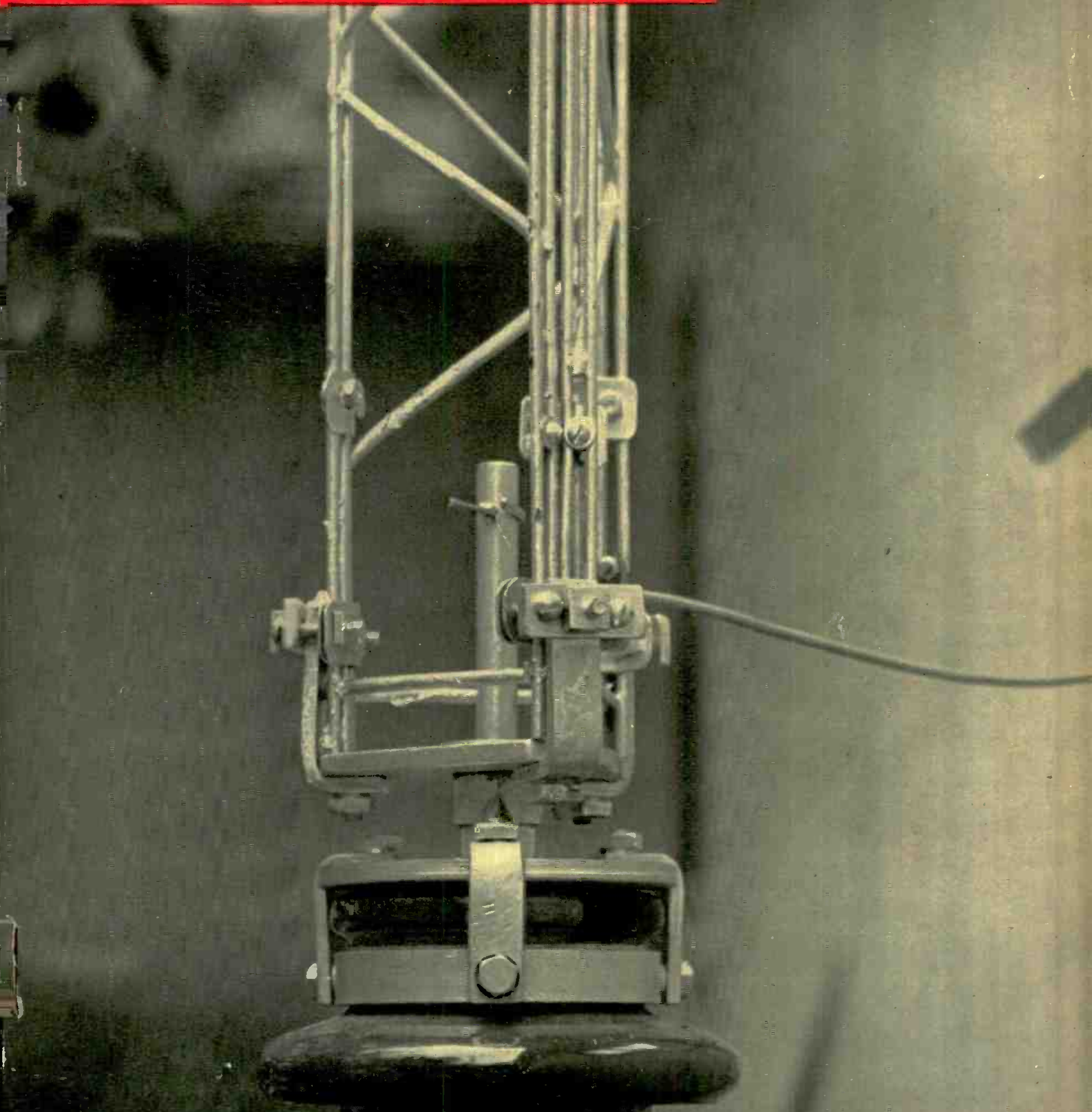
RADIO

ESTABLISHED 1917



THIS MONTH

- RADIO'S 1939 DX CONTEST RESULTS
- STEP-BY-STEP ROTARY CONSTRUCTION
- CARRIER REMOTE CONTROL DETAILS
- 5-WATT 112-MC. MOBILE TRANSCEIVER

The Worldwide Authority of Amateur and Shortwave Radio

★

June 1940

NUMBER 250

30c IN U.S.A.

Skyrider Defiant

One stage of preselection. New, highly efficient noise limiter circuit. Four bands cover from 545 kc to 43.5 mc. Accurately calibrated bandspread dial. Frequency stability throughout a wide range of line voltage, humidity and temperature variations. Six point variable selectivity. Meter calibrated in both S and DB units. Single-signal crystal filter. Complete with 9 tubes and crystal (no speaker) $69.50.

Super Defiant

Two stages of preselection. Automatic noise limiter. 540 kc to 42 mc coverage in four bands. Better signal-to-noise ratio. Calibrated bandspread dial. Compensation in oscillator circuit for frequency stability. Six-step variable selectivity. Meter calibrated in S and DB units. Push-pull output delivering 8 watts. Ten-inch PM speaker in metal cabinet. Complete with 12 tubes, crystal and speaker, $99.50.

the hallicrafters inc.

CHICAGO, U. S. A.

WORLD'S LARGEST BUILDERS OF AMATEUR COMMUNICATIONS EQUIPMENT

1300 Kenwood Road, Santa Barbara
CALIFORNIA

RADIO

Phone. 4242 — Cables: RADIOLTD SANTABARBARACALIF

Branch Advertising Offices: NEW YORK, 71 W. 35th St., Phone: CHickering 4-7399
CHICAGO, 3606 N. Bernard St., Phone: JUNiper 5575

Production Office for "RADIO": EAST STROUDSBURG, PA., 30 N. Crystal St. Phone: Stroudsburg 1734

The Editors . . . . of "Radio"

EDITOR
W. W. Smith, W6BCX

TECHNICAL EDITOR
Ray L. Dawley, W6DHG

ASSOCIATE EDITORS
Leigh Norton, W6CEM
K. V. R. Lansingh, W6QX
E. H. Conklin, W9BNX
CHICAGO

CONTRIBUTING EDITOR
Herbert Becker, W6QD

EDITORIAL AND TECHNICAL ASSISTANTS
Jack Rothman, W6KFQ
B. A. Ontiveros, W6FFF, Technical Draftsman

• • •

Business Staff

Santa Barbara

K. V. R. Lansingh, Publisher
A. McMullen, Managing Editor

Sales Department
John Snetsinger, Circulation and Advertising Manager; **M. F. Zeis,** Chief Subscription Clerk; **M. W. Kilvert,** Chief Order Clerk.

New York

V. R. Lansingh, Eastern General Manager

Chicago

C. W. Nelson, Asst. Advertising Manager

East Stroudsburg

W. E. McNatt, Jr., W8TLJ, Production Manager

Advertising

Advertising inquiries may be directed to our nearest office. For fastest service prepare advertising copy in duplicate; send original copy and cuts (fully mounted and mortised) to East Stroudsburg, where "Radio" is printed; send duplicate copy, proofs of cuts, and space order to the advertising department at Santa Barbara. No advertisements will run until the home office telegraphs its approval.

Correspondence

Direct all manuscripts, subscription and book orders, payments, and general correspondence to the home office at Santa Barbara. Regarding advertising, see notice above. Unusable, unsolicited manuscripts will be destroyed unless accompanied by a stamped, addressed return envelope.

Rates

SUBSCRIPTION RATES: Two years, $4.00, or $2.50 yearly in U. S. A. (add 3% tax in California), Cuba*, and Mexico*. To Canada and Newfoundland, 25c per year additional (unless paid in U. S. funds). To Pan-American countries and Spain, $0.50* per year additional. Elsewhere (except New Zealand), $1.00* per year additional. New Zealand: order only from Te Aro Book Depot, Ltd., 64 Courtenay Place, Wellington. Special issues are included only with subscriptions of one-half year or longer. Refunds on cancelled subscriptions will be made at the difference between the rate paid and the rate earned.
THREE YEAR SUBSCRIPTIONS at the rate of $5.00, net, in advance, are accepted from U. S. A. only. (Canada, $5.75) Such subscriptions must be sent direct to our home office, not through agents.
SINGLE COPY PRICES: Prices are for regular issues; prices for special issues may vary but are usually those shown in parentheses. At newsdealers, book stores, and radio parts dealers, 30c (50c) per copy in U. S. A. By mail, postpaid, from home office, 30c (50c) in U. S. A., Canada*, Newfoundland*, Cuba*, and Mexico*; 35c (55c)* in other Pan-American countries and Spain. Elsewhere, 40c* (65c)*.
BACK ISSUES, when available, 5c extra net. Back issues will not be included in subscriptions.
*REMITTANCES must be payable at par in continental U. S. A., except as follows: Add 10c plus exchange to Canadian checks, money orders and postal notes unless payable in U. S. dollars. From elsewhere, remit by bank draft (preferred) or international money order.

Miscellaneous Notices

IF YOU MOVE notify us in advance. We cannot replace copies sent to your old address. See "Changes of Address" notice elsewhere in this issue.
RADIO is published ten times yearly (including enlarged special annual number) about the middle of the month preceding its date; August and September issues are omitted.
PUBLISHED BY RADIO, Ltd., Technical Publishers, 1300 Kenwood Road, Santa Barbara, California, U. S. A.

TITLE REGISTERED at United States Patent Office.
RESPONSIBILITY will not be accepted for subscriptions placed with unauthorized agents. Prospective subscribers are urged to inspect carefully the credentials of anyone soliciting their business. Agents are never authorized to vary the rates quoted on this page.
BRANCH OFFICES transact a cash business with customers who call in person; mail and open account orders should be sent only to Santa Barbara.

Principal Foreign Agents

Europe: (Subscription) N. E. Read, 24 Church St., Oswestry, Shropshire, England. Australia: "The Bulletin", Box 2521BB, Sydney; McGills, 183 Elizabeth St., Melbourne; Swain & Co., Pitt St., Sydney. New Zealand: Te Aro Book Depot, Ltd., 64 Courtenay Place, Wellington. South America: F. Stark, Caixa 2786, Sao Paulo; "Revista Telegrafica", Peru 165, Buenos Aires; Editorial Pan America, Peru 677, Buenos Aires. South Africa: South African Radio Publications, 40 Trust Buildings, Fox Street, Johannesburg.

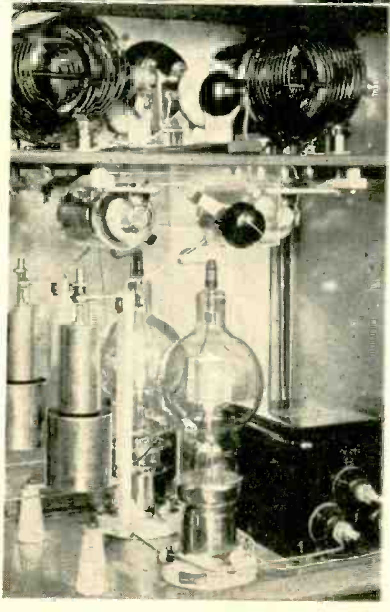
PRINTED IN U. S. A.

The Worldwide Technical Authority of Amateur, Shortwave, and Experimental Radio

RADIO, *June, 1940, No. 250.* Published monthly except August and September by Radio, Ltd., 1300 Kenwood Road, Santa Barbara, California. Entered as second-class matter September 26, 1939, at the Post Office at Santa Barbara, California, under the Act of March 3, 1879. Additional entry at East Stroudsburg, Pa. Registered for transmission by post as a newspaper at G.P.O., Wellington, New Zealand.

"The very nature of contest work requires equipment that can stand up under severe abuse, therefore my station is 100% powered with Eimac tubes in addition to KY21 rectifiers and Eimac Vacuum Tank Condensers"

Ralph E. Thomas, owner and operator of Station W2UK uses a pair of Eimac 250TH's in the final and a pair of Eimac Vacuum Tank Condensers with band switching for two bands. A pair of 75T's used as the driver. Ralph's success in scoring highest two years in succession is remarkable—a good illustration of what can be accomplished by the intelligent use of good equipment of which Eimac tubes are a vital part.



Eimac 250TH's and a pair of Eimac Vacuum Tank Condensers make up the final. Eimac KY21 tubes for the rectifier and 75T's for the driver.

Eimac TUBES

EITEL-McCULLOUGH, Inc. San Bruno, Calif.

Past • Present and • Prophetic

QRO Transceiver

When Editor Smith decided that his car needed a 2½-meter transceiver, he went about it in a big way and used an honest-to-goodness transmitting tube as the detector-oscillator. Just to prove that the rig really worked he took it up into the hills in back of Santa Barbara on a recent Sunday and nonchalantly broke the 2½-meter dx record by working W6OIN in San Diego, an airline distance of approximately 175 miles. As an anticlimax he then made a couple of 75-mile contacts with Los Angeles. The Big Bertha transceiver is described on page 28.

Golden Rule for V.F.O.'s

Accompanying the manufactured version of the v.f. crystal oscillator described on page 31 is the following paragraph, which, we think, could well be copied and pasted on the panel of every v.f.o.

> "In using a variable frequency exciter, common courtesy should be applied to prevent unnecessary interference with other operators. Thoughtless use of a variable frequency exciter will only rob others of pleasures to which they are rightfully entitled."

Change of Scenery

Tired of looking at the same old wall or out of the same old window while operating the transmitter? On page 13 Waller describes a remote-control unit which requires nothing more than a 110-volt a.c. outlet for complete transmitter control from anywhere in the house. The advantages of an operating convenience of this type are too obvious to require further comment.

Results

In the DX Department you will find the official results of our DX Contest of last November-December. The turnout for this, our first venture into contest sponsorship, was most gratifying. However, we were more than a little surprised by the lack of entries in the more-than-one operator divisions. In practically every call area and country a single contact by a station "admitting" more than one operator would have netted a certificate. Plans for this year's contest are well under way and, since we have had practically unanimous approval of the rules expressed by the contestants, no drastic changes are contemplated.

Portamobile

With summer approaching as this is being written, portable and mobile equipment would seem to be in order. Therefore with vacations and Sunday outings in mind we recommend Driml's pint-sized mobile rig shown on page 40 and Striker's combined portable transmitter and station exciter on page 33.

F.M. Moves Down

Elsewhere in this issue will be found a formal announcement of the opening of a portion of the 56-Mc. band to frequency modulation. Just exactly what the Commission means by "frequency modulation" we haven't yet been able to find out. Presumably, intentional frequency modulation—as contrasted to the unintentional type caused by amplitude modulation of a self-controlled oscillator—is what is implied. We sincerely hope that this is the case, since a return of the modulated self-controlled rig and the transceiver to 56 Mc. could hardly be classed as amateur "progress."

Of late a goodly amount of office gab has centered around the possibility of narrow-band frequency modulation on the lower frequency bands. This is an especially interesting subject since theory indicates that with a deviation ratio of 1 (frequency swing each side of center equal to frequency of impressed audio) the second and higher-order sideband components are of insignificant strength, while an improvement in signal-to-noise ratio of 1.7 to 2 times (depending upon the type of noise) over conventional amplitude modulation is obtained.

The most appealing part of this business is that a couple of receiving tubes will modulate the transmitter, be it ten watts or a thousand. Unfortunately, fading plays havoc with f.m., and could well nullify its laboratory advantages on the lower frequencies. Until the F.C.C. sees fit to open part of one of the lower frequency bands for actual "on the air" experimentation we can't do much about it.

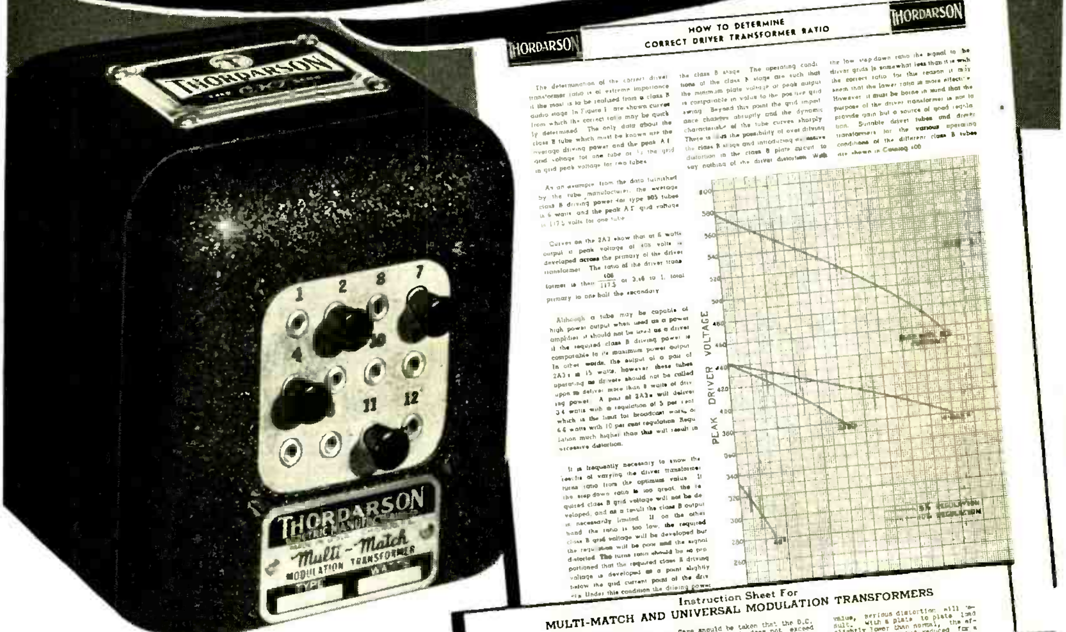
50 Vs. 60 Cycles

On page 17 Technical Editor Dawley describes the wide range audio oscillator we

[*Continued on Page 82*]

* The following Sunday this was shoved out to 200 miles, using same equipment, by perching on a peak farther north and working the same station.

TAKES GUESSWORK OUT OF SELECTING TRANSFORMERS



"How to Determine Correct Driver Transformer Ratio" and "Multi-Match and Universal Modulation Transformers" are two bulletins of great technical value to Amateurs. Both are available from your THORDARSON Distributor or may be obtained gratis by writing the factory and asking for SD-442 and SD-423.

THORDARSON

ELEC. MFG. CO.

45th Anniversary

TRANSFORMER SPECIALISTS SINCE 1895

RADIO June • 1940 No. 250

Table of Contents

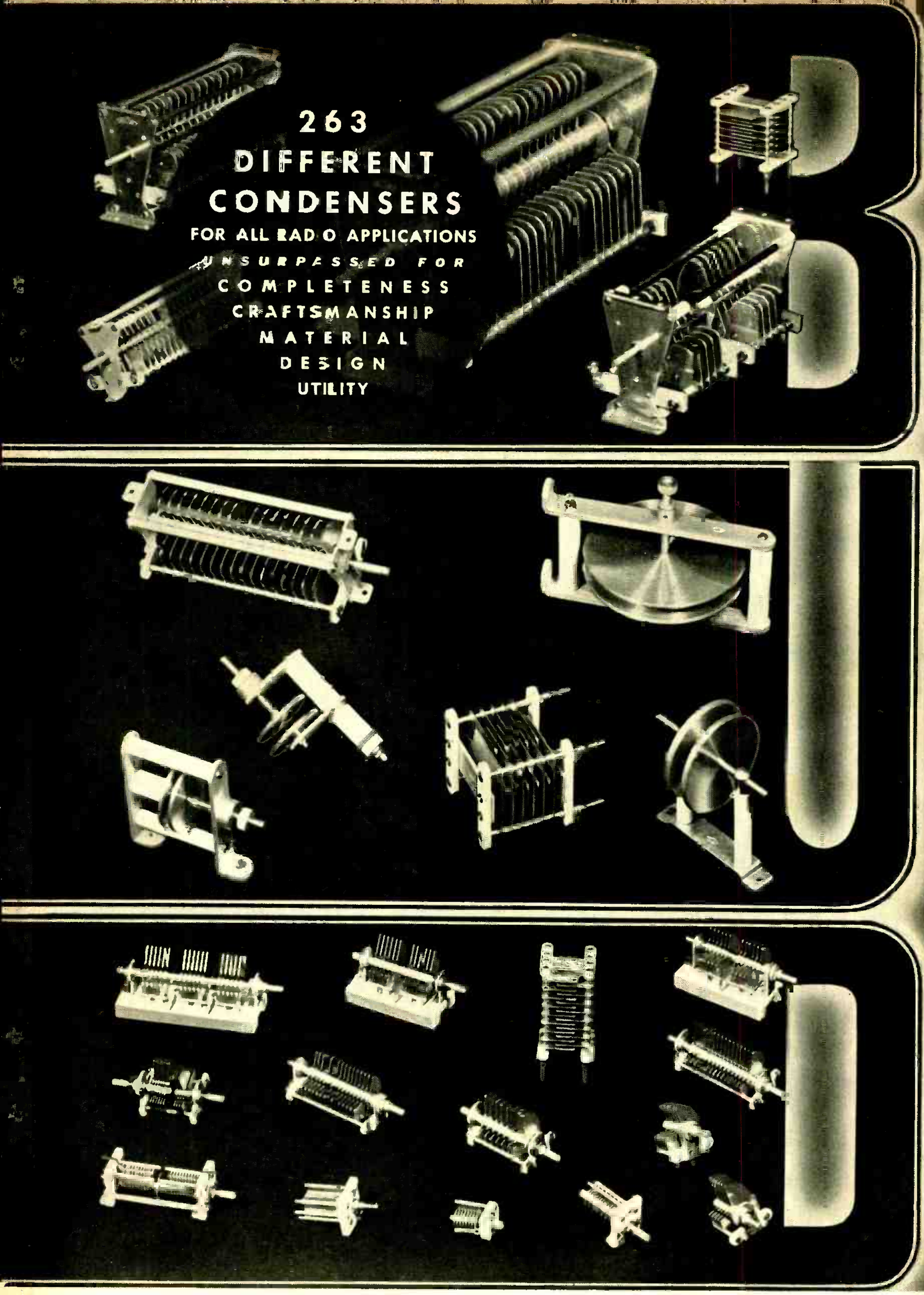
Cover: The base of W6JTN's vertical. Donn Smith used a lot of ingenuity in constructing it from commercially available metal studding—watch for a construction article on it next month.

ARTICLES

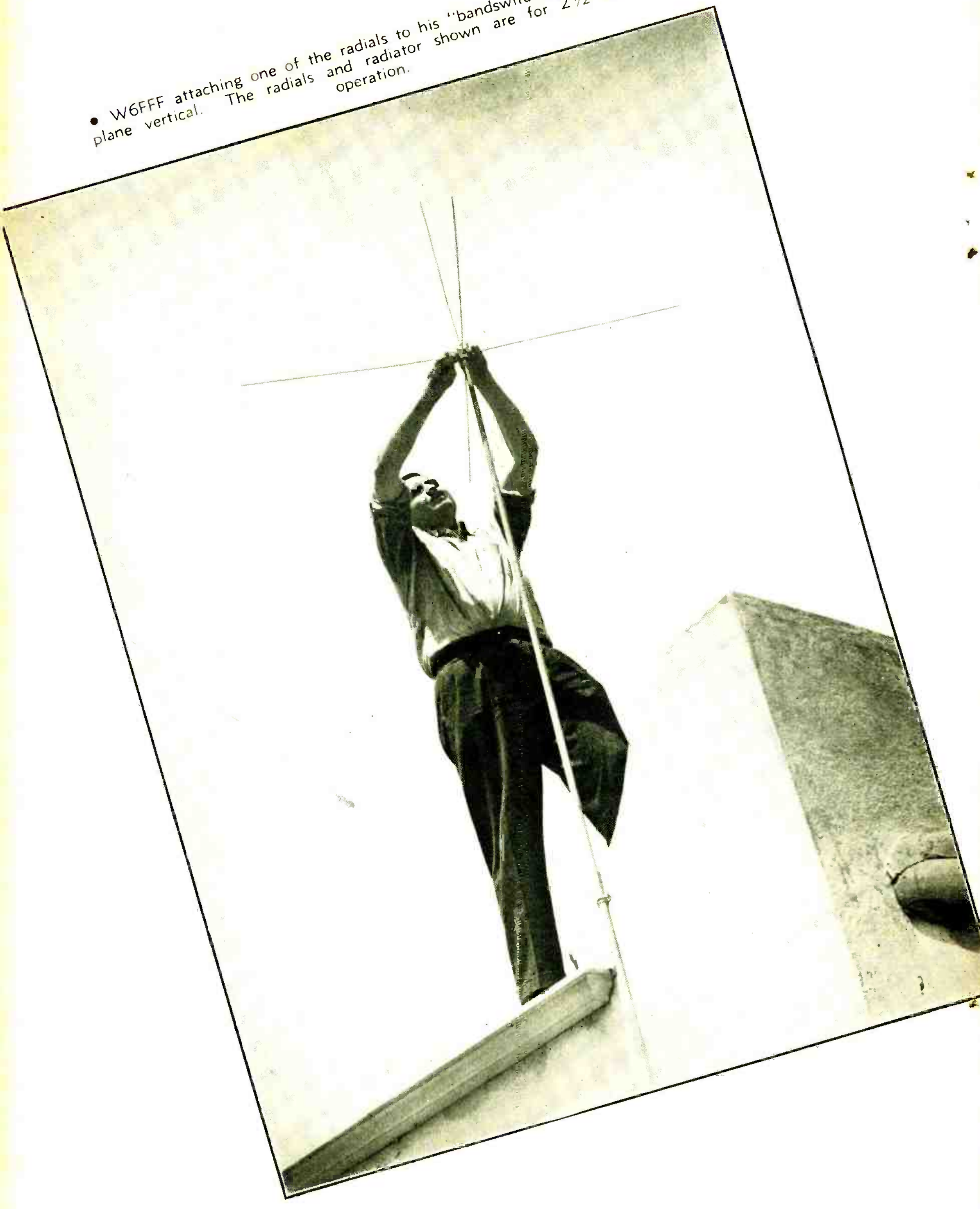
MISCELLANEOUS FEATURES

DEPARTMENTS

THE WORLDWIDE TECHNICAL AUTHORITY ON AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO


263
DIFFERENT
CONDENSERS
FOR ALL RADIO APPLICATIONS
UNSURPASSED FOR
COMPLETENESS
CRAFTSMANSHIP
MATERIAL
DESIGN
UTILITY

• W6FFF attaching one of the radials to his "bandswitching" ground-plane vertical. The radials and radiator shown are for 2½ meter operation.



Puka Pinnacle

By A. W. GREENLEE,* K6NYD, Lt. (jg) U. S. N.

The shades of Captain Bligh, "Mr. Christian," and their heroic companions undoubtedly recoiled in new torment early last March when portable KE6 went on the air from an unknown microscopic island far out in the Pacific Ocean and shattered anew the legendary silence of that vast and lonely section widely styled "the South Seas." To be exact, it was late in the afternoon of March 13, 1940 when Roger Parnell and I—after many hours of feverish construction and sometimes crude contrivance—crossed our fingers, snapped a switch, and put a CQ on the air. A few seconds later our faces stretched irrepressibly into broad grins, for answers began to roll in. Our glow of pleasure grew as we counted off the stations calling until we were practically incandescent.

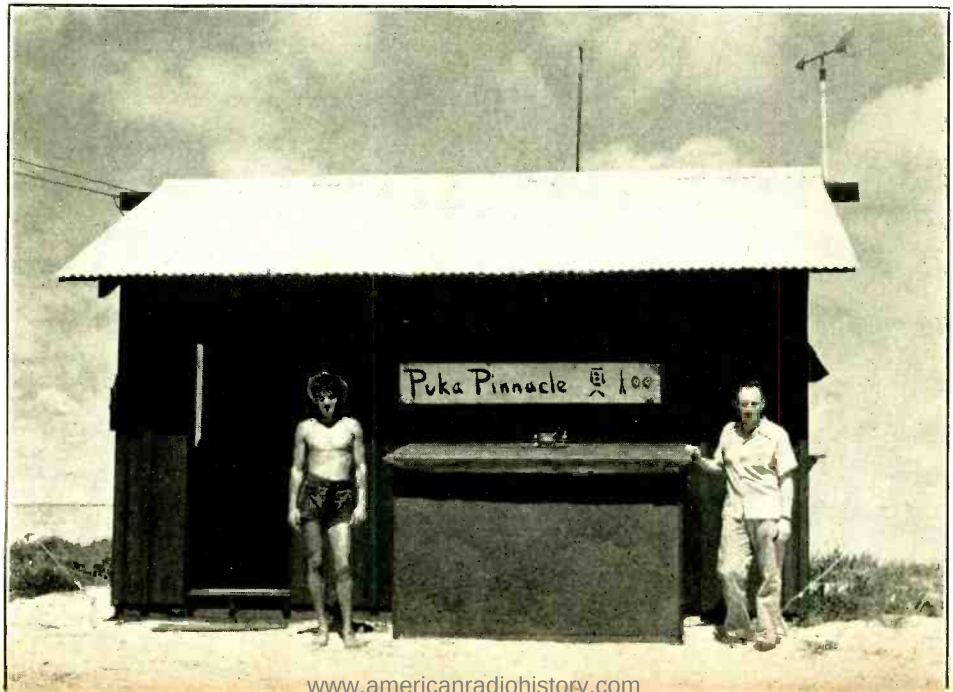
W6CQS near Oakland, California was our first contact, and the QSO with him helped us hang up some kind of a first, since our part of the world . . . but perhaps we should pause long enough to start at the beginning with an explanation that what follows is an account of a radio amateur's adventure in a comparatively unknown district and a description of his attempts to familiarize amateurs with the area.

In the first place the whole thing began as a typical "postman's holiday." I am, first and last, a radio ham; but in between the U. S. Navy pays my salary, and I reciprocate by serving as a line officer in the aviation branch where in some mysterious way communication duties constantly fall to me.

It was to get away from it all—all the gripes and growls which usually pour like a shower of harmless sparks on the head of a squadron radio officer—that I prepared to absent myself for a few days while most of the planes were out on advance base operations. But what motivated my packing up a 2000-foot coil of antenna wire and my handy old junk box I'm not quite sure myself. Any-

* 1001 18th Ave., Honolulu, T. H.

A view of Puka Pinnacle from the lowlands; Parnell is shown at the left in shorts and straw hat; the author, bareheaded, is on the right.



The regular assignment plane and crew of the author (extreme left); it was a plane similar to this in which they flew to Johnston Reef.

how, this gear was among my effects when they were stowed aboard a plane in which this time I was to fly as a semi-passenger, and some good natured razzing from the boys followed their discovery of what they termed "Bill's emergency kit."

We took off at dawn on the thirteenth of March, and the morning hours passed as pleasantly as the white fluffy clouds beneath us. In loose formation the planes hummed their way southwestward from the Hawaiian Islands. By mid-day the upthrust bits of ocean floor known as Johnston Reef or Johnston Island took shape out of the haze ahead, and shortly afterwards we were skimming wave tops alongside a barrier reef as the pilot cautiously settled the plane for a landing. There came the zip-swish of fast water beneath the hull and we were on.

Quickly assembling my personal baggage, I was soon set ashore on a low sandy island which reminded me at once of the old North Dakotan's remark to the effect that you could look farther and see less in his state than in any other state in the union. Nevertheless, it was just what I wanted. Tropical fish abounded in the lagoon inside the reef; the trade winds blew steady and cool all the way from the North American coast; and after tomorrow, when the planes took off again, I would have four days of uninterrupted peace and quiet with plenty of time for fishing and tinkering.

Companionship was available too, for as I made my way up the beach from where supplies, baggage, and myself had been landed, I saw Roger Parnell. Young, friendly, courteous, Mr. Parnell was to be associate, guide, and even student during my stay. A member of the widely scattered and unsung band of U. S. weather station operators, he was glad of the opportunity to talk with an outsider. He explained that supply ships were so distressingly infrequent, he had thought of offering a bounty for all English speaking humans brought to him alive.

As we proceeded up the beach toward his establishment, he explained that Sand Island, where we were, was the most habitable spot in the area. Johnston Island, about a mile to the westward, while much larger is uninhabited and inaccessible. All about us as we walked were the "nests" of sea fowl. Shallow depressions are scooped out of the sand by terns, booby, frigate and other varieties of

[*Continued on Page 89*]

Simplified Carrier Operated

REMOTE CONTROL

By L. C. WALLER,* W2BRO

An improved system using the house wiring as a transmission line for operating filament, plate, and keying relays.

Many radio amateurs sooner or later encounter circumstances which make it highly desirable to operate their c.w. rigs from a remote position. For example, in the hot summer months, a rig located on the second floor of a two-story house (or still worse, in the attic) may be "too hot to handle." The room temperature normally may be much too high for comfort, but after a transmitter of any appreciable power has been dissipating its usual quota of heat for a short time, the room is likely to become quite unbearable. How about moving the receiver and the operating switches of the transmitter to a table in that nice cool cellar? Or, perhaps, to that relatively cool rear bedroom on the first floor? Such a move can readily be accomplished without stringing unsightly relay wires hither and yon.

In a recent article[1] the writer described a simple, carrier-operated remote-control circuit which employs the house a.c. wiring circuit as a transmission line for relay operation. This system is quite workable but, as was pointed out at the time, possesses a number of disadvantages. An improved arrangement was promised for a later date and will now be described.

The new remote-control system permits the independent operation of three relays by means of a single, 300-kc. Hartley oscillator. This small control-oscillator unit can be plugged in any a.c. outlet in the house, as long as the transmitter is powered from an a.c. supply line which emanates from a common power-line-transformer winding. This is, of course, the usual condition encountered. Thus, the carrier-operated system does not tie the operating position down to one particular spot in the house. That cool cellar, the rear bedroom, or any other room can be quickly utilized, as may prove desirable at any given time.

In order to understand the operation of the new system, the reader should first refer to the previous article[1]—especially to that part which describes the operation of the gas triode, type OA4-G. In addition to one OA4-G, the new relay unit (to be located at the transmitter) also employs two of the new 2051's. The latter tube type is a sensitive gas "tetrode" designed especially for grid-controlled rectifier service. Its average control characteristics are shown in the curves of figure 1. The socket connections and electrode arrangements of both the OA4-G and the 2051 are shown in figure 2.

The remote-control relay unit is not quite as simple as the control oscillator and will, therefore, be described last. It is necessary to say, however, that its selector circuits operate on a *variation in amplitude* of the r.f. signal impressed across the a.c. line by the remote oscillator. In the normal operating cycle, three types of r.f. signal are required, in this order:

1) A high-amplitude signal of short duration.

2) A low-amplitude signal which can be switched on and left on.

3) A medium-amplitude signal which can be keyed.

These requirements can easily be met by the simple Hartley oscillator shown in figure 3. The 50L6-GT, which is operated as a triode with its screen tied to its plate, receives both heater and plate power directly from the a.c. line.

The tank coil L_2 is inductively coupled to the a.c. line through a low-impedance second-

---

* RCA Mfg. Co., Inc., Harrison, N. J.

[1] Waller, "Carrier-Operated Remote-Control Circuits," RADIO, Nov., 1939.

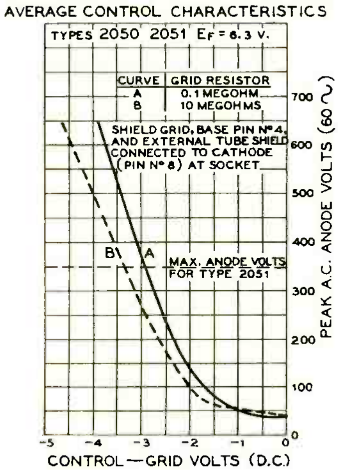


Figure 1. Operating characteristics for the 2051 gaseous tetrode.

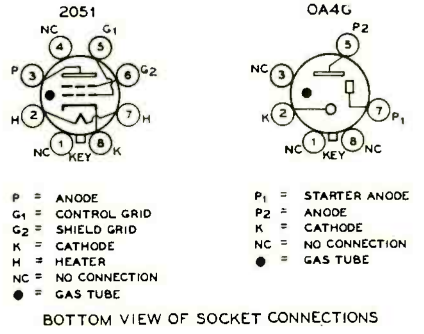


Figure 2. Socket connections for the OA4-G and 2051 tubes.

ary winding L_1. The oscillator frequency is not critical and can be in the order of 50 to 400 kc. With the circuit constants shown in figure 3, the frequency is about 300 kc. L_1 consists of four turns wound around L_2 at the point where the latter is tapped; that is, at the point of zero r.f. potential. Blocking condenser C_1 prevents L_1 from shorting the a.c. power line and also by-passes the plate-tank circuit at its r.f. voltage node. Grid bias for the oscillator is obtained from grid leak R_1.

Resistors R_2 and R_3 are *not* cathode bias resistors, but serve merely as series resistances in the —B lead to provide variations in the amplitude of the r.f. carrier. In figure 4, A, B, and C show the waveform and relative amplitude of the carriers impressed on the a.c. line. The large carrier C is obtained for a short interval when push-button switch S_1 is depressed and then released. S_1 serves to short out R_2 and S_2, thus placing the full a.c. line voltage on the plate of the oscillator. The large, momentary signal obtained in this manner triggers the OA4-G (see figure 5), operates relays Z_1 and Z_2, and thus turns on all transmitter filament supplies, as well as the heaters of the 2051's in the relay unit.

Toggle switch S_2 is next closed, so that the cathode of the 5OL6-GT is returned to —B through a 20,000-ohm resistor, R_2. This resistor greatly reduces the oscillator plate voltage and produces a very small carrier, as shown in figure 4A. Carrier 4A is used to trigger relay tube V_2 (see figure 5), which operates relay Z_3 and turns on all transmitter plate supplies.

The rig is now ready to be keyed by K (figure 3), which shunts R_2 with a 4000-ohm resistor, R_3. This operation increases the oscillator plate voltage so that carrier B (figure 4) is obtained. It should be noted that carrier B represents merely a sizable *increase* in carrier A. That is, when the key is up, carrier A still remains as long as switch S_2 is closed. Every time the key is closed, carrier B triggers V_3 and relay Z_4, the latter being connected in the keyed circuit of the transmitter.

The operation of the remote-control oscillator is quite simple and dependable. No difficulty whatever should be experienced in making it "perk," provided the recommended circuit constants are employed. The oscillator plate and grid current values for each of the three carrier amplitudes are as follows:

Carrier	*D.C. Plate Ma.*	*D.C. Grid Ma.*
A	2.2	0.8
B	5.2	2.0
C	8.0	3.2

These current values will vary considerably, depending on the impedance of the a.c. line at the remote position where the oscillator is located. If the plate current is too low, an impedance mismatch between L_1 (figure 3) and the a.c. line may be the cause. In some installations, therefore, it may be found advisable to try one or two turns more, or less, for L_1. In this manner, the impedance match can be improved so that a stronger signal will be delivered to the line.

The circuit for the remote-control relay unit is shown in figure 5. The OA4-G circuit is essentially like the one previously described.[1] Inductance L_3 and condenser C_6 comprise a series-tuned circuit shunted across the a.c. line. Trimmer C_7 serves to tune the circuit to resonance with the 300-kc. frequency of the oscillator. The carriers pictured in figure 4

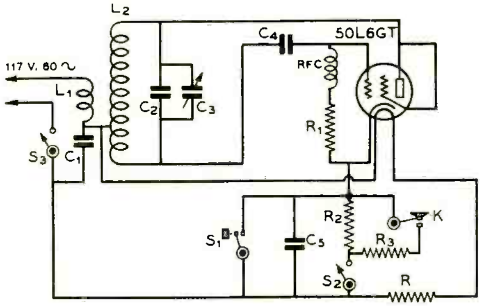


Figure 3. The 300-kc. remote control oscillator.

