules for which are given in each issue of
QST.

After the oscillator has become thoroughly
warmed up, it should hold its calibration over
periods of several hours. Continuous operation is
not necessary, however, because it is a simple
matter to check against a b.c. signal whenever a
high-frequency check is desired.

To pick up beats at amateur frequencies, a
short wire connected to the output terminal
should provide a signal of good strength at fre-
quencies below 14 Mc. At higher frequencies, it
may be necessary to connect the output terminal
to the antenna post of the receiver. With this
connection, good signals should be obtained up to
the 300th harmonic, or 30 Mc.

An oscillator of this type will be found useful in
lining up the high frequency circuits of a receiver
and for receiver calibration. With points available
at each 100 kc. throughout all amateur bands, an
accurate curve of calibration is easily drawn.
UNIVERSAL acceptance of any product is only possible when that product is outstanding in performance and reliability. To enjoy such a reputation, rigid supervision and adherence to strict standards is required throughout all manufacturing processes.

An example of Bliley thoroughness is the test oscillator pictured above. This is a specially designed oscillator having an adjustable dummy load and indicating meters in every important circuit. Each crystal unit is fully tested, both with and without load, before being OK'd for shipment.

For assured performance use Bliley Crystal Units in your transmitter. For the best all around mounted crystal, choose the LD2 Unit, priced at $4.80 — your distributor has them in stock for the 40, 80 or 160 meter bands. Bliley Electric Co., Erie, Pa.

BLILEY CRYSTAL UNITS

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DX Contest Policy

(Continued from page 22)

W8AWF W8BBI W8BTI* W8BBW W8DJW W8DME W8FPJ* W8FIC* W8HG W8HWE W8IMP W8KCM W8KTI W8LAP W8LKT W8LUQ W8LYK* W8MCY W8NRM W8NWB W8OFN W8PLR W8PPQ* W8QDA* W8QHP*, W9AIO W9AJA W9BMM W9CES W9CVI W9DVW W9EME W9FS W9FFZ* W9GHN W9GY W9HUU W9LZ W9LJK* W9LV W9RSQ W9RV W9TKX W9WTC W9YDD. V81EK VE1EX VE2EW VE3ADM VE4GE VE5EH.

D3DSR D4GAD D4KSD D4NXR D4YFT F3KH F4SRA LAC6 L4U L51J OK2OP Q3Z X03JB PA0PC PA0PK PA0P N PA0QZ PA0UN PA0UV SM5QU YU7DUX.

To operators inadvertently betrayed by undetected equipment faults we extend our sincerest regrets; to intentional offenders (if any) we express the belief that you may never have appreciated the potential harm off-frequency work might cause the amateur service, or thought that your choice of a channel might be considered unfair or unsporting by brother amateurs and participants, with the parting injunction that you consider these things; to all amateurs the suggestion that increased care in adjustment be employed to avoid out-of-band radiations with our request for your full cooperation. Also to all, our assurance that we shall not neglect our duty, even though many amateur friends may be in these lists. Our hope for 100% frequency observance in the next I

Dakota Division Convention

St. Paul, Minn., May 21-22-23

THE A.R.R.L. Dakota Division-Mid American Convention to be held at the Hotel Lowry, St. Paul, Minn., on May 21st, 22nd, 23rd will present, as one of the largest of all amateur conventions, a most pretentious and well arranged program. Fine modern technical exhibits will be contrasted with radio antiques combed from the ham shacks of old timers. The most informed speakers obtainable including Dr. Hartig, Dr. Reinhartz, Boyd Phelps and others will lecture, and leading manufacturers will send technical experts and motion pictures for conduction of demonstrations.

High lights of the entertainment program will be the Army Net, Navy Net and 'Phone Association luncheons; a mammoth stag and the grand banquet at which at least 1500 hams and their friends will break bread together. Special entertainment has been provided through the convention for the ladies.

Tickets are $2.75 and advance registration may be secured by sending check or money order to W9JIE, 1200 Fauquier Street, St. Paul, Minn.
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A Versatile Oscilloscope Using the 913

(Continued from page 34)

The general procedure for checking modulation in a transmitter has been described previously so need not be gone into in detail. The specific method for this oscilloscope is as follows:

1. Couple a small amount of r.f. from the modulated stage through a loop and twisted line to the "vertical input" terminals, setting Sw to the appropriate tap.

