
March 1964
50¢
ICD
CQ
s Month:
The Class C Linear
A Look At Sunspot Cycle 19
Using 400 c.p.s. Transformers
700 Watts for Twenty Meters
s...Seven Antenna Articles
Q's Incentive
roposal
See Page 7
The Radio Amateur's Journal

For further information, check number 3, on page 110

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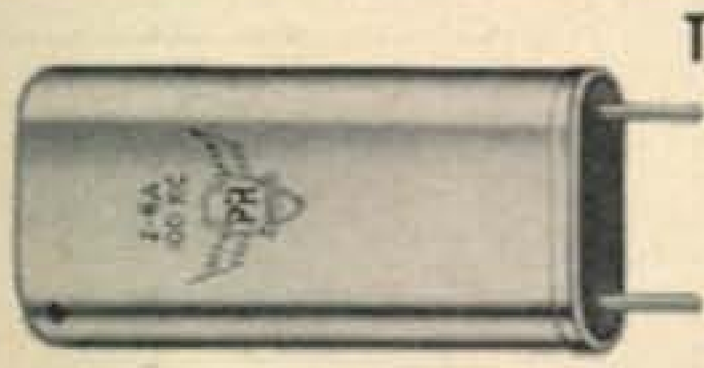

Type Z-6A, Frequency Standard

To determine band edge. To keep VFO and receiver properly calibrated. .050″ pins. 100 Kc. .... **$6.95** Net

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Third Overtone, PR Type Z-9A

Hermetically sealed; calibrated 24,000 to 24,666 and 25,000 to 27,000 Kc., ± 3 Kc.; .050″ pins. . **$3.95** Net

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Fifth overtone; for operating directly in 6-meter band; hermetically sealed; calibrated 50 to 54 Mc., ± 15 Kc.; .050″ pins.
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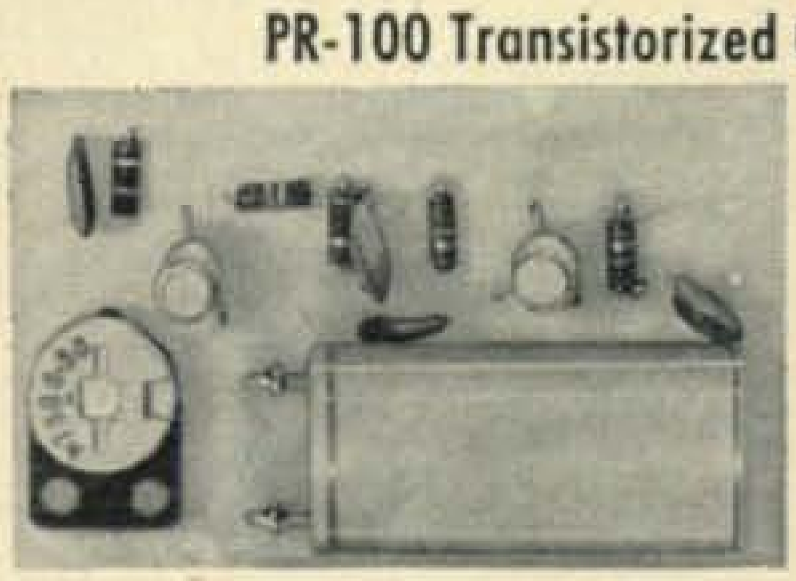

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**COMMERCIAL CRYSTALS AVAILABLE FROM 100 KC. TO 70 MC.
PRICES ON REQUEST.**

For further information, check number 1, on page 110

For further information, check number 2, on page 110

CQ

The Radio Amateur's Journal

Vol. 20, No. 3 *March 1964*

Editorial Staff

OFFICES

300 West 43rd Street
New York, N. Y. 10036
Telephone, 212 JUdson 2-4460

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Manufactured by the same highly skilled craftsmen who produce International commercial crystals for the broadcast industry, two-way radio communication, and our space and missile program.

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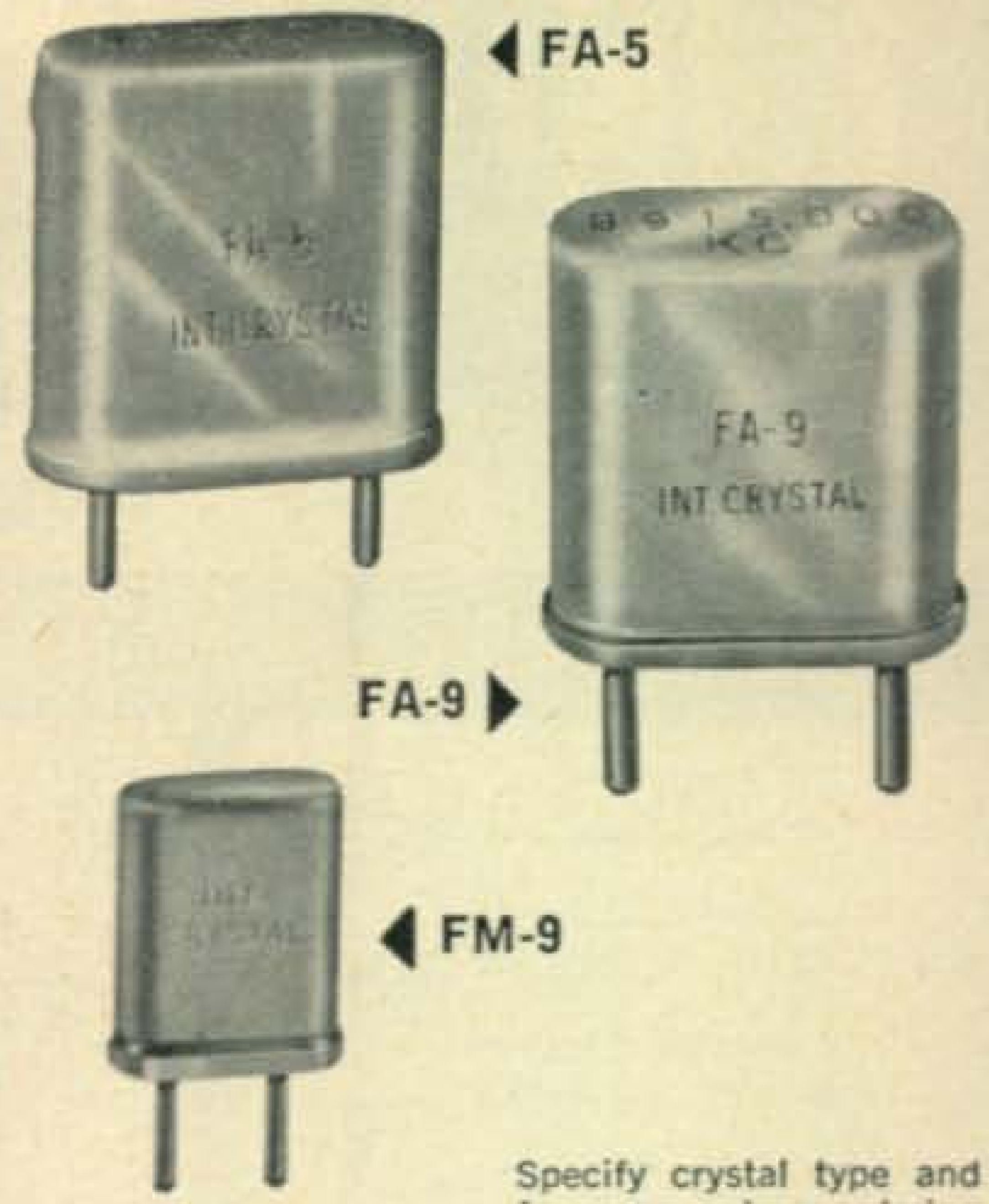

Specify crystal type and frequency when ordering.

	FA-5 and FA-9	FM-9
Fundamental	* 1000 - 1499 kc * 1500 - 1799 kc * 1800 - 1999 kc 2000 - 9999 kc 10000 - 14999 kc 15000 - 20000 kc	Not available Not available Not available 8000 - 9999.999 kc 10000 - 15000 kc 15001 - 19999.999 kc
Overtone (3rd)	10 - 14.99 mc 15 - 29.99 mc 30 - 59.99 mc	Not available 20 - 39.99 mc 40 - 59.99 mc
Overtone (5th)	60 - 75.99 mc 76 - 99.99 mc Not available	60 - 89.99 mc 90 - 100 mc 101 - 109.99 mc
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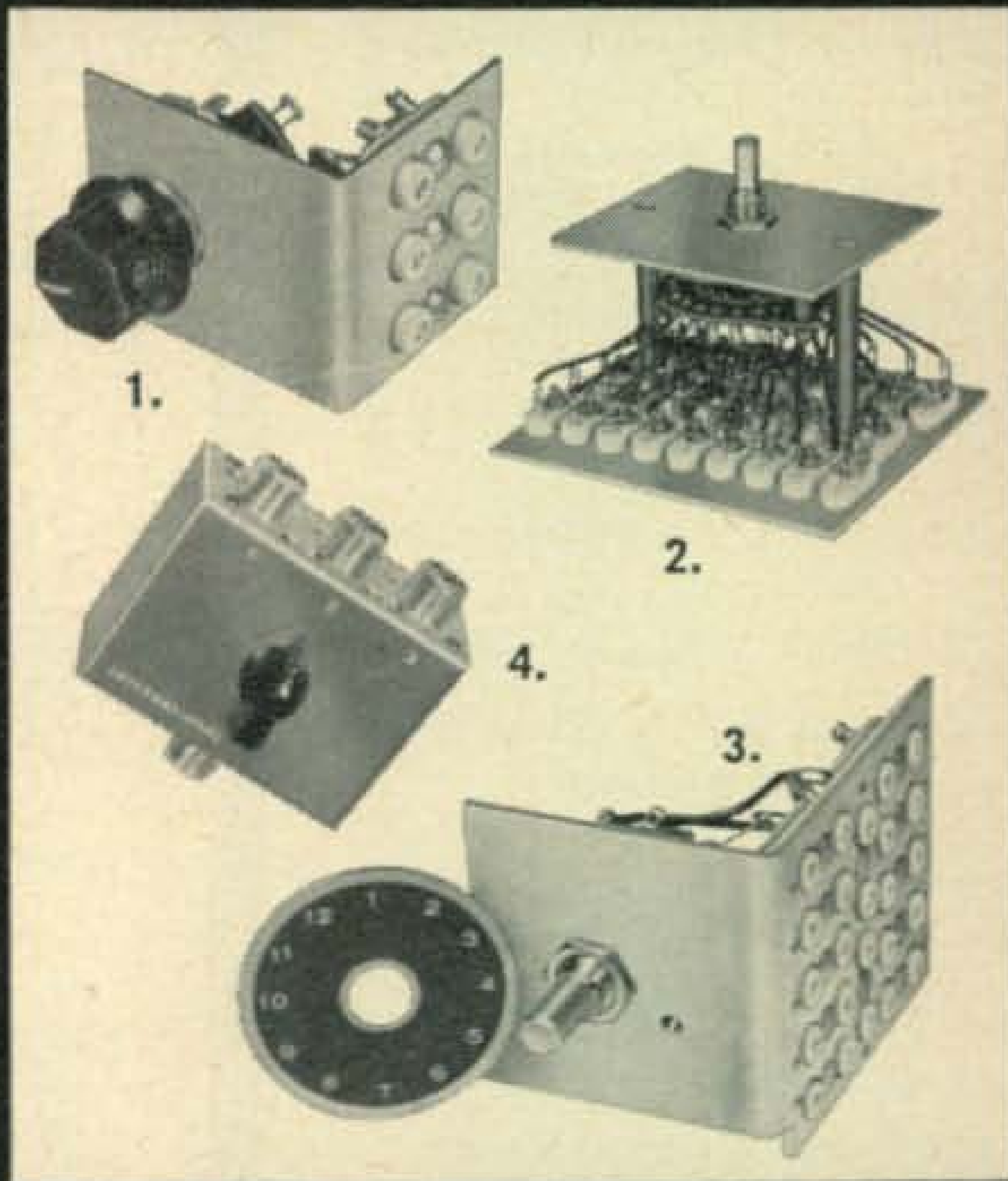

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For further information, check number 4, on page 110

NEW for SSB...

THE TURNER 454

The new Turner single sideband Model 454 is finding its way into hamshacks all over the world. And why not? This is the microphone **you** asked for . . . and Turner designed. You'll like it.

Choice of PTT or VOX. Crystal (454X) or Ceramic (454C). Response, 300 to 3000 cps; output level, —48 db, on the 454X and —52 db on the 454C.

Wired for PTT, the 454's feature two separate switching arrangements — push-to-talk, and a lever-lock switch to hold the mike live.

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This certificate is worth exactly $25 toward the purchase of an outstanding HQ-100A general coverage or HQ-110A Ham Band Receiver complete with 24 hour clock-timer and the high quality S-100 speaker.