C_1—0.1-μfd. 400-volt tubular
C_2—.002-μfd. mica
C_3—75-225 μμfd. mica trimmer
C_4—.00025-μfd. mica
C_5—0.1-μfd. 400-volt tubular
R—446 ohms, 20 watts
R_1—5000 ohms, ½ watt
R_2—20,000 ohms, 1 watt
R_3—4000 ohms, 1 watt
L_1—4 turns no. 26 d.c.c. (see text)
L_2—75 turns no. 26 d.c.c. closewound on 1.75" form, tapped 25 turns from grid end
RFC—60-mh. r.f. choke
S_1—Push-button switch for transmitter filament supply
S_2—S.p.s.t. toggle for transmitter plate supply
S_3—S.p.s.t. oscillator line switch
K—Key or "bug"

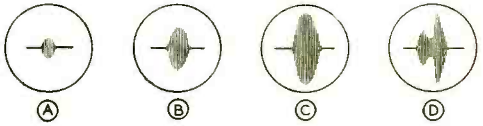


Figure 4. Oscillographic patterns of the 300-kc. carrier as it is received at the relay unit. Carrier (C) is distorted as in (D) when the OA4-G is firing. Carrier (C) turns on the transmitter filaments, (A) the plate supplies, and (B) keys the rig. (C) also closes the transmitter down after a QSO session. The transmitter can be controlled from any room in the house.

are as viewed on a cathode-ray oscillograph connected directly across L_3. Carrier C actually looks like D when the OA4-G is firing, the distortion being due to the intermittent loading of L_3 by the OA4-G. The oscillographic patterns offer a convenient, though not essential, method of indicating when L_3 C_6 are in resonance with the oscillator frequency.

The 60-cycle a.c. voltage from the junction of R_4 and R_5 has an amplitude which is *just too small* to trigger the starter anode of the OA4-G. Thus, when the high-amplitude carrier C comes on, the large r.f. voltage built up across L_3 adds to the a.c. voltage across R_5 and triggers the OA4-G. The tube acts as a half-wave rectifier, passing a d.c. anode current of about 20 ma. through the 2000-ohm winding of relay Z_1. This relay operates stepping relay Z_2, which closes and *stays closed*, even when carrier C has been removed. Relay Z_1 is necessary because stepping relay Z_2 requires a considerable amount of power to operate—much more than the OA4-G is capable of handling. Z_2, when closed, turns on the transmitter filaments and also the heaters of V_2 and V_3—the 2051's.

After a few seconds delay—which gives the 866's in the transmitter power supply a chance to "warm up"—the cathodes of the 2051's are hot and ready to operate. Carrier B is next applied by S_2 (figure 3). The small r.f. signal thus appearing across L_3 is *not enough* to trigger the OA4-G, but it *does* trigger V_2—through C_9 and R_8. The grid of V_2 is biased only 4.5 volts negative from a small C battery. Relay tube V_3 is biased at —22½ volts, and is not affected by small carrier A. When V_2 "fires," it passes a pulsating d.c. current of 35 to 40 ma. through relay Z_3, which operates to turn on the transmitter plate supplies—both low and high voltage. The rig is now ready for keying.

Next, the remote oscillator key boosts the line carrier from A to B; this increased signal is still too small to fire V_1, but it fires V_3. The plate-supply relay tube, V_2, continues to fire, of course, since carrier B is larger than carrier A. Thus relay Z_3 holds down, as desired, while relay Z_4 keys the transmitter —as rapidly as a fast bug will go!

After a transmission, S_2 is opened at the remote oscillator. There is then *no 300-kc. carrier* to cause harmonic interference on the station receiver. The mechanical locking of stepping relay Z_2 keeps the transmitter filaments hot, however, and the rig is ready to go again when S_2 is closed for the next transmission. When the operator is ready to close down the transmitter completely, he has only to give push-button switch S_1 a quick poke. This delivers carrier C, fires V_1, V_2, and V_3 for about the time interval of one dot, and causes stepping relay Z_2 to *open* and *stay open*. Thus the heaters of V_2 and V_3 are turned off, along with all transmitter filaments. Subsequent closing of S_2 and the key will produce no action, because the cathodes of V_2 and V_3 are cold. Just as a check to prove that Z_2 *is* open, the operator should close S_2 and the key. If the rig is turned off properly, the transmitter signal will not be heard in the station receiver.

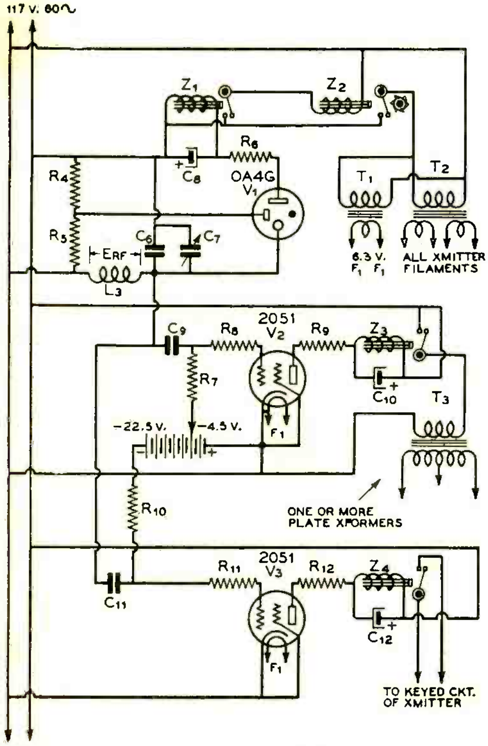


Figure 5. Three-circuit remote control unit for c.w. transmitters. No power is required by the relay tubes when the transmitter is not in use. The resistance of R_5 must be low enough to prevent line-voltage surges from firing the OA4-G. Otherwise the transmitter may be turned off when a surge happens to coincide with a closing of the key.

C_6—.002-µfd. mica
C_7—75-225 µfd. mica trimmer
C_8—25-µfd. 50-volt electrolytic
C_9—0.1-µfd. 400-volt tubular
C_{10}—8-µfd. 150-volt electrolytic
C_{11}—0.1-µfd. 400-volt tubular
C_{12}—8-µfd. 150-volt electrolytic
R_4—15,000 ohms, 1 watt
R_5—8000 ohms, 1 watt
R_6—500 ohms, 2 watts
R_7—100,000 ohms, ½ watt
R_8—50,000 ohms, ½ watt
R_9—250 ohms, 2 watt
R_{10}—100,000 ohms, ½ watt
R_{11}—20,000 ohms, ½ watt
T_1—6.3 v. 1 a. filament transformer
T_2—Transmitter filament supplies
T_3—Transmitter plate supplies
Z_1, Z_3, Z_4—S.p.s.t. a.c. relay, 2000-ohm coil
Z_2—S.p.s.t. mechanically locking, electrically reset a.c. relay, 200-ohm coil

• • •

This remote-control relay unit, as previously explained, employs three "selector" circuits, each of which operates on a different carrier amplitude. Relay tubes V_2 and V_3 operate independently by virtue of the voltage differential between their respective bias voltages. As shown in figure 5, this bias differential is 22.5 — 4.5, or 18 volts. The steep control characteristic of the 2051 (see figure 1) indicates that a considerably smaller bias differential might be used. So far as the sensitivity and uniformity of the 2051's are concerned, a bias differential of only 2 or 3 volts may be adequate. However, in actual practice, it was found difficult to control the differential in the amplitudes of the 300-kc. carrier within such small limits.

The amplitude of the carrier voltage E_{rf} measured across L_3 (figure 5) is affected by factors other than the oscillator plate voltage. Of these factors, the most important are:

1) Variations in the input impedance of the a.c. power line at various a.c. outlets in the house.

2) Variations in the load applied to the a.c. line.

3) Line voltage surges.

The first factor is apt to cause more variation in E_{rf} than the other two, but none will be troublesome if a suitably large bias differential is employed for relay tubes V_2 and V_3. Care should be taken that carrier B is not made large enough to trip the OA4-G. It is quite essential that the latter be operated *only* by carrier C.

Some operators object to using remote control because of the difficulties usually involved in shifting the transmitter frequency from the remote position. The carrier-operated relay unit can readily be adapted to remote frequency control by the simple expedient of adding a third 2051 relay tube, which we shall call V_4. This tube must, of course, be provided with a suitable grid-bias differential. That is, its bias must be somewhat larger than that applied to the grid of V_3.

If frequency control in small steps is deemed satisfactory, a number of crystals can be switched in and out, in the proper frequency sequence, by means of a simple multi-point stepping relay connected in the anode circuit of V_4. The circuit would be similar to that employed for V_3. In a system of this type, all r.f. stages except the crystal oscillator should be biased to plate-current cutoff, or nearly so, in order to protect the r.f. tubes while the crystals are being switched.

Continuous frequency control (for example, over a 50 to 100 kc. range in the 14-Mc.

[*Continued on Page 81*]

A Wide Range
AUDIO OSCILLATOR

By RAY L. DAWLEY,* W6DHG

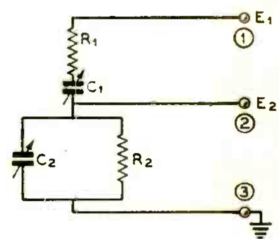
A description of a really inexpensive audio oscillator covering the range from 75 to 22,500 cycles and having relatively constant output and unusually good waveform over this frequency range.

For many years past there have been only two general sources of a.f. voltages of good waveform: the beat-frequency audio oscillator and the resistance-stabilized audio oscillator, the latter either with or without plug-in coils and condensers for different frequency ranges. The use of audio-frequency degenerative feedback, which has done so much for the communications industry in recent years, has allowed the design of the entirely new type audio oscillator described in this article. The design of this oscillator depends not purely upon the principle of degenerative feedback but rather upon the principle of obtaining a sharply selective circuit by the action of degenerative feedback upon a broadly selective circuit. Common circuits employing inductance and capacity, as is well known, show a sharply resonant peak at a frequency determined by the reactances of the inductance and capacity making up the circuit. It is not so generally known among radio amateurs that it is possible also to make up a selective circuit by the use only of resistance and capacitance. However, these resonant circuits made up only of resistance and capacity have not, until recently, been of great importance because of the very broad nature of their response characteristic.

The Wien Bridge

A simple resistance-capacity network which shows this characteristic of a rather broad resonance peak at some audio frequency is shown in figure 1. It is a simplified version of the so-called Wien bridge which balances out to a frequency determined by the resistance and capacity making up its branches. As can be seen from figure 2, the resonance characteristic of the circuit is extremely broad, although it does have a general *shape* which is very similar to that of the conventional tank circuit. It will be noticed also that the phase angle of the voltage E_2 varies with respect to E_1 as the frequency varies from the "resonant" value, leading on one side of resonance and lagging on the other.

Figure 1. The resistance - capacity network used in the audio oscillator as the frequency determining element.



A careful look at the circuit of figure 1 will show the reason for the peak in output

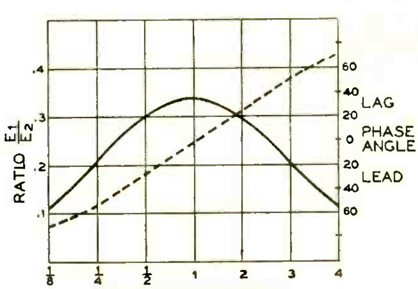


Figure 2. Relative frequency response and phase relations of the network shown in figure 1.

* Technical Editor, RADIO.

voltage as the input voltage is varied. The upper section can be thought of as a high-pass series element whose transmission would fall off gradually as the frequency is decreased. Then, the lower sections across which the voltage is developed can be thought of as a low-pass shunt element which would offer increasing impedance (and hence would allow a larger voltage to be developed across it) as the frequency is decreased.

As the frequency of the voltage across the complete circuit is decreased from a high value the impedance of the lower section would tend to increase until the increasing value of the *series* impedance of the upper section approached the point where its series impedance was increasing more rapidly than the shunt impedance of the bottom section was increasing. At the point where the two impedances are increasing at the same rate there will be a flat top on the response curve since the total voltage across the two sections is constant and since the two impedances are increasing at the same proportional rate.

As this point is passed, the reactance of C_2 becomes small with respect to R_2 so that the resistance makes up the major portion of the circuit. But, in the upper element the two are in *series* so that the reactance of the condenser continues to add to the resistance R_1. Hence, the voltage across the lower branch of the circuit falls off as the frequency is decreased past the "resonant" point—or the point at which the reactances of the upper and lower sections are increasing at the same rate.

Frequency of Resonance

Referring back to figure 1, the point at which the voltage at E_2 will be the greatest percentage of E_1, and will have the same phase as E_1, will occur at the frequency determined by:

$$F_0 = 1/2\pi\sqrt{R_1R_2C_1C_2}.$$

But if the special case is taken where R_1 is the same as R_2 and C_1 is the same as C_2, the equation for the determination of the frequency greatly simplifies to:

$$F_0 = \frac{1}{2\pi R_1C_1}.$$

A careful look at this equation will show a peculiar thing—the frequency of "resonance" is inversely proportional to capacitance, instead of being inversely proportional to the square root of capacitance as is the case with ordinary tuned circuits. This fact is characteristic of resistance-capacity circuits and allows a much wider frequency range to be covered with a given condenser ratio in this circuit as compared to an LC circuit.

The Circuit

Although the particular circuit of the unit described is new, the general circuit was first shown some time back[1] and an application in a manufactured audio oscillator was shown a year or so later[2]. The self-adjusting feedback control arrangement and certain material on the resistance-capacitance tuning arrangement was taken from an article by Terman and his associates which appeared in the *Proceedings* of the I.R.E.[3]

The complete circuit of the audio oscillator is shown in figure 3 and consists of six separate functions: the frequency determining network, a two-stage audio amplifier, a regeneration circuit, a variable degeneration circuit, an output control, and a power supply. Each of these sections will be described in detail.

The Frequency Determining Circuit

The frequency of oscillation of the unit is determined by the four-gang b.c. condenser C_{1A}-C_{1B}, the fixed-minimum condensers C_2 and C_3, and the set of ten resistors R_1 through R_{10} which are switched into the circuit in equal pairs by S_1. The capacitances and resistances in the two branches of the circuit are made the same so that the simpler equation given under Frequency of Resonance can be used to determine the frequency of oscillation from the known values of resistance and capacitance.

The highest frequency range, 4500 to 22,500 cycles is obtained with the two 40,000-ohm resistors R_5 and R_{10} in the circuit. The portion of this range above 12,500 cycles will probably not be of any particular use but since the oscillator did go on up above 20 kc. on the switch position which covers the useful range from 4500 to 12,500 cycles, these very high audio frequencies are available in case they should be needed for any purpose. As a matter of fact, it has been stated[3] that oscillators of this type have been constructed to give useful output at frequencies above 2 megacycles.

---

[1] H. H. Scott, "A New Type of Selective Circuit and Some Applications," *Proceedings I.R.E.*, February, 1938, p. 226.

[2] H. H. Scott, "A Low-Distortion Oscillator," General Radio *Experimenter*, April, 1939, p. 1.

[3] Terman, Buss, Hewlett, and Cahill, "Some Applications of Negative Feedback with Particular Reference to Laboratory Equipment," *Proceedings I.R.E.*, October, 1939, p. 649.

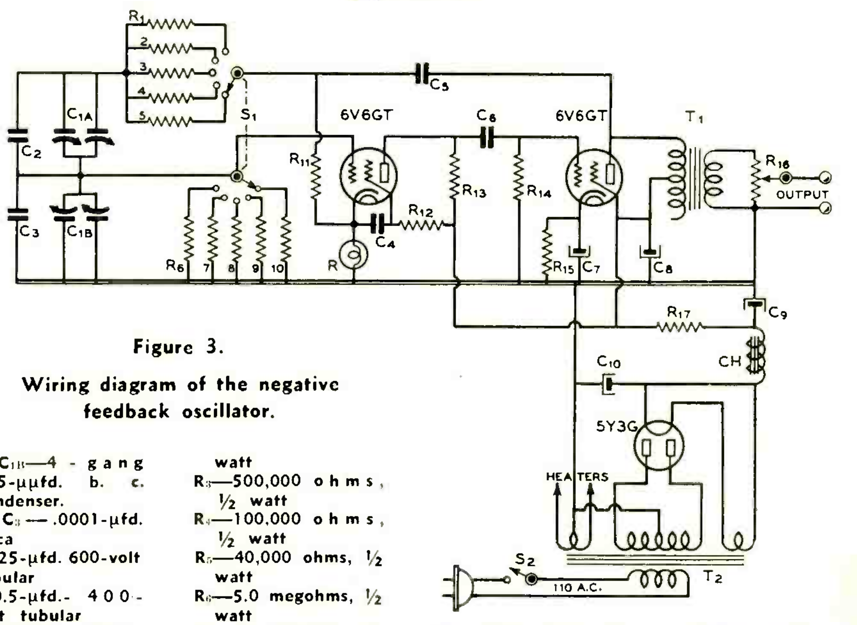


Figure 3.

Wiring diagram of the negative feedback oscillator.

- C_{1A}, C_{1B}—4-gang 365-μμfd. b. c. condenser.
- C_2, C_3—.0001-μfd. mica
- C_4—.25-μfd. 600-volt tubular
- C_5—0.5-μfd. 400-volt tubular
- C_6—0.1-μfd. 600-volt tubular
- C_7—10-μfd. 50-volt electrolytic
- C_8—8-μfd. 450-volt electrolytic
- C_9, C_{10}—Dual 8-μfd. 450-volt electrolytic
- R_1—5.0 megohms, ½ watt
- R_2—1.0 megohm, ½ watt
- R_3—500,000 ohms, ½ watt
- R_4—100,000 ohms, ½ watt
- R_5—40,000 ohms, ½ watt
- R_6—5.0 megohms, ½ watt
- R_7—1.0 megohm, ½ watt
- R_8—500,000 ohms, ½ watt
- R_9—100,000 ohms, ½ watt
- R_{10}—40,000 ohms, ½ watt
- R_{11}—2500 ohms, 1 watt
- R_{12}—10,000 ohms, 1½ watts
- R_{13}—5000 ohms, 10 watts
- R_{14}—100,000 ohms, ½ watt
- R_{15}—400 ohms, 10 watts
- R_{16}—1000-ohm potentiometer
- R_{17}—2000 ohms, 10 watts
- S_1—2-pole 6-position switch (only 5 positions used)
- S_2—A.c. line switch
- T_1—Universal output to voice coil transformer
- T_2—580 c.t., 50 ma.; 5 v., 3 a.; 6.3 v. 2 a.
- CH—10-hy. 65-ma. filter choke
- R—6-watt 120-volt tungsten lamp

The other ranges of the instrument are: 2000 to 9000 cycles with the 100,000-ohm resistors in the circuit, 450 to 2000 cycles with the two 500,000-ohm resistors, 220 to 900 cycles with the two one-megohm resistors, and 75 to 220 cycles with the two 5-megohm resistors.

It will be noticed that the range of the instrument becomes a smaller and smaller ratio as the frequency is decreased. This is because of the increased flattening off of the lower end of the characteristic for each band position as the efficacy of the by-passing and de-coupling within the circuit becomes less at the lower frequencies. The lowest frequency range goes only to 75 cycles and no reasonable changes in the constants of the RC circuit will make it go much lower than this frequency. This latter frequency of 75 cycles was deemed low enough for normal amateur and testing work, but if it is desired to alter the oscillator to allow it to go to a lower frequency, it will be found necessary to increase the values of coupling condensers, by-pass condensers, and filter condensers a rather sizeable amount. In addition, it will be necessary to replace the output transformer T_1 by a resistor of about 5000 ohms, or by an output transformer with an extremely high primary inductance.

The Audio Amplifier

Two two-stage audio amplifier of the oscillator is more or less conventional, using a pair of cascaded 6V6GT's, except for the use of a 6-watt Mazda lamp as the cathode resistor and variable feedback resistance in the first amplifier stage. Note that the screen of the first 6V6 amplifier stage is by-passed to the cathode of this tube rather than to ground. This is done to make the tube operate in its proper manner as a beam tetrode.

Regeneration and Degeneration Circuits

The energy for both the regeneration and degeneration circuits is taken from the plate of the output stage and coupled through the blocking condenser C_5. Here it is divided, the energy for regeneration being fed to the top of the frequency determining circuit and the degenerative energy being fed through the fixed resistor R_{11} and impressed across the automatically variable cathode resistance R. It is the function of having both a regeneration and a degeneration circuit to hold the overall gain of the oscillator to the level which will just allow oscillation. In other words the oscillation amplitude is kept small enough so that tubes are operating class A without grid current so that the output waveform will be a pure sine wave.

The Variable Degeneration Circuit

It is the function of R, the 6-watt Mazda lamp, in the cathode circuit of the first amplifier stage to act as a variable resistance in series with R_{11} and thus to determine the amount of degenerative voltage fed back into the grid circuit of the first tube. The resistance of this lamp (which has a tungsten filament and hence a positive voltage/resistance characteristic) varies from about 200 ohms when cold to about 2200 ohms with the full voltage drop of 110 volts across it.

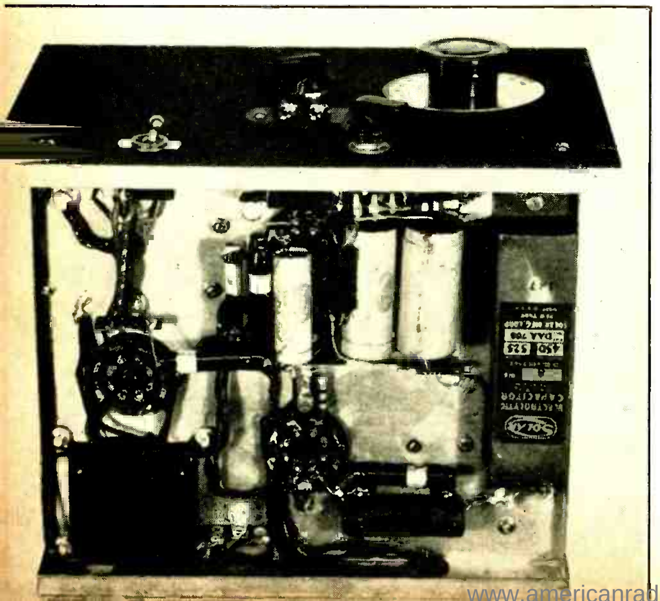
The resistor values on the first 6V6GT stage have been proportioned so that an increase in oscillation amplitude will increase the cathode current of the tube. Since the lamp, with its variable resistance characteristic with changes in current, increases its resistance with an increase in current, the increased resistance accompanying an increased oscillation amplitude will increase the feedback voltage. The increased *degenerative* feedback voltage accompanying the increased resistance will tend to *reduce* the oscillation amplitude back to the original low value.

Thus by properly proportioning all the resistor values and voltages in the first amplifier stage, the lamp will be operated at a current value which will allow it to show a large increase in resistance with a comparatively small change in current. Under these conditions of operation the amplitude of oscillation of the unit will be kept quite constant. Then, by utilizing the proper value of *fixed* series degeneration resistor at R_{11} the amplitude of oscillation may be kept at a value within the class A operating range of the amplifier tubes. The output is thus kept relatively constant over a wide range of frequency, and relatively free of harmonics.

Output Control and Power Supply

The plate of the output tube is fed into one half the primary of a conventional push-pull plates to speaker transformer, the audio output of the oscillator being taken from the highest impedance positions on the voice-coil secondary. By thus using a comparatively high step-down ratio in the output transformer, operating the oscillator into the normal impedances from 200 ohms on up will have almost neglible effect on the operation of the oscillator itself. A 1000-ohm potentiometer across the secondary of the transformer allows a variation in output voltage from a few millivolts to about 5 volts to be obtained.

The power supply is more or less conventional and uses one section of filter with a choke and one section with a resistance. It



Bottom view of the oscillator. The ten range determining resistors are mounted upon the switch which is directly above the two side-by-side tubular condensers.

supplies approximately 200 volts to the plates of the tubes.

Construction and Operation

The unit is built upon a standard chassis and panel and is placed into a standard cabinet. Note carefully that the rotor and frame of the tuning condenser are above ground potential and connected directly to the grid of the first amplifier stage. Consequently it was found necessary to isolate the power supply components physically from this condenser, to saw the rotor shaft short and use an insulated bakelite coupling to a metal dial, and to insulate the frame of the condenser from the chassis by small ceramic pillar insulators.

Aside from these precautions, and the one that the unit must be operated in its shielding box when in the vicinity of a high-power transmitter, the construction of the unit is quite conventional. It should be mentioned, however, that the exact components shown (especially resistor values) be used in the construction of the unit. The values shown are the result of considerable experimentation and variations greater than the normal tolerances of good-grade components are likely to disturb the balance between regenerative and degenerative feedback.

Testing the Oscillator

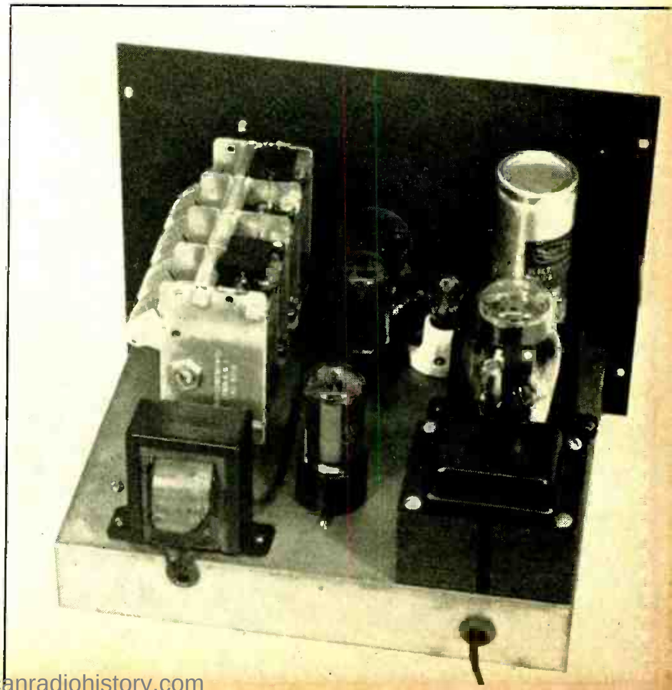
It is best to have a cathode-ray oscilloscope to test the operation of the oscillator on the various frequency ranges, although a good pair of headphones can be used. The most satisfactory test is to use both the phones and the oscilloscope across the output.

Set the tuning condenser approximately to the center of its range, turn the output control wide open, set the range switch to the third or center position, and turn on the power switch. Listen in the phones and at the same time watch the 6-watt Mazda lamp in the cathode of the first 6V6GT. The lamp should come up to about one-third brilliancy and then should drop back somewhat as the oscillator starts to generate approximately a 1000-cycle tone.

Take a careful look at the waveform on the oscilloscope to see if it is a pure sine wave. If the tubes are normal, the resistors are not too far off, and the unit has been constructed and wired carefully the waveform should be so perfect that it is impossible to detect any irregularities due to harmonic content. It must not be thought that it is improbable that the oscillator will start off properly at the outset since the unit shown and the experimental model just preceding it operated immediately in a satisfactory manner.

Then check the waveform and output over the whole condenser dial and on all switch positions. The waveform should be perfect from about 100 cycles out to the upper frequency limit of the unit. The frequency of oscillation will go out of audibility somewhere between half and minimum capacity on the highest frequency range although the output will still be as strong and as free of harmonics as viewed on the oscilloscope up

Rear view of the audio oscillator. The 6-watt Mazda lamp can be seen between the filter condenser and the rectifier can.



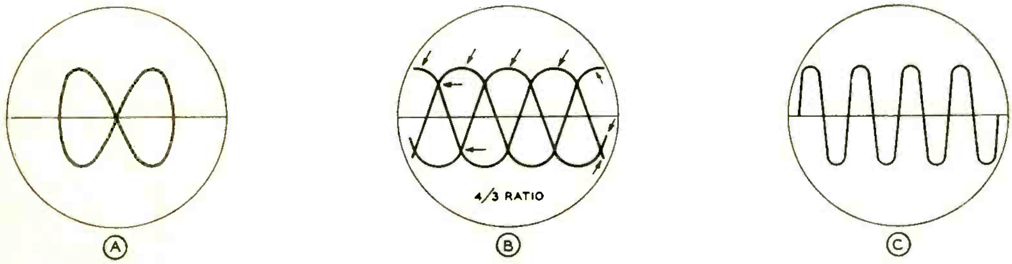
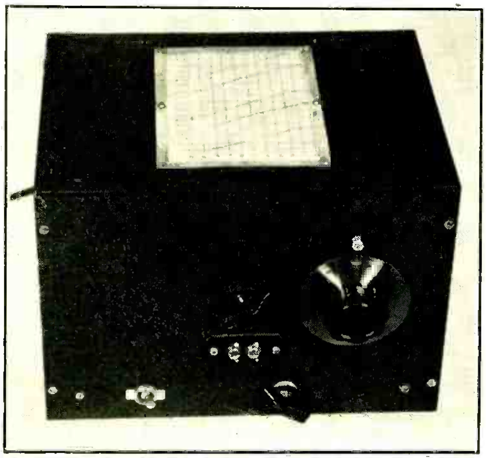


Figure 4. General oscilloscope patterns used in the calibration of the audio oscillator with the aid of a cathode-ray oscilloscope. (A) Pattern obtained with 60 cycles on horizontal sweep and 120 cycles on vertical (or 50 on horizontal and 100 on vertical). (B) Lissajou's figure showing relation of 4/3 between frequency of vertical deflection and of horizontal saw-tooth sweep. (C) Lissajou's figure showing relation of 4/1 between vertical deflection and horizontal saw-tooth sweep frequencies.

to the upper frequency limit of the oscillator. The highest frequency that can be heard will depend upon the reproducer (phones or speaker), the person's ears, and how tightly the laminations in the particular output transformer used are clamped. Most usual phones and inexpensive speakers will go out of audibility somewhere between 5000 and 12,000 cycles but the output transformer of the unit shown could be heard up to about 14,000 cycles.

If the oscillations are too intense and the waveform is distorted, it will be necessary to *decrease* the resistance of R_{11}. This will increase the amount of degenerative feedback and reduce the oscillation amplitude. Conversely, if the amplitude is too low or if the unit quits oscillating at some point on some range, the value of the degeneration resistor R_{11} should be *increased*. If the values shown in the wiring diagram have been followed carefully the unit should operate properly immediately but if it does not it should only be necessary to make a slight change in the value of R_{11} to correct the difficulty.



The audio oscillator shown mounted in its cabinet with the calibration chart on the top.

The amplitude will be found to be quite constant over all frequency ranges except the lowest frequency ones; here the amplitude of oscillation may vary over a range of 2 or 2½ to 1. Also, the waveform will commence to be imperfect at the lower end of the lowest frequency range—below 100 cycles. However, if it is desired for some reason to have perfect waveform at the extreme low frequencies, the alterations discussed at the first of the article can be incorporated into the unit.

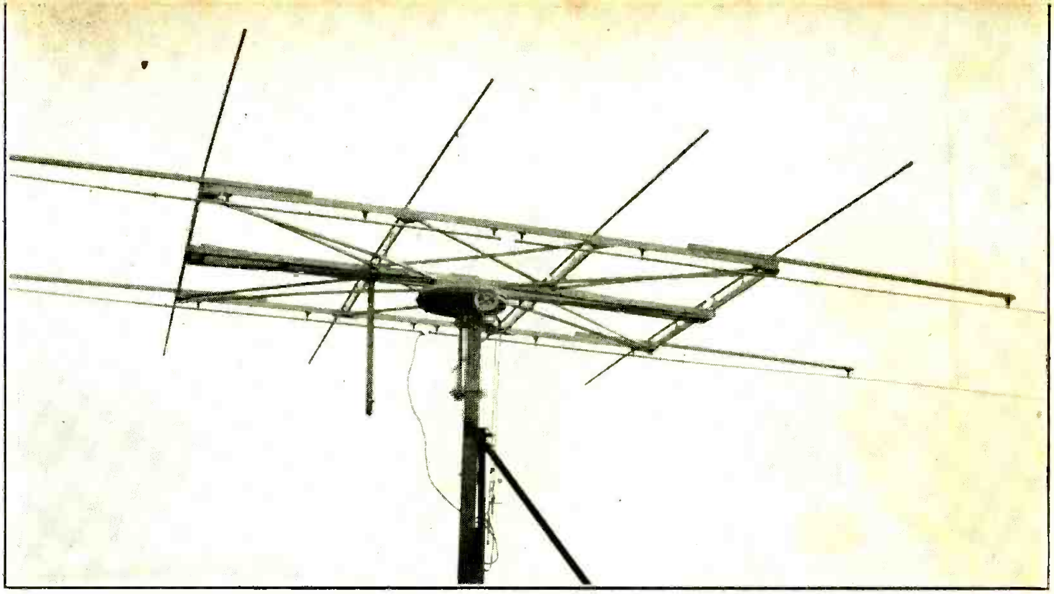
Calibration

As always, the calibration of a variable-frequency audio oscillator is somewhat of a problem. Naturally, the most satisfactory and least difficult method would be to check the unit by the zero-beat method against another audio oscillator which was already accurately calibrated. Such a piece of equipment will necessarily be available only to a few so that the method described below (which, incidentally, was used to calibrate the one shown) will most likely be used.

Calibrating with an Oscilloscope

If an oscilloscope having a sweep oscillator going from about 10 to 5000 cycles is available (the one shown on page 518 of the 1940 RADIO HANDBOOK was used in our case), the calibration becomes a simple matter of about one-half hour's watching of interesting waveforms. It may sound slightly involved or complicated in the description but it is really

[*Continued on Page 74*]



Practical Two-Band Rotary Beam

By FRED D. ROWE,* W6FK, and MAX P. FISHER**

A detailed article on the construction of a combined 10- and 20-meter rotary array with an exact list of the materials required and giving an easily understood step-by-step construction technique.

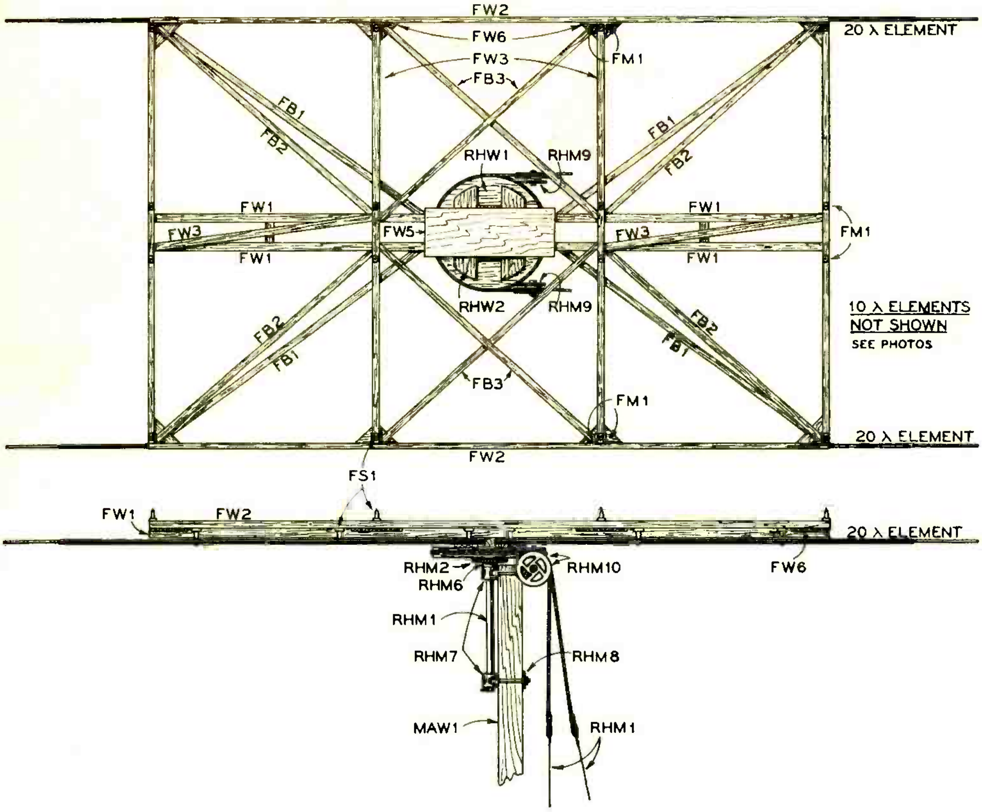
For the amateur with no opportunity to erect a telephone pole to support a beam; who instead has to work on a tar-paper and gravel roof in a restricted space; who, being a city dweller, is forced to conserve on weight, physical dimensions, and conspicuousness, the rotary beam antenna described herein will fit both his purpose and his pocketbook.

The beam consists of a four-element 10-meter beam in combination with a two-element 20-meter beam. Inasmuch as the type and the exact length of the elements are a matter of choice, as well as the method of feeding them, no specific preference is expressed. Tenth-wave spacing between the elements on both hands was used; however, by scaling up the sizes given later, any desired spacing may be used. This article will devote itself to helping the amateur with the constructional difficulties which confront him, and leaves the electrical problems to be solved by any of the recognized methods.

The rotary beam described below is hand-operated or motor-driven. Weight of the wooden framework for supporting the elements, including the standoff insulators, the head for rotating, and the iron brackets for fastening the whole unit to the mast is approximately 40 pounds. Screws and bolts are used throughout and the lumber can be obtained at even the smallest lumberyard. No machining or precision fitting is required, and anyone of even moderate ability should have no difficulty in making the beam in his garage, basement or spare room. For the amateur with a workshop at his disposal, the parts will literally fly together. The very large number of the brethren who have been putting off having a rotary beam to improve their signal reports from all points of the compass have mostly been held back on account of two factors: first, cost; and, second, limited facilities for a homebrew job. By following the cook book description of the beam's construction as outlined here, Mr. Average City Dweller will be enabled to put out signals on his new rotary beam two-band antenna in very short order.

The first consideration is how big should the frame for supporting the elements be? Using tenth-wave spacing on the two bands,

* 136 Cole St., San Francisco, Calif.
** 745 Eleventh Ave., San Francisco, Calif.



Detailed construction drawing of the framework and the rotating arrangement.

it was found to require a frame approximately 10½ feet long by 6½ feet wide.

Supporting Framework

To take the fabrication of the supporting wooden frame for the elements in progressive steps, the start is made by laying the two pieces of 2″ x 2″ (FW1) parallel, with a 4-inch space between. Then, using the scrap from the 2 x 2's, cut 4 blocks, 4 inches long, to go in between the 2 x 2's, and bolt (FM4) into place. This frame should be perfectly square. Now mount standoff insulators (FS1 & 2) on the cross pieces (FW3), and then lay cross pieces in position on top of the 2 x 2 frame. Adjust these to the desired spacing required between the elements by sliding on top of the 2 x 2 frame. When you have the cross pieces lined up for both spacing and squareness, mark the points of contact with the 2 x 2 frame. (If necessary, the 10-meter elements may be temporarily put on the insulators.) Remove the elements, if same were placed on the stand-offs, and then screw the cross pieces to the 2 x 2 frame (FM6). The next step is to fasten the ends of the cross pieces together by butting the end pieces (FW2) to the ends of the cross pieces, and then use 5-inch triangles cut out of either ⅜-inch presdwood, or ½-inch plywood (FW6) to fasten these together by screwing the triangles onto the bottom of the cross and end pieces. Now, using the small angle irons (FM1), bolt (FM2) the same joints together at the top, but on the inside of the frame. Next, using the extra piece of stock (FW3), cut to correct size and screw (FM5) these pieces onto the top of the 2 x 2 frame as diagonal cross braces. These should extend from the end cross piece to where the second cross piece meets the 2 x 2 frame. Now, right in the center of the 2 x 2 frame screw (FM5) the two pieces (FW5) on the frame, one on the top side and the other on the bottom. This completes the frame.