2. Feed the output of the audio oscillator to the microphone terminals or jack through a shielded line.

3. Turn on the transmitter and adjust the coupling loop to give a rectangular-shaped pattern on the screen between ¼ and ½ inch high.

4. Advance the speech-amplifier gain control to give fairly complete modulation.

5. Set the sweep frequency controls, Sws and Rs, to show two or three audio cycles in the modulated wave. Adjust the speech gain to bring the valleys in the modulated wave to the reference line, the limiting condition for 100% modulation. Then comparison of the modulated waveform with the original audio oscillator waveform will readily show distortion, non-linear modulation, etc. Percentage modulation also can be measured by using methods described in the papers to which reference already has been made. The oscilloscope also is readily adaptable to the familiar "triangle" or "wedge" pattern modulation measurements.

For other applications, the builder is referred to such texts as RCA's Cathode Ray Tubes, and Rider's The Cathode Ray Tube at Work. The oscilloscope has a wide field of usefulness in receiver alignment and general service work.

Finally, a precaution: Do not allow a bright spot to stay at one place on the phosphorescent screen, since the coating material will be burned. Keep the spot moving; in other words, always have a sweep of some sort applied to at least one set of deflecting plates.

Daily Ursigrams furnished by Science Service are now being broadcast in plain English by W1XAL on 11.79 Mc. from 4:55 to 5:00 P.M. to 0:45 E.S.T. Data on observations of sunspots, solar radiation, magnetism, ionized layer heights and other phenomena are given. As many amateurs know, the Ursigrams are now being broadcast daily in code from NAA; the English service from W1XAL gives the same information but in a form which does not require decoding.

Speaking of rapid QSY, consider this one told to W11GR by G6MK: Hearing VK6SA on the high-frequency of 14 Mc. and having no edge-of-the-band crystal, G6MK proceeded to dash out to G80Y's shack, found him at home, lifted the crystal out of his transmitter, rushed back again, got the rock in his own rig just as VK6SA was signing off, and made contact! No one can say there wasn't some speed involved!
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As you read these words you don't concentrate on each individual letter. At a glance, you grasp several words — faster than anyone can write them. The same is true when you talk. Without thinking of separate letters, you talk whole words. The CANDLER system will teach you to read and send code with the same ease and speed. It's very interesting. Just a matter of practicing the right way. Ask any skilled operator about the CANDLER system. Thousands of them, including Champion McElroy, owe their speed to CANDLER training. A few days of practice under CANDLER instruction is worth months of undirected effort. Get started right. The only difference between you and a skilled operator is the coupon below. Mail it today! Walter Candler will do the rest!

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A directory of suppliers who carry in stock the products of these dependable manufacturers.

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Stem Wholesale Parts Company
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PITTSBURGH, PENNSYLVANIA
Cameradio
963 Liberty Ave.

ROCHESTER, NEW YORK
Radio Service Shop
244 Clinton Ave., N.

BOSTON, MASS.
Selden Radio Company
28 Brattle Street

BUFFALO, NEW YORK
Radio Equipment Corp.
326 Elm Street

CONCORD, NEW HAMPSHIRE
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Schedules for WWV

EACH Tuesday, Wednesday and Friday (except legal holidays), the National Bureau of Standards station WWV will transmit on three frequencies as follows: noon to 1:00 P.M. E.S.T., 15,000 kc.; 1:15 to 2:15 P.M., 10,000 kc.; 2:30 to 3:30 P.M., 5000 kc. On each Tuesday and Friday the emissions are continuous unmodulated waves (c.w.); and on each Wednesday they are modulated by an audio frequency. The audio frequency is in general 1000 cycles per second.

Ultra-Midget Equipment

(Continued from page 80)

the antenna tuned to resonance the range is approximately one-half mile under average conditions.

At one glance a dozen both proper and improper applications of the midget units present themselves. However, it must be emphasized that a Federal license is required for operation of any transmitter regardless of how small its power output may be. This is imperative.