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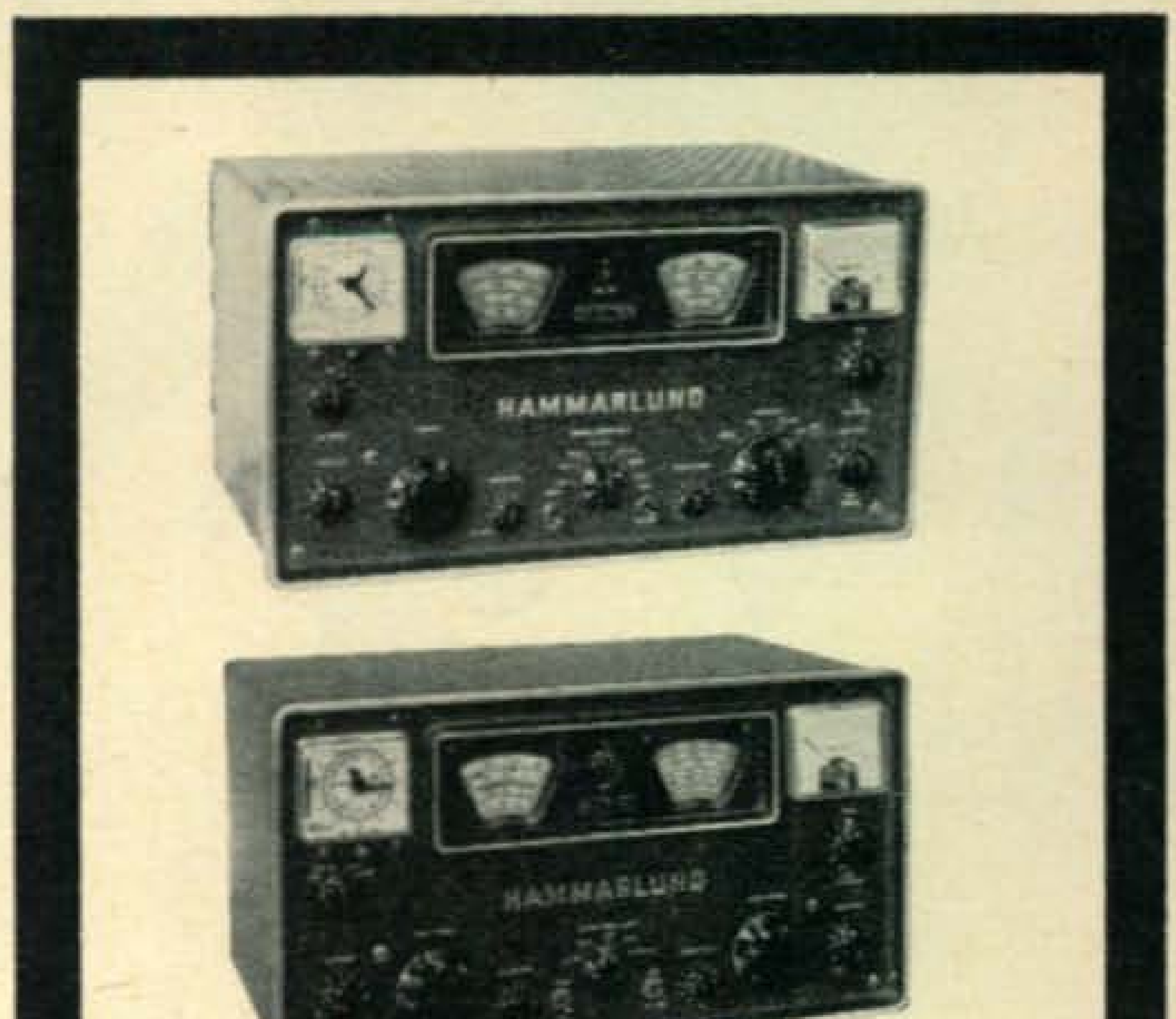
Don't delay. This offer is limited to the continental limits of the U.S.A. and is good only until *March 31, 1964*



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ZERO BIAS

It has now been over a year since the League's "Restricted Voice" editorial first appeared in the February, 1963 issue of *QST*. No one will doubt that in the last thirty years, nothing has stirred amateur radio more.

CQ has been, and will continue to be, for the principle of incentive licensing.

Frankly, we are rather shocked to find that to some amateurs the impending temporary loss of one mode of operation has meant the apparent loss of all amateur privileges. It is now quite obvious that the radio amateur of today is just not as versatile as he should be.

With our correspondence on incentive licensing now approaching the one-thousand mark we feel we have an excellent sample of public opinion. Taking into consideration a great deal of this correspondence, together with information gathered from convention debates and on-the-air ragchews, we propose the following plan for amateur self improvement.

As we suggested last March, a workable proposal must be considerably more complex than the League's; but unlike the League's proposal, our plan takes away no operating privileges.

In the belief that the Amateur Extra license examination appears a little too difficult to pass for a person lacking a formal electronics background, we feel the criteria for incentive licensing should be a no-code theoretical examination of present Advanced Class level. It should be available to the General Class amateur after being licensed one year and available to the Technician Class amateur after two years, provided he meets the 13 word-per-minute requirement at an FCC examination office.

In presenting the following plan we are not coming to the rescue of abandoned League members, nor are we presenting ourselves as the "good guys." We are simply recognizing that phone operation has unfortunately become a "way of life" for many amateurs and to deprive them of voice operation is to deprive them of amateur radio itself.

In many ways the following proposal will force incentive on those who choose not to bother. It effects both the c.w., as well as the phone man. It effects h.f. *and* v.h.f. bands.

Since this country is based on the principle of political compromise, we offer this proposal—not as a cure-all, but as insurance that incentive licensing will become reality—with the long term result being that we will have more competent technicians, more serious operators and cleaner signals.

The Plan

160 Meters: This is presently the only h.f. amateur band which has no clearly separated radiotelegraph and radiotelephone segments. The three segments which currently make up 160 are: 1800-1825 kc; 1875-1925 kc and 1975-2000 kc. We propose that the Advanced Class amateur be permitted exclusive use of 15 kilocycles in both the upper and lower segments of the band. We propose that 1800-1815 kc and 1985-2000 kc be set aside for both phone and c.w. operators who have passed the Advanced license.

80 Meters: We propose that the present segment 3950-4000 kc, known as "75 Meters" be exclusively allocated for amateurs who hold the Advanced Class license. The frequencies 3500-3550 kc is also proposed as an Advanced Class segment for c.w. work only.

40 Meters: We propose that for radiotelephone operation the segment 7250-7300 kc and for radiotelegraph, the segment 7000-7050 kc be allotted exclusively for the Advanced amateur.

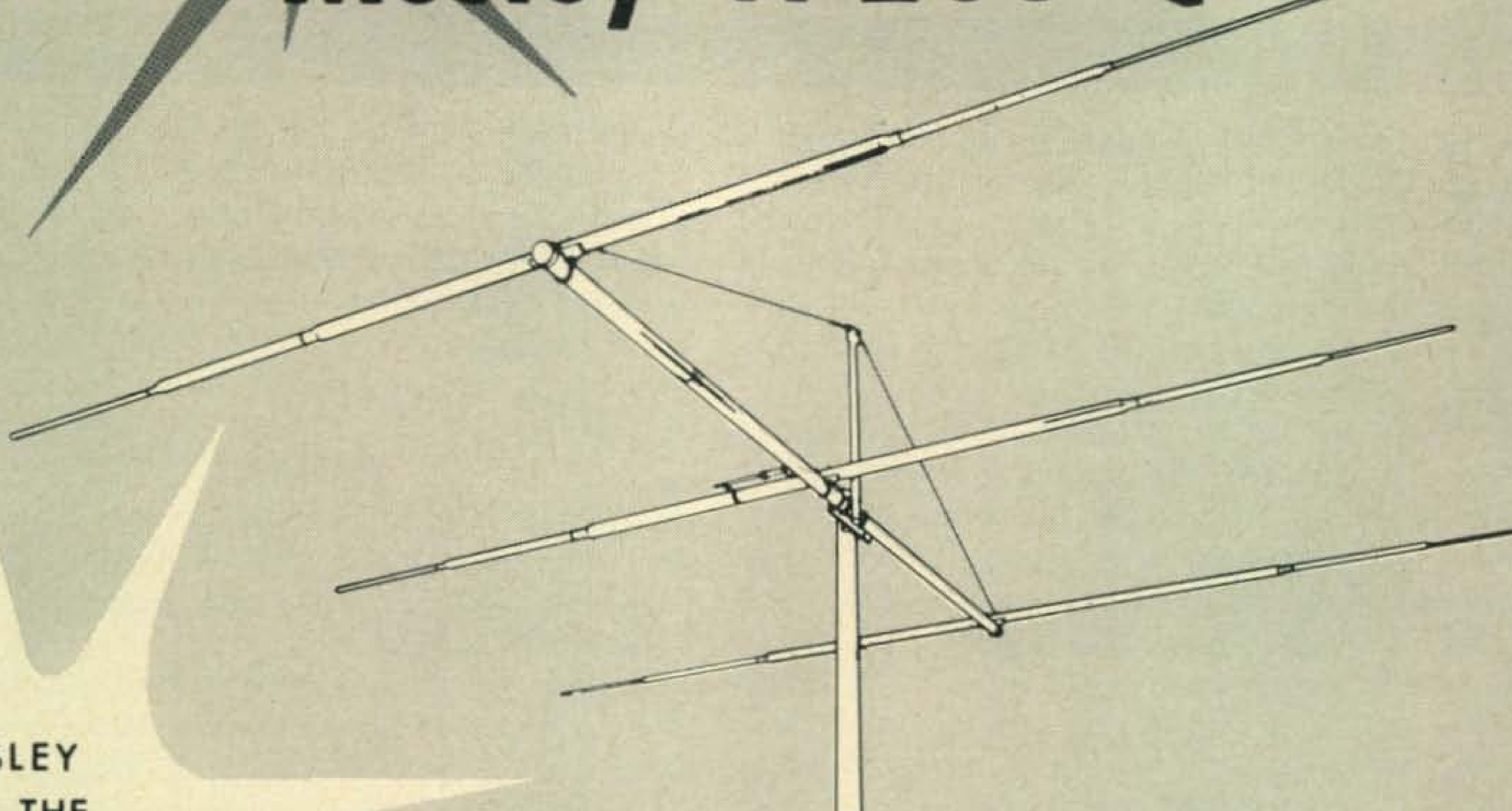
20 Meters: We propose that the frequencies 14.0-14.025 mc (c.w. only) and 14.275-14.300 mc be specifically reserved for Advanced Class amateurs only.

15 Meters: We propose that the Novice band be decreased from its present 150 kc (21.100-21.250 mc) to 100 kc (21.100-21.200 mc). We also propose that radiotelephone emission be expanded from its present 200 kc (21.250-21.450 mc) for a total of 250 kc (21.200-21.450 mc). We further propose that the c.w. segment 21.000-21.050 mc and phone segment 21.400-21.450 mc be reserved exclusively for the Advanced Class operator.

10 Meters: We propose that the segments 28.0-28.1 mc (c.w. only) and phone segment 28.5-28.6

[*Continued on page 10*]

NEW .... for 20 meter operation
Mosley A-203-C



MOSLEY HAS THE OUTSTANDING THREE ELEMENT ARRAY FOR TWENTY METER DX OPERATION.

The new clean-line A-203-C will give you that DX punch that will over-ride QRM. The A-203-C is a three element twenty meter beam using swaged tubing elements to give this antenna rugged durability. The antenna has a special new type element design that virtually eliminates element flutter and boom vibration. A-203-C is a wide spaced, gamma matched, full size beam that every ham needs for the tough competition enforced by the present conditions on the DX bands. This antenna will equal the performance of many four to six element beams without the headaches of large size and heavy weight necessary for these big beams.

- *GAIN (8 db. or better) (F/B 24 db.)*
- *HANDLES MAXIMUM LEGAL POWER*
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- *WIND LOAD (80 mph wind) – 140 lbs.*
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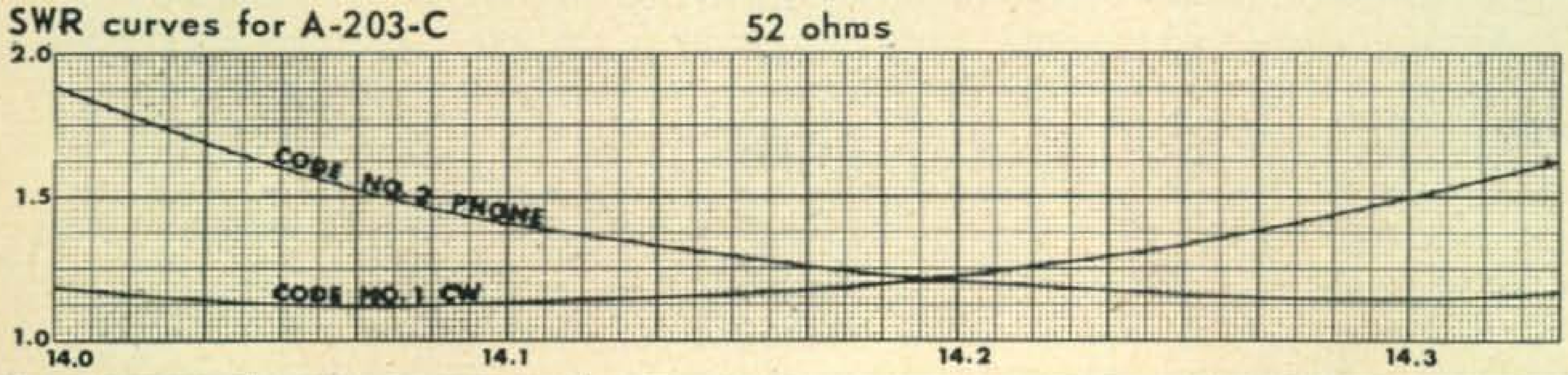
- *SHIPPING WEIGHT 49½ lbs.*

SWR curves for A-203-C 52 ohms



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For further information, check number 8, on page 110

DELUXE HEATHKIT® SSB RECEIVER SB-300

ONLY $265.00

CHECK THESE FEATURES!

• Professional styling & features at 60% savings! • Complete coverage of 80 through 10 meter amateur bands with all crystals furnished, plus provision for VHF converters • Prebuilt, calibrated linear master oscillator (LMO) • 25 KC per tuning knob revolution offers bandspread equal to 10 feet per megacycle • Built-in crystal calibrator • 2.1 KC crystal bandpass filter • Stability of 100 CPS after initial warmup • Wiring harness & two heavy-duty circuit boards for easy assembly

CHECK THESE SPECIFICATIONS!

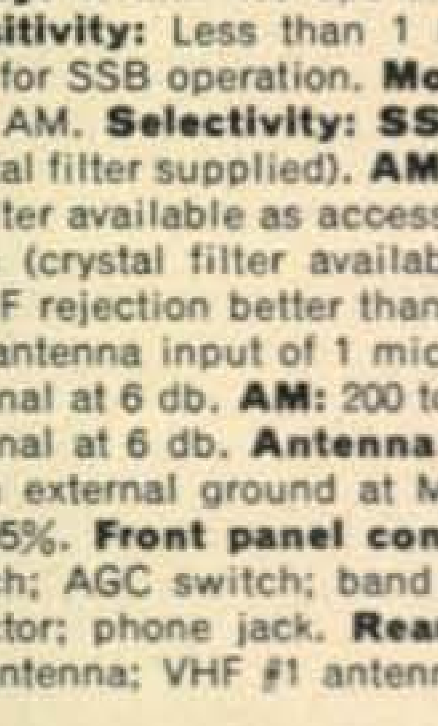
Frequency range (megacycles): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** 100 cps after warmup. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity: SSB:** 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). **AM:** 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). **CW:** 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response: SSB:** 350 to 2450 cps nominal at 6 db. **AM:** 200 to 3500 cps nominal at 6 db. **CW:** 800 to 1200 cps nominal at 6 db. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal, ±.005%. **Front panel controls:** Main tuning dial; function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; preselector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500 ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 Heterodyne mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LM osc.; (1) 6AU6 LMO mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HF8 1st audio, audio output; (1) 6AS11 Product detector, BFO, BFO, amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps, 50 watts. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

The SB-300 SSB Receiver is the first in an exciting new series of Heathkit SSB amateur gear designed to bring you the finest in communications facilities at great savings. Its professional styling, quality and features offer performance never before found in kit equipment.

Features include a crystal-controlled front-end for same rate tuning on all bands; prebuilt, Linear Master Oscillator (LMO) for linear tuning with 1 kc dial calibrations; built-in crystal calibrator; hermetically-sealed 2.1 kc crystal bandpass filter; smooth, non-backlash vernier dial drive mechanism; optional AM & CW filters; high frequency I. F.; AGC control; provision for transceive operation with matching transmitter available soon.