Bracing the Frame Internally

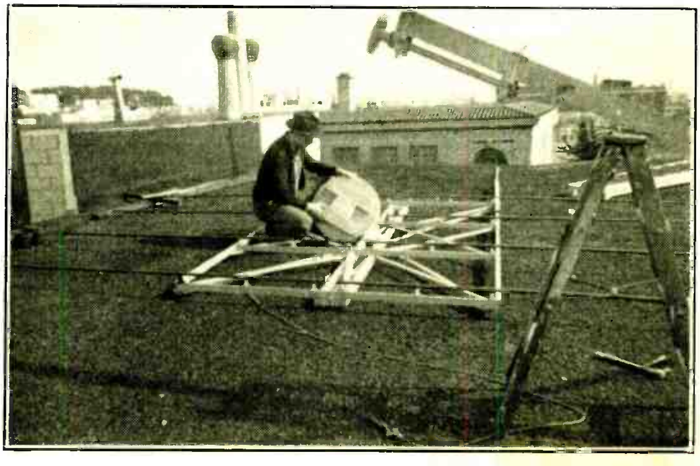
Looking at the bracing when completed, it looks complicated, but in reality it is very simple. Begin the bracing by screwing (FM5) the four 10-foot pieces of bracing stock (FB1) to the bottom of the 2 x 2 frame where the center piece or cradle ends (FW5). This operation should be done with the frame upside down; i.e., the standoffs on the cross pieces should be pointing down towards the floor or ground. The next step depends upon the movability of these braces (which we will now call the long diagonal braces), so do not anchor or fasten these to the corners of the frame as yet. Looking at the frame, and the four braces just put on, you will see four points where the two center cross pieces and the long diagonal braces cross. Here a space of some three inches exists between them. These spaces are now put to use by springing the long diagonal braces down against the two center cross braces and screwing together. If the strain seems to be excessive, modify by inserting a ¾ inch piece of wood between and then screw together.

When this is completed, the long diagonal braces will be found to be pushing down against the four corner triangles, on the frame. Now drill holes for the bolts to fasten the ends of these long diagonal braces to the triangles at the four corners of the frame. Slip the bolts in place and fasten. Turn the frame right side up. We are now ready to put on the second set of braces or the short diagonals (FB2). These are screwed on top of the 2 x 2 frame at points where the two center cross pieces fasten onto the 2 x 2 frame. The opposite ends are placed on top of the corner triangles, and the same bolt that holds the long diagonal braces on the bottom of this triangle slips through the end of the short diagonal. Now, we are ready for the last braces or "X" braces (FB3). These are put on by fastening their outer ends to the triangles on the inside of the two center rectangular spaces formed by the two center cross pieces and the end pieces bounded on the inside by the 2 x 2 frame. Cross the two pieces to form an "X" on each side of the 2 x 2 frame, and then screw onto the top of the 2 x 2 frame at points where the two center cross pieces and the frame touch.

This completes the frame and the bracing; and here is a good point to get out the old paint brush and weatherproof the frame. Enamel is good. As soon as the paint or enamel is dry, the 10-meter elements are ready to mount on the cross pieces, and the beam is complete for the 10-meter elements. This brings us to the 20-meter elements.

Mounting the 20-Meter Elements

The 20-meter elements are mounted by simply screwing standoffs underneath the frame at desired spacings on the end pieces (FW2). This provides approximately 10½ feet of support for the approximate 34-foot span of these elements. If ¾ inch or smaller diameter tubing is used, an outrigger on each of the four ends extending another six feet will add the much desired rigidity to the 20-meter elements. In the case of the author's beam, tubing of 15/16 inch diameter was used, and the outriggers designed to eliminate all droop at the ends of the elements as well as to take out the play between the elements. It was also found that with this device stand-



Frame on roof, ready to proceed with the mounting. Mast and rotary head in the foreground ready to take the frame.

PARTS AND MATERIALS

FRAME (F)

Wood (FW)

1.	two pieces	2" x 2"	11 feet long
2.	two pieces	1¼" x ¾"	11 feet long
3.	five pieces	1¼" x ¾"	7 feet long
4.	four pieces	1⅛" x 1⅛"	8 feet long
5.	two pieces	8" x ¾"	2 feet long
6.	one piece	10" x ½"	2 feet long

Frame Braces (FB)

1.	four pieces	¾" x ¾"	10 feet long
2.	four pieces	¾" x ¾"	6 feet long
3.	four pieces	¾" x ¾"	4 feet long

Metal (FM)

1.	twelve	1½" galvanized iron angles
2.	fifty	2½" x ⅛" round head galv. iron bolts, with nuts and washers
3.	eight	3" x ⅛" round head galv. iron bolts, with nuts and washers
4.	four	8½" x ¼" round head carriage bolts, with nuts and washers
5.	sixty-two	heavy shank, flat headed 1⅜" brass screws
6.	eight	heavy shank, flat headed 2½" brass screws

Standoffs (FS)

1.	forty	1½" standoff insulators with 1¼" brass bolts and lead washers
2.	eighty	1" narrow shank round head brass screws with fibre washers

ROTATING HEAD AND DRIVE (RH)

Wood (RHW)

1.	two pieces	1½" x 10"	2 feet long
2.	one piece	1½" x 10"	2 feet long

Metal (RHM)

1.	one	1¼" diameter round shaft, 2 feet long
2.	one	7" diameter round gear (have welded to end of shaft)
3.	four	⅜" bolts with nuts and washers, 9 inches long
4.	four	½" bolts with nuts and washers, 6 inches long
5.	two	5/16" bolts with nuts and washers, 2 inches long
6.	one	flat ball thrust bearing
7.	two	cast iron pillow blocks with 1¼" hole
8.	one piece	iron 5/16" thick, 2" wide, with two 9/16" holes drilled
9.	one piece	iron 5/16" thick, 2" wide, bent to form clothesline pulley support with two 9/16" holes drilled
10.	two	5" dia. die cast clothesline pulleys
11.		cable for driving any required length, and any small pulleys for dodging corners, if necessary
12.	one	pulley 1½" dia. and 7" long, fastened firmly to ½" shaft
13.	one	½" diameter shaft, any required length
14.	two	small pillow blocks, with ½" hole
15.	one	crank handle for turning beam

MAST ANCHORAGE (MA)

Wood (MAW)

1.	one piece	4" x 4"	15 feet long
2.	one piece	2" x 4"	5 feet long
3.	three pieces	2" x 2"	10 feet long

Metal (MAM)

1.	six	2" lag screws with washers
2.	four	3" lag screws with washers
3.	two	⅜" bolts with nuts and washers (9" long)
4.		one quart of paint or enamel

ard stock lengths of tubing could be used, and the splices were within well-supported areas. The outriggers were made of 1⅛ x 1⅛ inch wood stock, mounted on top of the end pieces of the frame, and extending out six feet with a 14-inch overlap on the frame to which they were bolted (FM3). Also by adjusting the distance out from the frame to where the standoff is mounted, on the bottom of the outrigger, the elements can even be raised slightly above level, if so desired. With the outrigger painted and in position, the 20-meter elements can be mounted on the bottom of the frame and the two-band beam is complete and ready for erection.

Getting the Frame Topside

If not convenient to raise the frame to the roof in one piece, it may be taken apart and hauled up in small bundles on ropes. Either method should be done with the elements off the frame to prevent breaking of the standoffs. The suggestion is made of placing the frame on the roof, if the roof is flat, and letting it stand in the weather for a day or two until the rotating mechanism is completed. If this is done, any bolts or metal parts will show signs of rust and can be painted before the final raising of the beam on the mast.

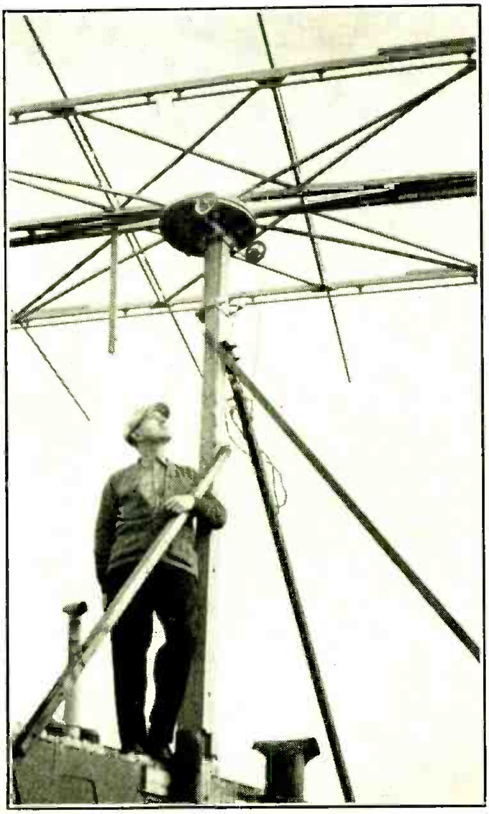
Rotating Mechanism

The simple and time-tried method of "cable and pulley" rotation was found to be the most economical and positive, especially where one is working with just a few tools and a limited pocketbook. The four essentials of this system are: a bearing for the beam to rotate on, a method of turning the frame, a positive lock in any position, and heavy duty type of construction. The bearings for the frame are made by using a secondhand flat ball thrust bearing to take the downward weight, and two standard "pillow blocks" for the side support. The top pillow block also carries the downward thrust of the thrust bearing.

The connection between the frame and the rotating shaft is made by having a plate, or, in the author's case, an old gear wheel 7 inches in diameter and ½ inch thick, welded to one end of the rotating shaft. Four holes are drilled in the plate or old gear to take the four ⅜-inch bolts (RHM3) which bolt the frame, master pulley and the plate together. When the shaft (RHM1) has the gear or plate on one end, slide on the opposite end the flat thrust bearing and then the two pillow blocks (RHM6). As a precaution against the beam ever lifting the shaft upward out of the bearings, a small ⅜-inch pin was put through the shaft, just below the bottom pillow block.

To rotate the beam, a large pulley was made out of three pieces of wood (RHW1 & 2) by cutting the two pieces (RHW1) 21 inches long, and cleating them together with a third piece (RHW2). This was then taken to a local carpentry shop and sawed round to form a round pulley 20 inches in diameter. Thus the master pulley is completed. Next make the two pulleys to feed the cable on and off the master pulley by fixing two 2 inch diameter clothesline pulleys on an iron bracket which mounts on the mast. The bracket (RHM9) was made using a piece of iron 5/16-inch thick and 2 inches wide. This was bent to the desired shape so that it formed a yoke across the back of the mast to retain the bolts which clamp the top pillow block to the 4 x 4 inch mast. The drive cable (RHM11) is then wrapped one and

[*Continued on Page 93*]



W6FK makes final inspection. Note detail of the rotary head and the method of mounting it on the mast.

De Luxe, High Output

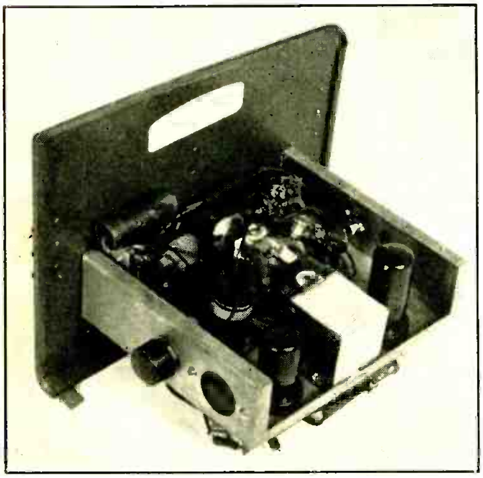
112 MC. TRANSCEIVER

By W. W. SMITH,* W6BCX

Besides delivering 7 watts of carrier, this transceiver possesses none of the usual disadvantages of the typical transceiver now in common use. Improved performance is realized at only a slight increase in the total cost of the installation.

Widespread interest shown by old timers and newcomers alike in the small, battery-powered 112-Mc. transceiver described in the March issue of RADIO indicated that an article on a transceiver suitable for permanent installation in an automobile would be in order. Subsequently several circuits were tried, and after the results with various circuits and tubes were compared, there evolved the unit shown in the accompanying illustration. In many respects this unit is somewhat unorthodox.

* Editor, RADIO



Final version of the transceiver, after being torn down and rebuilt about four times and being subjected to a dozen alterations. The result is a job that delivers from 6 to 8 watts output and is a pleasure to operate.

Most of the 112-Mc. mobile transceivers now in use incorporate either a 6J5GT, 7A4, 6P5GT, or HY615 as the oscillator. With these tubes the output is limited to about 3 watts maximum. In fact, most transceivers using such tubes deliver about 1½ or 2 watts to the antenna. That more output is not realized is due to the fact that when the oscillator is loaded so as to deliver maximum output on *transmit,* it will not superregenerate on *receive*. Loosening the antenna coupling so as to restore superregeneration on *receive* results in lower output on *transmit.* If an attempt is made to raise the output by increasing the plate voltage, the tube gets excessively hot and either "runs away" (the plate current creeping until the tube finally goes out of oscillation) or else does not "come on" for several seconds when first turned on *receive* after several minutes of transmission. If more than 200 volts is used on the plate, a moderately high value of grid leak must be used in order to keep the tube from becoming too warm on *transmit.* Then there is trouble with the oscillator trying to superregenerate on *transmit,* which requires that the feedback be reduced by means of a small condenser from grid to ground, or by using a very small value of grid condenser. Thus we see that while these tubes may work well for reception, they are not especially well suited for use as a transceiver oscillator where more than about 2 watts is wanted in the antenna.

The QRO Oscillator

The transceiver illustrated uses one of the new HY-75 triodes. These tubes cost con-

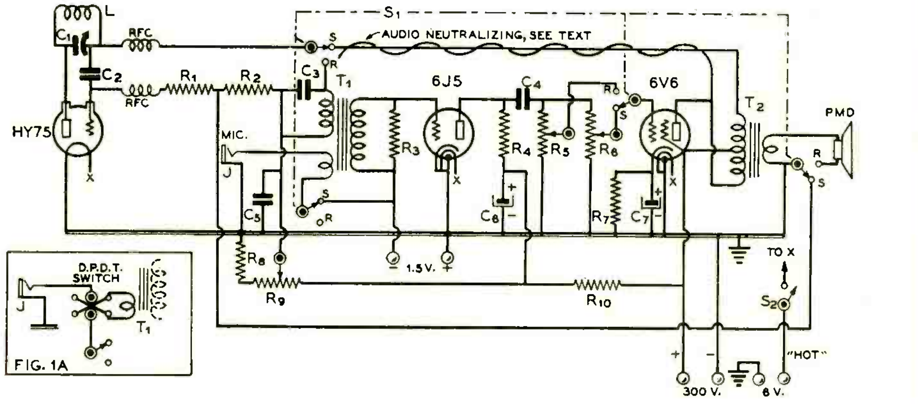


Figure 1. Wiring Diagram of the High Output Transceiver.

A method of reversing the polarity of the modulating voltage is illustrated at figure 1-A. An ordinary d.p.d.t. toggle switch is used.

C_1—5-μμfd. double spaced midget condenser (with mounting bracket and ceramic shaft coupling)
C_2—100-μμfd. smallest mica condenser
C_3—.01-μfd. tubular condenser, 400 v.
C_4—.05-μfd. tubular condenser, 400 v.
C_5—0.25-μfd. tubular condenser, 400 v.
C_6—8-μfd. midget tubular electrolytic, 450 v.
C_7—10-μfd. 25-v. electrolytic
R_1—2500 ohms, 5 watts
R_2—1 meg., 1 watt
R_3—100,000 ohms, ½ watt
R_4—100,000 ohms, 1 watt
R_5, R_6—100,000-ohm potentiometer, a.f. gain taper
R_7—500 ohms, 5 watts
R_8—150,000 ohms, 1 watt
R_9—50,000 ohms, linear (voltage divider) taper
R_{10}—7500 ohms, 1 watt
RFC—Midget u.h.f. chokes
J—Open circuit jack (a closed circuit jack will short the microphone battery)
S_1—4-pole 2-throw rotary switch
S_2—S.p.s.t. toggle switch
T_1—Transceiver transformer: plate and s.b. mike to single grid
T_2—Universal output transformer: 14,000 ohm c.t. pri., adjustable voice coil winding
PMD—Small p.m. dynamic speaker
L—See text

siderably more than a 7A4 or 6J5, but are ideally suited for oscillator use in a transceiver. They have a μ of 10, which is about optimum for use as an ultra-audion oscillator, as no provision need be made to reduce the r.f. feedback to prevent superregeneration when transmitting. They are not microphonic, and are husky enough that a respectable amount of input may be run with the tube just loafing. The only possible disadvantage to the use of an HY-75 is its greater filament power (2.75 amps.), and greater cost.

Built around an HY-75 oscillator, the transceiver illustrated works so much better than the average transceiver that the slightly greater cost is more than justified. Some of the advantages are as follows:

1) Will still superregenerate on *receive* when the antenna coupling is adjusted for maximum output on *transmit* (approximately 7 watts output when fed from a 300-volt vibrapack).

2) Has more than sufficient gain to drive a p.m. dynamic speaker to full volume.

3) Does not exhibit "backlash" in the regeneration control (point at which the set goes into superregeneration on *receive*).

4) Is not objectionably microphonic. Can be used with the car in motion—both transmit and receive—if a rigid antenna is used.

5) Gain controls both for microphone and receiver, each operating independently.

6) High modulation capability in a positive (upward) direction.

7) No "hash" in microphone circuit as is common when mike voltage is taken from the auto battery. No need for frequent replacement of microphone battery.

8) Several components (such as mike battery and speaker output transformer) do double duty, thus minimizing number of components.

9) No tendency towards motorboating or instability when both microphone and receiver gain are run "wide open."

10) Not critical in adjustment; requires no juggling or fussing with values for proper functioning.

Modulator Coupling Innovation

An unusual feature is the use of the speaker output transformer as a modulation transformer. This not only eliminates the need for a modulation choke, because a speaker transformer is required anyhow, but permits a phase reversal of the modulating voltage applied to the oscillator. This is desirable because a single-ended beam tetrode operated slightly over-biased to cut down plate current will deliver nearly twice the rated a.f. output for a given plate voltage if about 20 per cent 2d harmonic distortion can be tolerated. This degree of distortion would not be permissible on music, but does not noticeably affect the intelligibility of speech. The important thing is to apply the modulation to the oscillator phased so that the "flattening" by the modulator lops off the *negative* peaks. With ordinary Heising modulation in which a choke (not center tapped) is used, this result is not obtained; the positive peaks are flattened off first. By using a center-tapped choke, not only is the core saturation reduced (thus permitting the use of a smaller choke), but the polarity of the a.f. output of the single-ended modulator is reversed before being applied to the oscillator, the phase then being that desired. The output transformer T_2 simply acts as a center-tapped choke on transmit, the voice coil winding being opened.

This transformer may be most any output-to-dynamic-speaker transformer designed for push-pull pentodes, or may be one of the new adjustable ratio output transformers. The impedance match to the voice coil is not critical, and it may off as much as 2/1 with no effect except a slight reduction in maximum available volume from the speaker.

The primary winding should be rated to stand about 40 ma. or more. The actual current drawn will be about 50 ma. on one side and 30 ma. on the other when transmitting (assuming a 300-volt plate supply). As the unit will seldom be used on *transmit* for long periods of time, a slight overload on one half the winding will not cause the transformer to heat excessively. A midget, adjustable voice coil winding transformer rated at 36 ma. has given no trouble in the unit illustrated.

The sheet that comes with the transformer cannot be used to determine *directly* the correct voice coil tap, even if the voice coil impedance is known. It can be calculated from the sheet as follows, however. Multiply the voice coil impedance (usually 4 or 6 ohms for a small p.m. dynamic) by 2, and taking this new value as the impedance of the voice coil, refer to the chart to see what taps reflect a 14,000-ohm plate-to-plate (entire primary) load for this value of voice coil (8 or 12 ohms).

It is just about as quick to determine the proper tap by ear, trying different taps until maximum volume is obtained. The matching of the voice coil has no effect whatsoever on the matching of the 6V6 as a *modulator,* as this is automatically taken care of by the center-tapped primary.

Avoiding A.F. Feedback

Most transceivers that incorporate a stage of a.f. ahead of the modulator or power output tube have a tendency toward a.f. feedback (motorboating or howling) when the gain is advanced very far. This is a result of running leads from both the input of the speech stage and the output of the power stage to one set of contacts on the send-receive switch. Shielding these leads does little good, because it is impossible to shield the switch contacts from each other so long as they are on the same switch. This small amount of capacity coupling between the switch contacts is sufficient to cause a.f. feedback when much gain is used.

A simple way to cure this feedback when a split choke or transformer is used for coupling the modulator is by means of capacity neutralizing as shown in the schematic diagram. A piece of hookup wire is soldered to the opposite end of the transformer primary and twisted around the lead running from T_2 to S_1. At the switch, the end of the free wire is adjusted with respect to the wire from T_1 (thus varying the capacity between them) until is possible to run the gain "wide open" both on transmit and receive without a.f. feedback. Occasionally the motorboating or squeal may be cured simply by reversing the leads either to the secondary *or* high impedance primary of T_1, thus making the feedback degenerative instead of regenerative. However, this does not always work, in which case the twisted "neutralizing lead" will be required.

The dual volume controls may appear to some as an unnecessary refinement, but practice has shown the desirability of being able to adjust both the receiver gain and the microphone gain *independently.*

Voice Polarizing Switch

In figure 1-A is shown a simple means of incorporating a d.p.d.t. toggle switch to reverse the microphone polarity. This optional refinement is included for those who are concerned with voice waveform asymmetry. With most male voices, slightly heavier modulation

[*Continued on Page 82*]

A CRYSTAL CONTROLLED V.F.O.

The recent introduction of wider-range variable crystals has made a direct crystal-controlled v.f.o. unit capable of covering a wide frequency range an economical possibility. These new crystals are 80-meter units having a fundamental frequency variation of approximately 12 kc. with ranges of two, four and eight times this amount when their frequency is multiplied into the 40-, 20- and 10-meter bands, respectively.

Since these new crystals have the relatively high temperature coefficient of 50 cycles/°C./Mc. it is imperative that the crystal oscillator stage be designed to have an absolute minimum of crystal current. The use of one of the wide-range crystals in a relatively high-power crystal stage such as is commonly used with low-drift crystals will almost certainly result in a great deal of frequency drift. As the crystals require a low-power oscillator, and since their wider range makes them suitable for crystal-controlled v.f.o. use, their logical application is in an operating-desk exciter feeding the transmitter through a link.

The Circuit

The diagram of the crystal-controlled v.f.o. is given in figure 1. From this diagram it may be seen that a "hot cathode" type of oscillator is used, the screen acting as the anode for the oscillating portion of the tube. Electron-stream coupling to the plate of the 1852 provides either fundamental or harmonic output in the plate tank L_1-C_1 which covers the 80- and 40-meter bands. The circuit constants are so proportioned that the excitation to the crystal is the minimum required for reliable operation, thus keeping the crystal current to a minimum. The use of an 1852 as the oscillator tube is another feature which helps to stabilize the oscillator, since this type of tube has such high transconductance that a very minimum of excitation is required for full output.

Two crystal sockets on the sloping panel allow the use of two variable crystals for covering a wider range of frequencies. Alternatively a single variable crystal may be used in one of the sockets and a fixed crystal in the other. The latter crystal may have a fundamental frequency in the 160,- 80- or 40-meter bands. With either 80- or 160-meter crystals, the output circuit may be tuned to 80 or 40 meters. When a 40-meter crystal is used the output frequency is limited to 40 meters since the output tank circuit covers only the 80- and 40-meter bands.

Switching

The v.f. crystal oscillator is provided with two sets of terminals at the rear of the cabinet for keying the relay-control purposes. Keying is accomplished directly in the cathode of the 1852. The terminals for the relay allow the transmitter to be controlled by switch S_2, which is on the panel of the exciter. This switch is a double-pole single-throw type which shorts the keying contacts and closes the transmitter relay circuit when it is thrown to the "on" position. The crystal switch, S_1, may also be used to control the transmitter by switching it to the center open position. This requires that the stages following the exciter be biased so that their plate current does not rise unduly when excitation is removed.

Output Indicator

A novel feature of the v.f. crystal oscillator is the use of a 6U5 tuning "eye" tube as a direct output indicator in place of the usual meter. The triode section of the 6U5 is coupled to the output tank through a small coil and the rectified r.f. is made to open the eye. Tuning the output tank to resonance in-

This small cabinet houses the oscillator and its power supply. The large knob at the center of the panel tunes the output circuit to either 80 or 40 meters. Crystals are plugged into the panel, where they are available for quick change or frequency shift.

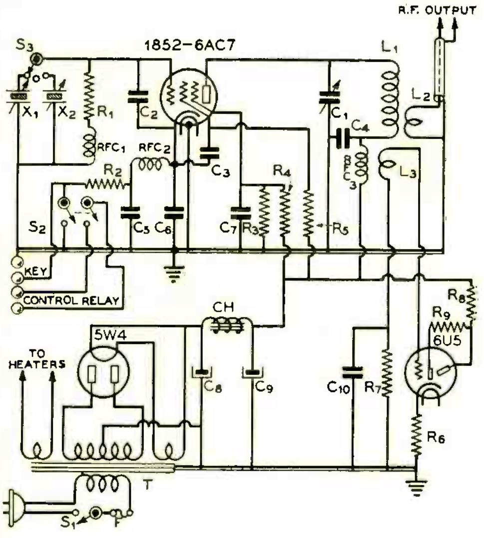


Figure 1. Diagram of the V.F. Crystal Exciter.

C_1—140-μμfd. midget variable
C_2—.000015-μfd. mica
C_3—.01-μfd. 400-volt tubular
C_4—.01-μfd. mica
C_5—0.1-μfd. 400-volt tubular
C_6—.00015-μfd. mica
C_7—.01-μfd. 400-volt tubular
C_8, C_9—4-μfd. 450-volt electrolytic
C_{10}—0.1-μfd. 400-volt tubular
R_1—20,000 ohms, ½ watt
R_2—150 ohms, 1 watt
R_3—20,000 ohms, 1 watt
R_4—100,000 ohms, 1 watt
R_5—30,000 ohms, 2 watts
R_6—10,000 ohms, 1 watt
R_7—100,000 ohms, 1 watt
R_8—200,000 ohms, 1 watt
R_9—1 megohm, ½ watt
RFC_1, RFC_2, RFC_3—2½ mh. r.f. choke
S_1—S.p.s.t. toggle switch
S_2—D.p.s.t. toggle switch
S_3—Three-position tap switch
L_1—30 turns no. 22 d.c.c. closewound on 1" dia. form
L_2—3 turns no. 22 d.c.c. at cold end of L_1
L_3—3 turns no. 22 d.c.c. below L_2
T—500 v. c.t., 50 ma.; 5 v., 2 a.; 6.3 v., 1 a.
CH—10 hy., 50 ma.
F—2-amp. fuse
X_1, X_2—Variable or fixed crystals

volves merely tuning for greatest opening of the shadow on the tube target.

The self-contained power supply is of the simple brute-force filtered type employing a single choke and two 4-μfd. electrolytic condensers. The transformer may be of the midget broadcast variety.

Transmitter Coupling

The output available at the transmitter end of the link is slightly under 3 watts on both 80 and 40 meters with 80-meter crystals. This same amount of output is also obtainable on 40 meters when crystals having a fundamental frequency in that band are used. The 80-meter output when using 160-meter crystals is again around 3 watts, but the 40-meter output from a 160-meter crystal will be somewhat reduced. When using a 160-meter crystal care must be taken to be sure that the output circuit is not tuned to the third instead of the second or fourth harmonic of the crystal.

The 3 watts of output from the exciter is sufficient to excite practically any present crystal stage in the transmitter, and in many cases will be found to be great enough so that the v.f. exciter can replace the present crystal stage. Normally the transmitter's present crystal stage will be operated as a doubler with link coupling from the exciter. The socket formerly used to hold the crystal can then well be used to mount a tube-base type coil acting as a grid tank. The grid tank may be made quite low C and consequently have a broad resonance characteristic to allow a large amount of frequency shift without retuning.

• • •

Radioddities

The 160-meter band is the only one which is an odd number of kilocycles wide.

U. S. hams occupy a total of 18,485 kc. of radio spectrum. Approximately one-third of this territory is taken by the 1¼-meter band alone.

Phone operation is permitted in over three-quarters of the total ham spectrum.

Switching from the lowest to the highest amateur frequency represents a frequency change of over 230 to 1.

Radio shield "experts" will be interested to know that at the other ends of the tremendous band of vibrational phenomena, shield materials take odd forms. Lead is used against radium rays, while glass will shield the ultra violet.

If human eyes responded to radio waves and ordinary light did not exist, eyeglasses would be made of paraffin.

Lately it has been the practice of the F. C. C. not to assign three-letter broadcast calls "except in cases where 'good will' has attached to the use of such existing call letters."

2000 and 4000 kc. are the only top-edge ham frequencies whose harmonics also mark the lower edges of higher-frequency bands.

An All-Purpose

PORTABLE TRANSMITTER

By J. E. STRIKER,* W6MOV-W6OPG

A description of an all-band portable transmitter with self-contained modulator and power supply and having provision for genemotor operation when at a distance from an a.c. line.

After building a number of portable transmitters and having them sit on the shelf until a field day came along or the big rig failed during a QSO, the thought came to mind that for just a few cents more a portable could be constructed so that it would be adaptable as an exciter unit for both audio and r.f. The average r.f. power output of a portable is comparable to that of the average buffer stage. By the same token the audio power output of the portable's modulator is about the same as the conventional class A driver stage in a larger transmitter. In order to conserve space, but still meet all of the necessary requirements, including d.c. adaptability, the transmitter shown here was decided upon.

With cost in mind, it was decided to use 6L6's for the final r.f. stage and also the modulator. Inexpensive tuning condensers are used in the exciter section and a single-button microphone is used instead of the usual crystal. However, an extra octal socket was installed so that if at some future time it was decided to use a crystal microphone it would be a simple matter to wire up a high gain speech amplifier (see figure 1A).

The power transformer chosen delivers 400 volts d.c. under load. The uncased type chokes for both filter and modulator were chosen due to their compactness. A 6A6 oscillator was decided upon as a suitable exciter, with the second triode as a frequency multiplier. Ample excitation is supplied to the 6L6 (4 ma. under load) with only 150 volts on the 6A6. The 6L6 operates straight through and is neutralized. The only time it is necessary to double in the 6L6 is for 5-meter operation. A 40-meter crystal is used for both 5 and 10 meters, as the second triode of the 6A6 quadruples quite nicely from 40 meters to 10.

---

* 1655 Everett Ave., San Jose, Calif.

For a.c. operation S_6 connects the heaters to the filament transformer and for d.c. the same switch is placed in the other position connecting the heaters to the Amphenol socket in the rear of the chassis. The input side of the filter choke is also connected to another prong in the same socket so that a single cable from an external d.c. supply need merely be inserted. Unfiltered d.c. may be applied to the choke; external filter will be unnecessary since CH_1 and C_{15} offer ample filtering action.

In order to use the r.f. section for a crystal and buffer, and at the same time use the audio section as a speech and driver, S_7 is placed in the c.w. position. The voltage applied to the 6L6 final amplifier is now unmodulated d.c. The plate of the 6L6 modulator is brought out to another Amphenol socket into which a cable may be inserted, coupling the 6L6 to a class B audio amplifier. With the proper choice of tubes it is an easy matter to run 400 watts input to an external final amplifier with all of the necessary drive from the portable.

The main transmitter at W6MOV uses a pair of 35-T's in the final, modulated with another pair. Ample drive was obtained from the portable's audio section to drive the class B stage to full output and at the same time to furnish enough r.f. excitation to the final amplifier to operate at 350 watts input. In coupling to the primary of the 35-T driver transformer a 1.0-μfd. condenser was used as shown in figure 3.

Tuning Up

It is advisable to tune up the transmitter on 10 meters first. Insert the 40-meter oscillator coil, 40-meter crystal, 10-meter multiplier coil and 10-meter final coil. Be sure that S_1 is in the *multiply* position. Adjust oscillator tuning condenser C_8 for maximum output as indicated by maximum grid current to the multi-

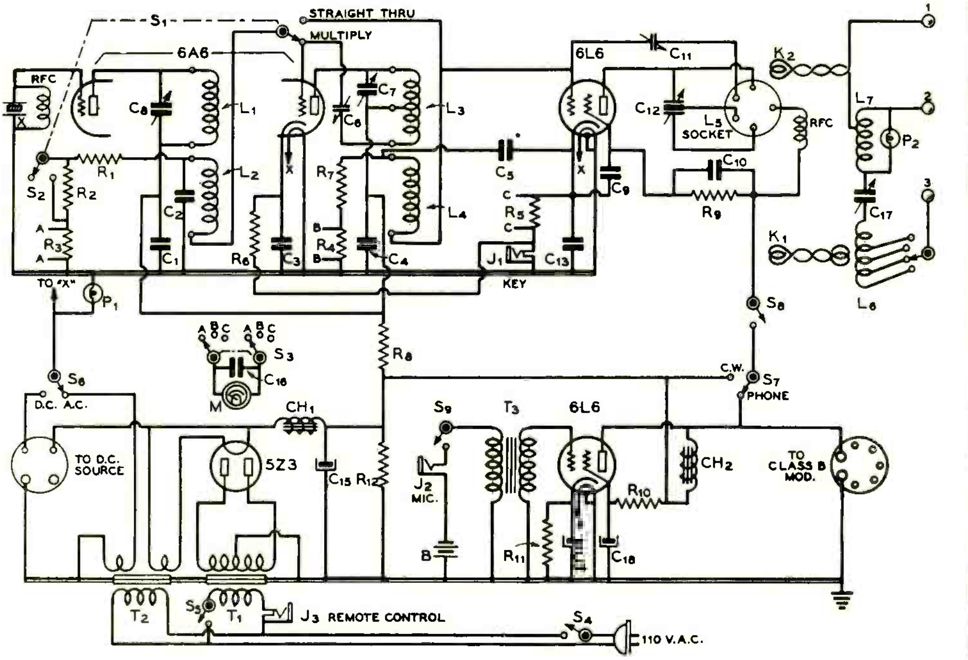


Figure 1. Wiring diagram of the portable transmitter.

C_1, C_2, C_3, C_4, C_5—.01-μfd. oil-imp. metal-case vibrator condensers
C_6—3-30-μμfd. mica trimmer
C_7—50-μμfd. midget variable
C_8—100-μμfd. midget variable
C_9—.001-μfd. midget mica
C_{10}—.006-μfd. midget mica
C_{11}—Twisted hookup wire or 3-30 μμfd. mica trimmer with screw removed
C_{12}—100-μμfd. per section split stator
C_{13}—.005-μfd. 1000-volt mica
C_{14}—10-μfd. 50-volt electrolytic
C_{15}—8-μfd. 500-600 volt paper or oil
C_{16}—.002-μfd. midget mica
C_{17}—200-μμfd. midget variable
C_{18}—2-μfd. 450-volt electrolytic
R_1—15,000 ohms, 1 watt
R_2—25,000 ohms, 1 watt
R_3, R_4—75 ohms, 1 watt
R_5—25 ohms, 10 watts
R_6—500 ohms, 10 watts
R_7—15,000 ohms, 1 watt
R_8—10,000 ohms, 20 watts
R_9—15,000 ohms, 10 watts
R_{10}—50,000 ohms, 20 watts
R_{11}—600 ohms, 10 watts
R_{12}—50,00 ohms, 25 watts
S_1, S_2—Mult.-straight through switch
S_3—Meter switch
S_4—A.c. line switch
S_5—Plate power switch
S_6—A.c.-d.c. filament switch
S_7—Phone-c.w.switch
S_8—Amplifier plate switch
S_9—Mike battery switch
RFC—2.5-mh. 125-ma. r.f. choke
J_1—Closed circuit keying jack
J_2—Open circuit mike jack
J_3—Closed circuit remote jack
T_1—1000 v. c.t., 250 ma.
T_2—6.3 v. 3 a., 5 v. 3 a.
T_3—Single-button mike transformer
CH_1, CH_2—8-hy. 150-ma. choke
Coils—See coil table
P_1—Pilot lamp, 6.3 v.
P_2—6.3 v. ant. tuning lamp
M—0-100 d.c. milliammeter

plier section (second triode of 6A6). If, after removing the plate voltage, the oscillator does not start readily, move the rotor slightly toward the low capacity side. With the regeneration condenser C_6 about 50 per cent engaged adjust the multiplier section tuning condenser C_7 to resonance. This will be indicated by maximum grid current to the 6L6. Gradually increase the capacity of C_6 until an optimum position is reached. This will be when the maximum output from the multiplier section is obtained without self-oscillation being present. After each adjustment is made on C_6 it will be necessary to readjust C_7 and C_8 slightly. After these three condensers are adjusted remove the crystal to see if there is any self-oscillation in the multiplier section and if so reduce the capacity of C_6 just below the point of self-oscillation. After these adjustments are properly made there should be

COIL DATA

STAGE	WINDING	160	80	40	20	10	5
Oscillator L_1	No. of turns	50	29	16			
	Size of wire	26	22	18			
	Spacing of turns	none	none	none			
	Space btw. L_1 and L_2	.25"	.3"	.4"			
Multiplier Grid L_2	No. of turns	65	35	18			
	Wire size	28	26	24			
	Spacing of turns	none	none	none			
Multiplier Plate L_3	No. of turns		33	24	13	8	
	Tap from top of coil		18	13	7	4	
	Wire size		18	18	18	20	
	Spacing of turns		none	none	wire diam.		
	Space btw. L_3 and L_4		.3"	.25"	.25"	.1"	
Amplifier Grid L_4	No. of turns		32	17	14	8	
	Wire size		26	24	20	20	
	Spacing of turns		none	none	wire diam.		
Amplifier Plate L_5	No. of turns	45	32	18	14	6	3
	Wire size	20	20	18	18	10	10
	Spacing of turns	none	none	wire diam.		air wound self-supporting	

All oscillator coils are wound on Bud Senior forms. Multiplier coils are wound on Bud Junior forms except the 10-meter multiplier which is wound on a Hammarlund CF-5-M type. This is an isolantite form and will be of a lower loss than bakelite. Amplifier plate coils are wound on Bud Senior forms except the 10- and 5-meter coils which are air wound and self-supporting. A piece of lucite makes an excellent base for homemade low-loss coils. Just salvage a 5-prong tube and use the prongs from it.

about 5 ma. flowing in the grid circuit of the 6L6.