Strays

W8MEE would like to get in touch with any hams who make their own transmitting tubes.
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<thead>
<tr>
<th>Country</th>
<th>City</th>
<th>Company Name</th>
<th>Address</th>
<th>Phone Numbers</th>
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<tr>
<td>ALLENTOWN, PENNSYLVANIA</td>
<td></td>
<td>Radio Electric Service Co.</td>
<td>1094 Hamilton Street</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Complete stock transmitting equipment</td>
<td></td>
</tr>
<tr>
<td>ATLANTA, GEORGIA</td>
<td></td>
<td>Wholesale Radio Service Company, Inc.</td>
<td>430 West Peachtree Street, N. W.</td>
<td>&quot;The World's Largest Radio Supply House&quot;</td>
</tr>
<tr>
<td>BALTIMORE, MARYLAND</td>
<td></td>
<td>Radio Electric Service Co.</td>
<td>3 N. Howard St.</td>
<td>Everything for the amateur</td>
</tr>
<tr>
<td>BUFFALO, NEW YORK</td>
<td></td>
<td>Radio Equipment Corp.</td>
<td>326 Elm Street</td>
<td></td>
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<td>Dymac Radio</td>
<td>216 E. Genesee Street</td>
<td>Cl. 9080</td>
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<tr>
<td></td>
<td></td>
<td>Complete Line Ham and BCL Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JAMAICA, L. I.</td>
<td></td>
<td>Wholesale Radio Service Company, Inc.</td>
<td>90-08 1600th Street (Merrick Road)</td>
<td>&quot;The World's Largest Radio Supply House&quot;</td>
</tr>
<tr>
<td>MONTREAL, CANADA</td>
<td></td>
<td>Canadian Elec. Supply Co., Ltd.</td>
<td>285 Craig St., W.</td>
<td>Quality parts and equipment for discriminating buyers</td>
</tr>
<tr>
<td>NEWARK, N. J.</td>
<td></td>
<td>Wholesale Radio Service Company, Inc.</td>
<td>219 Central Avenue</td>
<td>&quot;The World's Largest Radio Supply House&quot;</td>
</tr>
<tr>
<td>NEW YORK, N. Y.</td>
<td></td>
<td>Gross Radio, Inc.</td>
<td>51 Vesey Street</td>
<td>Fair dealings plus fair prices. Anything in radio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wholesale Radio Service Company, Inc.</td>
<td>100 Sixth Avenue</td>
<td>&quot;The World's Largest Radio Supply House&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consolidated Radio Corp.</td>
<td>612 Arch Street</td>
<td>Ham receivers, Transmitting tubes, Collins transmitters, etc.</td>
</tr>
</tbody>
</table>

Say You Saw It in QST — It Identifies You and Helps QST
You Are Protected When You Buy From QST Advertisers

"Advertising for QST is accepted only from firms who, in the publisher's opinion, are of established integrity and whose products secure the approval of the technical staff of the American Radio Relay League."

Quoted from QST's advertising rate card.

Every conceivable need of a radio amateur can be supplied by the advertisers in QST. And you will know the product has the approval of the League's technical staff.
"Built Like a Battleship"
YOU WILL BE PROUD TO OWN THE NEW
GROSS CP-55 OR CB-55

COMPARE
and
CHECK THESE FEATURES

- Full 95 Watts input
- Ten Meter Operation
- New Taylor T20 tubes
- For operation on 10-20-40-80-160 meters
- Built-in power supply
- 3 stages, 42 Osc, 6L6 buffer, 2-T20's in final

Kit $42.70 Less tubes, meters, crystal — One set coils included in price

The "CP-55" uses the marvelous new T-20's in the output stage. These real transmitting tubes will give outputs and performance not possible with ordinary receiving tubes — their price is very low.

The ideal unit for the beginner or the "Old Timer" desiring an additional Transmitter for operation on 10 meters, or any other band. In the CP-55 you have available an Xmitter having real power at a ridiculously low price.

Compare the construction of the "CP-55" with units selling at many times its price. Only finest components are used such as Cardwell Condensers, Steatite Sockets, IRC Resistors, Cornell Dubilier and Aerovox Condensers, etc.