Kit SB-300...17 lbs....no money dn., $25 mo.....**$265.00**
SBA-300-1 CW Crystal Filter (400 cps)...1 lb...... **$ 19.95**
SBA-300-2 AM Crystal Filter (3.75 kc)...1 lb. ...... **$ 19.95**

WATCH FOR ANNOUNCEMENT OF OTHER MODELS IN THIS DELUXE HEATHKIT HAM SERIES!



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AM-122R

For further information, check number 9, on page 110

Zero Bias [*from page 7*]

mc be exclusively assigned to the Advanced Class licensee.

6 Meters: We propose that the 50 kc segments 50.050-50.100 mc (c.w. only) and the adjacent phone segment 50.100-50.150 both be allocated exclusively for use by the Advanced licensee.

2 Meters: We propose that the 100 kc segment 144.0-144.1 mc (both radiotelephone and radiotelegraph) be exclusively set aside for Advanced amateurs.

1¼ Meters: We propose the segment 222.0-224.0 mc be set aside for the Advanced amateur.

¾ Meters: We propose the segment 432.0-434.0 mc be set aside for the Advanced amateur.

Power

As an added incentive we propose an increase in power input for Advanced Class amateurs, allowing them two kilowatts d.c. input on frequencies now allowing a maximum of one kilowatt input.

We believe that this proposal deprives no one their amateur privileges, yet clearly places a "burden" on those who do not go on to a higher license. This proposal effects all amateurs, on all frequencies; we would appreciate your comments.

More Legal Trouble

We're sorry that space doesn't permit elaborating on two widely separated court trials involving amateur radio.

In Santa Barbara, California, the city is asking for a court order, claiming that WA6IBR, K6KCI and K6GHU are public nuisances and should be stopped from operating.

Near Denver, Colorado WØJRQ's four neighbors claim that his 47 foot tower and tri-band beam are "unsafe, noxious, not an accessory to the home, create disturbances, was unsightly" and demanded damages in the amount of $8,000.00. WØJRQ lived in his home (with his beam) before his neighbors moved in.

Both cases will cost a great deal of money and due to the time lag in publication the trials may be underway as you read this. The Santa Barbara A.R.C., P.O. Box 273, Santa Barbara, California and Walt Reed, WØWRD, 1355 East Amherst Circle, Denver, Colorado will let you know of the trial status. Both are asking for contributions and would appreciate your support.

OUR COVER

W6BLZ is at it again! This time it's a single band r.f. amplier using a 4-400A. These close up pictures give you an idea of how simple a 700 watt final can be.

◀ For further information, check number 10, on page 110

C·P COMMUNICATION ANTENNA SYSTEMS

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CERTIFIED PERFORMANCE!

BASE STATION COAXIAL ADVANCED DESIGN ANTENNA (2X-Omnidirectional Gain)

CAT. No. 79-509, FREQUENCY RANGE 108-174 MC*

Cat. No. 79-509 2X-Gain Antenna combines the simplicity of a coaxial antenna with the gain of a more complex structure. Though external appearance is that of a standard coaxial antenna, the union of special element lengths and internal matching devices produces 3 db omnidirectional gain.

SPECIFICATIONS

Electrical:

Nominal input impedance	50 ohms
Maximum power input	500 watts
Omnidirectional gain	3 db
Internal feedline	RG-8A/U
Flexible terminal extension	18″ of RG-8A/U
Termination	Type N male with Neoprene housing
VSWR	1.5:1
Bandwidth	±1%
Lightning protection	Star gap

Mechanical:

Skirt	2″ dia. red brass
Whip rod	6061-T6 aluminum
Support pipe	1-5/16″ dia. hot-galvanized steel, 24″ minimum length exposed available for mounting
Rated wind velocity	100 MPH at 150 Mc
Lateral thrust at rated wind	19 lbs. at 150 Mc
Bending moment 6″ below skirt	55 lbs. at 150 Mc
Weight	30 lbs. at 150 Mc

**Exact frequency must be specified*

SINCE 1933

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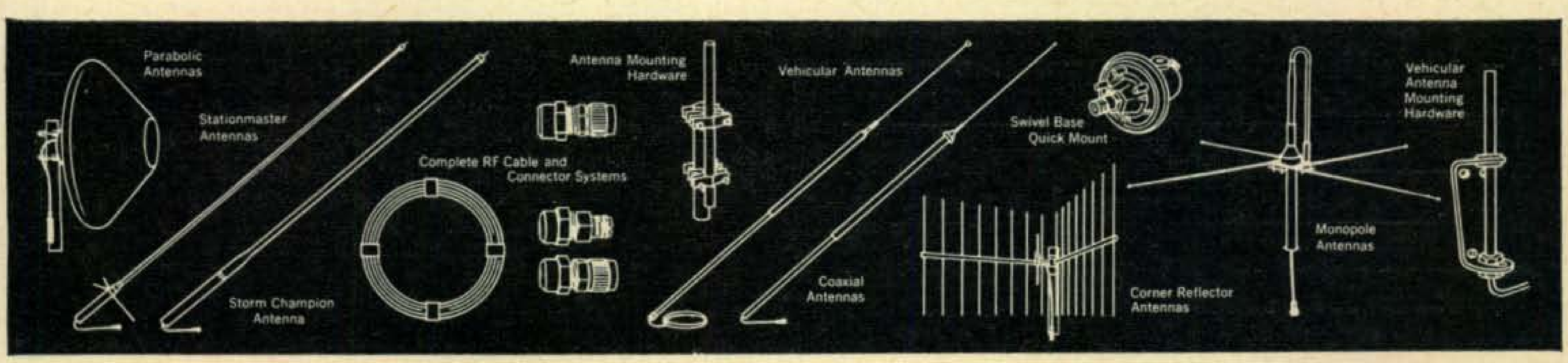
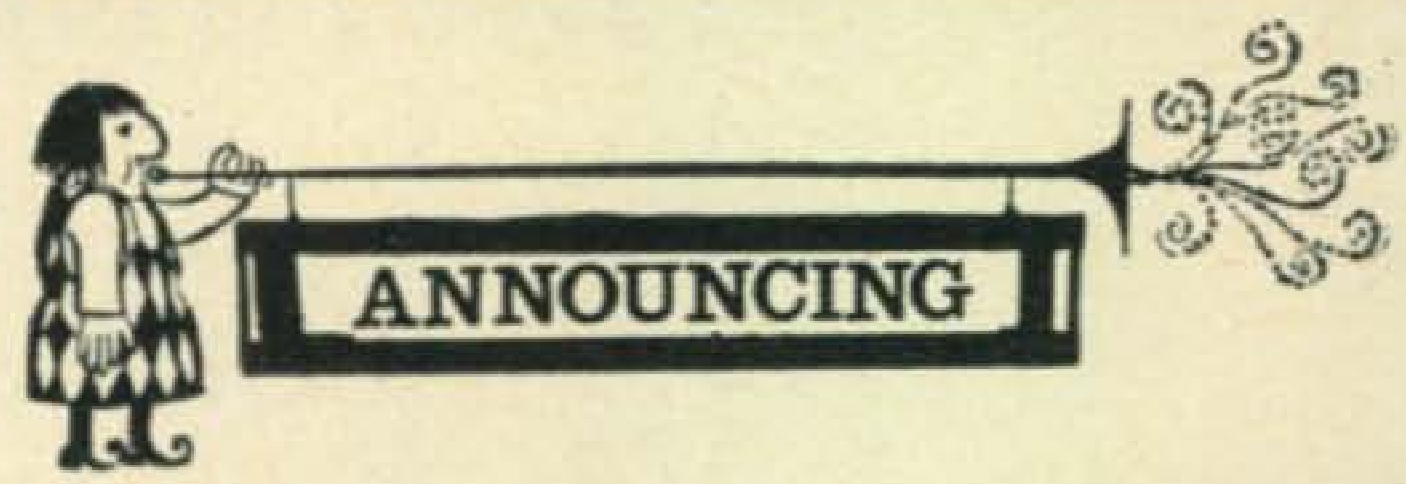


No Letters This Month

Our Letters To The Editor have been omitted this month due to the enlarged Announcing section. Readers' views will return, as usual, next month.



RTTY

The annual RTTY Dinner and get-together held during IEEE week in New York City will take place on Monday, March 23rd at Patricia Murphy's Restaurant, 260 Madison Ave. The "clan" meets at 5:30 P.M. and chow's on at 7:00 P.M. Rush your reservation to Elston Swanson, W2PEE, c/o Instruments For Industry, 101 New South Rd., Hicksville, New York.

OOTC

The Old Old Timers Club is saddened to announce the passing of their President Earl E. Cline, Sr., W4PPZ. Earl was also Editor of *The Spark-Gap Times* and those who have had the opportunity of reading that fine paper will appreciate the work that went into it. New officers for 1964 are: Pres., W4MF; Sec.-Treas., W2EG; V.-Pres., W6WPF; Asst. Sec., W2WL; Membership and Publicity, W1KC; Net Mgr., W5RIH; Historian, W2ZI, and Listing Chairman, K2NP.

Columbus, Georgia

The Columbus A. R. C., Inc. will sponsor the annual Columbus Hamfest, to be held this year, on Sunday, March 22, at the Fine Arts Building in that fair city. For information, etc., contact K4VGI, 3500 14th Ave., Columbus, Georgia.

Third Party Addition

Effective last December 29th, Colombia became the 18th country allowing U.S. amateurs to pass traffic on behalf of third parties. The list now comprises: Bolivia, Canada, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Haiti, Honduras, Liberia, Mexico, Nicaragua, Panama, Paraguay, Peru and Venezuela.

East Coast VHF Society

The 6th Annual dinner and hamfest sponsored by the East Coast VHF Society will be held at "The Chalet," 120 West Passaic St., Rochelle Park, New Jersey on Saturday, March 21st. Tickets at $6.00 per person are available from K2HHS, 135 Herbert Terrace, Saddle Brook, N. J. Ticket deadline is Sunday, March 8th, so make your reservation early.

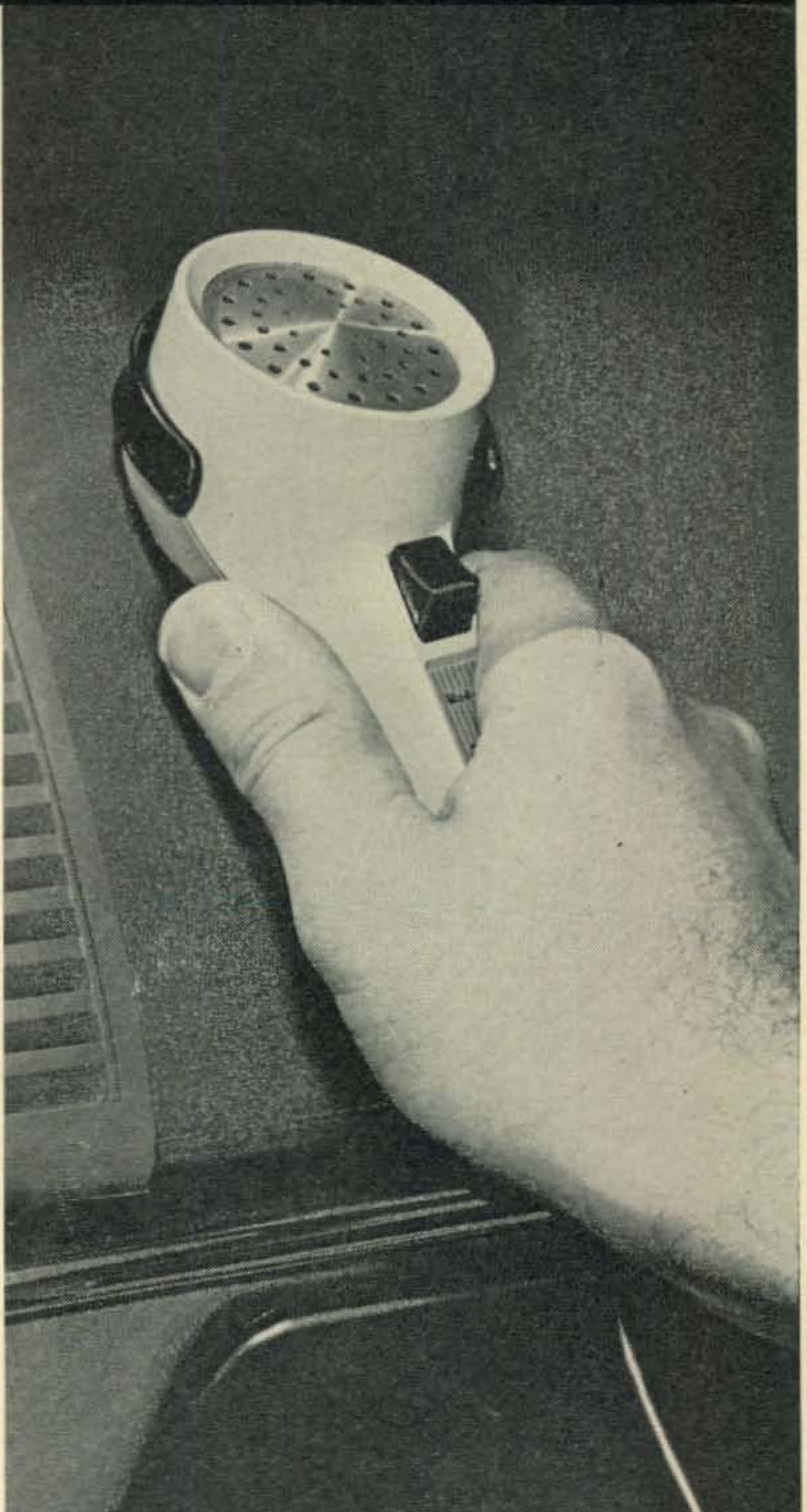
Stolen

On or about November 29th, 1963 four items were stolen from Swan Electronics Incorporated, 506 Bouie St., Hattiesburg, Mississippi. They were: SX-110, Nr. 302247; CB-3A, Nrs. 334099 & 334134 and CB-5 MK. II, Nr. 340024. Any information concerning these items would be appreciated.

Sideband Dinner

The SSBARA will sponsor the 13th annual Dinner and Hamfest on Tuesday, March 24th at the Hotel Statler-Hilton, 33rd St. and 7th Avenue, N.Y.C. Equipment displays open at noon and dinner starts at 7:30 P.M. Tickets are $10.00 each and reservations for a complete table can only be made in groups of ten. Tickets are available from W2JKN, 4665 Iselin Ave., New York 71, N. Y.

ASTATIC HAS THE RIGHT MIKE FOR YOUR NEEDS



the ASTATIC

CERAMIC OR DYNAMIC

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MICROPHONES

DESIGNED FOR THE CITIZEN OR HAM ON THE MOVE

ASTATIC MODEL 511 CERAMIC and 513H DYNAMIC were human engineered to give flexibility of operation. SWITCH MAY BE OPERATED WITH EITHER HAND. When it comes to mounting to equipment or instrument panel, ASTATIC HAS THE ULTIMATE IN MOUNTING BRACKETS. Microphone may be mounted in ANY position. SNAP-IN action even allows mounting in INVERTED positions. These light weight microphones with greater talk power and rising response characteristic also make IDEAL SSB MIKES for IMPROVED CLARITY OF SPEECH.