At this time it would be a good thing to check the frequency of the multiplier to be sure that you are actually quadrupling from 40 to 10 meters and not picking up some other harmonic. C_7 should be about 40 per cent engaged when tuning to the middle of the 10-meter band. It will be found that even though regeneration is used in this circuit there is no evidence whatsoever of frequency instability. The regeneration control need never be adjusted again after this initial setting. For reasons unknown to the writer an RCA 6A6 seemed to be the only tube of this type that would function properly on 10 meters. Neutralize the 6L6 in the conventional manner and everything is in readiness for 10-meter operation. For 5 meters merely double to 5 by replacing the 10-meter final coil with the 5-meter coil.

S_1 and S_2

S_1 and S_2 are ganged together, the reason being that the total resistance of R_1 and R_2 is the grid bias for the second triode when S_1 is in the *multiply* position. When S_1 is in the *straight through* position this total resistance then becomes the grid resistor for the 6L6. The resistor bias requirement for the second triode of the 6A6 is greater than that of the 6L6 so a portion of this resistance is shorted out with S_2 when S_1 is in the *straight through* position. This portion is 25,000 ohms, R_2.

Meter Switching

When S_1 is in the *multiply* position, position no. 1 on S_3 reads grid current to the second triode of the 6A6. Position no. 2 reads grid current to the 6L6 and position no. 3 reads plate current to the 6L6. When S_1 is in the *straight through* position there will be no reading in the no. 2 position. The no. 1 position

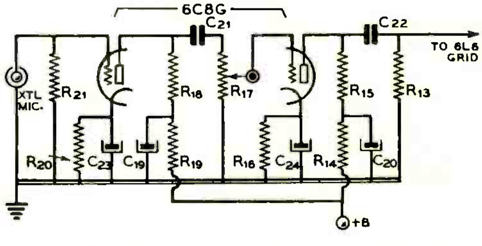


Figure 1A. Circuit of optional two-stage speech amplifier to feed 6L6 modulator from a crystal microphone.

C_{19}, C_{20}—Dual 4-µfd. 450-volt electrolytic
C_{21}, C_{22} — .01-µfd. 600-volt tubular
C_{23}, C_{24}—Dual 10-µfd. 50-volt electrolytic
R_{13}—750,000 ohms, 1 watt
R_{14}—10,000 ohms, 1 watt
R_{15}—500,000 ohms, 1 watt
R_{16}—1500 ohms, ½ watt
R_{17} — 750,000-ohm potentiometer
R_{18}—500,000 ohms, 1 watt
R_{19}—10,000 ohms, 1 watt
R_{20}—1,500 ohms, ½ watt
R_{21}—2 megohms, ½ watt

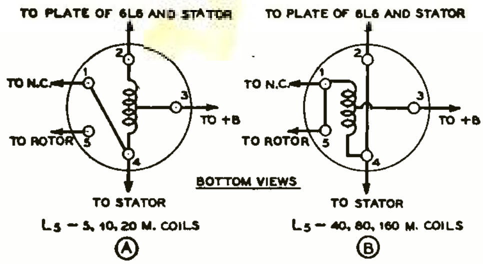


Figure 2. (A) Prong 1 is strapped to prong 4 connecting the neutralizing condenser to the opposite end of the coil from that connected to the plate. The coil itself is wound between prongs 3 and 4 thereby placing the tuning condenser in the split-stator position. The effective tuning capacity will range from 3 μμfd. to about 50 μμfd. (B) Prong 1 is strapped to prong 5 connecting the neutralizing condenser to the opposite end of the coil from that connected to the plate. The coil is wound between prongs 4 and 5, and prongs 2 and 4 are strapped. This arrangement places the tuning condenser in the parallel position with a maximum capacity of 200 μμfd. and a minimum of 12 μμfd.

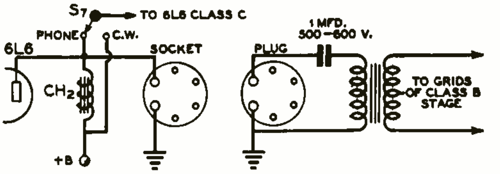


Figure 3. Method of connection for using the audio section of the transmitter as a speech and driver unit for a medium powered class B stage.

will now read grid current to the *6L6* with no. 3 reading the plate current.

When operating straight through on the fundamental frequency, the second triode (multiplier section) is not in use. All tuning adjustments are made in the conventional manner. When operating on twice or four times the crystal frequency the procedure to follow is the same as that outlined for 10 meters except that it will not be necessary to make any adjustments on the regeneration control C_6. On frequencies lower than 28 Mc. it is quite possible to obtain too much excitation to the 6L6. In that event detune the oscillator or frequency multiplier condensers slightly until the proper amount of grid current flows, about 4 ma. The dissipation of the 6A6 will not be exceeded in doing this due to the low plate voltage applied to the tube.

If a crystal microphone is desired it is well to remember that adequate shielding is necessary. A small shield can should be mounted around the microphone jack and a 2-megohm grid resistor, R_{21}, placed inside the shield can. Shielded wire should be used to the grid cap on the top of the 6C8G tube as well as all other long leads, such as those leading to the gain control, etc. Also use a shield between the speech and the r.f. sections. Sometimes it will be necessary to place r.f. chokes in the first and even sometimes the second grid of the 6C8G. It is also well to shield the gain control.

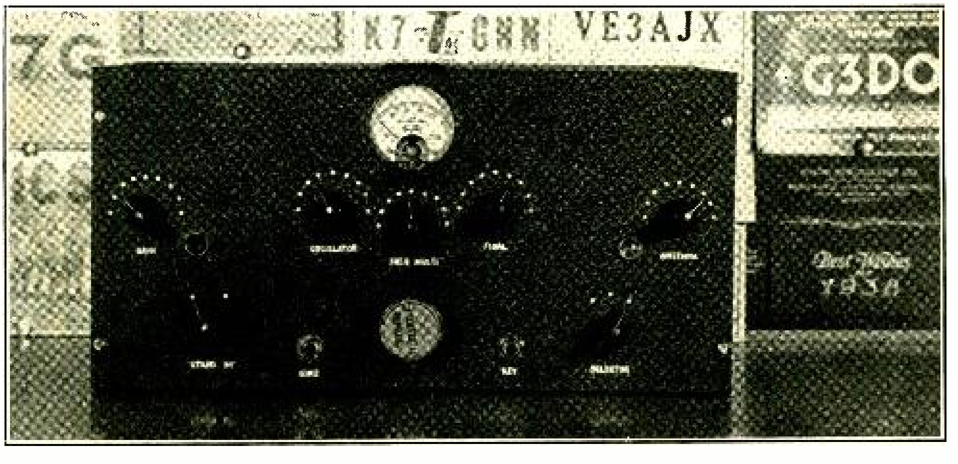


Figure 4. Front view of the all-purpose portable transmitter. The white reference dots behind the control knobs were made by spotting a shallow hole with a small twist drill and then filling the hole with heavy white paint.

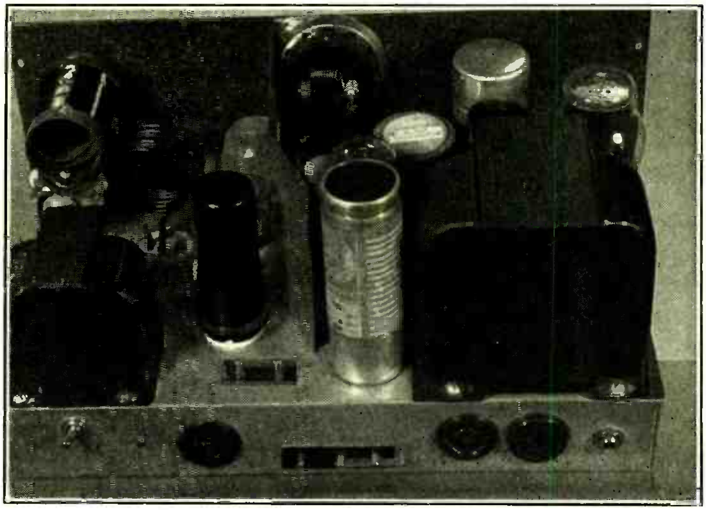


Figure 5. Rear view of the unit showing coil placement and the location of the baffle shield between the oscillator and amplifier stages

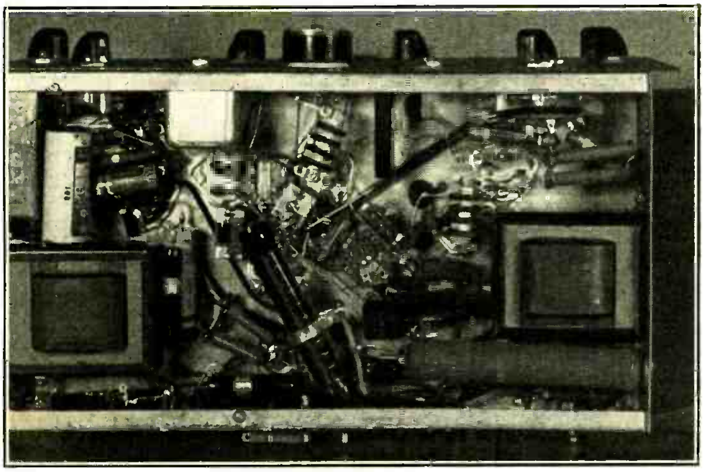


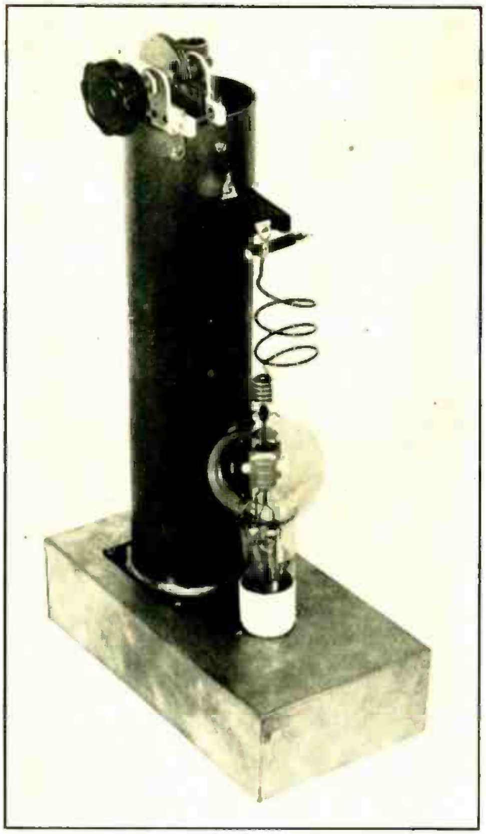
Figure 6. Under-chassis view of the portable transmitter.

Illustrations

Figure 4 shows the front view with all of the tuning controls. The white dots above the bar knobs were made by drilling small holes about 1/32" deep and filling them with thick white paint. The lettering was done with a rubber stamp set. A set of rubber stamps may be purchased at the five and dime store for 10 cents. The pilot light on the right is the antenna tuning and modulation indicator and the one on the left the filament pilot.

Figure 5 is the rear of the transmitter. The filament transformer is on the left with the antenna condenser and coil directly in back of it. Just to the right of the antenna coil is the final tank coil, with the final tank condenser and 6L6 adjacent. To the right of the shield can be seen the multiplier coil form and its tuning condenser directly behind it. To the right of this is the oscillator coil form. The oscillator tuning condenser cannot be seen behind this coil. Between these two coils and slightly forward is the 6A6 and directly in front of that the filter condenser. The power transformer is on the right, and in back of it may be seen the 6L6 modulator and the 6C8G speech amplifier (6C8G in shield can). The 5Z3 rectifier is on the extreme right and hides the gain control. The 6L6 final amplifier switch, S_8 is just to the right of the filament transformer. Along the rear of the chassis, in the vertical edge, are from left to right, the a.c.-d.c. toggle switch S_6, a.c. socket,

[*Continued on Page 92*]



This concentric-line oscillator with a 75T gives good stability and a quite reasonable power output on the 2½-meter band.

TWO U. H. F.

A 100-WATT RESONANT LINE 112-MC. OSCILLATOR WITH A 75T

The accompanying photograph and diagram illustrate a concentric line controlled 112-Mc. oscillator using a 75T, which will put out approximately 100 watts of stabilized r.f. on any frequency in the 112-116 Mc. amateur band. A short concentric line, which is resonated to the operating frequency by means of a 35-$\mu\mu$fd. midget variable, acts as the frequency determining element, while the output power is taken from a self-resonant coil in the plate circuit.

The concentric line itself is 12 inches long and 2⅞ inches inside diameter (3″ o.d. with 1/16″ wall), and the inner conductor is 13¼ inches long and ¾ inches in diameter. Both pieces which make up the line are cut from standard lengths of thin-wall copper water pipe. To make up the line first the inner conductor is soldered to the center of a piece of 20-gauge copper sheet about 3½ inches square with the aid of a small alcohol torch and a soldering iron. Then the outer conductor is slipped over it and also soldered in place. Considerable heat is required to do the soldering, but if the work is placed on a block of wood as insulation, a small alcohol torch *and* a conventional electric soldering iron will do the job quite easily. The wood will be thoroughly charred when the work is finished but it will have served its purpose. Asbestos would probably be better but wood will be satisfactory.

A hole is drilled in both the inner and the outer conductor 2¼ inches up from the base on the line. Then another hole is drilled in the center of the base so that a wire may be run through it, through the inner conductor, and then through the hole 2¼ inches up through both the inner and outer conductor to connect to the grid of the tube. This wire is by-passed immediately to ground and one side of the filament of the 75T as it leaves the base of the line.

The plate coil consists of three turns of no. 12 wire 1¼ inches in diameter and 2 inches long. The upper end of this coil is by-passed to the concentric line by means of a .0001-μfd.

Semi-schematic of the 75T 112-Mc. oscillator.

C_1—35-$\mu\mu$fd. midget variable

C_2—.0001-μfd. 5000-volt mica

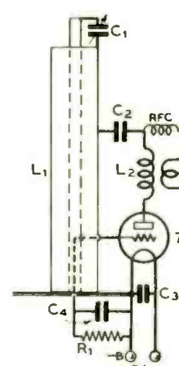
C_3—.003-μfd. midget mica

C_4—.0005-μfd. 1000-volt mica

R_1—5000 ohms, 10 watts

L_1—Concentric grid line—see text

L_2—Resonant plate coil and link—see text



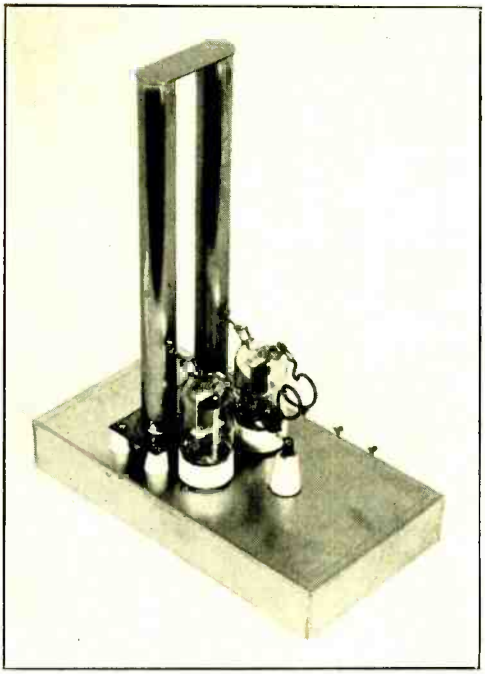
OSCILLATORS

5000-volt mica condenser. This plate coil was found to resonate over the entire 2½-meter band with the plate-to-ground capacity of the 75T and the distributed capacity of the circuit.

With the circuit constants shown the grid condenser will tune the oscillator to the center of the 2½-meter band when it is about half meshed. About 30° rotation of the condenser will cover the band. Approximately 100 watts output may be obtained from the oscillator at 1250 plate volts and at a plate efficiency of 50 to 65 per cent.

A 20-WATT PARALLEL-ROD 224-MC. OSCILLATOR WITH HY75'S

The unusual push-pull parallel-rod oscillator shown alongside has proven to be quite a satisfactory source of power for experiments in the 1¼-meter amateur band. A parallel-rod



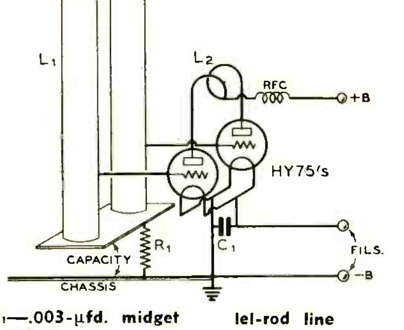
A 224-Mc. oscillator of good power output using the new HY75's.

line is used as the frequency controlling element and a small self-tuned coil is used in the plate circuit. The resonant line is made up of two ⅞ inch, thin-wall copper pipes spaced ⅞ inch, 9½ inches long overall, and connected together both at the top and bottom to act as a half-wave line instead of the more common quarter-wave arrangement. The base for the line is a piece of 20-gauge sheet copper 1¾" by 4" which is mounted above the 9½" by 5" by 1½" chassis by means of one-half inch standoff insulators.

The capacity to chassis of the copper base plate acts as a by-pass for the center of the parallel-rod line. The copper plate can be proven to be acting normally as a by-pass since its center will be quite cold to r.f. One of the standoffs which supports the copper plate is of the feedthrough type and has the grid leak connected between its lower end and the grounded side of the filaments of the tubes.

The power output of the oscillator as shown is 20 to 25 watts with 450 volts on the plates of the tubes. The plate efficiency is approximately 40 per cent with the half-wave line in the grid circuit as shown. The plate efficiency was somewhat less than this until the original quarter-wave grid line was replaced with the capacity-shortened (grid-to-ground capacity) half-wave line.

Semi-schematic of the 20 to 25 watt 224-Mc. oscillator.



C_1—.003-µfd. midget mica

R_1—5000 ohms, 10 watts

L_1—Half-wave parallel-rod line

L_2—2 turns ⅝" dia., 1" long

RFC—6 turns hookup wire, ¼" dia.

A Compact

28-MC. MOBILE TRANSMITTER

By WILLIAM J. DRIML,* W6NAT

During two years of experimenting on low power portable mobile units the writer wished for a small, compact transmitter which could be placed in any convenient corner of any part of the car, even including the glove compartment. Finally, the little "High Power Midget" was developed. In every way results are equal to those obtained with previous, more bulky models.

The total drain from the battery is only 9 amperes, including that of a 300-volt 100-ma. vibrapack and all heaters. The 7F7 tube is a single-ended duo-triode of loktal construction, designed especially for use as a phase inverter or as a voltage amplifier. The plate and grid of each triode section are brought out separately, thus permitting adaptations to special circuit requirements. The 7F7 tube is the nearest loktal counterpart of a 6N7. This was put to work as a crystal oscillator and doubler.

* 1817 Colegrove Ave., Montebello, Calif.

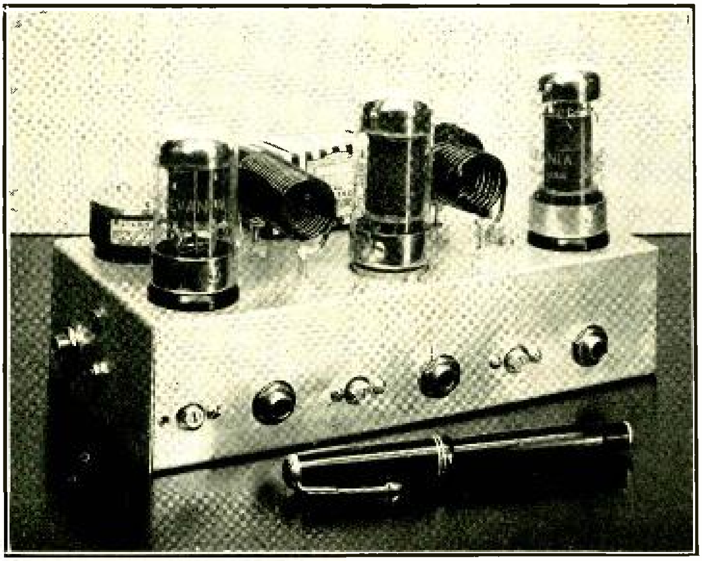
The 7C5 tube is a beam power amplifier which provides high power output with low heater drain. The electrical characteristics and applications are similar to those of the type 6V6.

Construction

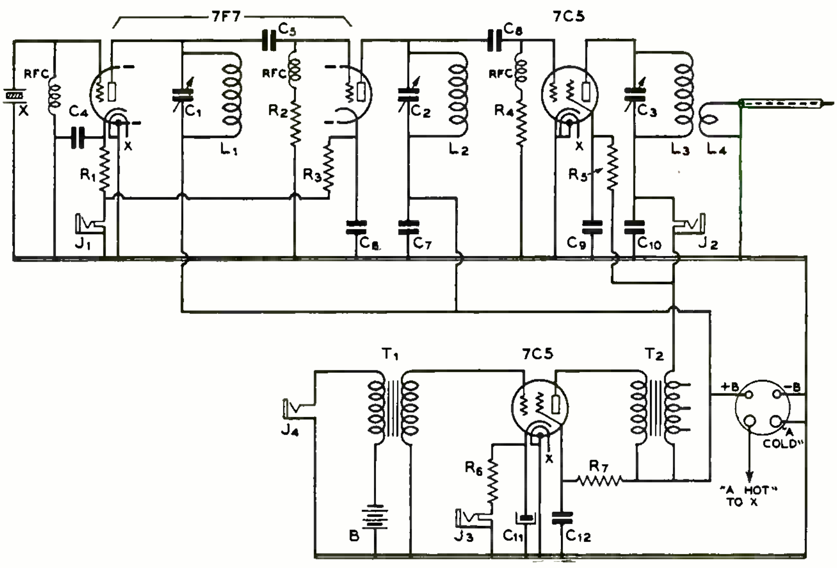
The transmitter is built upon a standard manufactured chassis measuring 4" x 8" x 2". All tuning condensers and meter jacks are placed in front of the chassis, making very convenient tuning and metering of the transmitter. Because of the unusually compact construction, it will be found best to mount and wire the components in the order to be given.

The oscillator-doubler tube is mounted one inch from the end of chassis. The type sockets that were chosen can be held in place by means of a mounting ring, and take up but little space when so installed.

The crystal coil, wound on ¾" bakelite tubing, is mounted under the chassis with



This compact 28-Mc. mobile transmitter will fit in the glove compartment of most cars. It uses the new loktal tubes.



Schematic Wiring Diagram.

C_1, C_2—50-μμfd. ultra midget variables
C_3—25-μμfd. ultra midget
C_4—.001-μfd. midget mica
C_5—.00025-μfd. midget mica
C_6, C_7—.001-μfd. midget mica
C_8—.0001-μfd. midget mica
C_9, C_{10}—.001-μfd. midget mica
C_{11}—10-μfd. 25 v. electrolytic
C_{12}—0.25-μfd. paper tubular
R_1—1000 ohms, ½ watt
R_2—75,000 ohms, ½ watt
R_3—1500 ohms, ½ watt
R_4—75,000 ohms, ½ watt
R_5—10,000 ohms, 1 watt
R_6—450 ohms, 5 watts
R_7—10,000 ohms, 1 watt
RFC—2.5 mh. midget r.f. choke
J_1, J_2, J_3—Closed circuit midget jacks (J_2 must be insulated from chassis)
J_4—Open circuit midget jack
T_1—Midget microphone transformer
T_2—Midget modulation transformer, 1-1 or preferably slight step-up ratio. Connect so d.c. in windings buck, thus reducing core saturation.
B—3-volt microphone battery
X—7-Mc. crystal

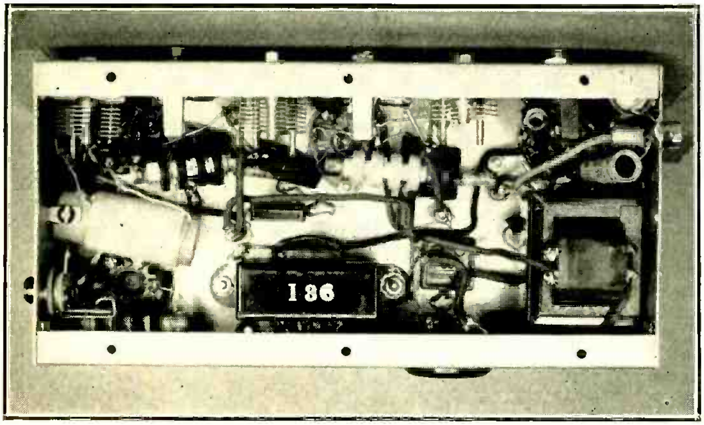
spade bolts, and screwed down to the side of the chassis in back of the oscillator tuning condenser. By soldering the cathode resistors and the by-pass condensers first, it is possible to avoid the difficulty that will be experienced if an attempt is made to solder them in after the oscillator tuning condenser is mounted.

Right in back of the oscillator tube is the socket for the crystal; directly underneath this socket is the microphone input jack. The final amplifier socket is next with by-pass condensers placed as illustrated. The modulator socket and associated parts then are wired, with the meter jack put in place and soldered to the cathode resistor of the modulator tube. The last things to mount and wire are the microphone input transformer and modulation transformer. All of these units are comfortably placed under the chassis, with ample working room if directions are followed carefully.

The doubler coil is wound with no. 14 enamel wire and mounted on polystyrene through-panel insulators and soldered firmly in place. The final tank coil is mounted exactly as the doubler coil, with through-panel insulators. The antenna link coil then is mounted on the cold end of the final coil, one side grounded to chassis and the other going through a panel insulator to an auto antenna connector on the side of the chassis.

The microphone battery is a small "airplane" 3-volt type and is mounted on top of the chassis directly in back of the final amplifier tube. A larger, external battery will give somewhat better battery economy.

One lead is grounded to chassis and the other lead runs through a rubber grommet connected to the microphone jack. The mi-



While it looks as though the parts and wiring were "poured in," no difficulty will be experienced if the components are mounted and wired in the recommended order.

crophone can be any good single-button type.

A four-prong socket mounted on the back of the chassis serves for the heaters and power supply connections.

Operation

When the transmitter is ready for operation, place a 0-50 milliameter in the crystal circuit and adjust condenser C_1 until the meter jumps up to about 20 ma. Now tune the doubler condenser C_2 for resonance dip on the meter.

COIL DATA

L_1—37 turns no. 22 d.c.c. on ¾ inch bakelite tube.

L_2—18 turns no. 14 enam., 1 inch dia., space-wound.

L_3—8 turns no. 14 enam., 1 inch dia., space-wound.

Place the meter in the final amplifier circuit and tune to dip. It should read about 15 ma. When the final amplifier is tuned out of resonance the meter should read about 40 ma. when no antenna is connected.

Next connect the antenna to the link and adjust the final coupling until there is only a very slight dip in plate current as the plate tank is tuned through resonance. (A quarter-wave antenna is recommended. Any good fish pole antenna will be satisfactory.)

Now check the modulator tube to see that it draws about 25 ma. Retune the crystal oscillator condenser until the plate current reads about 30 ma. If less current is read the oscillator may not come back into oscillation every time.

The complete transmitter unit can be purchased at a price every amateur can afford for portable work. The total cost including tubes is only $12.00 (less the Vibrapack.)

The transmitter has worked many dx stations with good reports. Contacts with Hawaii have been R-7-8, "very good quality and heavy modulation."

• • •

Five Meters Opened to F.M.

In a press release dated April 13, 1940, the FCC announced opening part of the 56-to-60 Mc. amateur band to frequency modulated radiotelephone transmission. To quote the official release:

"The Federal Communications Commission today modified the rules governing amateur radio operators and stations to make available to amateurs the band 58,500 to 60,000 kilocycles for radiotelephone frequency modulation transmission.

"Previously amateurs were permitted to use radiotelephone frequency modulation in all amateur bands above 112,000 kilocycles. The change in the rules will make possible wider experimentation in this type of transmission, since equipment is quite generally available for the lower band.

"The Commission also took the opportunity to re-arrange, in the interest of clarity, the other rules which specify the use to be made of the amateur bands, although no changes were made therein."

A RURAL ROTARY ROTATOR

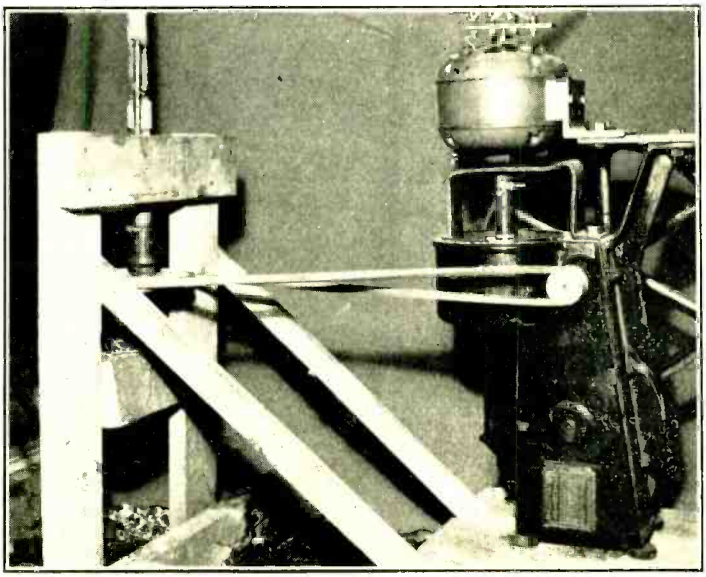
By C. O. BISHOP, *W7HEA

We had seen pictures and been told over the air of many gadgets that could be used to "rotate the rotary," but when the time came for us to provide some means of spinning the old beam around, none of these devices could be found in this part of the state of Washington. Investigation did reveal though that a number of old cream separators were on hand in the local hardware stores and could be obtained very reasonably, as most of them were sold as junk. The parts that wear out and render them useless as separators are not required for beam swinging; so we beat the junk man to the draw and hauled one of them home. It turned out to be just what the doctor had ordered and the picture shows the final result.

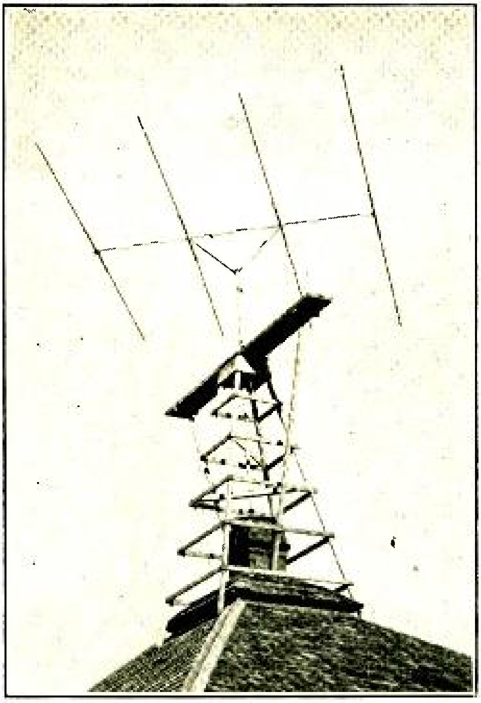
All unnecessary parts were removed and the remainder taken to the machine shop for the conversion. The motor mount was installed so that the motor connects directly to the former high speed shaft with a short piece of hose and two clamps. The main shaft was turned down to take a standard "V" pulley with half-inch hole, which is the power take-off. The original handle was on a stub shaft and this was removed. The stub shaft just slips nicely over a three-quarter-inch water pipe, and so was remodeled to be used on the base of the pipe mast as the pulley shaft. The shaft was then turned to take a "V" pulley with a half-inch hole. On the end of this shaft a small section or stub was cut down to one-quarter inch for the purpose of attaching the indicator switch.

The motor is an old washing machine motor which can be reversed by means of a switch from the operating position. Be sure to get a motor that has a wound field instead of the winding on the armature; otherwise it will be impossible to reverse it remotely. The terminal strip on top of the motor shows how the leads were brought out. From there four wires go to the reversing switch at the operating position. With the standard 1750 r.p.m. motor, the power take-off pulley turns just twelve revolutions per minute. With the added reduction of the two "V" pulleys and

* Box 82, Zillah, Washington



A view of the rotator installation. The revamped cream separator is at the right with the reversible washing machine motor mounted, shaft vertical, on top of it. The V-belt runs from the power take-off on the revamped separator to a pulley on the turned-down stub shaft which is mounted on the end of the vertical pipe support for the rotary. The direction indicator is coupled to the stub shaft below the pulley and mounted on the crooked piece of wood below the pulley.



The four-element rotary itself, installed through the dummy chimney in the house.

belt, the beam speed is three r.p.m. This has been found to be very satisfactory.

Original trials of the arrangement showed that the beam had a lot more drift than could be tolerated; so an additional pulley was installed in the bowl just under the connecting hose. A short piece of belt is bolted to each side of the bowl and allowed to drag very gently at all times. Very little drag is needed to stop the drift. The bolt shown sticking up alongside the mast is used as a stop to keep the beam from going around too many times in the same direction and ripping off the feeders. A bolt was placed through the pipe, and when this hits the stop the belt slips and no damage is done. The indicator switch is mounted on the cockeyed piece of lumber just below the end of the pipe mast. It consists of an eight-point switch made from an old volume control. This is connected by means of a nine-wire cable to the indicator with its eight pilot lights representing the points of the compass.

This rotator, although rather bulky, was economical to construct and has given very good service ever since its installation. It is mounted in the attic, and as the chimney happens to be a dummy, the pipe mast was brought down through it a la Santa Claus, with the unit mounted directly underneath. Rubber washers under the rotator make it practically silent in the house.

• • •

Dotty Dots and Dashes

By THE GUY WITH THE SNOWSHOES

One of my associates who doesn't know a bug from a modulator asked me a nice easy one the other evening. "Say," he said, "why do they have two codes; wasn't the old Morse code good enough for wireless?" I went into a discourse on the inadvisability of spaced characters of the landline Morse from a standpoint of accuracy, how easy it was to read a T for an L and how static might take out one dot from the letter H and make the sign &. He seemed impressed and accepted the answer as final. But I kept on thinking.

The first thing that came to mind was that the only spaced character in the Continental code was the sign &. I started thinking how much we hams owe to the old Morse operators. Of course we owe them the "and" sign (&), a dot, a short space and three dots. Why hams will write & as "es" I'll never know. It's no more "es" than the Morse R (. ..) is "ei."

Our semi-automatic key has been called a "bug" since the day of the old "side-swiper" and Mr. Martin's first Vibroplex. Legend has it that the term "bug" was used by Morse operators long before it became the trade-mark of the Vibroplex. The term "fist" to identify the nature of an operator's sending is even older. It took a good fist to work some of those "Rube Goldberg" keys in the old days. But what about our abbreviations, and how did punctuation start?

Originally there was no punctuation and most of the necessary punctuation was developed as necessity demanded. The most in-

[*Continued on Page 87*]

112-224 Mc. Hints

By E. H. CONKLIN, *W9BNX

With a larger interest in the ultra-high frequencies now than at any earlier time, our readers may welcome some ideas on the construction and operation of u.h.f. power oscillators that will remove the dangerous high voltage from the plate circuit, eliminate the need for filament chokes, improve frequency stability, and help to get good performance.

If the power supply negative is disconnected from chassis and ground, it becomes *very* difficult to get across the high voltage unless the negative is exposed—all arguments to the contrary notwithstanding. Unless grid lines are used without isolating them from the bias circuit, however, very little is accomplished by such an unorthodox suggestion. The d.c. connection to these lines, too, can be eliminated without difficulty.

The fundamental push-pull oscillator circuit is shown in figure 1. It is readily seen that a large mass of metal is hooked to both sides of the high voltage. This means that the apparatus should not be approached with the power on, even to adjust shorting bars, because it is impossible to touch anything without a large chance of getting across the high voltage. It is much easier to isolate the negative than it is the positive, by grounding the negative to the chassis only through a high voltage by-pass condenser. There are several ways of taking the power off the grid lines by using grid condensers, and either separate grid leaks or by running insulated d.c. bias leads inside of the grid pipes. These methods are shown in figure 2. It will be seen that the need to insulate the line from the chassis is completely eliminated in either case. Drilling holes in the grid pipes may be bothersome, in which case the bias leads can be run close to and alongside of the pipes rather than within them, with the same effect.

* Associate Editor, RADIO, Wheaton, Illinois

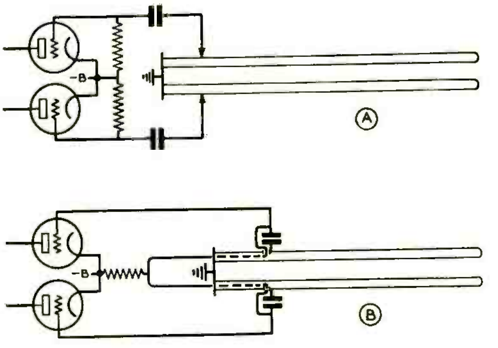


Figure 2. Alternative methods of obtaining d.c. grid bias when using grounded grid lines.

A similar stunt is easily applied to the plate line, as shown in figure 3. This arrangement allows the plate pipes to be bent down to the chassis and secured there, making possible a vertical coupling hairpin that can be mounted conveniently on the chassis rather than way up in the air. A sliding shorting bar is unnecessary when the lines are deliberately made short and are loaded slightly with a two-plate condenser which, incidentally, facilitates adjustment. The r.f. path between the lines, in any event, should be copper or copper plated metal. Silver is better, aluminum nearly as good, but brass is out.

A line that approximately resonates with the tubes' output capacity can be adjusted considerably by altering the pipe spacing—rather than by moving a shorting bar—because a given capacity has a greater loading effect on a more widely spaced line. A disadvantage of wide spacing, of course, is radiation of power within the room. How much this

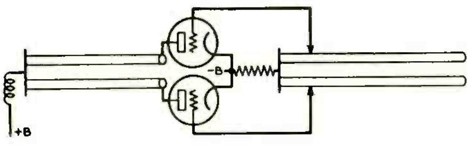


Figure 1. Fundamental push-pull oscillator circuit.

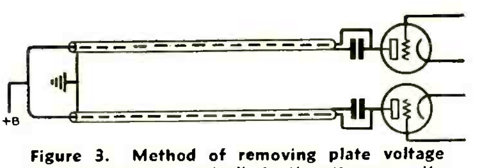


Figure 3. Method of removing plate voltage from plate pipes and eliminating the necessity of insulating them from the chassis.

radiation can be, is readily illustrated by the ease of coupling out the power by means of a "hairpin" coupled only to the shorting bar.

A transmission line circuit, in which tube elements are hooked on the "hot" end of the line, or otherwise load the resonant circuit with the equivalent of a low resistance, cannot build up a high impedance with the tube in operation. This suggests that an attempt to use lines closely approaching a quarter wavelength, or made of large diameter pipe, may be uneconomic in many cases. For instance, if the grid line can be made to control the frequency, with the grids tapped far down the line, large plate rods will probably add very little to the efficiency or stability of the oscillator. On the other hand, when the plate line controls the frequency, a grid line may be no better than a coil. Plate tuning becomes much more critical when a grid coil is replaced with a good line, limiting operation to a much smaller range of plate circuit tuning. Some effect on frequency will remain, of course, but careful adjustment will result in a sharper signal, capable of heavier modulation without spreading over a good share of the band.

The taps on the grid lines, the grid and other r.f. leads should be made with thin copper strip or tubing in order to reduce inductance. Some transmitters are controlled by the plate lines until the connections from tubes to the grid line taps are made with short pieces of copper strip.