The addition of a modulator unit which is available converts the CP-55 into a fine Radiophone Transmitter.

NEW! "THE STANDBY" (2 TO 2000 METERS) 3-TUBE A.C. AND D.C. RECEIVER

This excellent 2 to 2000 meter receiver is offered with full realization of the present-day need of the amateur for a dependable "standby" receiver which will cover practically all of the radio bands in use today, super regeneration, which is the most efficient form of detection at these frequencies, is used from 2 to 15 meters. The R.F. stage is effectively used over the entire tuning range. Throughout the entire tuning range, there are no skips or dead spots. Loud speaker volume is available from practically every station received.

- 10/100 to 1 tuning ratio
- Super regeneration below 15 meters
- Automatic changeover from straight to super regeneration
- Power supply incorporated
- Individual antenna tuning for high and low wave ranges
- 1-5/5C detector, 1-6J7 R.F. stage, 1-12A7 audio amp. and rectifier.

WRITE IN FOR FREE NEW CATALOG ON HAM AND P.A. EQUIPMENT

20% DEPOSIT WITH ALL C.O.D. ORDERS  REMIT BY M.O. INCLUDE POSTAGE  Cable Address: GROSSINC

GROSS RADIO, INC., 51 VESEY STREET, NEW YORK CITY

Say You Saw It in QST — It Identifies You and Helps QST
CHINESE COPY

An authentic reproduction of an imported lamp carton label. Due to lack of knowledge of the underlying design principles only 10% of such "Chinese copies" will pass Federal specifications.

"Free from Engineering"

As leaders in transformer development, the UTC Research Staff prides itself on the many revolutionary designs released during the last few years. It is only natural that competitive manufacturers copy these new developments. Some of these copies, however, have low efficiency and poor frequency response. Some have a new gadget, case or terminal arrangement to give the impression of originality, but which only detract from the simplicity and efficiency of the original design. The inferior characteristics of duplicates only bolster the progress of UTC...the line which is a year ahead.

VARIMATCH MODULATION TRANSFORMERS
UTC VARIMATCH Modulation Transformers Will Match ANY Modulator Tubes to ANY RF Load...

<table>
<thead>
<tr>
<th>Transformer</th>
<th>Description</th>
<th>Power Output</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-0</td>
<td>Maximum audio output 20 watts</td>
<td>$3.00</td>
<td></td>
</tr>
<tr>
<td>VM-1</td>
<td>Maximum audio output 30 watts</td>
<td>$4.80</td>
<td></td>
</tr>
<tr>
<td>VM-2</td>
<td>Maximum audio output 60 watts</td>
<td>$7.50</td>
<td></td>
</tr>
<tr>
<td>VM-3</td>
<td>Maximum audio output 125 watts</td>
<td>$12.00</td>
<td></td>
</tr>
<tr>
<td>VM-4</td>
<td>Maximum audio output 300 watts</td>
<td>$19.50</td>
<td></td>
</tr>
<tr>
<td>VM-5</td>
<td>Maximum audio output 600 watts</td>
<td>$42.00</td>
<td></td>
</tr>
</tbody>
</table>

VARIMATCH INPUT TRANSFORMERS
Varimatch Input Transformers will take care of Practically every driver requirement.

<table>
<thead>
<tr>
<th>Transformer</th>
<th>Description</th>
<th>Power Output</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA-50AX</td>
<td>Single 89, 53, 56, 6C5, etc. to class B 53, 6A6, 89, etc.</td>
<td>up to 12 watts</td>
<td>$3.30</td>
</tr>
<tr>
<td>PA-51AX</td>
<td>Single 56, 6C5, 45, 59, 6L6, 2A3, etc. to class B 46, 59, 79, or A prime 42's, 49's, etc.</td>
<td>up to 30 watts</td>
<td>$4.80</td>
</tr>
</tbody>
</table>

LINE VARIMATCH TRANSFORMERS
The UTC LINE VARIMATCH units will match any single or group of voice coils to a 500 ohm line. Impedance range is from .2 to 75 ohms in 50 combinations...UTC LINE VARIMATCH AUTOFORMERS will match one to ten 500 ohm lines or LVM 500 ohm windings to the 500 ohm output of an audio amplifier.