Ask your distributor for complete literature or write us today.

ASTATIC

ASTATIC CORPORATION
CONNEAUT, OHIO 44030 • U. S. A.
In Canada: Canadian Astatic Ltd., Toronto, Ontario
Export Sales: Roburn Agencies, Inc., 431 Greenwich Street, New York 13, N. Y., U.S.A.

For further information, check number 13, on page 110

"Part 12" Changed

For editorial reasons only, the old familiar "Part 12," which governs radio amateur operations under FCC rules has been changed to "Part 97." Some minor regroupings have been made but no changes in regulations have occurred. Text of the Commissions Order follow.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Editorial Revision of Parts 7, 8, 9, 10, 11, 12, 14, 16, 19, and 20 of the Rules and Regulations

O R D E R

The Commission having under consideration the need for editorial revision of its rules and regulations, and the opportunty for such revision afforded by the reprinting of Title 47 of the Code of Federal Regulations; and

IT APPEARING, That the needs of the public and of the Commisison will be served by editorial revision of the Commission's rules and regulations; and

IT FURTHER APPEARING, That Subchapter A was published November 22, 1963, 28 F. R. 12386, Subchapter B on December 5, 1963, 28 F. R. 13002, and Subchapter C on December 14, 1963, 28 F. R. 13572, and that Subchapter D is ready for publication now; and

IT FURTHER APPEARING, That numerous provisions of the rules and regulations have been rearranged and renumbered, and that cross-reference tables for the entire chapter were published November 22, 1963, 28 F. R. 12386; and

IT FURTHER APPEARING, That the changes effected by revision of the rules are editorial in nature, and hence that compliance with the notice, procedural, and effective date provisions of section 4 of the Administrative Procedure Act is unnecessary; and

IT FURTHER APPEARING, That authority for revision of the rules and regulations is set forth in sections 4(*i*), 5(*d*), and 303(*r*) of the Communications Act of 1934, as amended, and in § 0.261(*a*) of the Commission's rules:

IT IS ORDERED This 13th day of December 1963, effective December 21, 1963, that Parts 7, 8, 9, 10, 11, 12, 14, 16, 19 and 20 are redesignated 81, 83, 87, 89, 91, 97, 85, 93, 95, and 99, respectively, and editorially revised.

IT IS FURTHER ORDERED, That this order shall not be construed as advancing the effective date of any rule change previously adopted by the Commission.

FEDERAL COMMUNICATIONS COMMISSION

BEN F. WAPLE
Secretary

Hopeful RTTY Changes

Those addicted to RTTY will be happy to learn that for identification purposes the FCC is planning to adopt the League's proposal of transmitting only your *own* call using phone or c.w. W8DTY's proposal for amateur registration at FCC offices was turned down. Perhaps when FCC monitors finally utilize portable RTTY equipment, we'll be rid of the dual identification once and for all. Text follows.

FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Amendment of Section 97.87-(*a*)(2) of the Commission's Rules governing the Amateur Radio Service to delete a "dual identification" requirement.	DOCKET NO. 15267 RM-358 RM-435

NOTICE OF PROPOSED RULE MAKING

By the Commission:

1. The Commission has before it for consideration

For further information, check number 15, on page 110

petitions from the American Radio Relay League (ARRL), Newington, Connecticut (RM-358), and from Edwin B. Bruening, Ann Arbor, Michigan (RM-435), both proposing to amend Section 97.87(*a*)(2) [formerly Section 12.82(*a*)(2)] of the Commission's Rules governing the Amateur Radio Service. The ARRL petition proposes to delete the requirement for the identification by telegraphy or telephony of the call sign(s) of the station(s) to which an amateur radio teleprinter station is transmitting.

2. Mr. Bruening submits the same proposal but only as an alternative to his primary recommendation. Primarily, Mr. Bruening proposes that all telegraphic or telephonic identification requirements for amateur radio teleprinter stations be deleted and that, as a substitute therefor, licensees be required to file prior written notice of their proposed radio teleprinter operations with appropriate Commission Field Offices.

3. Section 97.87 of the rules sets forth station identification requirements in the Amateur Radio Service. Section 97.87(*a*)(1) provides that identification shall include transmission of the call sign of the station being called followed by the call sign of the transmitting station. Section 97.87(*a*)(2) provides that this identification shall be by either telegraphy or telephony, as appropriate, and, in addition, when a method of communication other than telegraphy or telephony is being used, such as radio teleprinter, the identification shall also be transmitted by that method. The requirement for telegraphic or telephonic station identification, in addition to radio teleprinter station identification, is commonly referred to as the "dual identification" requirement.

4. Deletion of the "dual identification" requirement was considered by the Commission in connection with an earlier petition (RM-277), filed by the ARRL. In denying that petition by its Memorandum Opinion and Order released February 26, 1962 (FCC 62-214:22 RR 1573), the Commission stated that:

"The dual identification requirement is necessary for the Commission properly to perform its duties. Amateur stations are not assigned specific frequencies, and as a consequence, the interference resulting from the overlapping of signals makes identification difficult at best. Infraction notices are issued only upon positive identification. Without the dual identification requirement, positive identification would be very difficult for the monitoring stations, and practically impossible for the Commission's mobile units which are not equipped to receive radioteletype transmissions. It appears to the Commission that the advantage to the Amateur service as a whole in having proper and prompt enforcement of the Amateur Rules and Regulations outweighs any possible advantage to be gained from the relaxation of the present identification requirements."

5. Petitioner Bruening takes note of the Commission's comment in RM-277, but he maintains that by requiring licensees to file prior written notice of their proposed radio teleprinter operations, elimination of "dual identification" could be accomplished without detracting from monitoring efficiency. He contends that since radio teleprinter operations are conducted by very few amateurs, "Such an amendment should not, therefore, place any administrative burden upon the district offices of the Commission, and will indeed help their monitoring efforts through such special registrations. In the case of suspected interference by an amateur using a mode of operation other than telephony or telegraphy, the district Engineer-in-Charge would have immediate access to a list of amateur stations participating in special forms of transmission and communications."

We cannot agree with this contention. A filing of a notice of proposed operation would not provide the means of rapid and positive identification which is so necessary to investigative and enforcement activities.

6. The Commission does, however, feel that, notwithstanding its view with regard to deletion of the entire "dual identification" requirement, a partial relaxation of Section 97.87(*a*)(2) is appropriate as proposed primarily by the ARRL and alternatively by Mr. Bruening. In support of its petition, the League notes that: ". . . the Commission's identification needs will be fully met by modifying the present dual identification requirement for teletype operation only to the extent of making it unnecessary for telegraphic transmission of the call sign

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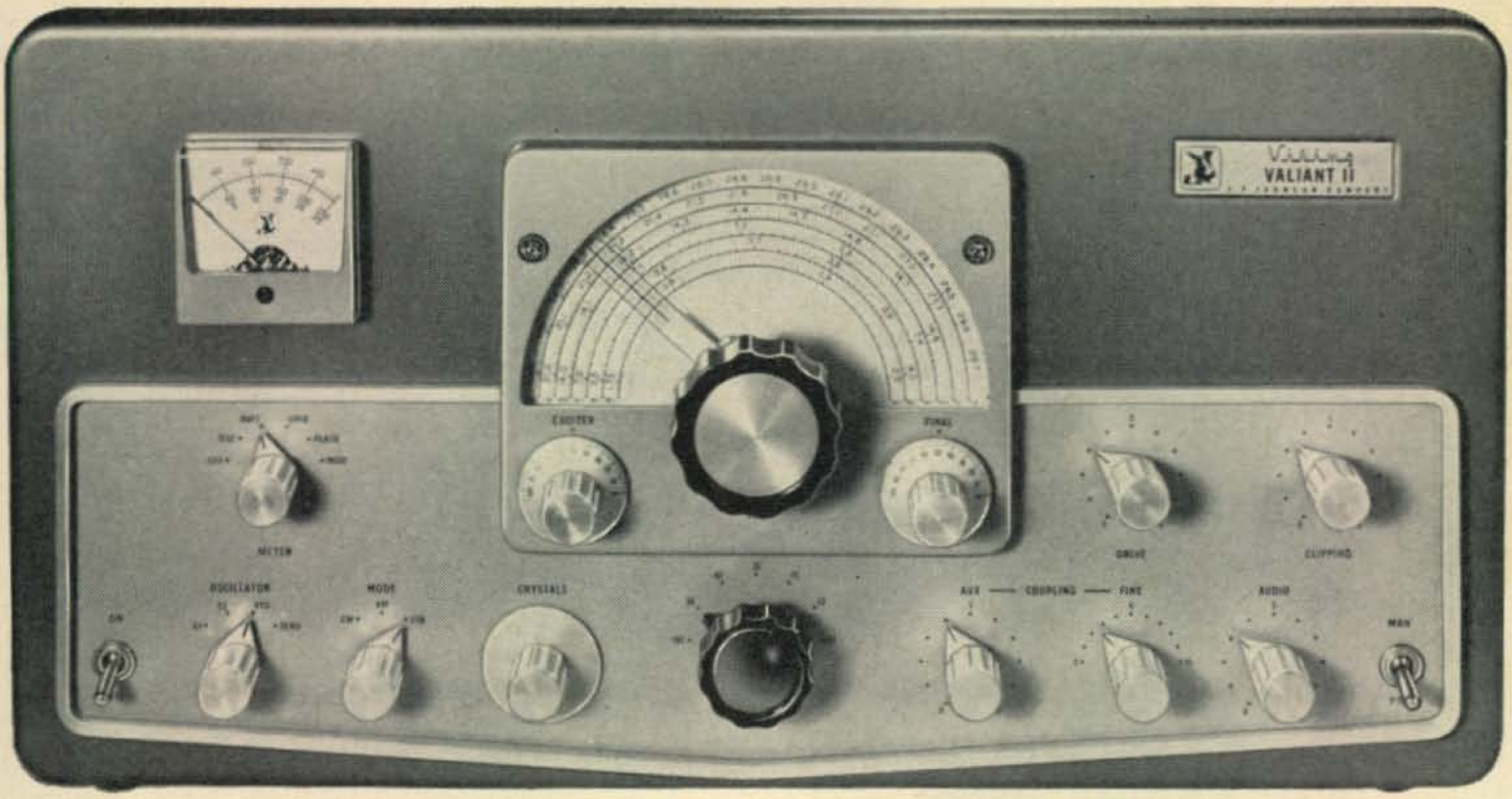

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For further information, check number 17, on page 110

or signs of the station or stations being called or communicated with by a station conducting teletype transmissions. The Commission's monitoring stations and mobile units, as well as the League's Official Observer, still will be able to identify the transmitting station by the telegraphic transmission of its own call sign. Should the Commisison desire to learn the identity of the station or stations called or communicated with, it need only ask the transmtting station to supply the desired information from the logs it is required to maintain."

7. For the reasons set forth by the ARRL, the Commission concludes that it dose not appear that the omission of the telegraphic or telephonic transmission of the call sign of the station being called during teleprinter operations will unduly detract from the Commission's monitoring efficiency. Therefore, the Commission proposes to delete this requirement by amending Section 97.87(*a*)(2) as set forth in the attached Appendix.

8. As a corollary to its basic proposal, the ARRL notes: ". . . that telegraphic identification of the transmitting station might be superimposed upon the carrier without interrupting the teletype transmission. It is suggested that any notice of proposed rule making based upon this petition invite comments and suggestions on such a method of telegraphic identification." With regard to this suggestion, the rules do not now specifically preclude the use of such a method of identification, provided that the type of emission used therefor is in accordance with those specified in Section 97.61 [formerly Section 12.111]. However, satisfaction of the purpose of Section 97.87(*a*)(2) requires that the International Morse identificaiton be easily discernible by ear using a conventional communications receiver. To date, the experience in other radio services with such superimposed identification indicates that a method which provides clearly unmistakable identification and which is also simple and inexpensive has not yet been developed. Therefore, untl a suitable method has been developed and demonstrated, amateur licensees experimenting with superimposed identification may not omit making the required identificaton by proven conventional methods. However, in addition to coments on the proposed amendment to Section 97.87(*a*)(2), the Commission invites the submission of comments and suggestions on methods of superimposed identification, including methods using (superimposed) emissions not now permtted by Section 97.61.

9. Authority for this proposed amendment is contained in Sections 4(*i*) and 303 of the Communications Act of 1934, as amended.

10. Pursuant to applicable procedures set forth in Section 1.415 of the Commission's Rules, interested persons may file comments on or before March 16, 1964, and reply comments on or before April 1, 1964. All relevant and timely comments and reply comments will be considered by the Commission before final action is taken in this proceeding. In reaching its decision in this proceeding, the Combmission may also take into account other relevant information before it in addition to specific comments invited by this Notice.

11. In accordance with the provisions of Section 1.419(*b*) of the Commission's Rules, an original and fourteen copies of all statements, briefs, and comments filed shall be furnished the Commisison.