As the frequency is raised, the length of a wire in terms of wavelength becomes more appreciable. It may be possible no longer to connect the filament leads of two tubes in such a way that the filaments are at ground potential, and with no impedance between them. This may introduce hum and may make impossible either perfect neutralization or a 100 per cent modulation capability in an amplifier, and may seriously affect the operation of an oscillator.

In general, the larger the tubes and the higher the frequency, the more necessary filament chokes or lines will become. The use of chokes in each filament lead was suggested some time ago. More recently, commercial

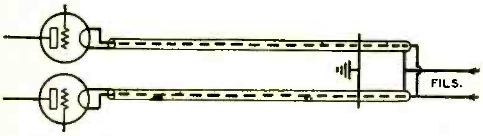


Figure 4. Arrangement for using shortened ½-wave line in filament circuit instead of r.f. chokes.

television requirements have led to the development of lines in the filament circuit, electrically a half wavelength long, so that the ground point on the shorting bar is reflected to the center of each filament. The circuit is shown in figure 4. Each cathode is hooked to the end of a pipe. An insulated wire inside of the pipe carries one side of the filament circuit. The other connection is fed either on the pipe or on a second insulated wire inside. The length of the rods will be considerably less than a half wavelength due to the reactance of the filaments and their leads. Wider spacing between the rods will permit them to be shorter, due to the greater loading effect upon higher surge impedance lines. The rods can be folded back for convenience. In one amplifier, RCA uses rods running in different directions along a metal chassis.

In some amateur rigs, the three sets of lines (grid, plate, filament) have been reduced to two by grounding the grids and using roughly ¼ rather than ½ wavelength lines in the filament. This moves the grid tuned circuit around to the filament but apparently does not remove the resistance loading effect of the tubes' input circuit which is then connected across the whole grid (filament) line. Maximum stability, therefore, may not be obtainable with this method. Furthermore, the same problem of grid lead impedance may lead to the application of the former ½ wavelength filament lines to the grid circuit!

The copper tubing required by a u.h.f. oscillator may deter the isolated amateur from constructing an auxiliary u.h.f. rig. Rain spouting and plumbing tubing may not be available, but often sheet copper can be obtained. Two parallel strips of sheet metal are cheaper than tubing, but are more susceptible to mechanical vibration that might modulate the transmitter. If the edge of the strip is bent to form an L-shaped cross section, the strength will be improved materially.

In adjusting an oscillator for a good note and for stability under conditions of changing plate voltage (modulation), a five- or ten-meter superhet is very useful. It is amazing how vile some rigs sound on a good superhet equipped with a beat oscillator, and how much they drift. Often, they are heavily modultaed with a.c. hum.

Some interesting things about neon bulbs have been noticed that help in adjusting a transmitter. When these bulbs are used on 60 cycle power, they glow orange over a large part of their interior. As the frequency is raised, the light becomes blue with a bright

[*Continued on Page 88*]

• "Pete" Towle, W4DMY, boarding the ship on which he returned from a recent trip to the Bahamas. Left to right: Inglis Howe, VP7NC; Hugh Curry, second op at VP7NU; Pete Towle, W4DMY; Joe Forsythe, VP7NU; and Lloyd Thompson, engineer at ZNS.

DEPARTMENTS

- **DX**
- **The Amateur Newcomer**
- **U. H. F.**
- **What's New in Radio**
- **Yarn of the Month**

"WAZ" HONOR ROLL

CW and PHONE

Call	Z	C
ON4AU	40	158
G2ZQ	40	147
J5CC	40	130
W8CRA	39	156
W2BHW	39	156
W8BTI	39	154
W1BUX	39	153
W2GTZ	39	153
W2HHF	39	152
G6WY	39	151
W6GRL	39	151
W6CXW	39	150
W2GT	39	150
W9TJ	39	149
W4CBY	39	144
W6CUH	39	143
W6KIP	39	143
W8OSL	39	143
W9KG	39	141
W6ADP	39	140
W6BAX	39	140
W8OQF	39	139
W9TB	39	134
W6QD	39	134
W2ZA	39	134
VK2EO	39	133
G5BD	39	133
W2GVZ	39	132
W4CYU	39	132
W3EVT	39	131
W5KC	39	130
W2GWE	39	129
W6KRI	39	129
VE4RO	39	126
W7BB	39	123
W6HX	39	123
G5BJ	39	120
W2IYO	39	119
W8JSU	39	118
W2CYS	39	117
G2LB	39	115
W4IO	39	115
W7DL	39	115
W3BEN	39	115
W2GNQ	39	113
W6FZL	39	112
ON4HS	39	111
ON4FE	39	110
W1AQT	39	110
W6FZY	39	109
W6SN	39	99
W9NRB	39	98
W6GPB	39	94
XE1BT	39	90
K6AKP	39	78
W1CH	38	150
W2GW	38	143
W5VV	38	144
W3HZH	38	139
W3EMM	38	139
W8BKP	38	138
ZL1HY	38	138
W5BB	38	136
W8LEC	38	136
W3EPV	38	136
W9GDH	38	134
W3HXP	38	133
W4FVR	38	130
W9FS	38	130
W3EAV	38	130
W8JMP	38	127
W2GRG	38	127
ON4EY	38	126
W8ZY	38	125
W1ADM	38	125
W3GAU	38	125
W3EVW	38	124
W3GHD	38	121
W8AU	38	120
W8LYQ	38	120
W8DFH	38	119
W9PST	38	119
W8QXT	38	119
W8JIN	38	119
W3FQP	38	119
W8DWV	38	118
W1GDY	38	118
W2BMX	38	118
W1BGC	38	117
W6AM	38	117

Call	Z	C
LU7AZ	38	116
W3DDM	38	116
W9UQT	38	116
W8MTY	38	114
W9KA	38	114
W9ELX	38	113
W6VB	38	113
W8LFE	38	113
G6CL	38	112
W8HWE	38	112
G2QT	38	112
W8EUY	38	112
W9CWW	38	112
W2BXA	38	111
W6GRX	38	111
LY1J	38	110
W1AB	38	110
W6HZT	38	110
W4MR	38	108
W8KWI	38	108
W8BOX	38	106
W9ADN	38	106
W8OE	38	106
W9PK	38	105
W8GBF	38	105
ON4UU	38	104
G2IO	38	103
W8BWB	38	98
J2KG	38	95
G6XL	38	95
ON4FQ	38	92
W9VDQ	38	79
SU1WM	37	138
W2BJ	37	134
W6GAL	37	131
W8KKG	37	127
W7AMX	37	125
J2JJ	37	123
W1BXC	37	123
W2IOP	37	122
W1RY	37	120
W6MVK	37	118
G6NF	37	115
W8PQQ	37	115
W9RCQ	37	114
W3TR	37	113
ON4FT	37	112
W9RBI	37	112
W6MEK	37	112
W6ADT	37	111
W1IED	37	111
G2MI	37	110
W7AYO	37	110
VE2EE	37	108
W4DMB	37	108
W5ENE	37	107
W6ITH	37	105
W6NLZ	37	105
W3KT	37	104
W9PTC	37	103
W3FJU	37	103
W9GBJ	37	103
G6GH	37	102
W3AYS	37	102
VK2DA	37	101
W6FKZ	37	101
W6JBO	37	101
W8KPB	37	100
W4DMB	37	100
W9AJA	37	99
W4EQK	37	99
ON4VU	37	99
W3EXB	37	98
ZL2CI	37	97
W6DLY	37	97
W6MHH	37	95
W6MCG	37	92
G2UX	37	91
W2BSR	37	90
W9UBB	37	77
W8AQT	36	120
K4FCV	36	109
W8AAJ	36	106
W3GGE	36	106
W6BAM	36	106
W8DOD	36	106
W9AFN	36	105
W5PJ	36	105
W8QDU	36	105
W5ASG	36	104
SP1AR	36	103
W6NNR	36	100
W6KWA	36	99

Call	Z	C
W8LZK	36	99
G6BJ	36	99
VE1DR	36	98
W9VES	36	98
W8LDR	36	97
W8AAT	36	96
W9GKS	36	95
G6YR	36	94
W2IZO	36	94
VE5AAD	36	92
W4ADA	36	90
W1APU	36	91
W9LBB	36	90
W8JAH	36	89
OK2HX	36	86
W6MUS	36	84
VK2NS	36	84
W6TI	36	80
W7DSZ	36	73
W2GXH	36	71
W1WV	35	119
W8OXO	35	113
W6GHU	35	103
W4QN	35	103
W9PGS	35	103
W6HJT	35	103
K6NYD	35	100
W8CLM	35	99
W8OUK	35	99
W8CJJ	35	98
W2WC	35	98
OK1AW	35	96
W3RT	35	95
W9EF	35	94
G6QX	35	94
W8NV	35	94
W3DRD	35	93
W6AQJ	35	92
VE5ZM	35	92
LU3DH	35	89
W9GNU	35	88
W9ERU	35	88
K6CGK	35	88
W9VDX	35	86
W6KQK	35	85
W6ONQ	35	83
ON4NC	35	82
GI6TK	35	80
W4ELQ	35	80
W8QIZ	35	78
W6GK	34	105
W6HEW	34	103
K7FST	34	102
W8CED	34	102
W8BSF	34	100
W1APA	34	98
W2BZB	34	99
W9VKF	34	96
VK2AS	34	94
W8HGA	34	93
W3EYY	34	91
W9MQQ	34	89
W2FLG	34	89
W6TE	34	88
G6WB	34	88
W6CVW	34	88
VK2OQ	34	87
G5VU	34	85
W9BCV	34	83
ZS1CN	34	82
W6PNO	34	82
VK2TF	34	81
W6MJR	34	81
ON4SS	34	80
W6HIP	34	76
VK2TI	34	75
W7AVL	34	75
W8JK	34	75
ZL2VM	34	72
W6LHN	34	71
VK2AGJ	34	70
VK2EG	34	70
VE5MZ	34	69
VK2VN	34	63
W9QOE	34	56
F8XT	33	112
W8ACY	33	106
W3DAJ	33	97
W6KEV	33	96
W8BWC	33	93
W6KUT	33	90
W6CEM	33	88

PHONE

Call	Z	C
W3LE	38	128
F8UE	38	103
W6OCH	36	107
W6ITH	36	99
W3FJU	36	87
VE1CR	36	81
W9NLP	35	95
W9TIZ	35	93
KA1ME	35	79
F8VC	35	78
W4CYU	34	100
W9ELX	34	88
W1ADM	34	93
ON4HS	34	92
W6EJC	34	84
W7BVO	34	80
W4DAA	34	71
W2IXY	33	102
W6NNR	33	92
GM2UU	33	84
F8XT	33	70
W3FAM	33	68
W6MLG	32	97
W8LFE	32	91
W2IKV	32	90
W4DRZ	32	89
W9QI	32	86
W1HKK	32	85
W8QXT	32	85
G5BY	32	85
W9BEU	32	85
VK4JP	32	85
W4DSY	32	84
W6OI	32	83
W9TB	32	82
W6IKQ	32	80
VE1DR	32	59
W1AKY	31	92
W3EMM	31	88
W8LAC	31	85
G6BW	31	83
G3DO	31	78
W1KJJ	31	78
W6FTU	31	77
G8MX	31	73
W8RL	31	71
W9UYB	31	71
W6AM	31	67
F8KI	31	58
W9ZTO	31	53
W4EEE	30	86
W2GW	30	86
W1JCX	30	81
W2IUV	30	79
W2AOG	30	77
W8AAJ	30	77
W9BCV	30	68
W6MZD	30	52
G6DT	29	83
W4BMR	29	80
K6NYD	29	78
CO2WM	29	78
W9RBI	29	71
W6NLS	29	64
W6GCT	29	62
W6NRW	29	60
W2GRG	28	74
W6PDB	28	65
W8NV	28	65
W7EKA	28	63
VE2EE	28	62
W4DRZ	28	62
W1BLO	28	62
VK2AGU	28	61
W3EWN	27	93
W2DYR	27	77
W2HCE	27	76
W5CXH	27	52
G5ZJ	26	77
W5ASG	26	62
W5VV	26	61
W4EQK	26	61
W8QDU	26	61
W9NMH	26	61
W5DNV	26	60
VK2OQ	26	56
W4TS	26	54
W6MPS	26	51
VE4SS	26	50
W6FKK	26	47
W7AMQ	26	47
K6LKN	26	46
G6CL	26	46

DX AND OVERSEAS NEWS

by Herb Becker, W6QD

Send all contributions to Radio, attention DX Editor, 1300 Kenwood Road, Santa Barbara, Calif.

Last December RADIO sponsored its first World-Wide DX Contest and following will be found the final roundup of scores and pertinent facts of the contest. Just to refresh your memory regarding the rules of the "WW" Contest, it will be remembered that a station could work another station anywhere else in the world. A station received 3 points for working another one, providing it was on a different continent than his own. All contacts on his own continent were counted as 1 point. There was the usual country multiplier which we have been used to having, and on top of this we added a zone multiplier. This proved to be quite good as it added an additional incentive for the gang to check in as many zones as possible. It was unfortunate for everyone that the war had to begin just as the rules were announced, with the consequence that many of the fellows lost some interest and did not show up on the air again for some time. Probably the greatest miscue on our part was the fact that RADIO

Certificates like this one go to the winners in each call area and country.

did not reach the foreign countries in time for them to read the rules. This of course led many of the foreign stations to work only W stations as they had been in the habit of doing in the A.R.R.L. contest. I might as well bring up at this time that next month in the July issue we

WINNERS
1939 WORLD-WIDE DX CONTEST

Radiotelegraph Division

United States	W1RY	58,032
	W2UK	138,564
	W3FQP	71,280
	W4QN	34,200
	W5KC	143,640
	W6GRL*	359,100
	W6QAP	143,424
	W7DVY	49,248
	W8OQF	160,680
	W9GDH	147,972
Argentina	LU9AX	160,182
Brazil	PY2GS	30,360
Chile	CE4AD	67,221
China	XU8MI	68,420
Ecuador	HC1FG	144
Haiti	HH2MC	1,245
Hawaii	K6CGK	319,400
Hungary	HA8D	25,431
Italy	I1IR	12,675
Japan	J3FJ	122,474
Korea (Chosen)	J8CH	8,460
Mexico	XE1CM	154,583
Netherlands Indies (Borneo)	PK5JT	81
Philippine Islands	KA1PO	18,920
Puerto Rico	K4DTH	202,500
Salvador	YS2LR	2,190
Uruguay	CX2AJ	155,624
Yugoslavia	YU7AY	108

*** W6GRL receives certificate for the more-than-one operator division.**

Radiotelephone Division

United States	W1FOV	15,184
	W2DYR	13,552
	W3BET	24,102
	W5EDX	18,139
	W6OCH	254,880
	W7AMQ	1,656
	W8LW	54,096
	W9BEU	49,248
Alaska	K7HCX	264
Argentina	LU7BK	391,136
Bolivia	CP8AI	260
Brazil	PY2AC	21,098
Chile	CE3AG	618,896
China	XU8AM	27,430
Cuba	CO2WM	7,326
Ecuador	HC2CC	43,860
Hawaii	K6BNR	463,176
Japan	J2NG	18,630
Mexico	XE1CQ	77,700
Netherlands Indies (Borneo)	PK5KF	8
Peru	OA3B	26,460
Philippine Islands	KA1LZ	573,002
Paraguay	ZP2AA	756
Uruguay	CX2CO	143,106


CE3AG
XE1CQ

will print the rules for the 1940 World-Wide DX Contest. This contest will be in early fall, possibly October, and the rules should be able to reach the most remote points.

Looking over some of the high ones in this contest we find W6GRL leading off the c.w. division with 359,100 points. Doc not only was high in the country but in the world—this of course in that division. GRL made 146 contacts in 21 zones and 50 was the country multiplier. Doc did most of the operating, but Dave was around some of the time with other guests so he took a hand in a little brasspounding. Doc got mixed up one of the week-ends and had a lot of folks around the house, or otherwise he might have done better. Speaking of Dave, W4DHZ, he hasn't been doing much brasspounding and is again getting an itchy fist. Word has it that he is looking for one of those "spots" and so maybe we will hear him blazing away by the time of RADIO's contest.

The highest c.w. station outside of USA was K6CGK with 319,400 points. Kay had 288 contacts in 13 zones. His antennas consisted of a V beam and a 4-section 8JK. Next in line was K4DTH with 202,500. Jose's contacts numbered 508 and zones were 15. He used a vertical the first week-end and the second he used a 66-foot zepp.

W2UK didn't have much time but did get on enough to run up 138,564 points. Tommy made 81 contacts in 19 zones. While talking about W2UK, he made mention of having a contest only for yl's and xyl's. Says he bets his would come out on top. Any takers?

W5KC is one of the most consistent contest operators in W5 and made 80 contacts in 18 zones. The points added up to 143,640. You can get a look at Vincent's station in one of the photos shown in this section.

In the W6 area W6QAP took the honors for single operator division with 143,424. Bud was in Tucson at the time and had a heck of a job getting organized. His exciter, which was built at the last minute, konked out on him and by the time he rigged up something he was so exhausted that he slept most of the first 24 hours of the contest. Anyway, Bud did very well and does not have to apologize for the score. Bud has located in L.A. and in a few more weeks will be a "native son."

I suppose I might mention at this point that W6QD is not eligible for any award, although he had just as much fun as the rest of you. The W9's were very few and far between.

W8OQF made 88 contacts in 20 zones and scored 160,680 points. Ralph did very fine work and claims not to have lost too much sleep. W9GHD came out first for the W9's with 147,972. Zones numbered 19 and the contacts 73. Station pictures of these two may be found in the column nearby.

W1RY was the best up in the W1 area with 58,032 points. There were not very many competitors in this district so I guess we should give them a fight talk before the next brawl gets started. W2AIW did nice work in getting 75,230 points. W4QN with 34,000 took it for this district with W4FIJ giving him a run with 31,000. Not too much activity here either. W6VB forgot to get started until the second day but ran up 92,880. Up in the northern part of the state W6NGA grabbed off 78,387 points. For some reason or another most of the activity around the S.F. bay is phone, and the c.w. stations are few and far between. W8ZY got 72,000 points out of the contest, and would have had more but for misunderstanding the rules. He worked a lot of the same stations the second week-end that he had the first. W9GKS did exceptionally well in getting 95,000 for second spot in the 9th district.

Outside of USA LU9AX grabbed the LU honors with 160,182 points, followed by LU2CW. LU7AZ didn't get into it this time but he claims he will make it up in the fall. Old faithful CE4AD was heard banging away in there all the time getting his 67,000 for first place. HC1FG wasn't on c.w. much, but she was loud in praise for the type of contest we had. Most of the boys out of the country were of the same opinion because they could work anything they desired. In K6 we mentioned K6CGK was in first spot, but he was given a terrific run for his dough by K6LKN. Dave scored 263,844 points and can always be counted on for his consistency on all bands.

In Hungary HA8D and HA4H were the only participants. HA8D nosed out 4H with 25,431 points, while HA4H had 24,444. I1IR made 12,675, being the only Italian station reporting. In Japan J3FJ added his points and found he had 122,474, which put him away out in front of J2KN with 29,484. In Korea J8CH and J8CG were heard in there quite often with J8CH copping the honors with 8,460 points. CX2AJ can always be counted upon to add his signal to the rest of them and this time was no exception. Enzo ran up 155,624 points, most of which were from W contacts. We cannot overlook YS2LR

Top left—**W9BEU, one of the most consistent phone stations in the band, did all right in the contest. The rig uses a pair of T-125's in the final.** Top right—**W9GDH scored high in the ninth district, running a kw. into a pair of T-200's.** Center left—**XE1CQ came out on top for Mexico. His transmitter uses a pair of HF-100's modulated by a pair of ZB-120's.** Upper center—**CE3AC was tops in the phone section for CE. He has a mighty fine looking station, and from the looks of the score both he and the station went to town.** Lower center—**CE4AC also was in there on phone, doing very well by himself.** Center right—**CE4AD is one of the best known on the air, in and out of contests. In the c.w. division for Chile he finished first.** Lower left—**W5KC was up to his usual consistency and finished away out in front for the fifth call area.** Bottom left—**K6BNR, the station of Emil Rettig. BNR reached a point beyond being hoarse in winning the phone division for K6.** Bottom right—**K6CGK, c.w. winner in Hawaii. Final uses a pair of 100TH's with a 75T driver, while the rig starts out with a v.f.o. "Kay" says his receiver is an FB7 with 7 degrees of bandspread on 20 meters—fine tuning is done by body capacity.**

OFFICIAL SCORES, 1939 WORLD-WIDE DX CONTEST

RADIOTELEGRAPH

1st Call Area

W1RY 58,032
W1APA 12,168
W1WV 4,560
W1BFT 2,750
W1KMY 462
W1LMQ 96

2nd Call Area

W2UK 138,564
W2AIW 75,230
W2WC 25,875
W2CJM 25,517
W2BQK 7,700
W2BO 4,800
W2LXI 3,456
W2DZA 1,710
W2GT 945
W2DXL 432
W2JWY 100

3rd Call Area

W3FQP 71,280
W3EPV 36,720
W3ASW 24,794
W3EMM 10,251

4th Call Area

W4QN 34,200
W4FIJ 31,746
W4BJX 17,680
W4BYF 336

5th Call Area

W5KC 143,640
W5HQN 7,488
W5GRH 4,320
W5ASG 192

6th Call Area

W6GRL ... 359,100[1]
W6QD .... 232,806[2]
W6QAP ... 143,424[3]
W6VB 92,880
W6NGA 78,387
W6GPB 34,112
W6BAM 33,050
W6PNO 29,260
W6NLI 20,559
W6EPZ 14,274
W6DZE 13,632
W6JOH 12,348
W6BVM 11,760
W6FKZ 10,080
W6MUS 6,932
W6OVU 4,392
W6SN 3,850
W6RDR 3,600
W6EJA 2,160
W6LGD 1,944
W6DHS 1,296
W6MUF 576
W6CLZ 175

[1] W6GRL receives certificate in the more-than-one operator division
[2] W6QD not eligible for award
[3] W6QAP receives certificate in single operator division.

7th Call Area

W7DVY 49,248
W7DWA 17,587
W7FD 11,700

8th Call Area

W8OQF ... 160,680
W8ZY 72,765
W8IOT 31,590
W8CED 28,560
W8MOA 23,946
W8QIZ 9,024
W8PUD 8,470
W8JDG 5,148
W8NKI 2,448
W8NCJ 1,120
W8LOF 945
W8DAE 630
W8KPL 480
W8FGV 400

9th Call Area

W9DGH ... 147,972
W9GKS 95,418
W9PK 34,216
W9VW 13,950
W9GBJ 11,880
W9CWW ... 10,800
W9DGH 10,800
W9VES 10,484
W9YXO 9,240
W9WGL 8,064
W9VDX 6,720
W9EKC 3,240
W9QMD 1,920
W9AMM 1,764
W9ZRP 588
W9ERU 510
W9OKB 300
W9ZRQ 275

Argentina

LU9AX 160,182
LU2CW ... 103,680
LU5FB 3,696
LU2AW 792

Brazil

PY2GS 30,360
PY2DV 2,480

Chile

CE4AD 67,221
CE3AJ 1,305
CE3DG 171
CE4BH 8

China

XU8MI 68,420

Ecuador

HC1FG 144

Haiti

HH2MC 1,245

Hawaii

K6CGK 319,400
K6LKN 263,844
K6PAH 129,880
K6IAE 23,856
K6QYI 7,992
W6ERQ/K6 ... 1,776
K6PHD 1,620

Hungary

HA8D 25,431
HA4H 24,444

Italy

I1IR 12,675

Japan

J3FJ 122,474
J2KN 29,484
J2MH 11,226
J2KI 20

Korea (Chosen)

J8CH 8,460
J8CG 3,920

Mexico

XE1CM 154,583
XE1LM 2,736

Netherlands Borneo

PK5JT 81

Philippine Islands

KA1PO 18,920

Puerto Rico

K4DTH 202,500
K4KD 15,197
K4FCV 5,424

Salvador

YS2LR 2,190

Uruguay

CX2AJ 155,624
CX1BG 6,741

Yugoslavia

YU7AY 108

RADIOTELEPHONE

1st Call Area

W1FOV 15,184
W1ADM 14,910
W1APQ 9,360
W1CJH 4,800
W1ATE 3,100
W1WV 3

2nd Call Area

W2DYR 13,552
W2IUV 7,774

3rd Call Area

W3BET 24,102

5th Call Area

W5EDX 18,139
W5HDU 1,188

6th Call Area

W6OCH ... 254,880
W6RCD 94,350
W6AM 45,024
W6AED 35,264
W6NHK 20,948
W6MEP 19,506
W6ITH 12,506
W6CHV 8,400
W6QLN 7,436
W6EFC 5,280
W6QOZ 4,356
W6QGI 1,616
W6HCE 600
W6AK 570
W6EPZ 128

7th Call Area

W7AMQ 1,656

8th Call Area

W8LW 54,096
W8LFE 25,536
W8BF 14,850
W8AAJ 9,240
W8QGZ 1,519
W8FGV 864

9th Call Area

W9BEU 49,248
W9ZYL 11,505
W9KOH 2,520
W9BDL 721

Alaska

K7HCX 264

Argentina

LU7BK 391,136
LU5AN 265,950
LU6DJ 65,664
LU4DJ 6,380
LU3HA 6,270

DX Scores Continued

Bolivia	CP8AI	260
Brazil	PY2AC	21,098
	PY2LN	735
Chile	CE3AG	618,896
	CE3AC	509,490
	CE3CK	132,750
	CE4AC	27,132
	CE3CG	22,491
	CE3EW	11,856
	CE2BO	10,452
China	XU8AM	27,430
	XU1B	8,320
	XU8RB	5,760
	XU8ZA	3,465
Cuba	CO2WM	7,326
Ecuador	HC2CC	43,860
	HC1FG	3,060
Hawaii	K6BNR	463,176
	K6MVA	442,017
	K6PHD	1,260
Japan	J2NG	18,630
	J2NQ	10,192
	J2KI	5,104
	J2KN	4,160
	J2NT	1,050
Mexico	XE1CQ	77,700
	XE1AC	40,500
	XE1FF	13,050
	XE2GO	24
Netherlands Borneo	PK5KF	8
Peru	OA3B	26,460
Philippine Islands	KA1LZ	573,002
Paraguay	ZP2AA	756
Uruguay	CX2CO	143,106

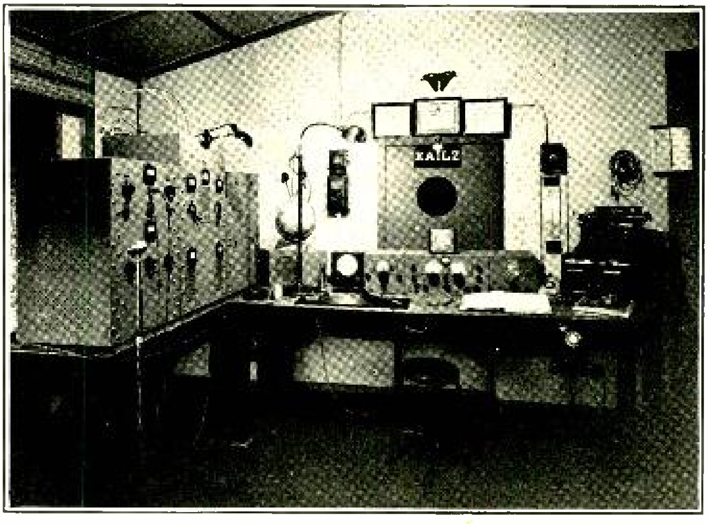
who once again participated, giving a much sought after multiplier.

Phone Scores

The highest score in the world was from CE3AG who had 618,896. He made 297 contacts in 16 zones. Receiver was an RME-70, and the antenna for 14 Mc. is a half-wave doublet, horizontal. For 28 Mc. he uses two half waves in phase, vertical, and both antennas are fed with 600-ohm lines. CE3AC gave him a run and gathered 509,490 points in 18 zones. He uses a National transmitter and a Super-Pro receiver.

The highest in the States was from W6OCH in San Leandro, who yelled himself into 254,880 points. Larry worked into 20 zones which is mighty fine . . . his antennas run almost all over town, while the rig runs about a kw. input to 250TH's. W1FOV with 15,000 was closely followed by W1ADM with 14,910. W2DYR didn't have much trouble getting 13,000 for the W2's. W8LW ran up 54,000 for tops in W8, and W9BEU with his 49,000 grabbed the W9's without a struggle. W6RCD, a comparative newcomer in dx circles, really went to town in Southern California rolling up 94,350 points in 17 zones.

Getting out of USA, we find KA1LZ making a fine showing with 573,000 points. His log, pictured herein, was the longest turned in . . . being typed on a sheet of paper 14 inches wide and 8 feet long. Luigi made 323 contacts in 19 zones for this imposing total of points. His rig lineup is as follows: 6F6G crystal oscillator into parallel 6L6G's doubling to 20, then into a 35T which drives a pair of 250TH's to a kw. input. For 10 meters another 6L6G is switched in after the oscillator. All final plate tank leads and coils are silver plated with a noticeable increase of efficiency, especially on 10 meters. KA1LZ uses a dynamic mike, and the class B stage uses a pair of 250TH's also. The antenna setup is im-



KA1LZ, radiotelephone winner for the Philippines. Left cabinet contains speech equipment and exciter, center cabinet contains 250TH final on top and 250TH modulators beneath, and right hand cabinet houses power supplies.

The DX Editor casts a speculative eye at KA1LZ's log. The logs arrived in all sizes and shapes and in all forms of legibility and illegibility. This one was typed on a sheet of paper 8 feet long.

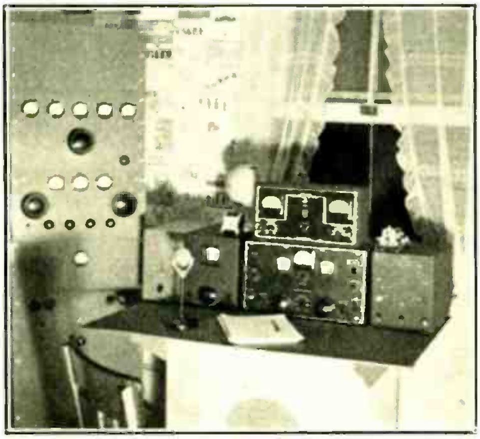
W6RCD was the highest around southern California in the phone division and second high in the district. The rig uses a pair of 100TH's in the final and starts out with an X-EC.

posing. For 20 he has a 4-element array on a tower 92 feet above the ground . . . and 10 meters is handled by a compact dual H beam by 8JK and 8RNC as described in October, 1939, RADIO. Receiver is an RME-69 and a DB-20.

LU7BK went to town and wound up with 391,136 points—zones were 16 and number of QSO's 268. Not far behind him was LU5AN with 265,000 points, 15 zones and 219 contacts. As mentioned before the CE's were very active on phone, 7 of them reporting with logs. XU8AM led the XU's with 27,000 points. HC2CC was quite active and turned up with 43,000.

K6BNR had his hands full in keeping ahead of K6MVA, that is if you can judge from the score. BNR had 463,176 while MVA ended with 442,000. BNR made 322 contacts in 18 zones while MVA worked 341 stations in 17 zones. The difference between the two was in zones and country multipliers. BNR had a country multiplier of 28 and MVA had 27. Notice the photos of each station. CX2CO was the only one reporting from Uruguay and he had a nice total of 143,106. From Mexico XE1CQ came in first with 77,700, with XE1AC in second spot.

All in all I believe the gang was satisfied with our first effort at a dx contest. I sincerely hope that everyone will cooperate again in spreading the word to the other countries regarding the rules of the next contest. Much will be done by printing them sufficiently in advance for this next one. The July issue will contain these rules for the 1940 World-Wide DX Contest.



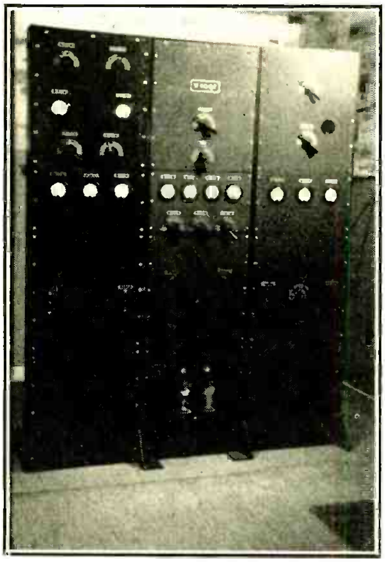
K6MVA was right on K6BNR's heels all the way and the closeness of their scores indicates quite a race.

Marathon Omission

W8CED was omitted from the final scores of the 1939 DX Marathon. He should have been in 38th position with 34 zones and 91 countries. We regret that this had to occur in this final and last reckoning of scores, because Lee had been so consistent in reporting from time to time. He, above all, should have been included. But, as has been said before "To err is human," so I guess that more or less establishes us in this category. W8CED will receive his certificate accordingly.

8th DX Roundup . . . W1SZ Guest of Honor

On April 17 a DX Roundup was held in Los Angeles, with Clark Rodimon, W1SZ, as guest of honor. It was a swell turnout of dx men and Roddy met many of them personally. Most of them had worked him during the past few years. There were 150 dx men present and I must say



W8OQF used c.w. with 150T's in the final. He was tops in the 8th call area.

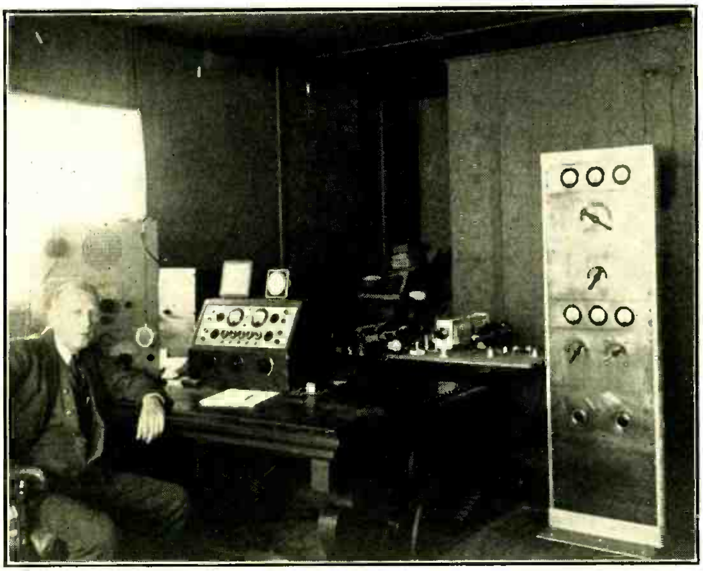

W2UK and xyl. Tommy's rig has been shown so many times we thought it high time the "happy combination" was introduced. She's actually the power behind the guns.

the power companies took a big loss that night with all of those kw's off the air. Roddy gave us a few highlights on east coast doings, Bill Eitel, W6UF, gave a talk on one of the subjects he knows best, tubes. Dave Evans, W4DHZ/6 discussed antennas with the boys. Johnny Griggs, W6KW, gave a little dope regarding the Antarctic situation, while Leigh Karaki, who operated at J2MI and XU8OZ, went into ham radio as found in Japan—and all about their 20 watts allowable input. It made some of our California kw's shutter after he finished. "Yours truly" acted as MC the best he could, although it was quite a busy day.

(In all the years that W6QD has been conducting this column, the editors have left this space strictly alone, figuring that it was more or less Herb's "private property." However, the events of April 17, as revealed by Herb's private operative no. 1492, are sufficiently important and informative to warrant our muscling in for a moment.

It all started on Tuesday, April 16, when Roddy, W1SZ, arrived in Los Angeles and W6QD and a gang showed him a few ham stations—and other places. Early the next morning Herb blearily groped his way to the airport to meet Bill Eitel, W6UF, the "Ei"

K6LKN finished right behind K6CGK and did a lot of fine operating. Dave is very consistent on phone as well as on c.w.



W6OCH — operator, Larry Barton. Transmitter runs a kilowatt into a set of rhombics and phased arrays. Receiver is an RME-69 with DB-20.

XE1CM came out on top in the c.w. division for Mexico. The rig has a pair of T-40's with 250 watts input.

part of Eimac, who was to speak at the DX Roundup to be held that evening, with Herb as MC. After this chore he rounded up the rest of the speakers, arranged for prizes, and located and installed the p.a. system in the meeting hall. All this in addition to the regular daily chores. This would be enough to keep anyone busy, but Herb had even more important business to attend to on that day. He was pacing the hall in a Los Angeles hospital awaiting the arrival of . . . Linda Jean Becker, 7 lbs. 2 ozs. The yl. and xyl are doing fine; in fact Herb says they're both "42 db above R9."

We know that our readers will join with the staff in heartiest congratulations to Herb and the xyl on the new arrival. Incidentally, Herb has a new job—other than handling the DX Dept. for RADIO—still in the amateur field of course. With that we will step out and turn this space back to its rightful owner.)

What Is DX?

I'll bite, what is dx, or maybe we should say "where is it?"

One thing we can be sure about and that is

[*Continued on Page 94*]

Transmitting Antenna Vs.

B. C. L. INTERFERENCE

By VICTOR RUEBHAUSEN,* W9QDA

During the past three years the author has used a number of different antennas for operation on the 10-meter band. In making changes to improve the signal, effects upon b.c.l. interference were carefully observed.

The amount of b.c.l. trouble experienced is a fairly good indicator as to the efficiency of a 7-, 14- or 28-Mc. antenna system. The type of interference referred to is that present when an intense field appears around the broadcast receiver. The strong unwanted signal is rectified by the second detector or elsewhere in the receiver and oftentimes raises havoc with b.c. reception. But no remedy should be needed on any *receiver* if the transmitting antenna system creates little field strength in the vicinity of the broadcast set or its antennas (28-Mc. operation). It should also be borne in mind that at increasingly higher frequencies the amount of radiation from nearby objects goes up too. Reradiation, of course, increases the field strength in the vicinity of the antenna, with a consequent increase in b.c.l. interference. Amateurs, particularly those living in apartment houses, would be wise to suspect all surrounding objects until they are proven innocent of reradiation.

The reports on various antennas tried by the author were tabulated with readings of a field strength meter and the observations made by local 10-meter stations in the immediate vicinity.

The first antenna to be tried on the roof of the apartment house was the simple half-wave doublet. The feed line consisted of 50 feet of high grade 72-ohm cable. The final amplifier in the transmitter had an input of 500 watts. The results with this arrangement were mediocre for communication work, while

* 7434 No. Oakley Ave., Chicago, Ill.

The three-element rotary (before the guy wires were broken with insulators) which finally reduced b.c.l. interference to a minimum.

severe b.c.l. interference was caused throughout the apartment building. The normal radiation pattern of this half-wave doublet was such that there would be considerable field strength anywhere in the vicinity, regardless of direction. Some improvement resulted when the antenna was raised above and clear of all surrounding objects by at least 16 feet.

After using the doublet for several months it was decided that the results left considerable to be desired. This time two half-wave antennas in phase were tried, using a quarter-wave matching stub at the center to phase the radiators. The 72-ohm cable was inserted in the low impedance, or cold end, of the quarter-wave matching section. Signal strength reports from amateurs were better broadside to the antenna, while off the ends the reports were less complimentary. B.c.l. interference cleared up only slightly from that noted while the doublet was used. Considerable improvement in signal reports resulted when a balanced, open-wire feed line replaced the 72-ohm cable. Interference increased until the standing waves were removed from the feed line and the stub was properly matched to the antenna. In the favored directions, results were quite satisfactory for a transmitter with 500 watts input to the final amplifier.