<table>
<thead>
<tr>
<th>Transformer</th>
<th>Description</th>
<th>Power Output</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVM-1</td>
<td>12 watt Line Varimatch unit</td>
<td>up to 12 watts</td>
<td>$2.76</td>
</tr>
<tr>
<td>LVM-2</td>
<td>30 watt Line Varimatch unit</td>
<td>up to 30 watts</td>
<td>$4.80</td>
</tr>
<tr>
<td>LVM-3</td>
<td>50 watt Line Varimatch unit</td>
<td>up to 50 watts</td>
<td>$6.00</td>
</tr>
<tr>
<td>LVM-10</td>
<td>12 watt Line Varimatch Autoformer 500, 250, 167, 125, 100, 83, 71, 62, 50 ohms</td>
<td>up to 12 watts</td>
<td>$2.70</td>
</tr>
<tr>
<td>LVM-11</td>
<td>30 watt Line Varimatch Autoformer</td>
<td>up to 30 watts</td>
<td>$4.80</td>
</tr>
<tr>
<td>LVM-12</td>
<td>60 watt Line Varimatch Autoformer</td>
<td>up to 60 watts</td>
<td>$5.00</td>
</tr>
<tr>
<td>LVM-13</td>
<td>125 watt Line Varimatch Autoformer</td>
<td>up to 125 watts</td>
<td>$10.00</td>
</tr>
<tr>
<td>LVM-14</td>
<td>300 watt Line Varimatch Autoformer</td>
<td>up to 300 watts</td>
<td>$15.00</td>
</tr>
</tbody>
</table>

NEW VARIMATCH BULLETIN
See your distributor for the new bulletin listing details, valuable application information and technical tables.

ALL PRICES SHOWN ARE NET TO AMATEURS

UNITED TRANSFORMER CORP.
72 SPRING STREET
NEW YORK, N.Y.

QST for May, 1937, EASTERN Edition
This actual size picture of the TML gives some idea of compactness and high voltage handling ability. Its Through Rivets for heavy duty jobs. 40 mm 1/2-13 UNC Nut for the 50 mm, 15,000 V model. Another National product you can depend on...
USE THESE OUTSTANDING TYPES IN YOUR TRANSMITTER
FOR GREATER EFFICIENCY, RELIABILITY AND ECONOMY

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
<th>Use</th>
<th>Plate Volts*</th>
<th>Grid-Bias Volts*</th>
<th>Nominal Output-Watts Class C Single Tube</th>
<th>Nominal Output-Watts Class B Mod. Two Tubes</th>
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<tbody>
<tr>
<td>TRIODES</td>
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<tr>
<td>RCA-801</td>
<td>$3.45</td>
<td>Buffer, Power Amplifier</td>
<td>600</td>
<td>-150</td>
<td>25</td>
<td>45</td>
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<tr>
<td>RCA-805</td>
<td>15.00</td>
<td>Power Amplifier, Doubler</td>
<td>1500</td>
<td>-105</td>
<td>215</td>
<td>370</td>
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<td>RCA-806</td>
<td>24.50</td>
<td>Power Amplifier, Doubler</td>
<td>3000</td>
<td>-600</td>
<td>450</td>
<td>660</td>
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<tr>
<td>RCA-808</td>
<td>10.00</td>
<td>Power Amplifier, Doubler</td>
<td>1500</td>
<td>-200</td>
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<td>185</td>
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<td>RCA-802</td>
<td>$3.90</td>
<td>Oscillator, Buffer/Doubler</td>
<td>500</td>
<td>-100</td>
<td>16</td>
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<tr>
<td>RCA-803</td>
<td>34.50</td>
<td>Power Amplifier</td>
<td>2000</td>
<td>-90</td>
<td>210</td>
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<td>RCA-804</td>
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<td>Power Amplifier</td>
<td>1250</td>
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<td>BEAM POWER TUBE</td>
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<tr>
<td>RCA-807</td>
<td>$3.90</td>
<td>Oscillator, Buffer/Doubler</td>
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<td>RCA-866</td>
<td>$1.75</td>
<td>Half-wave, Mercury-Vapor</td>
<td>7500</td>
<td>Full Wave</td>
<td>2650</td>
<td>0.5</td>
</tr>
<tr>
<td>RCA-872</td>
<td>14.00</td>
<td>Half-wave, Mercury-Vapor</td>
<td>7500</td>
<td>Full Wave</td>
<td>2650</td>
<td>2.5</td>
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<td></td>
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</tbody>
</table>