FEDERAL COMMUNICATIONS COMMISSION

BEN F. WAPLE
Secretary

APPENDIX

Part 97 of the Commission's Rules is proposed to be amended as follows:

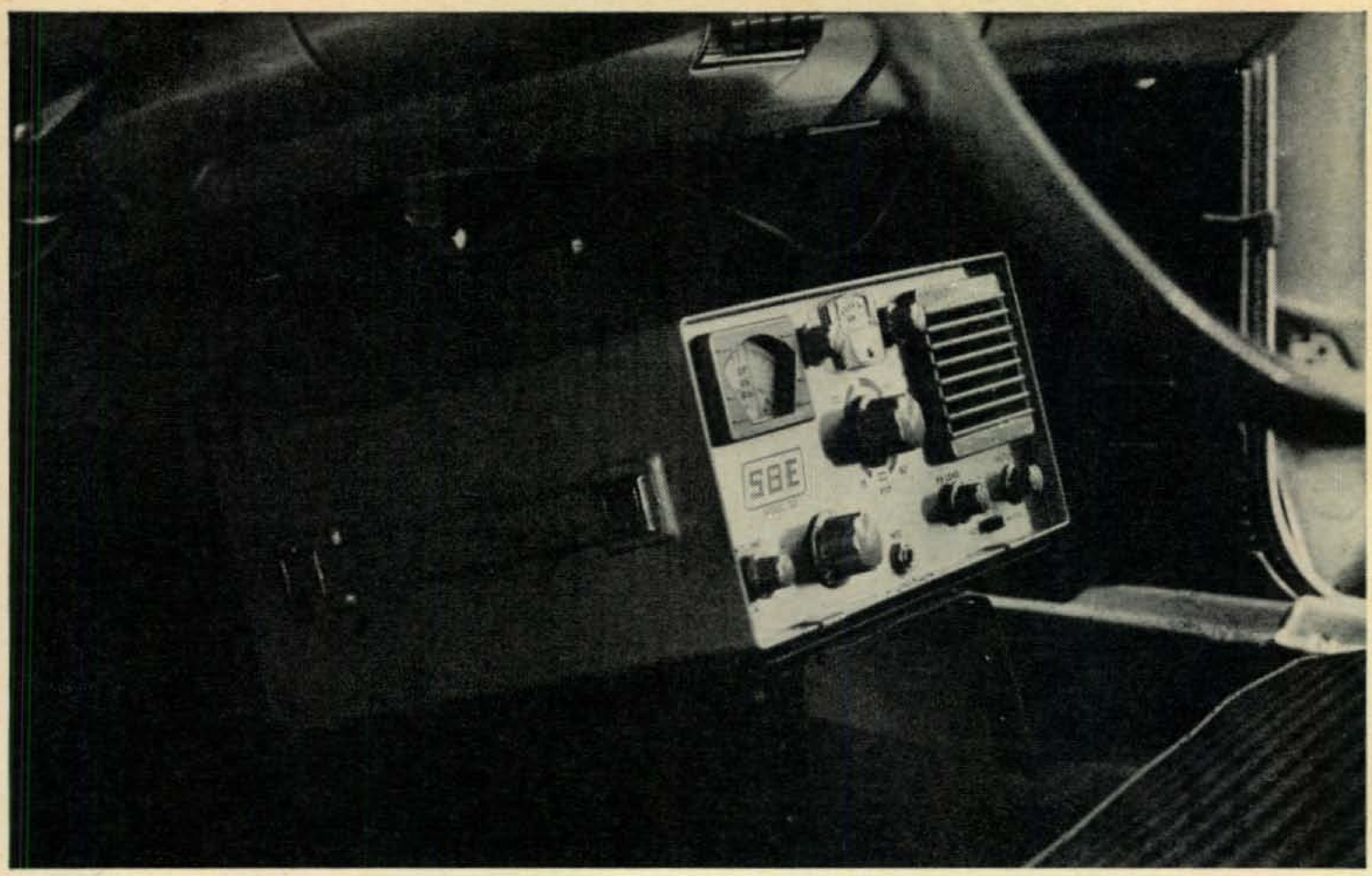
§97.87(*a*)(2) is amended to read as follows:

§97.87 Transmission of Call Signs.

* * * * *

(2) The required identification shall be transmitted on the frequency or frequencies being employed at the time and, in accordance with the type of emission authorized thereon, shall be by either telegraphy using the International Morse Code, or telephony, except that, when a method of communication other than telephony or telegraphy using the International Morse Code is being used or attempted, the required identification shall

[*Continued on page 93*]



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Space will not permit a complete description of this fine new receiver, but we'd like to suggest that you see one at your dealers or write to the factory for complete data

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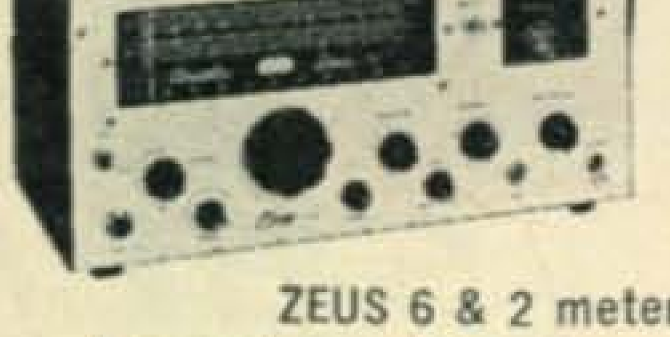

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This 700 watt final designed for 20 meter operation can be operated Class C for c.w. or AB_1 for s.s.b. operation. The total cost is kept down by the use of surplus components.

THIS amplifier is designed for the 20 meter DX man and is driven by the Hetrociter.[1] It is a 20 meter 700 watt c.w. amplifier that can be driven Class C at high efficiency or run Class AB_1 at reduced output. There is nothing new or spectacular about this amplifier except that it is specially filtered to prevent TVI. The power supply for it was made from surplus parts at great economy; thus the rig is large.

Several years ago I disposed of all my high power equipment. It was small compact transceivers for me from here on out. It didn't take long with my lower power rigs to find out that I just wasn't getting through to the DX. I started collecting parts, as I would see them on the surplus market, for that last high power rig. With the availability of a high voltage transformer at a very low price we were over the worst hurdle and construction began.

*528 Colima Street, La Jolla, California.

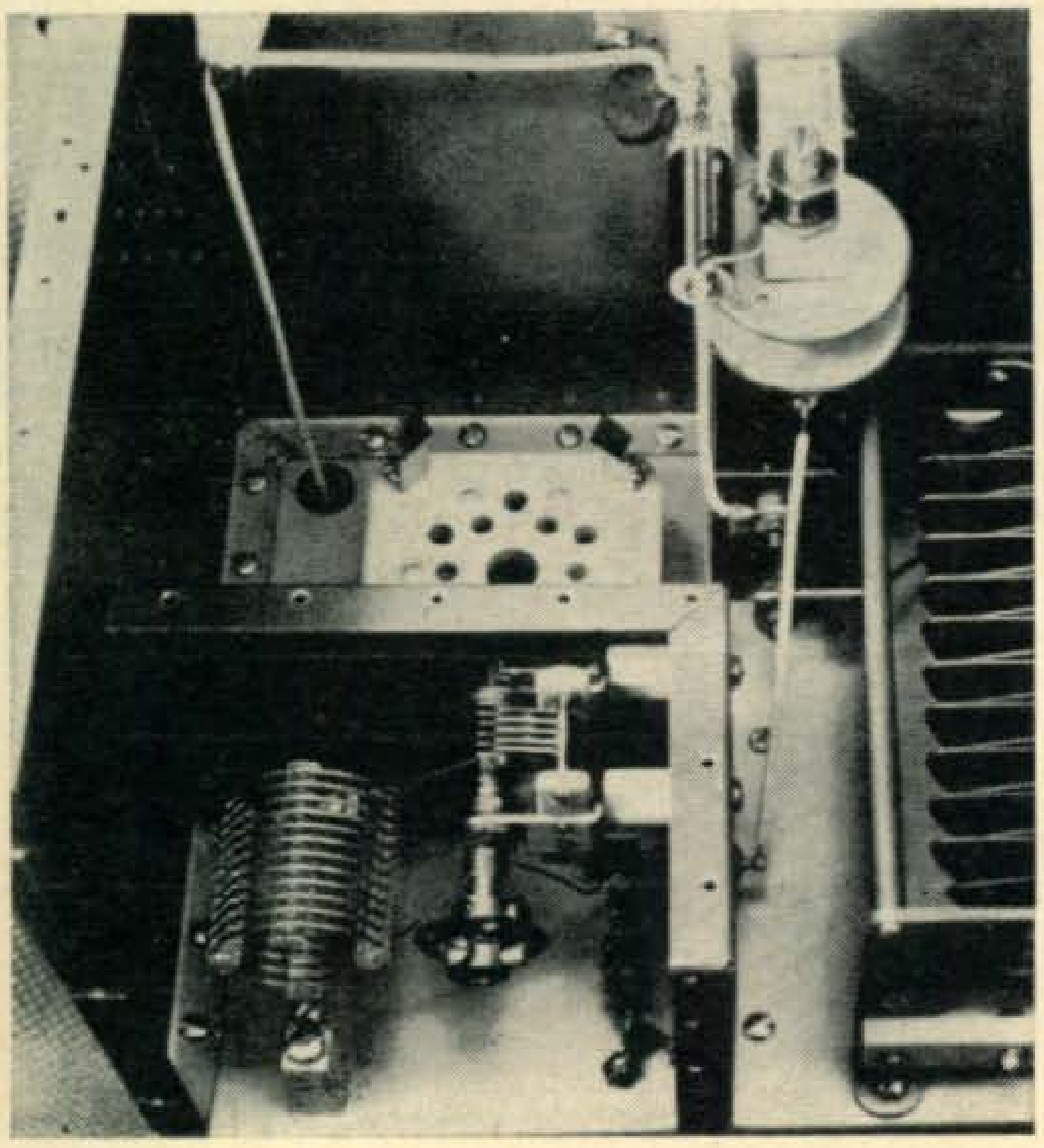
[1]Marriner, E. H., "The Hetrociter," *CQ*, April 1963, page 20.

Construction

Lay out the parts and shielding on an 8 × 17 × 3 inch aluminum chassis. The side shielding must be high enough to clear the top of the 4-400A heat sink by at least ½". The top cover can be pounded out a little above the tube to increase the distance. Using an 8¾" high panel, there is plenty of clearance even when the tube socket is mounted on ½" spacers. To begin, cut out the hole under the tube socket as large as possible with a hole saw, or whatever means available, to get good circulation of air up under the tube. The photographs under the chassis give a good idea where partitions for shielding can be placed, and there is plenty of room. On the topside make an aluminum shield box for the grid tank circuit that will not touch the 4-400A tube.

The grid coil is mounted and tuned with a grid dipper before putting the panel on. The link coil is fastened on the coax connector which is mounted on the front panel and comes up alongside the grid coil when in place. Note that the grid tuning capacitor is insulated from ground, as is the input coupling capacitor in series with the coax line.

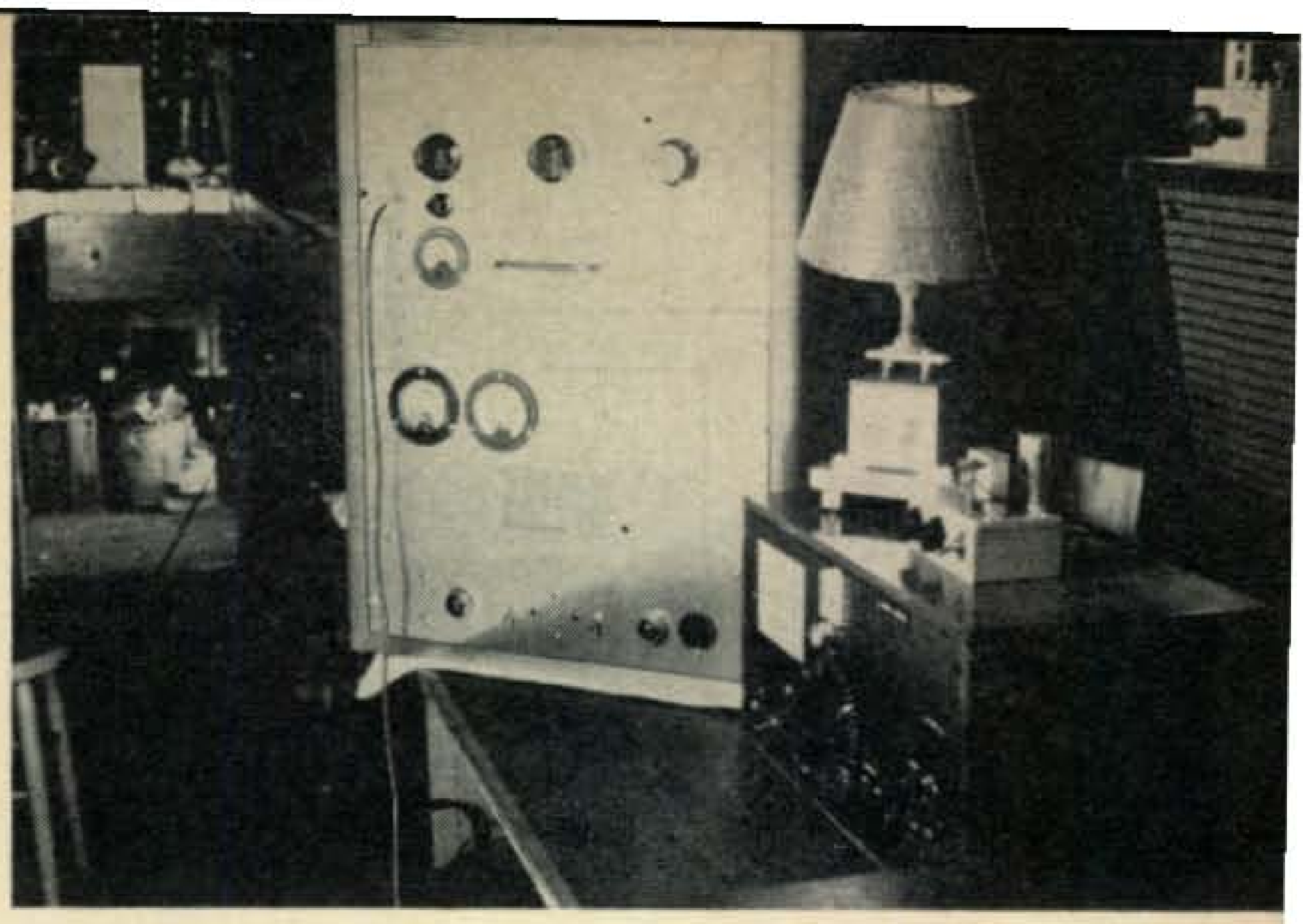
All of the bypass capacitors are returned to a common ground line across the base of the socket made from #6 bus bar wire. The transformer leads to the filament were fed through the shield by using insulated bushings and insulated #10 wire.



A close up shows the interior of the input shielded compartment and the neutralizing capacitor mounted on the rear wall. The plate tank tuning capacitor, C_4, is an oversized surplus unit and may actually be smaller in size. Note the grounding clips on the 4-400 socket.

Although large by current standards, the 700 watt linear presents a neat and clean appearance with its minimum number of controls. The small meter reads grid current while the two below read plate voltage and current. Amplifier controls from l. to r. are GRID TUNING, PLATE TUNING and COUPLING. R. f. input is through the connector and cable to the left of series input tuning capacitor C_1.

Atop the "W6BLZ Special" receiver sits the 20 & 15 meter preamp described in Oct. '63 CQ. The receiver, a c.w.-s.s.b. only design, will be seen shortly in CQ.



Power Supply

The power supply is built on a steel California Chassis HD-12, which measuers 12½ × 17 × 4 inches. The panel is made from ⅛" aluminum 15½" high.

Surplus parts vary in shape and size, so lay out the parts on the chassis the best way possible. The 3B28 rectifier sockets are mounted on micarta and raised above the chassis on ½" porcelain standoffs. For the filament wires to the rectifiers, punch a ½" hole in the chassis and put in an insulated bushing. Cover the bus bar with teflon sleeving if possible.

The multiplier for the high voltage meter should be on the hot side and the meter on the ground end. If individual resistors are used to make up the multiplier mount them on glass boards. Be sure to use bleeder resistors across the power supplies and always discharge each power supply by shorting them through a 10K resistor before working on the power supply. *Always pull the a.c. plug from the wall.*

The power supply voltages should be 2700 volts d.c. no load, 480 volts, and bias, adjustable from −100 to −220 volts d.c. In Class C operation the bias potentiometer will always be turned full on. The grid return is through the v.r. gas regulator tubes and no grid resistor is necessary. In Class AB_1 there is no grid current and the low wattage bias potentiometer is adequate.