About this time W8JK's flat-top arrays were gaining considerable well-earned popularity; so a double-section "8JK" for 10 meters was strung between the poles that formerly held the two half waves in phase. The stub from the other antenna was removed and attached to the new array at the center, while the same feed system was used with only a slight amount of pruning necessary to remove standing waves. The results were so gratifying that the final amplifier input was reduced to 250 watts. Again the broadside directions were favored but this time by a greater amount. Reports universally improved while the b.c.l. troubles dropped to a low level. This antenna was guiding the r.f. in specific directions instead of all over the neighborhood.

Lastly, the extremely popular three-element rotary was constructed. In comparing it with the performance of the other antenna, it is necessary only to say that the final amplifier power was reduced this time to 100 watts, with excellent reports.

Following the installation of the rotary beam, systematic efforts were made further to check antenna performance both as to field strength and interference. The first step was to set up a field strength meter in a neighbor's apartment and simultaneously to observe its readings and to listen to the interference in the b.c.l. receiver. With the transmitter turned on and the beam rotating, the field-strength meter indicated a series of rapid fluctuations. The modulation on the transmitted signal became quite noticeable in the b.c. receiver when the f.s. meter indicated a peak. The first corrective measure was to break up, with insulators, the three guy wires supporting the 17-foot tower holding the array. Another check with the f.s. meter while rotating the antenna revealed that breaking up the guy wires had halved the number of variations. The next undertaking was to remove all of the broadcast antennas to another part of the roof and to reinstall them so that they were no closer than 20 feet from the beam elements. This reduced the field strength within the building to a minimum, except when the antenna was pointed to the south. The reason for this exception was a complete mystery until it was remembered that assistance had been rendered to a shortwave enthusiast in a building in that direction by way of installing a 40-meter single-wire-fed antenna, which was resonant on 10 meters as well. Shortening the latter by several feet brought about the desired effect, inasmuch as the field strength meter read zero regardless of the antenna's position. Needless to say, b.c.l. interference had disappeared.

All these alterations were made over a period of a month or so; and with each change that reduced the field strength in the building, the pattern of the antenna as it rotated was reported to be more normal. These checks were verified by stations within 20 miles. In addition to the improved pattern, the forward gain was about 6 db better than it had been prior to the removal of the reradiating material.

There are very few types of antennas that will remain properly matched over a band as wide as our 10-meter band; for this reason care should be taken to operate at or very close to the frequency for which the antenna is adjusted. Unless this rule is carefully observed, b.c.l. interference may be severe in the vicinity of the antenna. The field strength surrounding the antenna, of course, will rise with the amount of mismatch developed.

Considerable care should be exercised in judging the "fundamental frequency" of the antenna, particularly if deductions are made from signal reports obtained from other stations. It can easily develop that an antenna is reported as producing "maximum signal" on a frequency well removed from the resonant frequency, due to resonance effects of the antenna being used on the checking receiver.

[*Continued on Page 72*]

U. H. F. . . .

By E. H. CONKLIN, W9BNX*

The big news of March and April was the ionosphere storms that churned up the layers and brought u.h.f. communication of the aurora type. Visible aurora and heavy magnetic storms accompanied the ionosphere irregularities. On several occasions, the Wednesday reports of the National Bureau of Standards indicated severe disturbances and, on March 27, they could not even measure any regular layer structure.

On Easter, March 24, ten-meter transmission over long F_2 layer paths gave way to short skip and then to skipless aurora flutter, according to several observers who have provided very complete reports. This condition brought considerable aurora-type skipless five-meter dx over a large part of the country but, in general, only those using c.w. could be understood because of modulation effects on all signals.

Easter at W9ARN

A detailed report from W9ARN in Bartonville, Illinois, indicated that K4 on ten meters and Army Amateur work on 160 seemed normal in the morning. At one p.m., the west coast had gone out on ten, though W6BOY mobile off Panama, YV4AE, K4DTH, some CE and LU stations came through weak and fading, with a high frequency buzzing over the entire band. In half an hour, signals decreased while the buzzing became worse. Still later, weak W4-8-9 stations came through with a flutter, followed by the east coast by 3 p.m., and a clearing up of the flutter. An R9 contact with W2MPA broke up sharply. At 4 p.m., the W4's were hard to read, and the buzzing so badly that Jack took his car out to check the nearby power line for leaks. At the airport, he found that the teletype had gone haywire and receiving conditions were not normal, with messages indicating similar troubles elsewhere.

At 6:15, ten was wide open with very loud signals. At seven, W9ZHB reported five-meter dx starting to come through and Jack heard peculiar sounding c.w. from W3DI EIS W8CIR W9GGH, the last two working each other. There were some unreadable carriers. W8VO was heard working a W2 at 8:20, with all of the signals coming directly out of the north. W8CIR mentioned the same peculiarity. At nine, ten meters was still good to the east and for 500 to 700 miles in other directions. At ten, five-meter c.w. signals from W2AMJ W3DBC BZJ W8LKD were heard, then a phone was made out, "Standing by for W9GHW at Kirkwood," Missouri. After ARN logged W8CLS TIU NYD on c.w., W9FHR came into the shack and worked out a keying system that would permit some contacts. Around eleven, they raised W8LKD in Ohio, W8TIU QQS in Saginaw, Michigan, for two new states, using the beam north. Signals were fewer, and without much fade. After midnight, W8CIR was raised with best signals using the beam northeast at ARN and due north at CIR. Ten meter sigs then were coming in from Minnesota, Nebraska, and the Dakotas and had a flutter again. In addition to being an interesting "serial" on conditions during an aurora display and heavy magnetic disturbances, Jack's letter impresses one with the necessity for a c.w. carrier keying provision in five-meter transmitters. More comments on who worked whom, will be found in the five-meter section.

In Hugo, Oklahoma, W5TW noticed so many queer things in late March that he wonders whether the wrong theory is being applied to u.h.f. work. Ten-meter signals went out east and west, but not north and south although wire line troubles were the reverse. On 2½, signals went out at fifty feet east or west, but were good at several miles north or south! Ed points out that the theory of light was changed twice—and even his old tom-cat returned after the aurora spell.

The Total Eclipse

W5TW decided to listen on 10, 5 and 2½ and to check conditions during an eclipse by transmitting on ten and 2½. In the morning, ten was dead as usual, five sounded alive with no signals, but 2½ mobile rigs were good until noon when they got weak and ununderstandable. At that time, 26 five-meter signals came in with a high noise like a hiss that prevented identification. Ten came to life at 1:10 Central time with a few weak signals. By 2 p.m., five was out with no more hiss but K6 and South American signals were good.

At 2:12 as the eclipse started, W4-5-9 came through, with Texas and Oklahoma signals loudest. A car was sent out at 3 p.m. to discover what was wrong with a 2½-meter job, and it was found that signals were out until the rig was in a valley, two miles away! At 4:30, things reversed themselves with 10 going out, five bringing in weak carriers, and 2½ working only from the hilltops. Shortly after, at 4:58, a flutter appeared on 2½ and this band passed out, leaving all three bands dead.

Antennas

Fred Bornman, W8QDU, comes out with different figures than W9PEI for the W.E. concentric-type vertical antenna. Fred has a longer skirt (that is, the concentric, lower half of the antenna), using the equation $221/F_{Mc.}$ for the upper section and $243/F_{Mc.}$ for the lower. Fred runs the concentric line a quarter wave below the skirt, matching with a quarter-wave transformer into an open wire line. This gives a 1:1.2 ratio of standing waves on the line, with equal line currents. This particular set-up is complicated, what with the half-wave concentric line, the unbalanced-to-

* Associate Editor, RADIO, Wheaton, Illinois

balanced connection, and the quarter-wave transformer, so the straight-forward problem for concentric line feed is not answered. Incidentally, a further factor and apparently a great help at QDU is the group of horizontal quarter wave radials placed a quarter wave below the antenna.

W1JFF says, "For five meters, give me a vertical antenna if I can't have a rotary beam; there are too many cq's called and not answered otherwise." That is just the opposite of the situation in Central Illinois, of course.

W8QDU points out that a beam sharp in horizontal directivity will discriminate against noise, provided that the stations worked are not in the direction of maximum noise generation. He feels that constructional advantages favor a simple, but high, vertical antenna. He mentions W8JLQ who replaced a horizontal insulatorless array with a vertical and began to hear ground wave dx (vertically polarized transmission) for the first time. Fred does not like the idea of some fellows using one polarization and the rest using the other, splitting the ground-wave dx into two groups. He is going to run some tests with W8CVQ, who feels the same way in view of the absence of congestion on five meters now.

While verticals are most common for mobile work, there is a distinct advantage in concentrating on this one polarization. When ten-meter long skip goes, and short skip is less frequent during the next five years, concentration on verticals for this band also may become advisable. It is not hard to build a stacked horizontal mobile array for 2½, but let's not bring *that* up just now!

The experience of W8CIR in finding a Yagi 20 feet high superior to a simple vertical 80 feet high has been explained by the fact that Ed is on a hill where anything is well in the clear; the added height just increases the horizon whereas the beam increases power and produces much the same result. At lower locations, there may be *no* substitute for height for ground wave dx.

Ed Harris, W5TW, suggests both horizontal and vertical beams on a mast, fed together. Yeah, but unless they are fed at 90 degrees phase relationship, they result in 45 degree polarization which can be resolved into half the power on either polarization; if they are fed at 90 degrees phase relationship to give circular polarization, the result still is to divide the power in half for either polarization. Perhaps it is better to choose one and stick to it, except for diversity reception of skip signals to reduce or eliminate fading.

Wave Propagation

A review of radio progress in 1939 published in the *IRE Proceedings* contains these comments:

> A remarkable aspect of progress was the development of formulas for the calculation of field intensities which are valid for both low and ultra-high frequencies and, in fact, for ground-wave propagation at all frequencies. The work of recent years on ultra-high frequencies has led to this advance in understanding of the propagation of radio waves at all frequencies.
>
> The theoretical formulas for ground-wave calculation were brought to a new stage of accuracy. Some of the results of these studies were given in graphical form, for a number of frequencies and ground conductivities and for transmitter and for transmitter and receiver on the ground. These and previous studies were for vertically polarized waves. A theoretical solution for the propagation of horizontally polarized waves appeared (M. C. Gray, *Phil. Mag.*, April, 1939—Ed.); it showed that the values of the ground constants are of much less importance for horizontally than for vertically polarized waves . . . It is probable that the calculations of instantaneous ground-wave intensity over great distances never can be highly exact because there is one factor, atmospheric refraction, which varies unpredictably (this is the borderline of tropospheric waves reflected by air-mass boundaries—Ed.)

Equipment

Some fellows think that they *must* have a modulator power equal to half of the transmitter input in order to get on the ultra-highs. Who started that idea? A little voice will modulate a rig heavily on peaks, and there seems to be no objection to a little extra carrier. Some transmitters, particularly oscillators, have a modulation *capability* well below 100 per cent, and can not legally be modulated in excess of it. How many really have checked this little point? Anyhow, use what you have in the r.f. end of the rig, and modulate with what you can scare up, even if it is only 20 per cent, and come on down to these wavelengths. C.w. and i.c.w. are o.k., you know.

O. K. Falor, operator at WBCM in Bay City, Michigan, says that he has solved the problem of cheap concentric lines. He uses 28 gauge copper sheet for the outer conductor, and standard sizes of wire or tubing for the inner conductor. His method of bending the sheet for the pipe is to clean and cut it *square,* leaving about a quarter inch for overlap when bent; then to bend it evenly along its entire length around a rolling pin. It can be tied down with string until the seam is spotted with solder at several points. If a solid iron heated in a gas burner is used, solder will flow into the whole lap.

A variation of this for other sizes is to roll the sheet copper around something, then to compress and feed it through a round hole in a board, soldering as the pipe comes through.

Cheap U.H.F. Tube

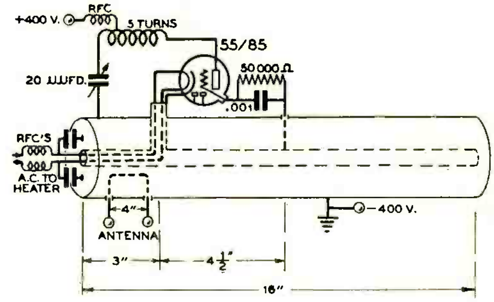
Falor points out that for those who want to try the ultra-highs for 50c rather than to buy acorn or HY615 tubes, the type 55 and its 6-volt equivalent, type 85, are quite satisfactory. These are double-diode triodes of which the modern version is 6R7-G, the advantage being the low interelectrode capacities and the triode grid coming out the top. Using one of these tubes in a single-ended 2½-meter oscillator, he has had good results. The grid is tapped through a 50,000-ohm grid leak and .001-$\mu\mu$fd. condenser to a 16-inch concentric line 7½ inches up from the shorted end. Three inches up, the cathode is tapped on the line, e.c.o. fashion, with a quarter inch tube. The heater wires are pulled through this and the lower part of the center conductor of the line. The plate could not be grounded with ordinary condensers, so was series-tuned with a five-turn coil and 20-$\mu\mu$fd. condenser, 400 plate volts being fed through a choke to the node on the coil. With this arrangement, the plate current dips down to a 6 ma. and loads up, either with a 4-inch hairpin to the grid line or inductive coupling to the plate coil, to 30 or 40 ma. That is 16 watts input, at good efficiency, for a 50c tube, 50c line and very little else! The plate tuning has been avoided by RCA by use of a mica-and-sheet-copper by-pass condenser plastered against the outer conductor, to reduce inductive reactance. A similar circuit with a pentode, using the screen as a triode plate, and the output coupled to the actual plate, may even be stable enough for five-meter phone. With one type 55 tube, Falor found that the grid line did not take over control, but oscillations took place on 226 Mc.

Incidentally, use wide copper strip or tubing for *all* taps and connections in short line oscillators, in order to avoid peculiar effects. A recent rig at W9BNX would not be controlled by the grid tank until the wire used for the grid taps and leads was replaced with ½-inch wide strip.

Another suggestion is the use of cheap "GE" 30-watt round bulbs, obtainable at the dime store, as a resonant load on 2½. It is necessary only to touch the inner conductor to a tank in order to light the bulb—if you have enough power. Hand capacity was found to be unnecessary. Another test with a variety of bulbs from ten to twenty-five watts showed that they all worked, but some would match better and take more load.

In RADIO for February, page 17, an RCA kilowatt oscillator—stable enough to be keyed—was mentioned. This uses a large concentric line, with grid and filament loops within the line, the plate being grounded. The tube and loops are mounted on a plate that covers a hole in the line's outer conductor, making changes in tubes, loop sizes and frequency very easy. The following is a quotation from RCA's letter giving actual data on the mechanical layout:

> "The size of the grid and filament coupling loops were in this particular case about 6" high by 6" long. The width of the grid loop was about 2", being made of 1/16" thick copper strip. The cross section of the filament loops is not so important. These were each ½" by ⅛" copper. The filament loops enclose about 75% of the area of the grid loop. Care must be exercised that no magnetic flux is looped between the filament leads themselves. This would overheat the filament and result in low transmitter efficiency. The loops should be constructed so that the broad surfaces are parallel with the electromagnetic flux. The size of the grid loop depends on the frequency and to some extent upon the general construction of the unit. The proportion of the grid loop area enclosed by the filament loop depends to some



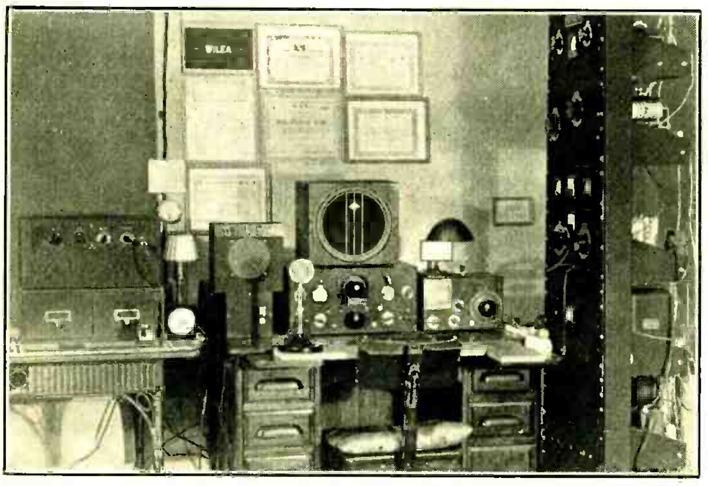
O. K. Falor's 2½-meter transmitter using a 55 or 85 tube.

56 Mc. DX HONOR ROLL

Call	D	S	Call	D	S
W9ZJB	9*	18	W1JFF	6	11
W1EYM	8		W1LLL	6	17
W3AIR	8	24	W2KLZ	6*	
W3BZJ	8	27	W2LAH	6	
W3RL	8	24	W6QLZ	6	11
W5AJG	8*	29	W8LKD	6	11
W8CIR	8*	29	W8OJF	6	
W9USI	8	22	W9NY	6	13
W8JLQ	8				
W8VO	8		W1JMT	5	9
W9ARN	8	17	W1JNX	5	12
W9CBJ	8		W1JRY	5	
W9ZHB	8*	29	W1LFI	5	
			W2GHV	5	8
W1HDQ	7*	18	W3GLV	5	
W2AMJ	7	22	W3HJT	5	
W2JCY	7		W6DNS	5	
W2MO	7	25	W6KTJ	5	
W3BYF	7		W8EGQ	5	10
W3EZM		24	W8NOR	5*	16
W3HJO	7		W8OPO	5	8
W4DRZ	7*	22	W8RVT	5	7
W4EDD	7*		W9UOG	5	8
W4FBH	7	20			
W5CSU	7		VE3ADO	4*	
W5EHM	7		W3FPL	4	8
W8CVQ	7		W6IOJ	4*	
W8PK	7*	9	W8AGU	4	8
W8QDU	7		W8NOB	4	
W9CLH	7		W8NYD	4*	
W9SQE	7	22			
W9AHZ	7*	14	W1KHL	3	
W9BJV	7	12	W1LKM	3	5
W9CHG	7*		W6AVR	3	4
W9WAL	7		W6OIN	3	3
W9QCY	7	10	W6OVK	3	4
W9ZUL	7	16	W7GBI	3	4
W9GGH	7		W8OEP	3	6
W1CLH	6	13	W8OKC	3	6
W1DEI	6	18	W9WYX	3	3

* plus Canada. (reported in 1939)

Note: D—Districts; S—States



W1LEA, Lawrence, Mass. On 2½, 10, 20 and 40 — the three-band transmitter for the lower frequencies uses a pair of 35T's with 500 watts. 2½-meter rig uses 35T's with 200 watts input.

extent on the multiplication factor of the tube. These loops were used with an 846 tube in a line 48" to 60" long and 16" i.d. The inner conductor was 4½" o.d., both copper tubing.

"Smaller lines and higher frequency tubes have also been used by us. These of course require proportionally smaller grid and filament coupling loops.

"In most of these transmitters the tube leads formed part of the coupling loops. In the type of construction where the glass end of the tube extends in through the outer coaxial conductor, care should be taken that no closed loops in the tube link the magnetic flux, which if such were the case might damage the tube."

Interference from superregen receivers is still bad on 2½ in congested areas. O. K. Falor was able to get several watts out of a carefully adjusted type 55 superregen detector on this band, which is comparable to the power of many small transmitters. A question has come up about the legality of using such a receiver if the quench oscillator modulates the detector in excess of the latter's modulation capability, in view of F.C.C. regulations. Perhaps troublesome cases could be urged to do something about radiating receivers by using such pressure.

Some of our readers have intended to make their own acorn sockets with built-in by-pass condensers, but do not know where to obtain the necessary clips. RCA will provide them. If they are not in the acorn tube box at the time of purchase, write RCA Radiotron Division at Harrison, New Jersey, and they will be forthcoming.

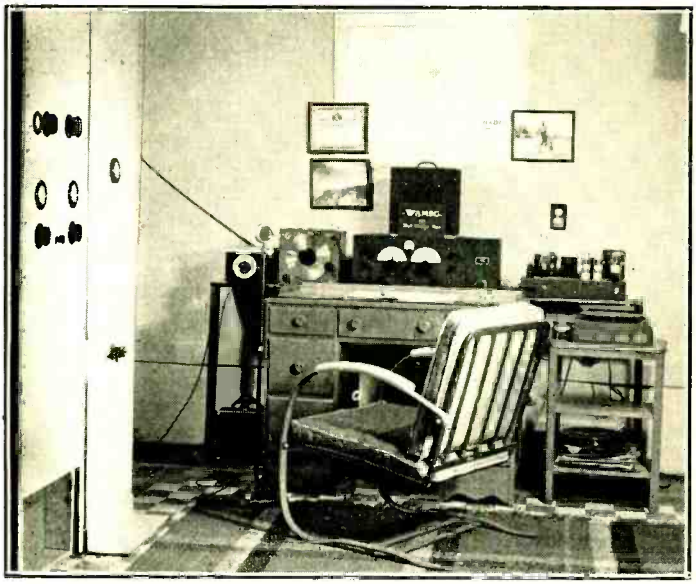
Superheterodyne Adjustment

John Voliva, W9VEK, wrote from Indianapolis about one of those organ pipe superhets described in RADIO for June, 1939. It did not work worth a hoot, and help was wanted. After a few letters, he advises that it is now working fine and is more than satisfactory. W9AQQ says that it is better than his commercially built 5-10 receiver, so he is going to build one up right away. VEK's difficulties may be encountered elsewhere, so some comments on checking superhets are in order.

Starting with the oscillator, check to see if it oscillates over the whole range. A long cathode tap to the coil can give trouble. The plate current should jump when the coil or grid is touched, at any dial setting. Oscillation can be stopped by too heavy loading by the mixer. The output of the oscillator is important but cannot be checked here without building up a v.t. voltmeter and without some knowledge of the required output voltage.

Going next to the mixer, grid injection gives greatest interaction of grid tuning on the oscillator, but requires least voltage (tap close to ground on oscillator coil, or use small coupling condenser) from the oscillator. Suppressor injection can be free of interaction provided that the grid circuit of the mixer is entirely shielded from the suppressor and plate circuit. Often, the suppressor can be connected directly (through a short lead) to the oscillator cathode tap. With grid injection or leaky injection connected to another element, the mixer can be biased close to zero, then driven up to recommended detector plate current. With the 954, this calls for about -6 volts on the control grid or a 20,000-ohm or larger cathode resistor. The plate current should be driven up to 0.1 ma. by the oscillator. If the oscillator is thoroughly shielded from the mixer grid, using suppressor injection, no bias or grid current will develop in a leak inserted in the mixer grid, in which case it may take 40 volts from the oscillator for optimum conversion gain, according to W9GFZ. This can be checked by output when listening to a local crystal harmonic.

The antenna can now be coupled to the mixer to check superheterodyne reception. If o.k. to this point, the r.f. stage can be fired up. In u.h.f. re-



W8MSG, Bud Shafer, Cleveland, Ohio. The rig uses a pair of 100TH's in the final with 500 watts input on 10; modulators, 203Z's.

ceivers, oscillation may be caused by poor layout and shielding, inadequate by-passing (resulting from too much inductance in the by-pass condensers), or use of a poorly by-passed cathode resistor. If the stage oscillates, it can be stopped generally by tapping down on the tuned circuits, or ruining them with a resistor of a few thousand ohms placed across them. Oscillation can be checked by plate current when the grid is touched, if there is a high resistance leak placed in the grid circuit. The effect of a cathode by-pass condenser can be checked by lowering plate and screen voltage, and shorting the cathode resistor, to see if undesired oscillation stops. Another way to check poor grounding is to take off the antenna, turn on a local oscillator, and touch supposedly by-passed points with a screw driver; an increase in received signal shows poor grounding.

The i.f. amplifier can be checked by listening to signals, when an antenna is coupled to it, or by replacing it with a handy receiver for comparison of gain.

28 MEGACYCLES

W9QDA finds that he can hear W9ZHB, about 100 miles away, seven R's above the noise, when using the little acorn-tube concentric-line converter that he described in the May issue of RADIO. On QDA's regular receiver, ZHB is down in the noise, 70 per cent readable when no car is passing.

QDA put W9QIB in Indianapolis and a W8 in New York on the Chicago telephone during a ten-meter three-way in April on one of those peculiar reflections in which all beams turned south-east. No other stations were coming in except a K4 on normal F_2 layer hop. Ordinarily, Indianapolis is in the skip zone for Chicago, except for unusually good extended ground wave dx or aurora-type communication.

W9AI has decided to go into the business of manufacturing concentric line converters, with built-in power supply, promising a layout providing good shielding of the oscillator from the mixer grid, and using a line folded into the cabinet. The first model will be for 10 and 5, while another for 2½, 5 and possibly 10 will be forthcoming.

W5TW in Hugo, Oklahoma, tried feeding both a horizontal and a vertical beam on ten meters, with the result that W6 contacts were continued into the dark, when the signal would be out on a horizontal flat-top beam and fading on a vertical.

On Easter, March 24, W1LKM noticed that "ten" opened up at night for short skip operations to W2-3-8-9. The report of W9ARN has already been commented upon in detail above.

W1LEA in Lawrence sends in some pictures of his layout. The 10-20-40 meter rig ends in 35T's with 500 watts input, working into a 33-foot antenna. A separate pair of 35T's are on 2½.

According to G2YL, there was not very much to be heard in England during February, but the 11th to the 21st was the best period. OQ5AE was logged on February 11, 20 and 26, with plenty of W's calling him on these and other of the fifteen days on which they came through. A solitary W6 was logged. PY1HP was audible nearly every day, and South American signals were improved over the previous month, being logged on fifteen days after the 9th. European calls heard included UE3YW UK3AH D4BUF HA3UH LX1UU LX2OK ZZ1A.

March conditions in England were similar except that western W's were more frequently heard, and a record number of South Americans were heard, thanks entirely to the dx contest. March 16 was best, otherwise the first week was

On the left, W9ZJB of Kansas City; on the right, W9USI, Brookings, S. D.

best. March 8 to 13 was poor except for a few southern stations. The storm on March 24 obliterated the finish of the contest and caused a wipe-out for several days. K6JPD was the first oceanic station of the year. OQ5IM is a new one heard four times. Unusual South American stations, mostly during the contest, were CE3BI CE3CO CX1AO CX1FB CX2CO HK4DK OA4L OA4U, and others reported were CE2BX HC1JB HCIJT YV1AQ, thirteen each LU and PY. W7ACD was outstanding. A casual listener on March 16, 17 or 23 would have been amazed at the sudden increase in c.w.—more than in the whole of the previous six months. W's were heard calling TF1L, possibly in Iceland.

On a dead ten-meter band just before noon, W6QLZ has worked W6PNO near Los Angeles, 250 miles away, both pointing their beams at Australia. Also, he has been hooking W6PQQ, 100 miles away, in the evenings with both pointing their beams south.

56 MEGACYCLES

W8PK near Rochester heard W8QDU in Detroit during the February 11 relay, but missed the March aurora dx during the ionosphere and magnetic storms that have been occurring. W9ZJB says that the band was open 2½ hours on February 14, but his rig blew up. He heard a Camden, N. J., station and some marathon talkers in Atlanta. W3BYF worked W8QDU during the aurora of February 24. W1IZY had to point his beam north that day for his contact with QDU.

During an aurora on March 8, W8OKC in central Pennsylvania heard two weak signals from low locations 60 and 85 miles away, despite a poor receiver and antenna as yet. One of his new acorn tubes arrived with a short between control grid and cathode, but it was sent back for a replacement before being put in the new concentric-line-tuned superhet. The pipes are three-inch cylindrical copper rainspout, thirty inches long, to be loaded up for ten and shorted part way down for 2½.

That Easter Event

The report of W9ARN was only one of many for March 24. In Cuyahoga Falls, near Cleveland, W8LKD heard garbled and fluttery signals sounding more like i.c.w. than c.w. when he got on the band at 7:45 p.m. Eastern time. He heard W1KJT W2AMJ W3DBC W8TIU W9GGU or GGS (GGH?) and worked W1LLL BJE W3BZJ W9ARN. Some doubtful ones were W2KEF DI CUD. W2AMJ called him, but at the wrong time. Phone, and i.c.w. without a keyed carrier, were unintelligible.

Near Chicago, W9VHG heard W3DBC EIS W8CIR TIU on c.w. with the beam north, starting at 7 p.m. Central time. Like W8CIR, he heard nothing above 57 Mc. and worked nobody. W9GGH in Kenosha raised CIR and others. W9QHZ in Glen Ellyn also heard some dx.

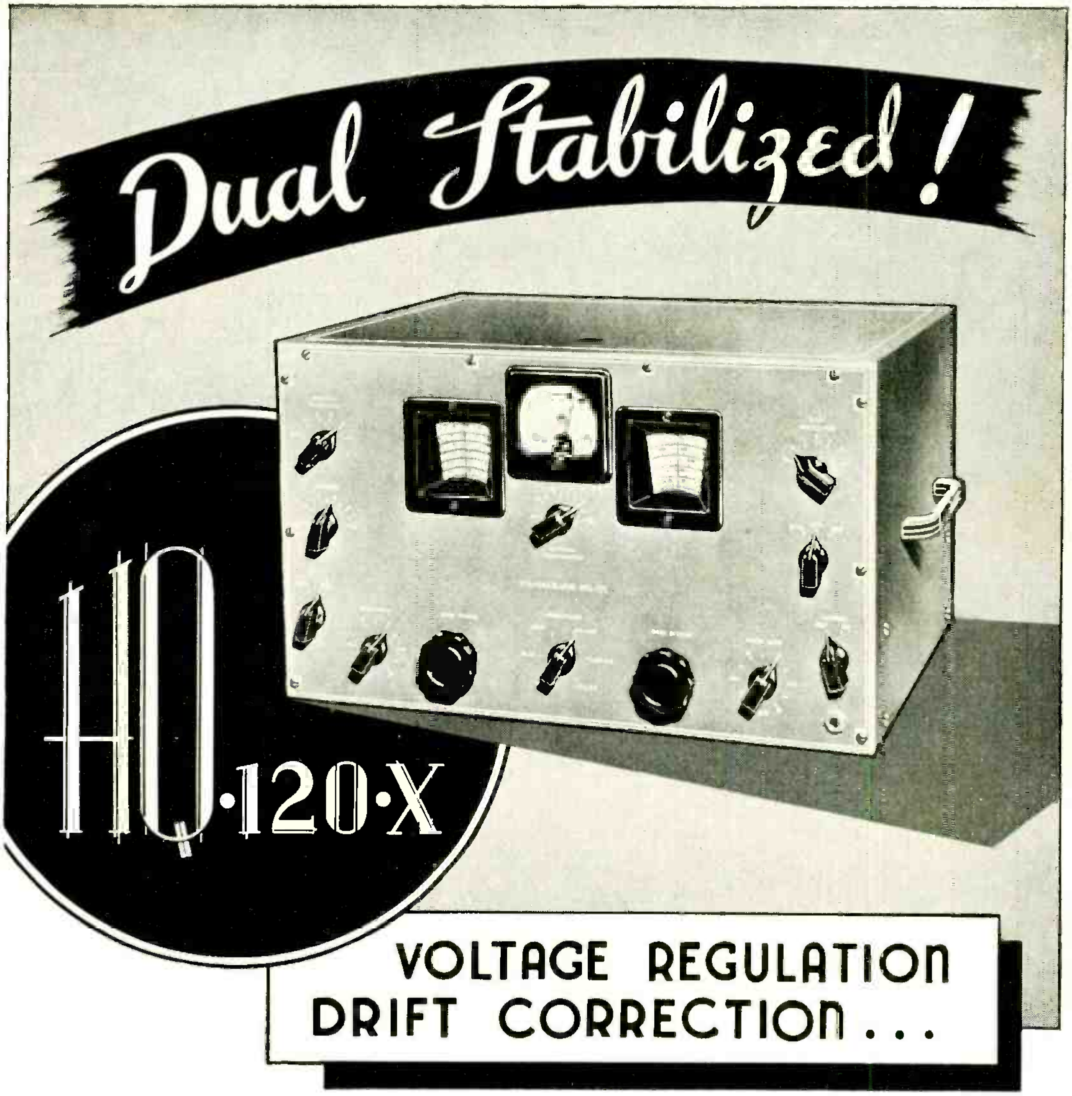
W8VO in Akron heard about the magnetic storm about 4 p.m. and checked his receiver. The high audio frequency noise on 56 Mc. was about 10 or 12 db above normal background, of fairly constant amplitude, and around 15,000 cycles. Another frequency around 2 to 5 cycles was just under the noise level. Around 5 p.m., the major noise began to subside and signals took shape. W2AMJ was very broad. W2KLZ W3DBC were picked out, sounding like a hiss, on which the beat oscillator had no effect. The c.w. stations could be identified whereas the i.c.w. and phone signals generally could not. At 8 p.m., W2AMJ was 500 kc. wide while 8CIR was spread over nearly a megacycle. After that, normal characteristics were resumed though CIR's c.w. sounded like the drone of an airplane motor.

W1CLH raised W3DBC for a new state.

W3BYF in Allentown worked W1VC IZY W3DBC W8CLS WCIR and heard W1HXP BJE KJT W8NYD, all of whom were using c.w.

At Saginaw, W8TIU started the dx off by hearing W8CIR at 7:58 p.m. Eastern time, continuing through a contact with the same station at 1:14 a.m. and going out at 2:30. He worked W8VO LZN CIR W9ARN and heard W2AMJ DBC (W3?) W3BZJ W8NYD LKD. He got both sides of c.w. contacts between W2AMJ W8LZN and W3BZJ W8LKD.

Bert Fageol, W8NYD, was on in Kent, Ohio, for the hour before midnight, extended H antenna pointed north, receiver starting with a 954 acorn preselector in front of his DM 36. He worked W3BZJ and heard W1LLL HDQ DEI W2KLZ JCY AMJ LAH W3DBC RL. That's the longest list and in only one hour—we wonder how much it is due to the coaxial tank and acorn



STABILITY in the "HQ-120-X" was obtained, first, by a voltage regulator for the high frequency oscillator so that even considerable changes in line voltage have no appreciable effect on the oscillator frequency—the oscillator doesn't see-saw back and forth during unsteady line conditions. Second, the "HQ-120-X" has drift correction which takes care of oscillator changes due to temperature rise. The usual warm-up period has been reduced to a matter of minutes. Mechanical construction probably has the greatest bearing on stability. In the "HQ-120-X" special attention was paid to design of the tuning condenser and coil rack so as to practically eliminate the possibility of twist during temperature changes. If you are looking for high class performance at a moderate price—try the "HQ."

WRITE DEPT. R-6 FOR 16-PAGE "HQ" BOOKLET!

HAMMARLUND MFG. CO., INC.
424-438 WEST 33rd ST., NEW YORK

EXPORT OFFICE: 100 VARICK ST., NEW YORK CITY

What's New . . . .

IN RADIO

ADJUSTABLE LINK 50-WATT COILS

A new series of "airwound" adjustable-link oscillator and buffer coils has recently been announced by Bud Radio, Inc. of Cleveland, Ohio. These coils are designed for use in circuits where it is desirable to adjust excitation or antenna loading by varying the link coupling.

Each coil is individually linked, and coupling is varied by pushing the link in or out of the main winding. In view of the fact that each coil has its own link, the coupling adjustment for each band can be left permanently set at the proper value.

All coils in this series fit standard 5-prong sockets and are designed for operation in stages where the input power does not exceed 50 watts. Coils are available for all amateur bands.

NEW MIDGET ELECTROLYTICS

For applications calling for very high capacity values at very low voltages, seven popular values and voltage ratings are now offered in the midget metal-can electrolytics by Aerovox Corporation of New Bedford, Mass. The capacities range from 1000 to 3000 ufd., with working voltages of 6, 12 and 15 d.c. The metal can is fully protected and insulated by the paper sleeve extending for the full length and rolled over the can edges,

to preclude shorting of leads on the can. Units are supplied with mounting straps, except for a larger can size unit which has a standard mounting ring.

NEW RME-99 RECEIVER

The Radio Mfg. Engineers, Peoria, Illinois, have recently announced a new receiver which has a number of features which make it an outstanding communications set.

Covering from 540 to 33,000 k.c. in six bands, the receiver has full calibrated bandspread on the 3.5, 7, 14 and 28 Mc. amateur bands. An illuminated R meter is calibrated in both decibels and R units.

Employing 12 tubes, including rectifier and voltage regulator, the receiver incorporates low loss loctal tubes in the r.f. and amplifier circuits. A special bandswitching system permits a high L/C ratio on all bands, and use of a wide-spaced, exceptionally rugged tuning condenser along with a cast aluminum chassis results in high stability even on the highest frequency band.

On the lower frequency bands, the r.f. coils are permeability tuned and have unusually high Q, due to use of iron cores. Low temperature drift is obtained on all bands as a result of careful design and quality components.

A new type crystal filter permits six degrees of i.f. selectivity and controlled phasing. The beat oscillator has a pitch control on the front panel. A highly effective noise silencer is incorporated, with panel adjustment for obtaining maximum silencing action at various degrees of modulation with a minimum of distortion.

Terminals are provided for break-in operation, as is a built-in relay control circuit for an external relay. The undistorted output is 4 watts at both 4000 and 600 ohms. The entire receiver is thoroughly weatherproofed for operation under the most adverse climatic conditions.

[*Continued on Page 91*]

Stancor MOBILE TRANSMITTER KIT!

DESIGNED FOR MANY TYPES OF MOBILE AND EMERGENCY INSTALLATIONS . . . SUCH AS LAW ENFORCEMENT AGENCIES, AMBULANCES, FIRE APPARATUS, FOREST SERVICE, AMATEUR EMERGENCY CORPS . . . PLUS MANY OTHER AMATEUR AND COMMERCIAL APPLICATIONS

A New and Complete Solution to the Problem of Mobile Operation on Either the Amateur or Police High Frequency Bands — the 30M Stancor Transmitter Kit.

- 30 watts amplifier plate input—100% modulated.
- Operating range, 28 to 40 MC.
- Only *four* quick heating, low drain tubes—no delay in operation.
- Press-to-talk operation—controlled at microphone handset.
- Low battery drain—40 amperes at 6 volts under full operating load.
- Chassis will accommodate either dynamotor or vibrator power supply.
- Rugged design—to stand up under severe mechanical abuse.
- Mechanically and electrically stable.
- Locking rings on tubes and crystal.
- Antenna change-over relay switch.
- Easily installed; requires connections only to battery, microphone and antenna.
- Complete metering provided by selector switch and either self-contained or plug-in meter.
- Servicing and operating breakdowns reduced to a minimum through the use of heavy duty components.
- Easily assembled and wired with Stancor's exclusive "POINT TO POINT" instructions.
- Size—14½" x 10" x 8" overall—Weight, complete, 39 lbs.

This unit may be purchased in kit form, less accessories (tubes, crystal, meter and power supply, etc.), for approximately **$41.00**

ASK YOUR STANCOR DISTRIBUTOR FOR BULLETIN NO. 191-A, COMPLETELY DESCRIBING THE STANCOR 30M TRANSMITTER KIT, ACCESSORIES REQUIRED, CIRCUIT, ETC.