*Rated value for Class C telegraphic service

RCA also offers the RCA-834 Triode at $12.50 for ultra-high frequency power amplifiers, the acorn tube types RCA-955 at $3.00 and RCA-954 or 956 at $5.00 for ultra-high-frequency receivers.

For all oscillographic applications use the RCA-913 one-inch tube at $5.60 and RCA-906 three-inch tube at $15.00.

Use RCA ALL THE WAY and get the best value money can buy.

RCA presents the "Magic Key" every Sunday, 2 to 4 P. M., E. D. T., on NBC Blue Network

RCA MANUFACTURING COMPANY, Camden, N. J. - A Service of Radio Corporation of America
A great drama of life and death was enacted when the raging waters of the Ohio and Mississippi spread terror and disaster during the recent flood. Out of this great drama emerged the nation’s cast of heroes whose efforts saved thousands of lives from watery graves and controlled the inevitable aftermath of disease. *Bendix is proud to have been able to play a part in the timely rescue efforts of the many governmental and independent agencies. The Coast Guard rushed men, boats, planes and communication trucks, some equipped with Bendix transmitters, receivers and other equipment to the flooded area.

In cooperation with the Naval Reserve, Army and Amateurs, they established a joint emergency radio network to facilitate rescue work and relieve human suffering. *Such occasions as this bear testimony to the reliability and efficiency of Bendix Radio products under all conditions. Bendix Radio Corporation provides complete research, engineering and manufacturing facilities for every type of radio equipment.

PARTIAL LIST OF BENDIX RADIO PRODUCTS:
- Hurricane-proof Spike Antennas
- Antenna Arrays
- Low Temperature Coefficient Quartz Crystal and Holders
- Variable Condensers
- Fixed Condensers
- Inductances
- Frequency Standards
- Frequency Monitors
- Frequency Meters
- Precision Gear Drives
- Synchronizers
- Audio Analyzers
- Modulation Monitors
- Tube Testers
- Set Testers
- Remote Control Devices
- Capacity Standards
- Field Intensity Meters

Direct All Correspondence to BENDIX RADIO CORPORATION 9th and Kearny Sts., N.E., Washington, D.C.
Honolulu must be ahead!

Out of the storm-swept skies that erased all visibility, a dozen seaplanes alighted on the land-locked waters of Pearl Harbor... and Man once again defeated the elements. These twelve Navy planes had spanned the 2853 miles of open sea from San Diego to Honolulu, thus completing the longest over-water mass flight in aviation history.* With the weather as thick as pea soup and visibility nil, these fliers flew with confidence toward a mile square spot in a vast ocean. They knew their goal MUST be ahead! Adverse weather conditions were forgotten, for these PBY-1 Consolidated long-range patrol boats were kept on a sure course with the unfailing precision and dependability of Bendix Radio Direction Finders. *When efficient performance is needed, over land or sea, Bendix equipment will not fail. Bendix Radio Corporation offers the finest engineering facilities for the development and manufacture of aircraft radio products of every type for use in commercial, naval and military aviation.

PARTIAL LIST OF BENDIX AVIATION PRODUCTS

Transmitters
Receivers
Direction Finders
Radio Compasses
'Approach' and 'Glide Path' Landing Systems
Radio—Instruments
Radio—Mechanical Devices
Intercommunicating Telephones
Ground Station Equipment
Traffic Control Transmitters
Receivers
Radio Ranges
Field Localizers
Marker Beacons
Quartz Crystals and Holders

Direct All Correspondence to BENDIX RADIO CORPORATION 9th and Kearny Sts., N. E., Washington, D. C.