The current through the regulator tubes can be adjusted by inserting a milliameter at the points marked × in the ground end of each string and adjusting resistors R_1 and R_2 so that no less than 10 and no more than 25 ma flows.

The relay, K_1, shown in fig. 2, simply parallels

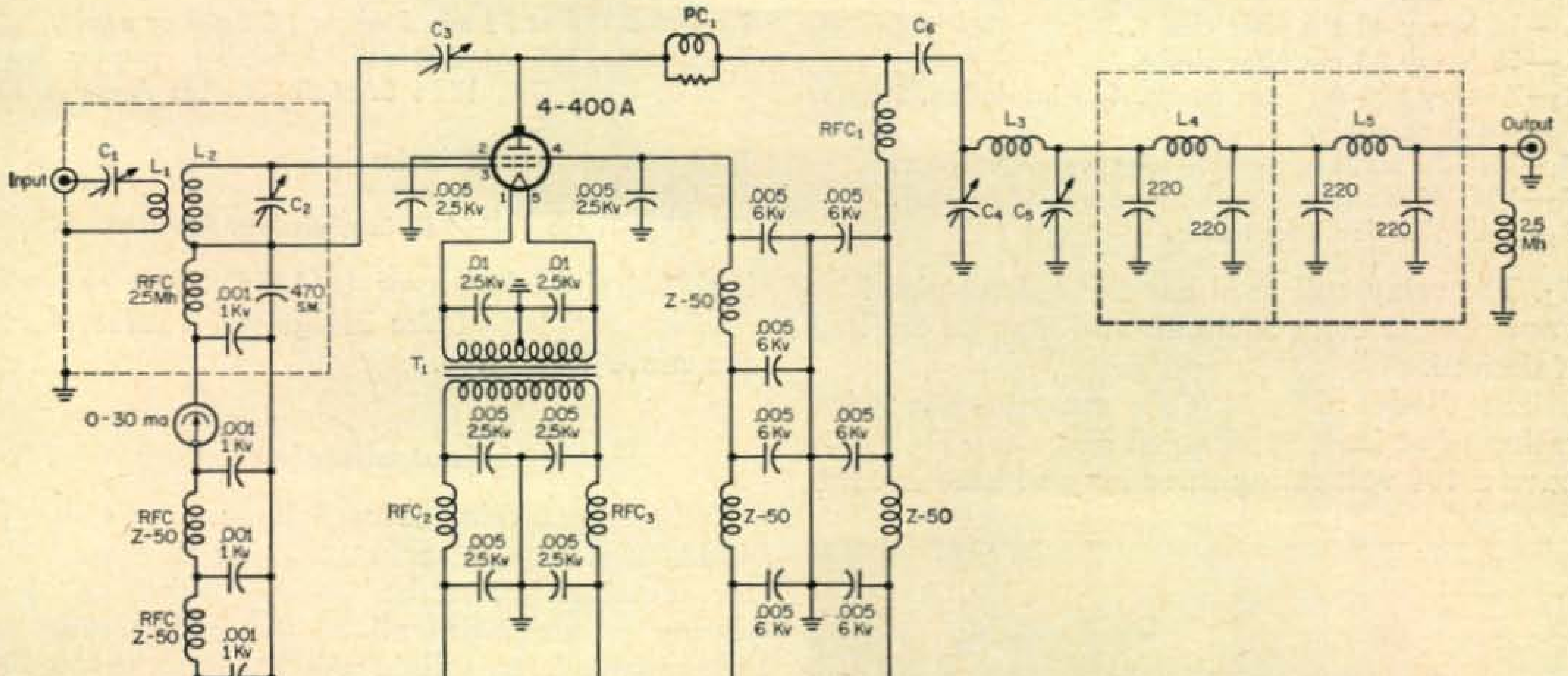


Fig. 1—Circuit of a 20 meter 700 watt final that may be operated Class C or AB_1 simply by adjusting the bias control in the power supply. All fixed capacitors are of the disc ceramic type unless otherwise noted. Capacitor values less than one are in mf greater than one, in mmf.

C_1, C_2—7.5—100 mmf, Hammarlund HFA or equiv.
C_3—2-10 mmf neutral. cap., disc plates 1¼" dia.
C_4—100 mmf variable with 0.08" spacing.
C_5—500 mmf broadcast type variable.
C_6—.005 mf, 5 kv, 11 amps at 1 kc. Surplus, Cornell Dubilier 173A-6L.
L_1—3 t of 1¼" Air Dux #1010, placed on the cold end of L_2.
L_2—12 t of 1¼" Air Dux #1010.
L_3—7 t of ³⁄₁₆" copper tubing, 2½" dia., ⅜" between turns.
L_4, L_5—7 t #12e., ¾" dia., ⅞" long.
PC_1—5 t of #14, wire spaced, wound around 3 parallel 100 ohm 2 watt resistors.
RFC_1—Ohmite Z-7, 44 μh., 1 amp, 3-20 mc.
RFC_2, RFC_3—Close wound #20 e. on ⁵⁄₁₆" × 1¾" long form.

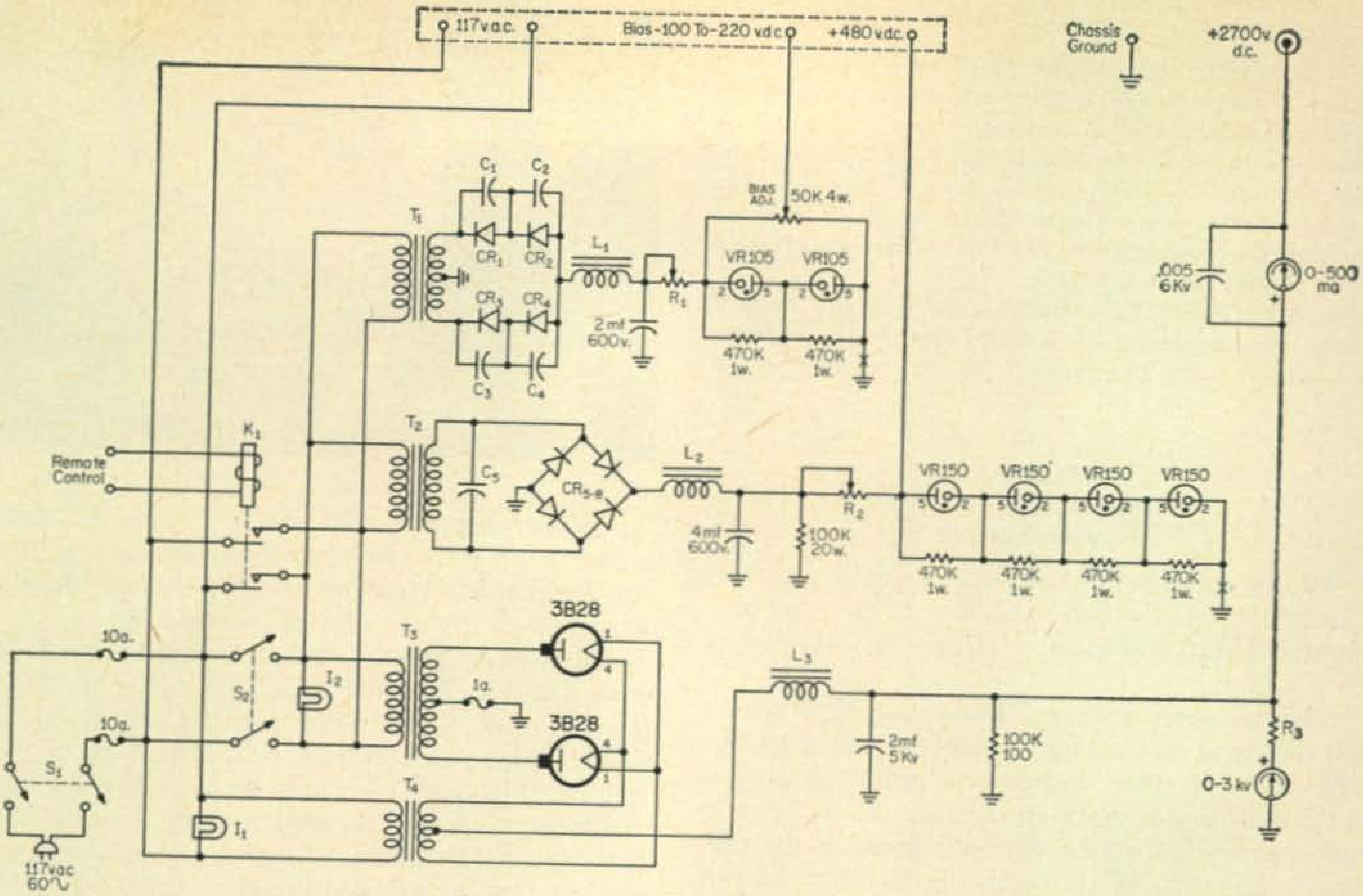
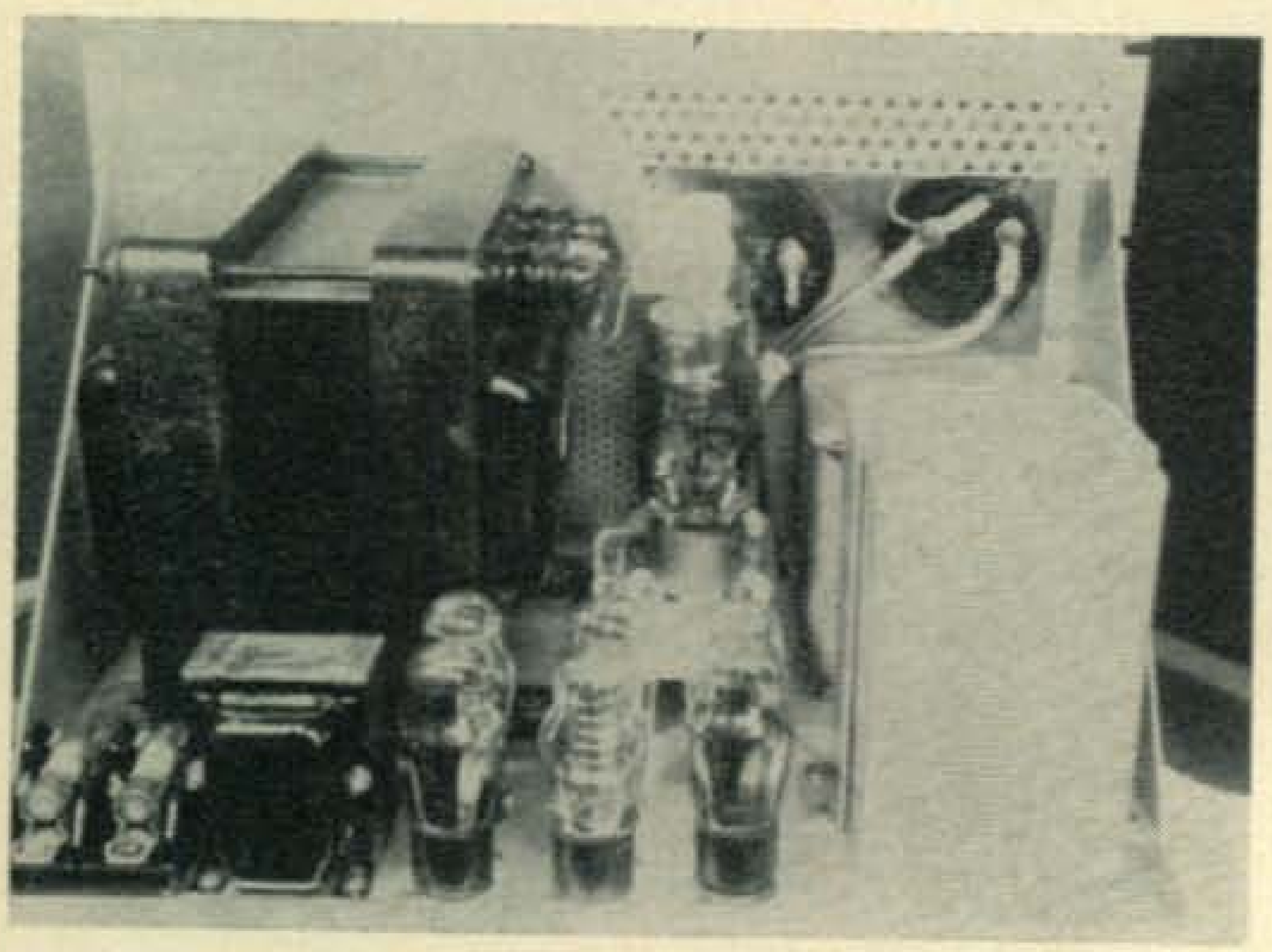


Fig. 2—Circuit of the power supply used to operate the 700 watt 20 meter final amplifier. No attempt was made to conserve space and maximum use was made of surplus components.

C_1, C_2, C_3, C_4—.001 mf 1 kv disc ceramic.
C_5—.005 mf 2.5 kv disc ceramic.
I_1, I_2—117 v. pilot lamps.
K_1—See text.
L_1—10 henry 40 ma filter choke.
L_2—10 henry 80 ma filter choke.
L_3—7 henry 300 ma filter choke, 4 kv insulation. Stancor C-1413 or equiv.
R_1—10K, 20 watts adjustable wire wound resistor.
R_2—10K, 50 watts adjustable wire wound resistor.
R_3—Multiplier for 3 kv meter.
S_1—D.p.s.t., 20 a. heavy duty toggle switch.
S_2—D.p.s.t., 10 a. toggle switch.
T_1—270-0-270 at 20 ma. Chicago Trans. Co. PU-20-S or equiv.
T_2—325-0-325 at 55 ma. Stancor PC-8407 or equiv.
T_3—2700-0-2700 at 350 ma. Available, surplus from J. J. Glass Co., 1624 S. Main St., Los Angeles 15, Calif. ($25.00).
T_4—2.5 v. at 10a. 10 kv insulation.
CR_1-CR_4—1N1694.
CR_5-CR_8—Three 1N1694's in each leg. See text.

S_2. The relay coil used has to be determined by your remote control circuit and may be omitted if desired.

The diodes CR_5 to CR_8 must have a p.i.v. rating of at least 1200 volts. Since the 1N1964's have a 400 volt rating three may be used in each leg. If desired four type 1N3563's may be used, one in each leg of the bridge. Of course, these are more expensive.