STANCOR

STANDARD TRANSFORMER
• CORPORATION •
1500 NORTH HALSTED STREET . . . CHICAGO

YARN of the MONTH

THE BIRTH OF A BROADCAST RECEIVER

Tremendous ingenuity and research go into the design of a modern b.c. receiver, a fact which the average ham usually fails to appreciate. The author, a former employee of a radio factory, realizes that the exact method of production varies in different factories; but this account is typical:

Several dozen stern-faced men are grouped around a long table. At the head of the group is the president of the company and on each side of the table are lesser executives and department managers. Next, the engineers are seated in order of rank, the 27th assistant engineer sitting at the foot.

It is of course first necessary to design the new receiver and, at a signal from the president, everyone feverishly scribbles on a pad of paper in front of him. Those present must draw a diagram of the part of a radio circuit which most appeals to them.. While one man may draw a detector circuit, his neighbor may draw an oscillator, and so on. Since there are so many employees present there are bound to be several circuits of each stage.

Upon finishing his circuit each member drops it into a bowler hat which is passed around. They are shaken up and each man selects one, shouting out what he has drawn. As the receiver design approaches completion the excitement becomes intense. Finally, only one stage is missing and all eyes are eagerly turned upon the man whose trembling fingers are reaching for a slip of paper.

He glances at what he has drawn and shouts "Bingo!" if he drew the needed stage, revealing to the group that the design has neen completed. Of course it may happen that three or four detectors are drawn before someone gets an oscillator. In this case the radio set is advertised as possessing "unique features never before found in any radio!"

After the design has been decided upon it is necessary to see if there are any restrictions governing its production. The Amalgamated Brotherhood of Radio Engineers and Bee Hive Architects held a conference in 1936 and introduced very strict production regulations which are observed by all ethical manufacturers. For example, Section 2, Rule 49, Paragraph 54 states that no five-tube receiver shall be built on a chassis bigger than 2½ by 5 inches. Another ruling to be found under Subsection 7 states that no resistor whose dissipation rating exceeds half a watt may be used in a four-tube set.

Considerable time is spent checking these regulations and in the meantime a conversation something like this takes place:

President: "I find that we still have two thousand 201A's on hand. I move that we use them in this receiver as a half-wave rectifier."

First Engineer: "We could make the power transformer smaller by drilling holes in the top of the cabinet to let the heat out."

Nineteenth Assistant Engineer: "An excellent idea! But wouldn't the customer be suspicious at the sight of the holes?"

Head Salesman: "Not if we tell him that they improve tonal qualities, increase distant reception and cut down static."

First Engineer: "Sure, tell 'em it's to let r.f. in."

President: "Here's a note from the Jalope Motor Car Company. They can give us a good buy in twenty-five thousand clutch pedals that were made a little too small. Do you think we can use them?"

Fourth Engineer: "We might work them into a bandchange switch."

Eleventh Vice-President in charge of wrapping and sweeping out: "Good! We can advertise something like this: 'You use your feet to operate your car—why not your radio?' Sensational! Different!"

By ERIC R. ADAMS, VE3ALG

THIS IS A PHOTO OF HALLICRAFTER SETS CARRIED IN STOCK

Write me about type of receiver you want. I will help you get the right receiver and will cooperate with you to see that you are 100% satisfied. Ask for technical information about any receivers.

YOU get ten days free trial — you don't buy unless you are satisfied.

YOU buy on 6% terms financed by myself with less cost — more convenience — quicker delivery. Transaction is entirely between us. Write for terms.

YOU get big trade-in for your receiver — describe it and I will tell you its value — you can pay the balance on my 6% terms. Don't trade until you get my offer.

YOU get prompt shipment from the world's most complete stock of amateur receivers. Or shipment from the factory if you wish.

I have a complete stock of all receivers, transmitters, kits, antennas, tubes, parts. Send to me for any equipment. I guarantee you can't buy for less or on better terms elsewhere. Your inquiries and orders invited.

Bob Henry
W9ARA

HENRY RADIO SHOP

BUTLER MISSOURI

In due course all red tape is ironed out and a working model is built. Naturally the feat of getting so much into such a small space calls for professional attention. The record in this respect is held by Mr. Cedric Throttlebottom, who, early in 1937, managed to get eleven resistors, six fixed condensers and two coils into two cubic inches of space. Mr. Throttlebottom unfortunately became mentally deranged after this achievement, and now is confined in a mental institution.

When the working model is finished it is tested by a committee of six who are most critical with respect to its operation. Even in the cheaper receivers it is seldom that more than six oscillations or "birdies" are permitted to appear across any one band. The aligning, too, is accurately checked and if the set is out more than twenty or thirty kilocycles it is immediately rejected.

Test sentences are broadcast, also. Unless four of the six on the committee can understand most of what is being said the set is not sold as a high fidelity model.

In view of the above information it is to be hoped that amateurs will look upon b.c.l. sets with a more tolerant eye and not be so quick to speak unkindly of them.

The Amateur Newcomer

[*Continued from Page 58*]

It is only natural that the reader should wonder as to how reradiating objects may be detected; this may be done quite effectively by first suspecting everything and secondly by approaching individual objects (keeping the transmitting antenna in back of you) with a field strength meter and observing whether there is any increase in the reading as the distance from the transmitting antenna is increased and the distance to the suspected object reduced. Lastly, all b.c.l. antennas should be taken down individually for a temporary check as to their contribution to the general field strength around the building. Once this is done, and providing the transmitting antenna is properly adjusted, b.c.l. interference should be absent or at least reduced to the point where a wave trap will be effective.

It would be advisable for amateurs operating on frequencies lower than 7 megacycles to consider their antenna system in the event of b.c.l. interference, for even on these lower frequencies a high field strength in the vicinity of a b.c.l. receiver will produce undesirable effects. A wave trap will be of very little value in removing the unwanted signal from the b.c.l. receiver if the field strength around the receiver is sufficient to be picked up by an audio tube.

According to the sales reports of leading b.c.l. receiver manufacturers, table model sets far outsell all other models. A typical, leading b.c.l. receiver manufacturer makes no table models with an r.f. stage, and none of their consoles costing under $100.00 have preselection adequate to reject 160-meter-band images. Since b.c.l. receivers are so susceptible to interference from amateur transmitters, it should be worth while to minimize the field strength in the vicinity of the transmitting antenna in accordance with the following:

1. Erect the transmitting antenna as much in the clear as is possible.
2. Check the feed system for standing waves and unbalance. Adjust if necessary.
3. Where possible use an antenna providing some gain, either unidirectional or bidirectional. The use of such arrays seems to minimize the blanketing or "shock" effect.
4. Operate on the exact frequency the antenna and feed system are cut for.
5. Avoid tuned feeders having high voltage at the transmitter end (use untuned feeders if at all possible).

●

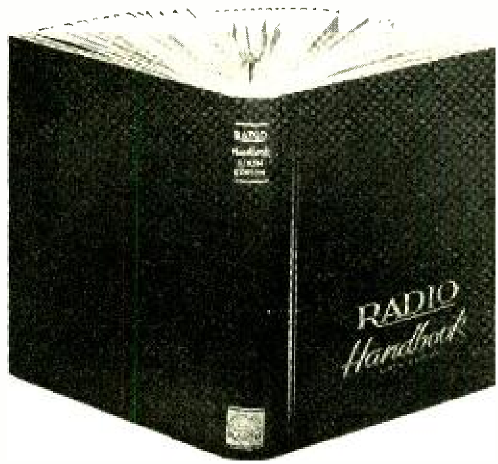
Properly defined completely, *electricity* is a property, a quantity, and a science.

640 PAGES—640 PAGES—640 PAGES—640 PAGES—640 PAGES—

BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER —

BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER — BIGGER AND BETTER THAN EVER —

TOPS!



The 640 page, 1940 Radio Handbook has been acclaimed the world over as the outstanding text of Amateur, Shortwave and Experimental radio.

Complete and easy-to-understand chapters on: Introduction to Amateur Radio; Introductory Electricity and Fundamental Radio Theory; Vacuum Tube Theory; Radio Receiver Theory; Receiver Tube Characteristics; Radio Receiver Construction; Transmitter Theory; Radiotelephony Theory; Transmitter Tubes; Transmitter Design; Exciters and Low-Powered Transmitters; Medium and High-Powered Amplifiers; Speech and Modulation Equipment; Power Supplies; Transmitter Construction; U. H. F. and Mobile Communication; Antennas; Test and Measurement Equipment; Workshop Practice; Radio Therapy: Radio Mathematics and Calculations; Radio Laws and Regulations; Etc.

STANDARD EDITION

Beautifully bound in strong, stiff card cover.

Continental U. S. A. **$150** (Elsewhere $1.65)

LIBRARY EDITION

Bound in handsome lifetime cover. Gold embossed in special library cloth.

Continental U. S. A. **$300** (Elsewhere $3.25)

(ALL SHIPMENTS PREPAID BY US—WHEN ORDERING, USE HANDY COUPON ON PAGE 82)

THE EDITORS OF RADIO *technical publishers*

1300 Kenwood Road, Santa Barbara
CALIFORNIA

Wide Range Audio Oscillator

[*Continued from Page 22*]

absurdly simple once the 'scope and the oscillator are in front of the operator. The procedure, though simple, must be followed exactly as given in order that no error be introduced, since any error introduced at the outset would be cumulative throughout the calibration.

First, it is best to have both the phones and the vertical plates of the oscilloscope (through the amplifier in the 'scope) connected across the output of the oscillator. Then with alternating current directly from the line fed into the horizontal plates of the 'scope adjust the frequency of the oscillator on the lowest range until a figure such as is shown in figure 4A is obtained. This figure indicates that the vertical deflection frequency is exactly twice that of the horizontal deflection frequency. If your local line frequency is 50 cycles the audio oscillator is putting out at exactly 100 cycles; if it is 60 cycles the oscillator is on 120 cycles. We will assume that the local line frequency is 60 cycles, since that is the line frequency in most places.

Turn the synchronization control until there is no interlocking between the incoming signal and the sweep oscillator, turn on the sweep oscillator, and adjust its frequency until a single stationary sine wave appears on the screen. The sweep oscillator is now on exactly 120 cycles. We have thus transferred our standard of frequency from the 60-cycle line to the 120-cycle linear sweep oscillator. Make up a chart of calibration frequencies against switch positions and dial settings. Make this the first calibration point: 120 cycles, range 1, dial 52 (or whatever it happens to be in your particular unit).

Lissajou's Figures

The determination of the calibration points for frequencies intermediate (fractional multiples) between the fundamental and integral harmonics, such as the second, third, etc., can be determined through a knowledge of certain geometrical patterns which will be seen on the screen of the oscilloscope, called Lissajou's figures. Their interpretation is simple enough since they represent, when standing still, fractional relations between the two frequencies which are being impressed upon the vertical and horizontal plates of the oscilloscope.

The fractional relation between the two frequencies can be determined by a simple inspection of the waveform which appears on the 'scope. First, the number of complete bumps which appear along the top in the horizontal direction is counted—this is the numerator of the fraction. Then the number of traces is counted (this may be determined by counting the number of free "tails" at either end of the figure, or by taking *one more* than the number of crossovers on any ascension or descension of one half of one of the sine waves) and this value is the denominator of the fraction which represents the relation between the frequency on the vertical plates with respect to the frequency of horizontal sweep.

Figure 4B shows a Lissajou's figure which represents a 4/3 ratio between the impressed voltage and the horizontal sweep frequency. If the sweep frequency were still 120 cycles in this case, the input frequency would be 160 cycles. Calibration points for frequencies which are intermediate between integral multiples may be obtained in this way.

Integral Multiple Calibration

Now switch to the next higher frequency range and, keeping the *sweep* oscillator on 120 cycles, set the dial of the audio oscillator to the point where two complete sine waves appear on the screen. The oscillator will now be on 2/1 times 120 cycles or 240 cycles. Put this down in the chart and increase frequency until three sine waves appear: this will be 3/1 or 360 cycles. Next comes four sine waves or 480 cycles (the figure for this is shown in 4C), five sine waves or 600 cycles, six sine waves or 720 cycles, and 7 sine waves or 840 cycles.

Since it becomes difficult to count the number of waves accurately with a small c.r. tube, we must increase our standard frequency to enable the calibration of the higher ranges. This is a very interesting and comparatively simple procedure, but it must be followed carefully, step by step. First, the oscillator is tuned down in frequency again until there are five sine waves on the screen indicating 600 cycles. It is important in making all these adjustments to tune the oscillator carefully until the pattern stands quite still. Now retune the *sweep* oscillator in the oscilloscope until there are *six* sine waves on the screen where there were five before. The sweep is now on 100 cycles instead of 120—hence the six waves instead of the five. Now retune the audio oscillator until there are *five* waves on the screen instead of six, the oscillator now being on 500 cycles, and then retune the *sweep* oscillator until there is only one sine wave on the screen. This puts the sweep oscillator on 500 cycles, our new base frequency.

Now by switching the oscillator to the third range the frequencies of 500, 1000, 1500 and 2000 cycles may be checked by their one, two, three, and four sine-wave patterns. Then the audio oscillator may be shifted to 1000 cycles, the sweep oscillator shifted to 1000 cycles to give a single wave, and the frequencies on the next range from 2000 to 9000 cycles checked.

For extremely high audio frequencies the oscillator may be shifted to either 4000 or 5000 cycles and the sweep oscillator increased in frequency until a single sine wave is visible showing that the sweep is on the same frequency. Then this frequency may be multiplied on up in the manner used for the lower frequencies until calibration up to 20,000 cycles or above is obtained.

As a check upon the entire calibration the entire process may be reversed and the difference between the resulting check line frequency and the actual frequency determined. If it is very far off the whole process had better be repeated in order to obtain a more accurate calibration.

See Buyer's Guide, page 98, for parts list.

Bamboo Radiator Elements

By "CHUCK" MURRAY,* W9NWU

Bamboo poles are very strong and also very light, and if they are covered with a thin metal film, they make excellent self-supporting radiator elements. Since, at radio frequencies, all of the r.f. current travels on the surface of the conductor, the metal film to be applied to the poles can be very thin. Lead foil (commonly called "tin foil") or aluminum foil will make a very satisfactory conducting surface for bamboo pole radiators. The cheapest and probably the best source for obtaining the aluminum or tin foil is the old junk box. A one-μfd. paper condenser has two pieces of foil over 16 feet in length, which will make two 20-meter quarter-wave sections with no break in the length of their metal films. If the two pieces of foil are separated with an equal number of sheets of the wax paper dielectric for a backing, the foil can be handled much easier than if it is used alone. This is especially true of "tin foil," which is very fragile.

---

* 3217 Gaylord St., Denver, Colo.

The type of bamboo poles to be covered will depend upon the source of poles in each particular case. The poles used by the author were 16-foot fishing poles, which were one inch in diameter at the large end, and tapered to 1/4 inch at the small end. In spite of the diameter of the small end, these poles were found to be extremely stable, even when covered with several inches of heavy snow and ice, and they are electrically efficient.

It is necessary before applying the foil to remove the knots from the poles. A heavy rasp or very rough sandpaper will take off these high spots in a hurry and leave the poles in good shape to be covered. To cover a pole, a single length of foil is laid out in an open space and smoothed over its length, with the foil facing upward. The smoothed bamboo pole is laid on the strip lengthwise, and using a little melted paraffin the foil and its paper backing are stuck to the pole, rolling the foil and paper around the pole. There may be an objection to the use of the wax paper with the foil, since it will not allow the formation of a perfect metal tube, but experience shows that this is not important, and the use of the paper with the foil adds to its strength and protects it while the pole is under construction. Actually, the bamboo pole acts as the support of a 16-foot (quarter wave) length of foil, whose large area gives a high Q.

Another protective covering is now applied so that the foil and the bamboo pole will withstand the elements. Cheesecloth or muslin cut into two-inch strips, and used as tape, is now wrapped tightly around the pole. After the pole is completely taped, it is painted with melted paraffin to hold the cloth in place and to weatherproof it. A pair of 16-foot poles uses one pound of paraffin, and 1 1/2 yards of cheesecloth or muslin.

To make connections at the end of a quarter-wave section a portion of the wax paper and tape wrapping are omitted over a length of about two inches, leaving the foil exposed. A clamp type connection is made using a thin sheet metal strip 2 inches wide as the clamp. A direct soldered connection *cannot* be made, because if tin foil is used it will melt upon application of heat, and if aluminum foil is used, a lead type solder cannot be used to make a connection.

These fabricated elements are inexpensive, lightweight, and very strong, and are suitable for the construction of rotating beam antenna systems or they make excellent, high Q, half-wave antennas which are easy to mount on a single ladder type structure.

U. H. F.

[*Continued from Page 66*]

fer in polarization). W9AQQ in Indianapolis worked ZHB around this time, but the distance is beyond the usual ground wave work for the Illinois gang and it may have been on an aurora night. It will be interesting to find out more about it.

With 500 watts on HK54's, W9ZJB in Kansas City has jumped up his signal to W9VWU in Topeka, and fading has become nil. VWU lost his beam in an 82 mile wind, so the circuit is now one-way using only a douhlet.

Miscellany

George Readio, who got the call 1AZ when H. P. Maxim got 1AW and Tuska was also in the RI's office, has been handed W1AZ back after being W1KEE for a while. He is on 5 and 75 with 300 watts into 35T's, modulated by RCA 811's with AMC. Before the first world war, George also held the call 1ON and used 1ZS on 425 meters.

In Bridgeport (that's in Conn., you know), W1CLH is still banging away on 56,304 weekdays at 11:30 p.m. Things were picking up by early April so that at least a few stations were still on around midnight. The beam is ready for the rotating gear.

Over at Newport, R. I., W1JFF says that his five-meter rig starts with a 6J5-G ten-meter crystal stage, 6A6 doubler, and 40 watts on a 6L6-G final. The ten-meter rig ends with 48 watts into an 809. The receiver has 1851 r.f., 6J8G mixer and 955 oscillator, all of which were on hand when Fred got the set-building urge. A Kraus twin-three beam *à la* November RADIO is used on ten, and a double section W8JK for five. Fred says that W1MMX will be on soon. He has spent many hours working W1JLK ZE FZU BJE JIS LPO HRZ BGA DJZ, especially late on Sunday nights. W1KLJ and HDQ come in like locals all the time. The Rhode Island and Mass. gang will welcome additions to the rag-chewing list.

W1LKM in Mansfield, Mass., has given up ten and is preparing to settle down on five with 150 watts on a 35T, and a hope for a 75-foot mast to clear power lines.

As receivers go, W3BYF has something different. The first r.f. stage is a concentric line tuned 954 acorn. This works into an 1852 second r.f. which is followed by a 6K8 mixer. The acorn stage increases the signals 2 R's but is at a disadvantage in stage gain when working into a low resistance 1852 input circuit. Noise level is high near BYF so set noise is well below it. The two stations that regularly come through are R9, and noise prevents accomplishing what he wants to do—to bring W3HOH in solid all the time. Pres says that the 954 coax. with only a 10-$\mu\mu$fd. tuning condenser is more selective than anything he has ever seen. The antenna is coupled in with a U-shaped turn ten inches long, right against the inner pipe.

From the Southwest

W5TW in Hugo, Oklahoma, says that he has heard lots of W1-2-8-9 but never a W5. The band has been open a lot but not for his transmitter.

He is going to get out on five this summer, he says, if he has to put the signal in a bucket and carry it out. For a while he used the band to operate the transmitter 20 miles away and to modulate it. Ed is at a nice distance from Dallas and Fort Worth, so may be able to give W5AJG-EHM something to do on dead days. He is converting his 300-watt, ten-meter final for five-meter operation.

Present five meter activity at W6QLZ near Phoenix is confined to nightly schedules with W6MVB at Squaw Peak. Both QLZ and W6KTJ put up lazy-H antennas for $2\frac{1}{2}$ and 5 as described in RADIO for April, with fine results; QLZ is using one-inch copper pipe with $1\frac{1}{2}$-inch line; KTJ uses 7/16-inch aluminum elements. The antenna at 100 feet has a slightly greater gain than a four-element $\frac{1}{4}$-wave spaced beam 50 feet high, and is not critical as to frequency, working well on 40 and 80 megacycles. With QLZ's transmitter on it, KTJ now needs no antenna on his DM36 for an R9 signal.

W8LKD in Ohio will move to Noblesville, 20 miles north of Indianapolis. He says that the gang works W8QDU CIR GGA. He is putting 217 watts on T55's, and is building up an organ-pipe pre-selector. He says that W8NYD and OPO have 954 acorn preselectors using two-inch copper pipes $28\frac{1}{2}$ inches long, as in the receiver described in RADIO last June. No doubt about it, the use of acorn tubes and coaxial line circuits is spreading, in one form or another. Your conductor has not tried them in preselectors, preferring the simple life, no more complicated than an r.f. stage and mixer working directly into the i.f. More stages seem unnecessary, while preselectors involve the difficulty of coupling out of them into something else, without losing gain.

Help for the Relays

W8PK has been having cross-band 95-mile contacts with W8FYC, PK being on 160. He adds that W8DOD and TEX in Rochester are now on five, and W8AGU PKJ BCL SGX are too. W8DRW from Syracuse is about ready with 50 watts. Now get a station in Utica and the relays can work through New York, without making it necessary for W8CIR or someone else to work portable to jump the mountains in Pennsylvania. PK is taking facsimile signals from Buffalo, 73 miles away, on 43.7 Mc. One of the WHAM ops returned from Saranac where he found that Empire State television, about 250 miles away, was being received on Whiteface mountain at 5000 feet.

W8QDU says that W8JLQ near Toledo is working pre-skip dx now with a vertical antenna.

W8SCS in Benton Harbor, Michigan, is really starting at scratch this year, with a new pole, a concentric-line acorn receiver, and the whole works. He and W8CVQ have encouraged the Elkhart, Indiana, gang to get on five. SCS is a little closer to Chicago than CVQ is, so should make things more interesting for the Illinois bunch. SCS has a pair of HK24's in his final now.

W9ARN says that he and ZHB are usually on at 7 p.m. with W9RGH WOQ GAO at Peoria, Illinois, W9BHT at Canton and W9CBJ at Washburn reporting in the net. W9DQH at Urbana is getting ready, and may help to bridge the gap to W9AQQ and W8LKD/9 around Indianapolis. W9UDO in Union, Illinois, promises that some five-meter stations in Rockford and Freeport will join the Illinois net soon.

One of the Milwaukee gang, W9IZQ, called here at Wheaton and brought the news. He does hear Chicago stations now and then, and W9CLH probably consistently. Perhaps it won't be hard to do some more Chicago-Milwaukee work after all.

A Yagi like that at W8CIR is going up at W9USI. W9AQQ and VEK ought to keep Indianapolis on the air, though it may take some organization for them to get a good range of distances to work within 150 miles or so. VEK mentions that some r.f. by-pass condensers in the Organ-pipe receiver described last June should be 50 $\mu\mu$fd., not .005 μfd. The object is to reduce the *inductance* in them, so that they can do some by-passing at five meters.

Vince Dawson, W9ZJB, thinks that BNX should come on with a high powered c.w. rig. Yeah, but it is a long way back from 336 Mc. where your correspondent was generating a lot of a.c. hum lately. ZJB claims to have bet VWU five beers on the best dx for the summer. He is the guy that offered a case to the first station to work all districts on five meters—and had to drink it himself! He has put up a "W2AMJ Powerhouse Antenna" which seems to be an extended vertical double zepp. No reports yet on what the Wichita gang threw, when Vince made a convention speech in April.

W9YZX has moved from Wichita to Kansas City, where he is on with an HK24. W9HCL is on with HK24's and is working on a receiver.

W9HIC of Independence, Missouri, has HK24's also and is building a converter. W9TOQ is getting back after a pause of two years. He and ZJB are putting coaxial lines into their new receivers. W9AHZ is back on the band too, and sends a message on five to ZJB for relay here by mail, to the effect that Bell Telephone is putting bells on their lines to be rung by sunspots. That is, when a magnetic storm develops 45 volts in phone lines, men are called off the poles. No mention is made whether these men can go home and work five-meter dx which is likely at the same time!

Above 112 Megacycles

Falor's suggestion of type 55 tubes for 50c looks good for low power transmitters. Recent 20% efficiency at W9BNX makes one wonder if large tubes and 125 watts are worth while if he can get more than half the power out of a single receiving tube and 400 volts. Ken says that the heavy loading of s.r. receivers is a result of adjusting them to oscillate too easily; if they won't oscillate until the plate voltage gets up to 35 or 40 volts, better results are possible. He objects to feeding the quench frequency into the control grid and drawing a lot of grid current. Except for strictly plate injection, the only other suggestion he made was the use of push-pull detection which he has found to be desirable. He likes a 3:1 ratio grid coaxial line 14 inches long, tuned with 15 $\mu\mu$fd. or less, and an 8-inch line with a 9:1 ratio for the cathode (and heater), similarly tuned, to provide an impedance to make the tube oscillate. His s.r. receivers use separate quench oscillators, of course.

W1LKM in Mansfield, Mass., has a receiver on 2½ and will be able to double down there when he works up some local activity. W1LEA in Lawrence has 200 watts on 35T's, having worked 16 stations out to about 45 miles. The antenna is a vertical doublet, the receiver an acorn 1-10.

Those Smith Transceivers

W5TW built up some of Smith's 2½ transceivers described in March RADIO, and found them good up to at least 24 miles mobile! He has a higher powered job now, and 100 watts at the home station. Ed suggests using the chassis as part of a concentric line for the tuned circuit; he notices that one-tube jobs of this sort work best when the antenna is coupled to both sides of the tuned circuit so as not to upset the line balance.

W6QLZ is certainly all over the spectrum. Some six fellows in Phoenix are building transceivers. The junior college has four for field work and is testing with Clyde, who uses an HK24 with 60 to 105 watts input at 70% efficiency (sounds like xtal control). It works into another of those X-H arrays he has on five meters. W6KTJ has HY615's with 12 watts output. QLZ and KTJ hold nightly schedules using acorn s.r. receivers and long wire antennas. They are making up converters for the band but haven't been reported as buying any copper pipe yet.

On 224 Mc., QLZ adds filament chokes to his HK24 rig, getting out to W6MVB at Squaw

Peak if he takes his receiver over there. Soon, KTJ will have the HY615's down there to give him some company. QLZ says that his 1-160 meter rig with two finals is one better than W1HDQ.

W8CVQ is getting results on 115 Mc. with HK24's, working Grand Rapids and W8NZ in Battle Creek. Walter says that he is using a superhet receiver but will have to try "our" coaxial lines.

The Seiler brothers at W8PK had a 17-mile, 2½-meter contact with W8AGU, using 110 watts into a crystal controlled W.E. 304-B. AGU used a 35 T doubler with 100 watts input. PK also got an R9 report with 20 watts input in an RK34, lines controlled. Rochester activity includes W8EBO and JPP using transceivers good for a mile or so.

W8QDU says that W8GU, on 1¼ using a stacked horizontal beam, found null points at 11-mile intervals. Bliley did not mention it but thinks that the work of the Erie gang is too sketchy to be of real value to anybody but themselves. At a new location, GU expects to do some real u.h.f. work this summer.

Detroit activity on 2½ is reported as "quite pitiful," with a few stations on once in a while. With the advent of frequency modulation and the possibility of fellows like W8CVQ NYD VO CIR getting stabilized equipment, QDU thinks that there will be a mark to shoot at. He has a push-push doubler for 2½ and 1¼, and is investigating the pipe converter as a possibility for a sensitive receiver. QDU has been on frequency modulation, but only s.r. receivers are available so far to check it.

In Akron, W8VO gets on 112 with three hundred watts, his best dx being Canton, Ohio.

June 15-16 Field Days

Julia Morgan, W9LRT, is arranging a Chicago-Milwaukee private field day on 2½ for June 15 and 16. Plans call for putting the LRT rig at W9FXB, 200 feet up, with a six-element Yagi pointed at Milwaukee. Julia is still looking for other good locations for a test. W9GV may help to get the tower of the Edgewater Beach Hotel, a beautiful location about 300 feet up. W9GGH in Kenosha will have a 2½-meter beam up soon and will be able to assist materially in the plan.

So far, most Chicago stations are using fifteen watts or less and the maximum distance is around 25 to 30 miles. Beams are almost unknown. About the only one not using 56's or 76's are W9BAN in Oak Park with T20's, TVT in Evanston with HK24's, and MQM in Evanston with a TW-75 doubler. Frequency modulation at MQM has not been so good, using ordinary s.r. receivers. Antenna coupling to these receivers has troubled many, proper adjustment making the difference between R9 and no signal at all. Tight coupling, high plate voltage, and bad radiation are the custom. LRT gets out better on 2½ than on 5 with the same rig. Harmonics from lower frequency transmitters present quite a problem at times, due to the broadness of receivers. Aha, another candidate for coaxial line circuits.

W9SQE is now active in Chicago with T55's. He will alter his five-meter antenna for two-band operation, which should help him to get out on 2½. A coaxial s.r. receiver is used mostly, inasmuch as signals drift too much for his concentric line superhet used on five. He works W9BAN in Oak Park but does not hear W9PNV in Riverside. W9VJO in Douglas Park is on too.

Dr. John Kraus, W8JK, very kindly arranged to call on W9SLG BNX on his return from giving some talks at the University at Ames, Iowa. Out of his suitcase he pulled a hinged square-corner reflector and folded antenna for 50 centimeters. It used sides a wavelength long made of 0.6 wavelength wires spaced 0.1 wavelength. He promised a full 10 db gain compared with perhaps 7 db from a three element array, and *no* critical adjustments at all. He has tested larger units on 1¼ meters using a simple W.E. doorknob tube and two pipes as the tuned circuit.

The folded antenna connects directly across the pipes, with no feed line. This square corner reflector has been described in RADIO.

W1SS notes the 112-224 dx honor roll run two months ago and writes as follows about a contact reported in this column some time ago: "While we do not agree with some of the articles as printed because of our close contact to what was taking place, we are not going to discredit anyone. So we are going to ask you to put on your honor roll the stations of W1BBM of Bernard Bates, North Harwich, Cope Cod, Mass., and W1SS of Art Stockellburg of Arlington, Mass., who have worked each other many times on 112 Mc., and still believe they hold the world's record of 81 miles for amateur station operation." The implication seems to be that the thing should be rechristened a liars' contest, which is quite o.k. by us, too. Only, let's make it good. The band *is* capable of the distances reported.

Out of Phase Excitation

After wishing you all good dx in June, the column is closed in a lighter vein with the following gem cribbed from the "literature":

There was a little daschund once
So long he had no notion
How long it took to notify
His tail of his emotion
And thus it was that while his eyes
Were filled with woe and sadness
His little tail kept wagging on
Because of previous gladness.

Simplified Carrier Operated Remote Control

[*Continued from Page 16*]

band) can be accomplished by means of a motor-driven vernier condenser in a suitable electron-coupled oscillator. A s.p.s.t. relay in the anode circuit of V_4 can serve to start and stop the motor. The motor speed should be geared down so that the tuning condenser in the v.f. oscillator can be stopped as the transmitter frequency reaches the desired spot (as checked on the station receiver or monitor). "Coasting" of the motor can be taken care of by means of a friction drag on the armature shaft. With a system of this type, one-half the frequency range covered by the vernier condenser in the e.c. oscillator must, of course, be limited to a value which corresponds to the permissible detuning of the other r.f. stages in the transmitter.

See Buyer's Guide, page 98, for parts list.

It's Getting to Be a Mouthful

"This is W2XXX calling CQ and standing by for any vertically polarized, frequency modulated 112 Mc. station with a modulation deviation not exceeding 25 kc., and tuning from the low frequency end of the band".

Past, Present and Prophetic

[*Continued from Page 6*]

promised here last month. When the story was nearly completed, Dawley suddenly awoke to the fact that the 50-cycle a.c. upon which he was basing his description of the calibration was most handy for the purpose, but was only available in a few spots in the United States aside from southern California. Why we are honored with the convenient stuff in this part of the country, we don't quite know. The method of calibration he finally described in the article is suitable for either 50- or 60-cycle supply.

De Luxe 112-Mc. Transceiver

[*Continued from Page 30*]

will be possible when the microphone is poled correctly. This switch permits the quick reversal of polarity that is required in order to make the difference easily detectable. When once correctly set, the switch may be left alone even when changing microphones, as single-button microphones do not generate their own voltage and hence have no inherent polarity so far as voice waveforms are concerned. The only way to reverse the polarity of the voice waveform *in the microphone circuit* is to reverse the polarity of the microphone battery with respect to the microphone winding. As the polarity of the microphone battery is fixed because of the fact that it is also used to supply bias, the reversal is accomplished by "flopping over" the leads to the microphone winding. *Simply reversing the two leads to a carbon microphone will not reverse the polarity of the voice wave form in the speech amplifier.*

One of the earlier versions of the transceiver took the mike voltage directly from the "hot A" through a filter choke, the latter being required to eliminate vibrator "hash." A 50-μfd. 25-volt electrolytic provided a return for the voice frequencies to ground. Bias for the 6J5 was obtained by means of a cathode resistor by-passed with a 10-μfd. electrolytic. The total cost of these components was just under $2.00. In the final version these components were displaced by a single 1½-volt dry cell costing 30 cents, this battery furnishing both microphone current and C bias for the 6J5. Because a single-button microphone draws only 50 ma. or so at 1½ volts, and because the battery is good for at least 30 amp. hours, a battery such as this will last for at least 600 hours of *transmission*. There is no drain on the battery when S_1 is on *receive* or the microphone plug is pulled out of the jack. It is evident that under these conditions the battery will probably last longer than the transceiver.

No attempt should be made to use a small flashlight cell for the microphone. The internal resistance is sufficiently high that trouble may be experienced with feedback when the battery is also used for bias. When a standard dry cell is used, no such difficulty will be experienced.

Thanks to the 6J5 speech amplifier, a single-button microphone will deliver more than enough gain even though the microphone voltage is quite low.

Construction

The rather strange and undeniably "haywire" arrangement of the unit illustrated is due to the fact that it was constructed with a dummy glove compartment panel as the front panel, in order to permit installation of the unit behind the instrument board, and also to the fact that the unit was changed or rebuilt at least a dozen times on the same chassis and front panel. Shorter tank leads to the HY-75 could be obtained if the HY-75 socket were lowered or the tuning condenser raised about an inch. However, as the tuning condenser was originally placed for an inverted 6J5GT, and as the socket could not be lowered any more than illustrated without its protruding too far below the line of the front panel and preventing the installation of the panel on the instrument board, it was decided to see what would happen if the leads were not as short as they should be. The high oscillator efficiency obtained indicates that nothing serious results from the comparatively long tank leads, though it undoubtedly would be advisable when constructing a unit from scratch to arrange the tuning condenser and oscillator socket for the shortest possible tank leads.

The exact layout of components is not particularly important so long as the r.f. leads are short and rigid. C_2 should be of the smallest available (physical) size, and the two r.f. chokes should have their leads cut off short on the "hot" end so there is just enough left to make a good soldered connection to the tank. The tuning condenser should be of the compact midget type which can be mounted by means of a bracket which bolts to the ceramic portion of the condenser. The shaft is sawed off as short as will still allow a ceramic insulated shaft coupling to be attached. Both sides of the condenser are "hot" to ground (both d.c. and r.f.). Be sure that the *rotor* of the condenser goes to the grid condenser, the stator to the plate.

It will be necessary to determine the exact number of coil turns by cut and try, as a very slight variation in turn spacing or in the diameter of the coil will throw the frequency out of the band by several megacycles. The exact number of turns also will be affected considerably by the particular physical arrangement of the r.f. components. For a starter, try 6 turns of no. 14 enameled, soldered directly to the lugs on the tuning condenser. Measuring the frequency by means of Lecher wires, the turns are squeezed in and out or a turn added or subtracted as necessary until the center of the band is hit at the center of the tuning knob.

Regardless of the type of antenna used, inductive coupling is to be preferred. One or two turns of solid, rubber-insulated no. 18 or 16 around the center of the tank coil will suffice for most any feed system. Intermediate values of coupling can be obtained by enlarging the turn or turns, or sliding them towards the grid end of the tank coil to cut down the coupling. For a given number of coupling turns, greatest coupling will be obtained when they are just slightly larger than the tank coil diameter and are placed around the center of the tank coil.

It is practically impossible to have really short tank leads if provision is to be made for removing the plate and grid clips. For this reason, the tube is inserted in the socket, clips placed on the grid and plate caps, and leads soldered directly to the clips. If the soldering is completed quickly there is no likelihood of the caps becoming loose, or the envelope glass cracking from the heat of the iron. No. 18 or 16 bare or enameled copper wire makes a much more efficient conductor than flexible braid, and if the clips are not to be removed there is no point in using braid. The wire should first be bent so that it will not be under tension when soldered at both ends. This will prevent the possibility of cracking of the envelope as a result of strain on the glass.

Operation

If the unit is to be used for actual mobile work, and not just while the car is parked, the antenna should be rigid. A length of 3/8 inch o.d. aluminum or dural tubing makes a good radiator, and will not vibrate or whip seriously when the car is in motion. A 2-foot length of such tubing, mounted on the side-cowl of the car by means of a feedthrough insulator at the bottom and a standoff insulator up about 3 inches from the bottom to steady it, makes about as good a radiator as does a longer rod or pipe, provided it is adjusted to exact resonance. This means that when excessive antenna coupling is used, a "dead spot" should appear at the exact center of the band. If it does not, the length of the radiator should be altered until it does. Then reduce the antenna coupling until the transceiver will just superregenerate over the entire band when the regeneration control is advanced full on. The bottom of the radiator is best fed with Amphenol low-loss concentric cable. If the line is quite short, the cheaper, rubber-insulated variety of concentric line may be used without excessive loss. The cable should not be over 36 ohms for best results.

A quarter-wave rod may also be fed with good results by means of a single wire feeder attached about ⅓ of the way up from the bottom. In this case the bottom of the radiator is not insulated from the car chassis, but instead is bolted directly to it with a good electrical connection to the car body. The length of the radiator should be "trimmed" as mentioned above to get it to resonate at the exact center of the band.

While it is possible to get the antenna to load the oscillator when considerably off resonance simply by increasing the antenna coupling, much greater field strength is produced when the antenna is operated at exact resonance.

The "hot" 6-volt lead to the Vibrapack should be of no. 12 or larger wire and be no longer than absolutely necessary if a full 300 volts is to be obtained. The switch used to turn on the Vibrapack should be rated to stand 10 amps. A filter consisting of a 16-μfd. electrolytic either side of a *low resistance* 100-ma. choke is recommended.

When all through operating the transceiver, be sure that the microphone plug is removed from the jack or else turn the send-receive switch to *receive*. If the microphone is left plugged in and the switch is left on *transmit*, the microphone will continue to draw current even though the transceiver is turned off.

Important note: Because the HY-75 detector has a directly heated filament, there may in same installations be an objectionable amount of hum in the speaker on *receive*. If such should be the case, the hum can be reduced to a negligible value simply by utilizing a separate lead and switch for the "A" supply to the Vibrapack. The Vibrapack "hot" lead should go *direct to the battery terminal*, so that there is no battery lead or switch common to both Vibrapack and transceiver filaments. It is the intermittent drop (due to the vibrator) in a common lead that results in modulation of the filament voltage, the modulation being applied to the grid in the form of varying bias and resulting in hum.

See Buyer's Guide, page 98, for parts list.

●

The resistor is known by more different names than any other radio component.

Non-twisting Feeders for the Rotary

By ED. RIMATHE,* W9TIO

One of the disadvantages of the unidirectional rotatable type antenna is the necessity of incorporating some sort of arrangement to feed the antenna without tangling the feeders when the antenna is rotated through a full 360 degrees. The arrangement used at W9TIO provides a very satisfactory solution to this problem and for that reason should be of interest to those at present using a rotatable antenna or those contemplating building one.

The three-element antenna at W9TIO is of the "revolving pole" type. The 4 by 4 pole and the bottom of the inverted A-frame which supports the elements may be seen in figure 1, which shows the action of the swivel during a 180-degree turn. A more detailed drawing of the swivel itself is shown in figure 2.

Three pieces of strap iron, a short length of ⅜-inch pipe and two 5/16-inch bolts about 4½ inches long are the only materials required for the swivel. The strap iron pieces are of 1½ by ⅛ inch stock. Piece A is 6 inches on each of its long sides, or legs of the U, and 4 inches across. As shown in the drawing, 5/16-inch holes through each end of the U act as bearing surfaces. The piece of ⅜-inch pipe is cut so as to fit between the open ends of the U, thus holding these ends firmly against the bracket B. This bracket holds the swivel assembly to the pole; it should have two holes drilled in the long side to pass lag screws or bolts running into or completely through the pole.

* Slater, Iowa

Piece C, which is the support for the feeders, is a 2½-inch long piece of the strap iron. It has a 5/16-inch hole at the center of the long dimension and near one edge acts as a bearing to allow it to turn when the pole is revolved. Since the feeders used are spaced 2 inches, the small holes in the opposite edge of this piece are likewise spaced this distance between centers. If feeders with wider spacing are used, piece B will have to be longer, of course. With more widely spaced feeders it will also be necessary to make piece A longer than its present 6 inches, to allow the feeders to clear the pole as it revolves.

In operation, the feeders from the shack to the pole do not turn, but move a small distance horizontally, as well as 5 or 6 inches back and forth. This motion makes it necessary to use springs or a weight at the shack end to keep the feeders taut at all times. The use of springs is illustrated in the drawing. The springs can be of the small, inexpensive variety used for door-closing purposes. A single spring with a bridle arrangement might be used but the two springs

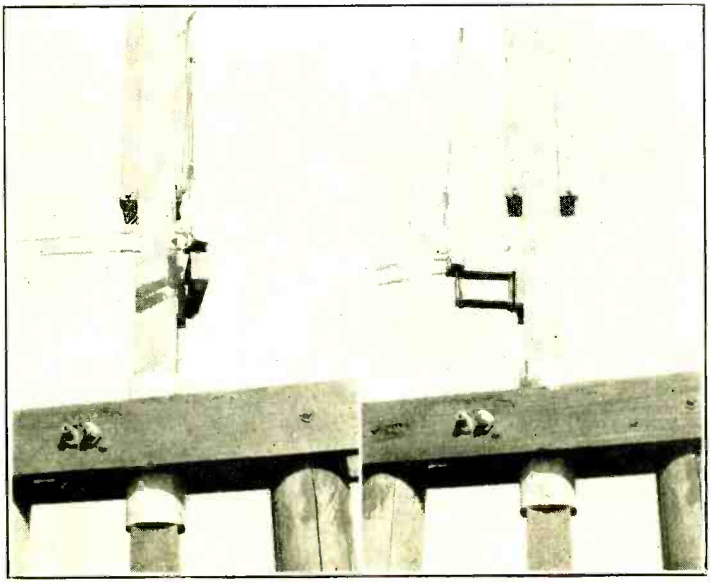


Figure 1. Showing the action of the swivel when the pole makes a 180-degree turn. The antenna is in its extreme clockwise position (looking from below) in the picture at the left and has been revolved 180 degrees in a counter-clockwise direction in the photo at the right. Another 180 degrees in the same direction will bring the feeders around behind the pole, but still in the clear.

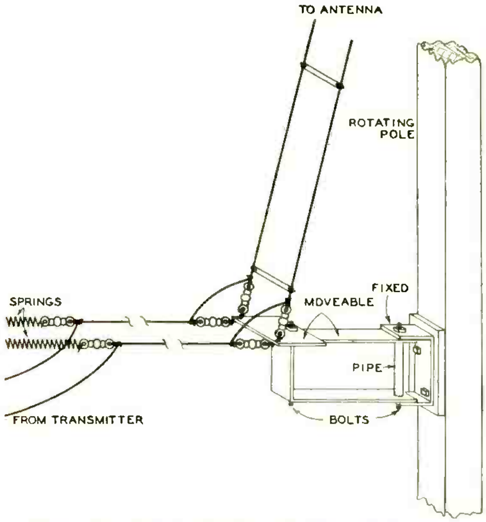


Figure 2. Detail drawing of the swivel and the method of holding the feeders.

will be of material assistance in keeping the feeders from trying to turn over.

A small amount of slack must be provided in the feeders between the swivel and the antenna, since the junction point at the swivel turns through 180 degrees in respect to the antenna when the pole is revolved through the full 360 degrees.

Dotty Dots and Dashes

[*Continued from Page 44*]

teresting of these is the legend of the development of the Morse question mark. Morse was first recorded on a tape, but the time taken for transposition was great and it was found that the recorder made a certain clicking sound that could be read by an efficient operator. Thus the sounder was developed and break-in was born.

The early operators were almost notorious for their profanity, and inasmuch as many operators were paid by the number of messages sent each day, a missent character brought on a very emphatic "damn" from the receiving operator, followed by the last word received correctly. As time meant money to these ops the "damn" was shortly abbreviated to "dn" (-..-.), which became recognized as the question mark on all Morse circuits. The sign for the period came about similarly. Originally the word was spelled out, but became shortened until the first syllable became completely lost and only the "ud" remained (..--..), which became the landline period.

How many hams know that the abbreviations "73" and "88" were used by the landline Morse operators long before Continental was ever used? The numbers 4, 5, 25, 30, 73 and 88 have been used by landline operators almost since the beginning of the art. Who used them first is no longer a matter of record and a number of legends surround their early use. The only ones used extensively by the ham fraternity are the last two, and both of them are subjected to abuse. Even on c.w. we hear "73s." The abbreviation "73" means "best regards," *plural.* Profanity is prohibited on landline circuits, just as it is on the air, and "88, love and kisses," was the equivalent of "sissy," and implied plenty to any seasoned op—to say nothing of the lids.

This reminds us that the term "lid" is another term borrowed from the Morse fraternity. Its origin also is surrounded with a number of legends, but the one most probably correct is that it is an abbreviation of the word "lifted." If an operator could not "cut the buck" on a hot wire he was taken off, or "lifted," and placed on a "way" wire where the going was not so rough. Consequently an operator that was continually "lifted" became known as a "lid."

We hams are often tempted to spring on the lid that classic but unofficial abbreviation "QLF?" (Are you sending with your left foot?) But none can compare with the old Morse man's question, "How come you are sending with snowshoes on and with the key screwed to the ceiling?"

Other abbreviations that the hams have borrowed from the Morse men are almost as numerous as the sands of the sea. Looking over a list of abbreviations in any amateur handbook is of little education to any Morse operator. Most of them have been listed in *Phillips Press Code* for years, and if some old timer sends you "asap," calm down. He isn't calling you names; he means "as soon as possible."

112-224 Mc. Hints

[*Continued from Page 46*]

pink spot at the point where the bulb is nearest to the r.f. In fact, at ten centimeters, the glow is almost all blue. This can be used to detect squeeging and other low frequency parasitic effects in the oscillator. Sometimes, when the rig is adjusted for best output, the neon bulb glows orange, but if the plate tuning is changed slightly, the glow may become pink and blue, and the hum modulation disappears from the carrier.

Puka Pinnacle

[*Continued from Page 12*]

birds, and in these the females deposit their eggs. So thickly populated with nests was this section of the island that we were forced to thread our way back and forth to avoid stepping on eggs or setting birds. Arriving at our quarters, I found sleeping space ample and comfortable. Rainfall tapped in tanks is sufficient to provide most of the water supply, and a sun heater contributed warm water for bathing purposes.

From my window the view consisted of a bit of sand spotted with sea birds and a wide segment of sparkling lagoon. Far beyond that was the barrier reef where combers were breaking in silent white explosions, their spray obscuring the horizon. Jutting into the picture in the near foreground was a corner of the building which housed the weather apparatus.

This structure we decided would be our shack. A few minutes of conversation had revealed that young Mr. Parnell was hot after the idea of becoming a licensed amateur. Discovering that in his school days he had been a licensed W9, I brought out a ham manual, a set of papers for the class C examination, and promised to give him the exam in two or three days if he'd bone up for it.

To this he agreed at once, deferring studies only until we'd had a talk fest, and it was unanimously agreed that conversation flowed most easily when hands were engaged most busily *in setting up a ham rig!*

The idea had been buzzing between my earphones throughout the flight, and great was my elation at hearing this Sand Islander name off enough odds and ends of his own to supplement the contents of my junk box.

We set to work feverishly.

The shack was situated on a slightly elevated mound of sand and coral. Total elevation above sea level of this knoll: ten feet! Indeed, the entire island has an average elevation of little more than six or seven feet. Coral, projecting here and there through the sand, was pitted with small depressions or holes. In the Hawaiian language such holes or pits are "pukas" (pronounced "pooh-ka"). Consequently the alliterative location we referred to on the air as our geographical position, "Puka Pinnacle," suggested itself long ago to whoever named the island and charted its elevation, although imagination must have supplied a great part of the "pinnacle."

The building which was to house the pioneer KE6 station was a wooden structure of some 10 by 16 feet. Its corrugated metal roof sheltered a number of weather gauging devices, but there was ample room for the installation of an amateur transmitter as well.

Here we worked through the hot afternoon with a combined collection of misfit parts which needs no further description. The coil of antenna wire now proved worth its weight, and we soon had an antenna erected fairly well clear of the ground and nearly 600 feet long. Its direction was slightly north of east.

In another hour or two we had a low power suppressor modulated rig on the air. Our glee over the first contact should by now be understandable, and so we grinned the incandescent grins referred to at the outset of this article.

Portable KE6 was on the air and would operate all bands when the antenna, with our one "mike" coupling condenser, would load. The station, now with a small tuned r.f. receiver, was complete. Then the fun began!

After the W6CQS contact was completed, pandemonium broke loose! Honolulu observers later reported that the band was crowded with stations, but to us it was a horse with a different color, since with the t.r.f. receiver on 14,200 its very broadness seemed to jam all R9 sigs onto one frequency and we could hear just about everybody on 20-meter phone at the same time. As a result, the last R9 station to give his call was the one we were able to contact.

Later that evening when 20 meters petered out and 80 seemed too crowded after one contact, we shifted to 160-meter phone. About twelve contacts were made on this band, and we gaily subscribed to the theory that this feat must be a record of some kind since operation over 3000 miles of water plus, in some cases, additional land distances gave a few contacts a total of over 4000 miles.

So enjoyably filled were the afternoons and nights with contacts from many mainland friends and from elsewhere around the world that time seemed to have run out of a dump valve. Before I knew it planes were landing on the return flight, and I was saying goodbye to Sand Island and Puka Pinnacle. But only in the flesh, for I left all my gear in the hands of Roger Parnell. Reason: I, too, would like a contact with Johnston Reef, and it is quite possible that this district will be heard from again, since on the day prior to our planes' departure, my associate in this adventure took his examination for the class C amateur license. If his ticket is granted we may all make his acquaintance soon and have another try for a contact from Puka Pinnacle.

(Roger Parnell has received his license and may now be heard on 14-Mc. c.w. signing KE6SRA. Mail should be sent care of the Postmaster at Honolulu.—Ed.)

There follows a brief summation of data from the log of K6NYD/KE6:

Worked on 20-meter phone: W1ADM, W2JT, W2IXY, W3FAM, W5VV, W5BB, W6BGW, W6CQS, W7GAE,* W7ACD, W8ROP, W9CVN, W9NDA. Foreign: J2NF, PK4KS, KA1OZ, ES5D, LU4BC, XU8AM . . . and many K6's including K6BNR, K6MVA, and the home rig with K6MZK at the mike.

On 75-meter phone W5EGR was worked.

On 160-meter phone: W5FSQ, W5ADJ, W6PZB, W6PGJ, W6AUZ, W6NYS,

* Charley, it is pronounced *"poohka."*

W6NUR, K6QMC, K6RVF, and due to the kind efforts of W5ADJ signal reports which ordinarily could not have been exchanged due to poor conditions were exchanged with W8SRV, W4ETY, and W9CZN.

On c.w.: W6MUS was worked but reports on the note were not so good. Later, W6OEG and W1IOZ were worked.

Some stations called that were not worked: W6LXA, W5BIN, W6EIP, W6JJ, W7GFU, W1IED, W6LR, W6KUF, W6MZD, W1JFG, W2HS, W4BMR, W6BMA. Foreign: OA4AI, I1JKV, CE1AH, PY2EA, LU7BK, ES4G, CE2BX.

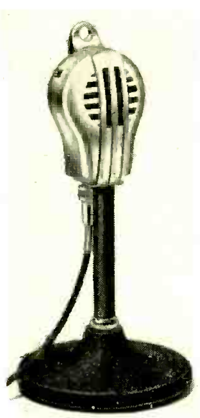
In five days 125 contacts were made on 3 bands.

What's New in Radio

[*Continued from Page 68*]

HAND MIKE FOR WIDE APPLICATION

The Turner Co. has released a new, low-cost microphone named the "Han-D" because it is shaped to fit the hand and also because it is handy for so many purposes. Available in both crystal and dynamic, this new microphone fits snugly into the hand, has a hook which allows it to be used as a hanging mike for stage work and call systems, and is designed to fit any standard desk or floor stand with 5/8-27 thread. It is furnished with an 8 ft. cable set, but a 25 ft. set or longer can be furnished. A removable connector is furnished so that cables can be changed or repaired without opening the mike.



A positive contact slide switch affords easy action on the Han-D, and permits the off and on switch to be operated without thumb fatigue. The frequency response of both the crystal and dynamic models is engineered to be suitable for both close speaking (voice application) and for voice and music pickup where the performer is at a distance. Voice reproduction is crisp and clear without unnecessary sacrifice of bass response, yet feedback problems are held to a minimum.

According to the manufacturer, the Model 9D Dynamic Han-D should be chosen when the microphone will be subjected to extreme heat, cold, humidity, or rough handling, or where extremely long lines are necessary. This dynamic is particularly recommended when the mike is to be used in an automobile. The model 9X Crystal is slightly less rugged than the 9D, yet withstands a great amount of abuse, and gives clear cut performance on both voice and music. The output is slightly greater than for the dynamic.

Complete information on these Han-D models may be had by writing the Turner Co., Cedar Rapids, Iowa.

All-Purpose Portable Transmitter

[*Continued from Page 37*]

phone-c.w. switch S_7, d.c. power socket, audio output socket, and remote control jack.

Figure 6 was taken after a crystal microphone input was installed and therefore doesn't show the microphone transformer. The modulation and filter chokes may be seen clearly and also the bleeder. It could hardly be termed a neat job of wiring, as the photo shows; however, rigidity and efficiency were the two factors as far as we were concerned.

Antenna Coupling

Due to the fact that a makeshift antenna is the usual thing when a person operates portable, we tried to design a versatile coupling arrangement that would still have the benefit of an antenna tuning indicator. When a tuned antenna is going to be used, such as a Marconi or zepp, the link K_1 is used. This is the conventional series-tuned system that practically everyone is familiar with. The pilot light is in series with the circuit with a few turns of wire shunting the light to keep it from burning out (L_7). If an untuned type antenna such as a doublet is available, link K_2 is used. One side of the link is brought out to a third binding post and the other terminates on the antenna light shunt about four turns in. It was necessary to tap down the antenna light shunt in this manner to prevent the light from burning out on the higher frequencies. Due to the fact that the antenna coil is so close to the final amplifier coil, only one turn on the link on both the antenna coil and final amplifier coil is necessary (K_1). Link K_2, however, should have two turns to load properly to some untuned antennas. A number of long-wire antennas were tried on the untuned coupling link, K_2, and it was surprising how well some of them loaded up and how good were the reports we received, especially on 10 meters. In one instance an 80-meter zepp was coupled just as though the line were of the untuned variety and the loading effect and reports on 10 meters far surpassed all expectations.

In the 6L6 final amplifier stage all r.f. bypass condensers, C_5, C_9, C_{10}, are connected direct to the cathode, with the cathode itself bypassed to chassis. This is good practice in any high gain r.f. amplifier and will do more to eliminate parasitics in many instances than parasitic chokes. There were no parasitics that we could detect in this particular 6L6 stage.

No cathode bias is used in the 6L6 final stage due to the fact that there was no voltage to sacrifice. However, if another transformer is chosen that supplies more voltage than the one used here a portion of the additional voltage may be used to advantage in the form of cathode bias. Also it would be possible to operate with condenser input and obtain the same results. If cathode bias is used it will be necessary to compensate for the additional bias by reducing the value of the grid resistor R_1 and R_7.

The complete unit would be adaptable for 5- and 10-meter mobile operation due to its small physical dimensions and rigidity. The outside dimensions of the cabinet are 7x 7½x14".

Practical 2-Band Rotary Beam

[*Continued from Page 27*]

one half turns around the master pulley, and at the center of the one and one half turns it should be fastened to the pulley. The cable is then fed over the feed pulleys and dropped down to the operating room.

On the window ledge of the operating room, a 1½-inch diameter pulley 7 inches long is used with 15 turns of the drive cable taken around this pulley. This pulley (RHM12) can be made by using a piece of shafting 7 inches long and 1½ inches diameter and having a hole drilled through it to take a ½-inch shaft as it must not turn independently of the shaft, but must be a part thereof. To support the shaft and pulley, two small pillow blocks (RHM14) are mounted outside the window on a board. The ½-inch shaft then can come into the room through a conventional under the window lead-in board. A crank handle or small wheel on the end of the ½-inch shaft and the installation is complete. If a pulley is used on the shaft instead of a crank handle, a very light motor with a reversing switch will drive the beam very easily. The cable drive can be made out of heavy clothesline wire. A good suggestion is to use a piece of phosphor bronze cable to make the 15 turns around the small pulley, as it will grip this small diameter pulley much tighter than the stiff clothesline wire. The cable should be pulled taut and no slack or sag permitted, as it is upon the tight and constant pull of the drive cable that the brake of the beam depends. If rope is used, be sure to provide a means of taking up the contraction due to weather changes. Pulley ratios are approximately 15 to 1.

Use a 4 x 4 inch mast for supporting the beam. First mount the shaft and bearings on the mast, then bolt the plate or gear to the pulley and the frame through the wood pieces (FW5) with the four ⅜-inch bolts (RHM3). Use a hinged bottom on the mast and push it up to the vertical position. The whole assembly can be raised by one husky, and two if needed.

DX

[*Continued from Page 56*]

tne conditions seem to be very fine, if only things were like they "usta" be with all the Europeans Africans, Aussies, Zedders, to say nothing of all the colonies. Yessir, remember when? The last Saturday night of the A.R.R.L. contest 7 Mc. sounded like old times. The Asians were surely pounding through in great style. With conditions like that it would have certainly sounded good to hear those rock-crusher signals come through from the above mentioned parts of the globe. However, let us be content with what we have and by all means let's not stick our neck out in such a way that we W's might lose the chance we have of remaining on the air. Briefly, if we hook up with *any* station, it doesn't have to be in Europe, let's keep our conversation strictly on the neutral side.

Well, let's see what we can dig out of the mail bag. W9ELX has been active on phone as well as c.w. On phone he has added OQ5AB and KB6CBN making 34 and 89, while on c.w. he has 38 and 113. Some of the stuff ELX has worked recently includes KC4USA, XU8AM, KA7FS, PK3BM, KA1OZ, KA4LH, OA4R, PK4KS, CE1AR, KA1CD, KA1CW, YS1MS, KA1LB, HR5C, YN1IP — these on phone. W8CLM adds a few to his honor roll list, KC4USC, HK2BD, HC1VT, and TG9AA making 35 and 99. W2AIW worked XU8MI and of course unless you've heard it before he grabbed AC4YN along about February 18. A word from Henry Jones, W6GCT, indicates he is getting set to be a little more active. GCT was in a terrific auto crackup last year and between you and myself, he has a dx man's luck, and is here to tell us about it.

W2GTZ went slightly berserk on March 23 and worked AC4YN. Reeve says he doesn't think he'll ever be normal again. (I just heard ol' 1492 snicker and say something about no dx man is normal.) Anihoo, this makes GTZ 39 zones and 153 countries. Oh yes, the time was 1325 G.m.t. W6MVK just discovered another zone that had been idle in his log . . . U9AC, and this gives him 37 and 118. MVK reports that XU5MK is David Liang, Box 61, Kumig, China, and that XU5MK is coming to the States soon to study at Michigan U. XU8WS has put up an 8JK and likes it fine. W6MVK has a new rig using 75T's with 750 watts input. For the benefit of those who do not know who XF1A is it can be told again here that it is just the same ol' dxer, XE1A/XE2N. I imagine that XF is an official Mexican prefix.

W8NV has been very active on phone and ran up 357,000 points in the recent A.R.R.L. test. George adds a few to his combined total, OQ5AB, KG6NVJ and YS1MS making 35 and 94, while on phone only he has 28 and 65. W8NV uses two rigs both of which wind up with 250TH's in the final. One is on 14 Mc. and the other is on 28 Mc. and each of them works into a 3-element rotary. W4EMV worked KC4USA April 8 and was running only 100 watts to his T55. He calls his antenna a Signal Pusher.

ON4AU says if any of you fellows have worked any of the ON stations you can send the

W6GRL and W6NLZ work AC4YN

Patience has its rewards they say. This case proves it. On April 18 at 6:00 a.m. p.s.t. Doc Stuart hooked up with AC4YN after two weeks of getting up at 5 a.m. This is to say nothing of the three years of casual gunning for Reg. On the next morning, April 19, W6NLZ worked AC4-YN. These are the first two W6's to connect up with Reg, and it shows that it can actually be done. Doc says he was pretty weak but clear enough. The skip at that time for the W6's is screwy, with one antenna working about as good as another. An hour later would be best for the west coast, but apparently Reg is tied up at that time. W9HLF and KB6RWZ are still skedding AC4YN every day they can. Nice going, Doc and Johnny. I guess you won't talk to us now.

cards to him and he will pass them along. ON4AU is having a tough time getting cards out of a flock of stations such as KF6DHW, YA5XX, U8IB, U8ID, J8PG, PK5HL, AC4YN, PJ5EE, YV2CU and FN1C. He says probably AC4YN and YA5XX are NG but it's worth trying.

K7GSC writes from Juneau, Alaska, stating that effective May 1 Southeastern Alaska will go on Pacific Time instead of the former 135th meridian time. Jerry says also that K7AOC has put up a new 3-element rotary, while he himself uses a V with 4½ waves per leg, pointed at Chicago.

A letter from Tom Cunningham, VE2JK and VO6D, states that he surely misses the key click across town as well as hearing a certain station working W9's. Tommy says he was checking over his old logs and finds that he had never worked zone 2, and yet he was located there himself for a year. He did work his old pal VO6J on commercial frequencies but that won't do very well for ham counting. Of course you fellows know that when we refer to the above dx men by their calls we realize they are actually ex-hams, but we think it better to call them as we have always known them, rather than to hang an ex in front.

W7AMQ had quite a time in the recent contest and claims his xyl also had a lot of fun supplying him with food, etc. He'll have to watch out in the next contest because with such enthusiasm on her part, she will be doing the operating and he will be dishing out chow. Gale added a couple in CX2CO and J8CI, which gives him totals of 26 and 47, on phone.

W2IXY, Dorothy Hall, has added quite a few to her list giving her a darn good total of 33 zones and 102 countries. As she says, "Remember I am only a yl." I guess a lot of the om's would be glad to do as well. W3KT has been gunning for a long time for an OQ5 as he needs that zone badly. He has revised his country total by dropping a VU and ZP which proved to be NG. This gives Jesse 37 and 104 . . . almost forgot to say he added one which helps, this one being J8CG.

W5VU from Dallas just got up his rotary in time for the contest, and it netted him about 602,000 points on phone. Here are some of his recent and their frequencies: J2CS, 14,210; J2NF, 14,175; J5CW, 14,080; J2XA, 14,090; J7CB, 14,060, J2NG, 14,070; J2NQ, 14,070; XU8AM, 14,092; PK4KS, 14,040; PK3GD, 14,030; PK3JK, 14,120; PK3BD, 14,035; PK1JR, 14,040; KA1ME, KA1LB, KA1FH, KA4LH, KA1OZ, KA1JH, all between 14,100 and 14,150.

W7AYO is heard from again. Stan was on in the contest to the tune of 350,000 points. He didn't have much time but had a lot of fun anyway. W6ITH has upped his phone total to 36 and 99, while on c.w. and phone it goes to 37 and 105. The new ones were YS1MS and KC4USA. W6FHQ has worked KC4USA for their first W6 contact. He also worked XU8AM; XU5TH, 14,090; PK1VM, 14,070; PK1OG, 14,070; and XU0A. Barney says if XU0A is in zone 23, what is there left to work? FHQ uses a 3-element rotary of his own and it seems to do very nicely.

W8LFE grabbed his key long enough to land TF5C for his 38th zone and 113th country. We hear that W9EQG from Chicago is on his way to California for keeps. He and the xyl appear to be moving out, mebbe to try a California kw., although I always thought 1000 watts was 1000 watts anywhere. W6MUS has YS1MS and UK9AN which gives Neil 36 and 84. W3BET reports some 14-Mc phone dx which he has been working: HA7P, 14,260; I1TAK, 14,095; I1RE, 14,145; XU8AM, 14,090; PK1OG, 14,050; KC-4USA, 14,150; HA1O, 14,020; K7HAR, 14,185; K6PLZ, 14,200; ES5D, 14,025; OA4R, 14,030; CE1AR, 14,015; YS1MS, 14,110; PK2AY, 14,040.

W1AKY landed three new ones in the contest: KF6JEG, ZP3AC, and YS1MS. This totals to 31 and 92 on phone for Ed. W6DLY has received his card from U9BC which will show this one to be OK. U9BC is in zone 18, making DLY 37 zones and 97 countries.

Whoever ON4A is has been telling the gang to send their cards to me and that I knew where to send them to him. I haven't as yet heard from ON4A but it's all right with me to continue sending them and if I ever do hear, they will be passed along. I hope you fellows will get all primed for RADIO'S contest in October. The next issue will be the last one before the summer lay-off and you will have the summer to get in trim for the "ordeal." As stated before, this next number, July, will contain all the rules for the brawl. Last November and December when we staged the first one things were pretty much on the dull side of dx, but I believe that there is considerably more activity now than then. Conditions should be better also. Last December the shack looked more like a club meeting most of the time, as is always the case here during a test. It seems to be a signal for the fellows to gather at the shack. Anyway, it was a lot of fun and a couple of the fellows pounded a little brass which added a few points to the total. W6OEG, who will be remembered as helping in the pick-up of the Honolulu yacht race, was on deck and surprised everyone by staying awake until midnight one night.

When Roddy, W1SZ, was out here last week he saw quite a lot of "power" for one evening. They were called "Zombies." Just ask him to have a third sometime. Says he, "This must be the so-called California kilowatt." I also introduced him to a W9, just to prove my contention is no myth.

W6OEG, W9ARL and W6QD Bag AC4YN

This is one time when I don't think you will object to your dx ed. giving off steam. Well, you see it happened like this. Having a restless night yours truly decided to get up at 5:30 a.m. and take a look around the band. Asia in general was coming through like the very deuce . . . so tuning up to AC4YN's frequency (14,292) who should I hear but Reg tossing out a lusty CQ. He was so good I thought it was a gag, so just sat paralyzed. After 5 minutes he gave out another one and by this time I was fully awake. The key durned near jumped off the desk, but after grabbing it and punching away for a minute, AC4YN came back. The rest is now history, except that right after our QSO good ol' W6OEG nabbed him in the best sneaker he has pulled yet. It will remain a mystery as to how Bill got up so early . . . because I haven't seen an alarm clock yet that will disturb him. I guess he just doesn't tell all. A little later in the morning W9ARL related how he had just finished his new rotary beam in the afternoon and the very next morning he snagged AC4YN . . . with a 589 report. Johnny believed in starting with the best contacts and working down. Anyway I'm glad the ice has been thoroughly cracked for the gang to get a whack at AC4YN. The W6's have been getting it on the chin long enough. Ouch!!

Advertising Index

The Marketplace

Classified Advertising

(a) Commercial rate 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 4th, and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed as often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(e) Used, reclaimed, defective, surplus, and like material must be so described.

(f) Ads not relating to radio or radiomen are acceptable but will be grouped separately.

(g) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Santa Barbara accompanied by remittance in full payable to the order of Radio, Ltd.

TRANSMITTING TUBES REPAIRED—Save 60%. Guaranteed work. KNORR LABORATORIES, 5344 Mission St., San Francisco, Calif.

QSL's—Samples. Brownie, W3CJI, 523 North Tenth Street, Allentown, Pennsylvania.

CRYSTALS—Police, marine, aircraft, amateur. Catalog on request. C-W Mfg. Co., 1170 Esperanza, Los Angeles, Calif.

SEVERAL guaranteed reconditioned 350 watt JRA3 110-v. A.C. light plants at $45. Ideal for amateurs. Write Katolight, Inc., Mankato, Minnesota.

MOBILE cabinets. Chassis. Panels. Racks. Specials. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

RECONDITIONED guaranteed receivers and transmitters. Practically all models cheap. Free trial. Terms. List free. SX-23s $89.00. W9ARA, Butler, Missouri.

SENSATIONAL—Universal power transformer. Tapped primary producing 600 - 750 - 1000 - 1250 - 1500 vdc at 250 mils. $6.50 guaranteed. 866 filament transformer to match $1.00. PRECISION TRANSFORMER COMPANY, Muskegon, Michigan.

QSL's—HIGHEST QUALITY—LOWEST PRICES. RADIO HEADQUARTERS, FT. WAYNE, INDIANA.

CUSTOM ground 40M X-cut crystals in ceramic holders $2.50. 160 or 80M crystals $1.00. KORADIO, Mendota, Illinois.

ALL communication equipment at lowest prices. SALE on used RECEIVERS, write for list and details. W9KJF, Van Sickle, 34 W. Ohio St., Indianapolis, Indiana.

QSL's—Special—Bargains—June—July! Fritz, 455 Mason Ave., Joliet, Illinois.

CRYSTALS in plug-in heat dissipating holders. Guaranteed good oscillators. 160M—80M $1.25. (No Y Cuts) 40X $1.65. 80M Vari-frequency (5 Kilocycle variance) complete $2.95. State frequency desired. C.O.D.'s accepted. Pacific Crystals, 1042 South Hicks, Los Angeles, Calif.

NEW RIG?—ENJOY earning cost, make—sell baseball games. Write W2HJM.

GOING ECO?—PF1 means RESULTS. Low cost—high ability—compact—complete—get details NOW. Pierce-French, P. O. Box 722, San Carlos, California.

QSL's—Samples. W9RUJ, P. O. Box 27, Auburn, Nebraska.

SELL—Stancor Twenty P. Transmitter. Also fifteen watt speech amplifier. W9QJB.

WANTED—HRO Senior for cash. State condition. W4FZW.

West Gulf Division Convention

The 14th Annual West Gulf Division A.R.R.L. convention will be held in Fort Worth, Texas, June 28 and 29, 1940, with the Kilocycle Club as host. The Blackstone Hotel has been designated as headquarters. Convention Executive Committee consists of R. E. Cowan, Jr., W5GKA, R. R. Stegall, W5ELC and A. B. Dobbs, W5FJP. The Kilocycle Club is being assisted by the Dallas Radio Club, and present plans contemplate the finest and most elaborate convention ever to be held in the West Gulf Division.

Roanoke Division Convention

The Roanoke Division of the A.R.R.L. is planning a convention to be held August 3 and 4, 1940, at Chamberlin Hotel, Old Point Comfort, Virginia. Captain Edmund C. Lynch, W3HWJ, is in charge of the program. Due to the popularity of the convention location as a vacation resort, the committee is emphasizing the bathing, deep sea fishing and other attractions of the area. The program will be light on heavy material and heavy on pleasure.

Changes of Address

To become effective with The Next Issue must be RECEIVED at SANTA BARBARA by the 5th of this month

Address labels are shipped to our mailers on that date. Remember: under U. S. postal laws, magazines sent to an old address are junked unless forwarding postage has been left in advance with the postmaster; unlike letters and cards, magazines are not forwarded either free or collect (except to addresses in the same city).

Circulation Department

Buyer's Guide

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

WALLER REMOTE CONTROL CIRCUIT

Page 13

Z_1, Z_3, Z_4—Guardian Series 60: 2000-ohm coil, type A3 contacts
Z_2—G.18597 Guardian S-120 stepping relay, 200-ohm coil, A2 contacts

●

DAWLEY AUDIO OSCILLATOR

Page 17

C_{1A}, C_{1B}—Radio Condenser Co., 4 gang.
C_2, C_3—Solar MW-1216
C_4—Solar S-0257
C_5—Solar S-0263
C_6—Solar S-0240
C_7—Solar DT-874
C_8—Solar DAA-708
C_9, C_{10}—Solar D-820
½ and 1 watt resistors—Centralab 516, 710, and 714
10-watt resistors—Ohmite Brown Devil
S_1—Yaxley 3226J
T_1—Thordarson T-57S01
T_2—Thordarson T-13R11
CH—Thordarson T-13C28
R—GE Mazda no. S6

●

SMITH 112-MC. TRANSCEIVER

Page 28

C_1—Cardwell ZV-5-TS with mounting bracket (discard 2 segment stator and substitute regular stator plate). A type A insulated coupling is used with the condenser.
C_2—Sprague 2FM-31
C_3, C_4, C_5—Sprague type TC
C_6—Sprague UT-8
C_7—Sprague TA-10
R_2, R_3, R_4, R_8, R_{10}—Centralab 710-714
R_1, R_7—Sprague 5-K
R_5, R_6—Mallory-Yaxley type L
R_9—Mallory-Yaxley Y-50-MP
RFC—Ohmite type Z-1
S_1—Centralab type 1450
T_1—Thordarson T-72A59
T_2—Thordarson T-13S38

Bat.—Burgess "Little Six"
Pwr Pack—Mallory VP-552 Vibrapack

●

STRIKER PORTABLE TRANSMITTER

Page 33

C_1, C_2, C_3, C_4, C_5—Aerovox 1131
C_7—Hammarlund Star SM-50
C_8—Hammarlund Star SM-100
C_9, C_{10}—Aerovox 1450
C_{12}—Bud 911
C_{11}—Hammarlund MC-200-M
CH_1, CH_2—Thordarson T-13C30
S_1—Centralab 1460
Cabinet—Bud ℔-995
Chassis—Bud CB-1194

●

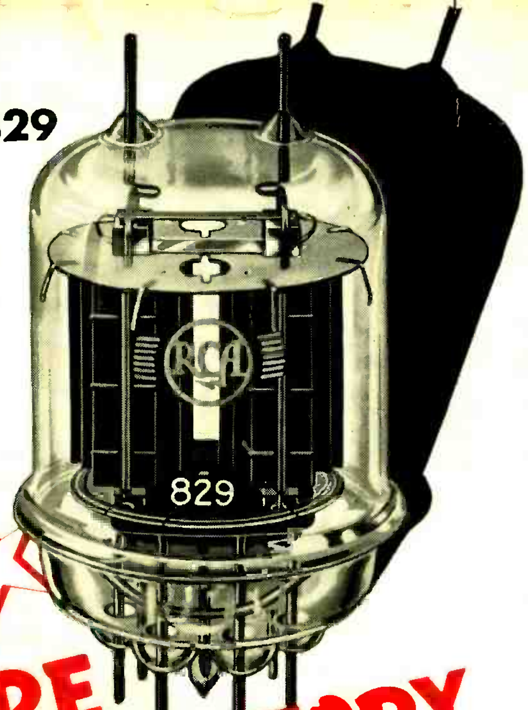
DRIML 28-MC. MOBILE TRANSMITTER

Page 40

C_1, C_2, C_3—Hammarlund type APC
Midget mica condensers—Aerovox 1467
C_{11}—Aerovox PRS-25
Carbon resistors—I.R.C. type BT
B—Burgess 2Z2SC
X—Bliley B-5

HUGHES PRINTING CO.
EAST STROUDSBURG, PA.

RCA-829



MORE TUBE HISTORY IN THE MAKING!

"A WHALE OF A TUBE FOR ITS SIZE"

Small enough to lay comfortably in the palm of your hand, the new RCA-829 Twin R-F Beam Power Amplifier is "big" enough so that a single tube in push-pull class C telegraph service can handle 120 watts power input with less than 1 watt of r-f grid drive—at frequencies as high as 200 Mc. At reduced ratings, it may be operated as high as 250 Mc. And don't forget! The 829 is a real money-saver, due to the simplifications it makes possible in transmitter design. *Neutralization is unnecessary.* The twin structure simplifies circuit adjustments. In brief, at the U.H.F.'s the 829 offers exceptional efficiency, high power sensitivity and plenty of power output. The heater can be series-operated from a 12.6-volt supply or parallel-operated from a 6.3-volt supply. Max. CCS (Continuous Commercial Service) Ratings are: D-c plate voltage, 500 volts; total d-c plate current, 240 ma.; and total plate dissipation for both units, 40 watts. At a plate input of 120 watts, typical power output is approximately 83 watts.

RCA-829 Amateur Net Price **$19.50**

RCA-828

270 WATTS INPUT UP TO 30 Mc WITH ONLY 2.2 WATTS DRIVING POWER

This new multi-electrode Transmitting Beam Power Amplifier offers, we sincerely believe, more for your money than any other tube of its class. It is tops for r-f applications, especially where quick band-change without neutralization is desired. May be operated at max. ratings as high as 30 Mc and at reduced ratings up to 75 Mc. Two RCA-828's may be used as a class AB_1 modulator with 300 watts a-f output and only 1% distortion. Maximum ICAS (Intermittent Commercial and Amateur Service) Ratings for class C telegraphy service are: D-c plate voltage, 1500 volts; d-c plate current, 180 ma.; and plate dissipation, 80 watts.

RCA-828 Amateur Net Price **$17.50**

RCA-1628 THIS TRIODE TAKES ITS FULL RATED 50 WATTS INPUT UP TO 500 Mc

The new RCA-1628 is a general-purpose triode with a tantalum grid and plate. It is capable of operating at maximum ratings at frequencies as high as 500 Mc and at reduced ratings as high as 675 Mc! The three filament leads may be connected in parallel through r-f by-pass condensers, thus minimizing the effect of filament-lead inductance at the ultra-highs. Double grid and plate leads brought out of the bulb through separate seals make neutralization at the U.H.F.'s easy. Max. class C telegraph CCS ratings are: D-c plate voltage, 1000 volts; d-c plate current, 60 ma.; plate input, 50 watts; and plate dissipation, 40 watts; typical driving power at a plate voltage of 1000 volts is approximately 1.7 watts; typical power output, approximately 35 watts.

RCA-1628 Amateur Net Price **$32.00**

Take the mystery out of ultra-high frequencies! Write today for complete technical information on these three new tubes to Commercial Engineering Section, RCA Manufacturing Co., Harrison, N. J.

RCA Radio Tubes

RCA MANUFACTURING COMPANY, INC., CAMDEN, N. J. • A Service of the Radio Corporation of America