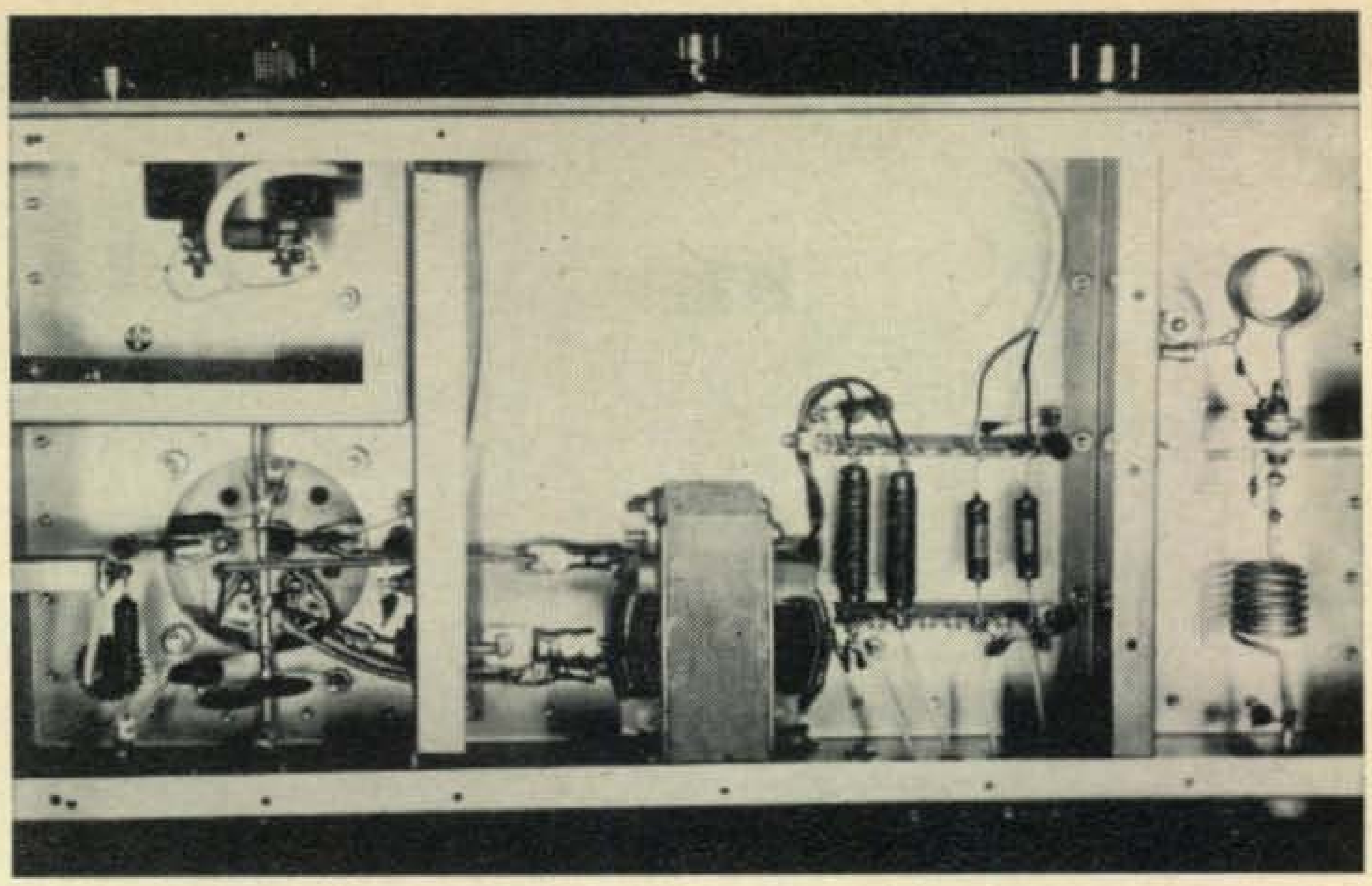


Top view of the power supply showing the general layout. A bleeder is located under the perforated shield above the meters and the filter choke is in the front right corner.

Neutralization

When the wiring is completed, insert the 4-400A tube into its socket, making sure the little metal clamps secure the base to ground. The first testing is done with all of the power supplies disconnected. Just light the filament to the 4-400A and connect a 50 ohm dummy load to the output. Feed in a signal from the exciter until there is an indication on a field strength meter held up close to the final tank coil. Resonate the grid coil and series grid coupling capacitor for maximum indication. Set C_5 to maximum capacity and vary C_4 for resonance. If there is not enough signal, screw the neutralizing capacitor closer together. Watch the f.s.m. and at the same time start to back off on the neutralizing capacitor. A point should be reached where there is no feedthrough signal; this is the neutralized position to leave C_3. If you cannot go through a null and the feedthrough continues to decrease when the neutralizing capacitor is fully

A bottom view of the 700 watt amplifier shows the method of shielding. The bottom left compartment shows the base of the 4-400 and the common bus for joining all the by-pass capacitors. The filament transformer is in the center section with the TVI filters for the a.c. line and the d.c. feeds. The bandpass filter in the output is on the right. Note that both coils are shielded from each other and at right angles.



apart, the disk will have to be cut down. The neutralizing capacitor was 1¾ inches in diameter and it had to be cut down to 1¼ inches so that it would go through a null as the disk were screwed closer together. They must not be brought closer than ⅜ of an inch or r.f. arcing might take place.

Testing

After the amplifier has been neutralized hook up the power supply and *keep your hands out of it!* Before turning on the high voltage, make sure that the bias control is set for at least —200 volts of bias on the 4-400A so that it will not draw too much plate current when there is no excitation. After the amplifier is operating, try decreasing the bias with no excitation. You will notice the plate current will increase as the bias goes down. As you approach the AB_1 condition the idle plate current should be at 85 ma. This should be accomplished with —130 to —150 v.d.c. of bias. When operating Class C condition with no excitation there will be no plate current.

With excitation the grid current should read about 18 ma for Class C operation. With the high voltage on, dip tuning capacitor C_4. If it is lower than 200 ma, decrease the loading capacitor C_5 and re-dip C_4. Repeat this process until you have loaded out to 300 to 350 ma. If the dip becomes broad, do not increase the loading beyond this point. The position of C_4 should be about 30 mmf, while C_5 will be about 450 mmf. If it appears to be less than this value, cut off one turn from the copper tubing.

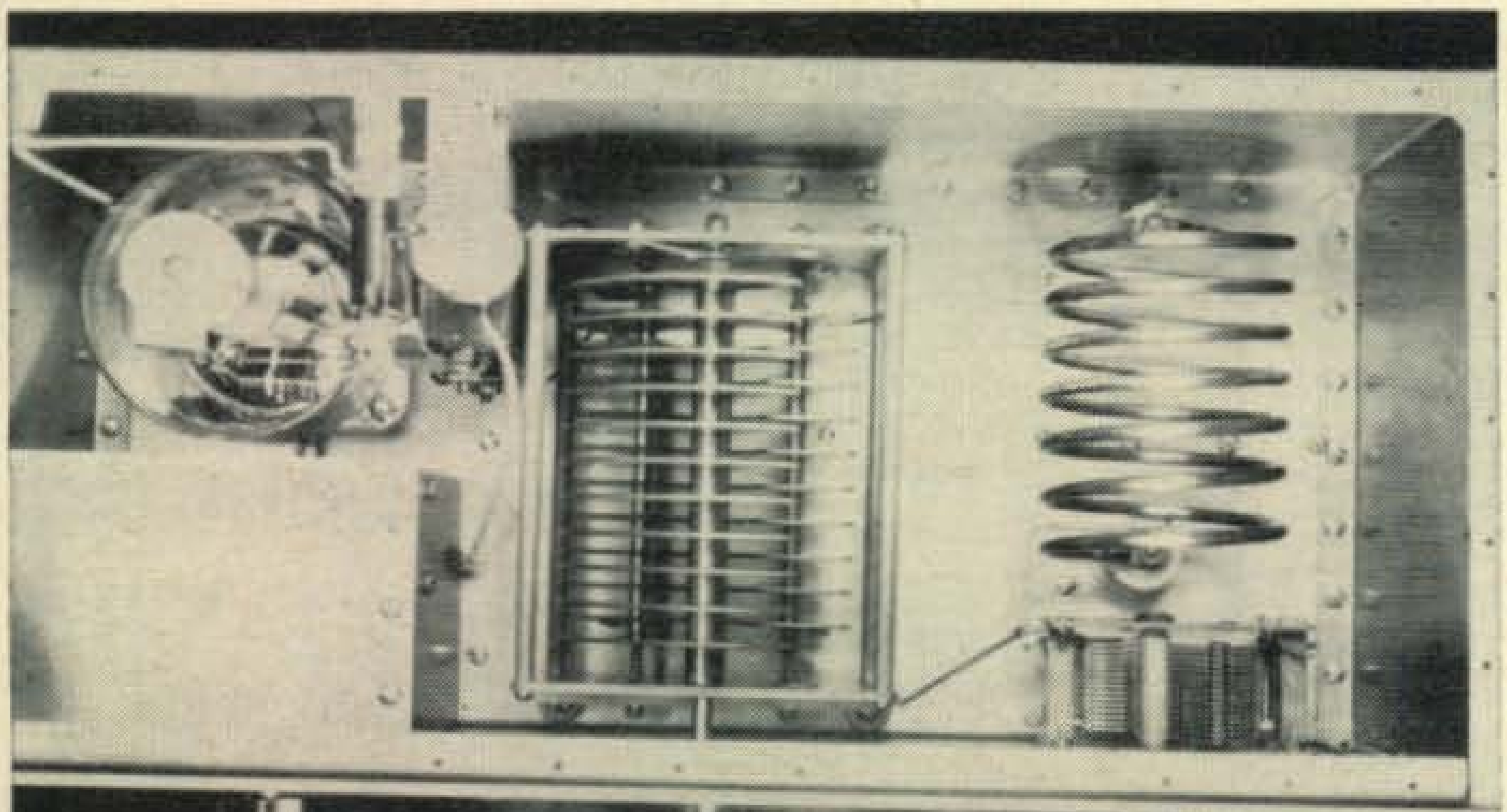
Band Pass Filter

You may wonder why the band pass filter was installed on the chassis. Every precaution was taken to make this a TVI free amplifier. This filter attenuates both the high and the low frequency signals other than the band for which it was designed. This is a good idea because any spurious signal will be attenuated and also the second harmonic signal will be knocked down. Getting off to a good start makes it easier for the regular low pass filter to do its job. By good tight shielding and filtering of all leads coming out from the chassis by the use of Ohmite Z-50 r.f. chokes there should be no TVI.

Using this filter, the second harmonic will be down 31 db and the third down 48 db if there is no coupling between L_4 and L_5. Make sure the one coil is mounted 90 degrees from the other to prevent coupling. Disk ceramic capacitors were used in the filter because they were obtainable at 1000 working volts. Mica values only go to 600 volts and it is possible with a high s.w.r. for the line voltage to exceed this value.

Running high power, attenuation from 700 watts has to be quite substantial to prevent TVI

[*Continued on page 98*]



Top view of the 700 watt 20 meter amplifier shows the input tank shield in front of the 4-400 and the pi-network on the right of the chassis. Note the use of a heat sink type plate cap on the 4-400.

A Look At...

The Remainder Of The Sunspot Cycle

Minimum Predicted in Thirteen Months

BY GEORGE JACOBS*, W3ASK

In early 1961, CQ featured a 3-part article entitled "The Sunspot Story, Cycle 19; The Declining Years." Written by CQ's Propagation Editor George Jacobs and Stanley Leinwoll, this is one of the most comprehensive articles written on the subject and it has become a classic in its field[1]. Much of what was predicted in this article concerning shortwave propagation conditions and the ionosphere has come to pass. Now, with the end of the present cycle in sight, W3ASK takes a closer look at the cycle in an attempt to predict when it will reach its minimum value.

THE year 1958 went down in scientific history as the year in which the most intense solar cycle ever recorded reached its peak. Rising rapidly from its beginning during April, 1954, the present cycle, the 19th recorded since daily telescopic observations of the sun began in 1755, reached an unprecedented peak of 201.3 during March, 1958. The previous record of 158.6 was recorded during the 3rd cycle in May, 1778.

Since March, 1958, the present cycle has been declining at a steady rate. The progress of Cycle 19 to date is shown in tabular form in Table I, and graphically in fig. 1. The latest available smoothed sunspot number, centered on June, 1963, is 28.

*PROPAGATION Editor, *CQ*.

[1]Jacobs, G., and Leinwoll, S., "The Sunspot Story, Cycle 19; The Declining Years," *CQ*, April, 1961, p.26 (Part 1); May, 1961, p.36 (Part 2); and June, 1961, p.44 (Part 3).

A limited number of reprints of the complete article bound into a 28-page booklet is available from the *CQ* Circulation Dept. for $1.00 per copy, postpaid.

Prediction For Minimum Of Cycle

For the most part, predictions of sunspot activity are based upon statistical analyses of one form or another of the previously recorded 18 cycles. As a basis for predicting the behavior of the remainder of the present cycle, the author chose the following characteristics of previous cycles for examination:

1. The time required for each cycle to decline from maximum to minimum values of smoothed sunspot numbers.
2. The length of each complete cycle from minimum to minimum.
3. The time required for each cycle to decline from a smoothed sunspot number of 28 (the most recent number recorded for the

TABLE I

Values of smoothed sunspot numbers observed during Cycle 19 and predicted for the remainder of the decline. Italic figures indicate future estimated sunspot numbers.

Year / Month	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Jan	....	14	89	170	199	179	129	80	45	29	*18*	*8*
Feb	....	16	98	172	201	177	125	75	42	30	*17*	*7*
Mar	....	19	109	174	201	174	122	69	40	30	*16*	*6*
Apr	3	23	119	181	197	169	120	64	39	29	*15*	*5*
May	4	29	127	186	191	165	117	60	39	29	*14*	....
Jun	4	35	137	188	187	161	114	56	38	28	*14*	....
Jul	5	40	146	191	185	156	109	53	37	*26*	*13*	....
Aug	7	46	150	194	185	151	102	53	35	*24*	*13*	....
Sep	8	55	151	197	184	146	98	52	33	*22*	*12*	....
Oct	8	64	156	200	182	141	93	51	31	*21*	*11*	....
Nov	9	73	160	201	181	137	88	51	30	*20*	*10*	....
Dec	12	81	164	200	180	132	84	49	30	*19*	*9*	....

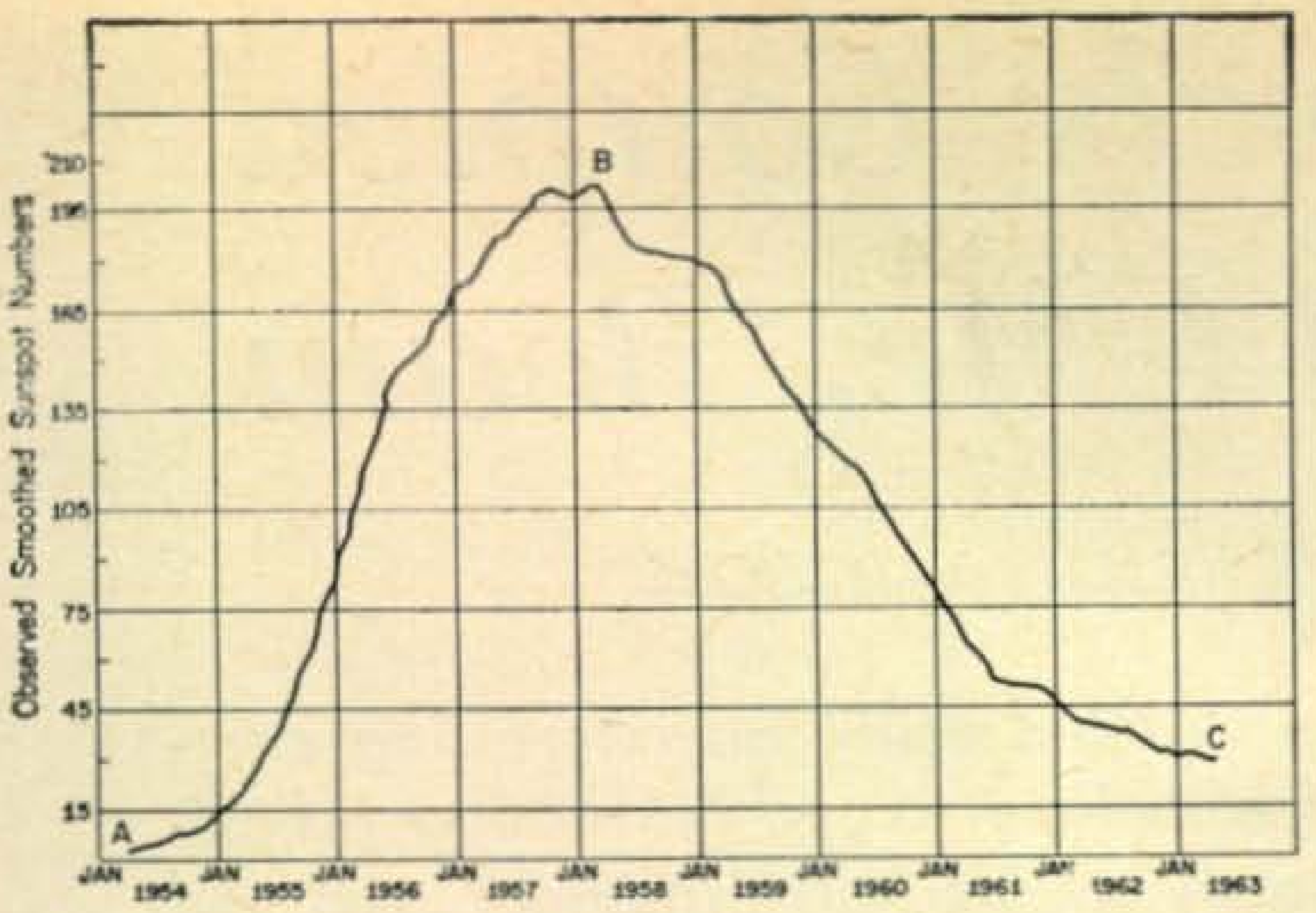


Fig. 1—Progress of Sunspot Cycle 19 for April, 1954 through May, 1963. At A, the start of Cycle 19, in April, 1954, the smoothed sunspot number was 3. The peak of Cycle 19 occurred at B, when the smoothed sunspot number was 201, in March, 1958. At C, the latest value observed, June, 1963, when the smoothed sunspot number was 28.

present cycle), to a minimum value.

4. The smoothed sunspot number at the minimum of each cycle.

The following are the results of this 4-point study:

1. The descending period from maximum to minimum of all previously recorded cycles varies between 4 and 10.2 years, with an average of 6.7 years. Using this average value as a basis, the minimum of the present cycle should occur 6.7 years after March, 1958, the date of maximum. This results in a predicted date of minimum of November, 1964.

2. The duration of previous cycles from minimum to minimum varies in length from 9 to 13.6 years, with an average span of 11 years. Based on this average value, the minimum of the present cycle should occur 11 years after April, 1954, the starting date of the cycle. This results in a predicted date of minimum of April, 1965.

3. The time it took for previous cycles to reach a minimum from a smoothed sunspot number of 28 varies between 10 and 53 months, with an average of 23 months. Using this average value, the minimum of the present cycle should occur 23 months after June, 1963, the date on which a smoothed sunspot number of 28 was observed during the present cycle. This results in a predicted date of minimum of May, 1965.

4. The minimum value of smoothed sunspot number observed during previous cycles varies between 0 and 11.2, with an average value of 5.

Based upon the above analysis, the present cycle is likely to reach a minimum value of 5 by the following dates:

November	1964
April	1965
May	1965

Although present sunspot predictions are based upon empirical methods developed from the behavior patterns of previous cycles, there is an observable pattern on the sun itself that makes it possible to predict the final stage of a cycle with a good degree of accuracy. This is the drift pattern of spots from high solar latitudes towards the equator of the sun, as the cycle progresses.

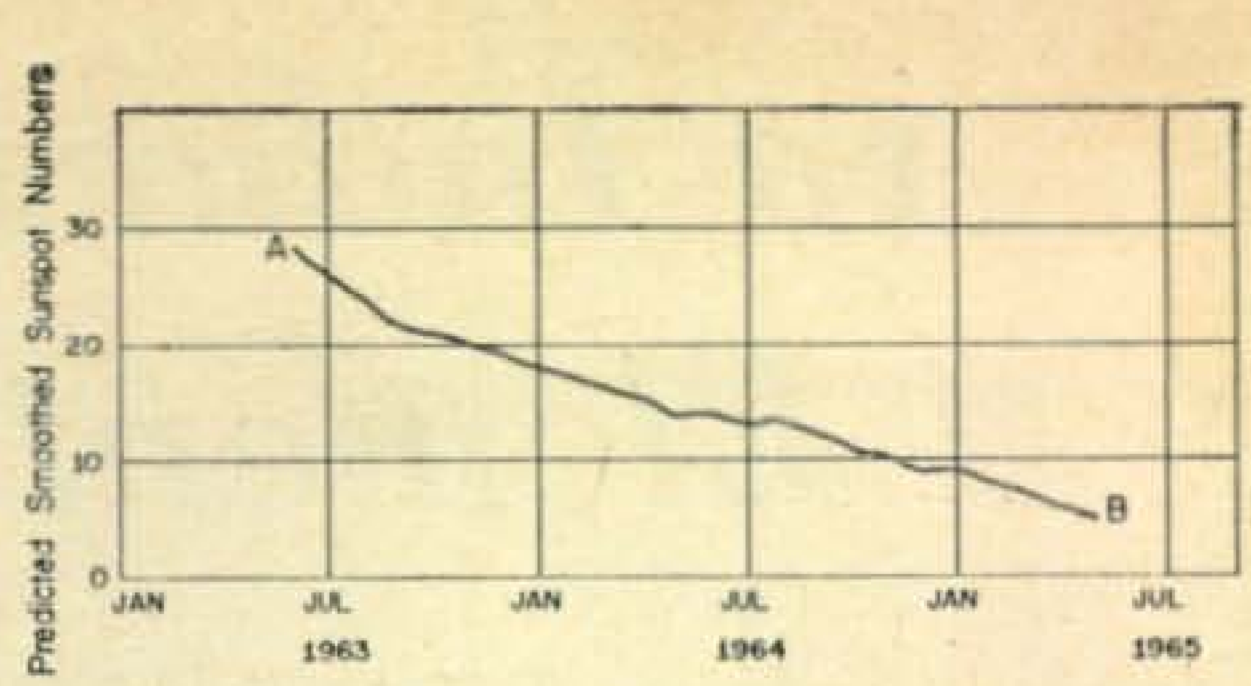


Fig. 2—Predictions for the remainder of Sunspot Cycle 19. At A, a smoothed sunspot number of 28 is predicted for June, 1963. The minimum of Cycle 19 is predicted to occur during April, 1965, shown at B, with a smoothed sunspot number of 5.

At the start of a new solar cycle, sunspots first break out in two zones, 25 to 35 degrees north and south of the sun's equator. The magnetic fields surrounding the spots of the new cycle are reversed in polarity from the fields surrounding the spots of the old cycle. As the sunspot cycle progresses, the zones in which the spots occur slowly drift towards the equator by about two degrees a year. By sunspot maximum, most spots break out at about 15 degrees, and by the end of the cycle, the sunspots nearly touch the solar equator. For a period between a year and 18 months, both the new and the old cycles overlap, with spots of the new cycle seen in high latitudes, while the few remaining spots of the old cycle break out near the equator. The date usually assigned to the end of the old cycle and the beginning of the new one is when the spots of both cycles are equally numerous.

The first spots of the new cycle were observed at 34 degrees on the face of the sun during September and October, 1963. Based on this observation, the end of the present cycle and the beginning of the new one is most likely to occur sometime between October, 1964 and April, 1965, which compares closely with the span of dates predicted from the statistical studies made above.

Figure 2 graphically depicts the author's prediction for the remainder of the present sunspot cycle. A minimum value of 5 is predicted to occur during April, 1965, the date most favored by the author[2]. According to the analyses discussed here, however, the end of the present cycle and the beginning of the 20th sunspot cycle may occur as early as October, 1964 or as late as May, 1965. The italic values in Table I show the sunspot numbers predicted for the remainder of the cycle in tabular form. ■

[2]This alters only slightly the prediction of a minimum date of May, 1965 made by the author three years ago in "The Sunspot Story, Cycle 19, The Declining Years."

An Inductively Coupled 4 Element 14 Mc. Beam

BY RONALD LUMACHI*, WB2CQM

This single-band beam is easily constructed using an interesting commercial product called a "NuRail" aluminum cross. No tuning adjustments are necessary with the inductively coupled arrangement used and the effects of weathering are held to a minimum. This rugged lightweight beam has the added advantage of low cost.

CONFLICT with QRM almost entirely eliminates the use of the dipole-type radiating system for reliable and consistent communication. When means permit, both financial and physical, the amateur will turn to the commercial antenna market for the directive beam array. In almost all cases, the commercial unit is a dipole with the lines of radiation reinforced and projected forward through the use of director-reflector combinations. For maximum transferral of r.f. potential, an antenna cut to the half wave or longer at the desired frequency will provide superior propagation characteristics.

For those interested in home brewing a light weight, efficient and flexible array for maximum energy transfer, consideration should be given to this 20 meter inductively coupled yagi monobander project.

Boom Construction

A 30′, 1⅝″ outside diameter boom (¼″ wall) was chosen to provide a higher characteristic impedance (due to the larger spacing) and consequently a lower Q resulting in additional bandwidth. The boom was constructed from a 20′ and 12′ length of tubing. The shorter length was cut into two 5′ sections and butted to each end of the longer section. The remaining two foot segment was halved and split lengthwise forming four half shells. Two muffler clamps over each butt and shell completed the extension. For additional sag support, a length of nylon rope was attached to the boom ends and supported about 6 feet above the mast boom clamp. (see photo)

*73 Bay 26th Street, Brooklyn 14, New York City.

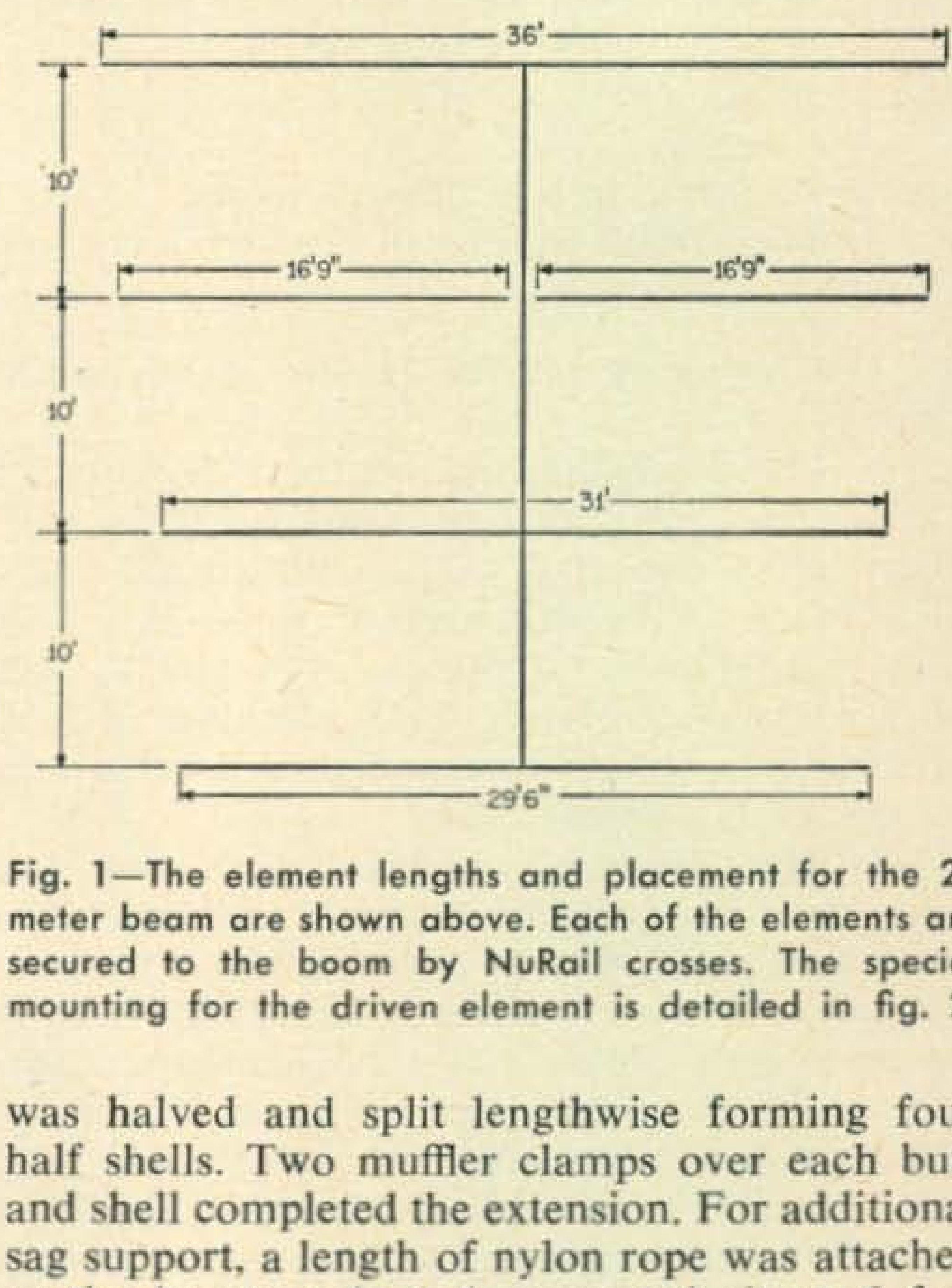
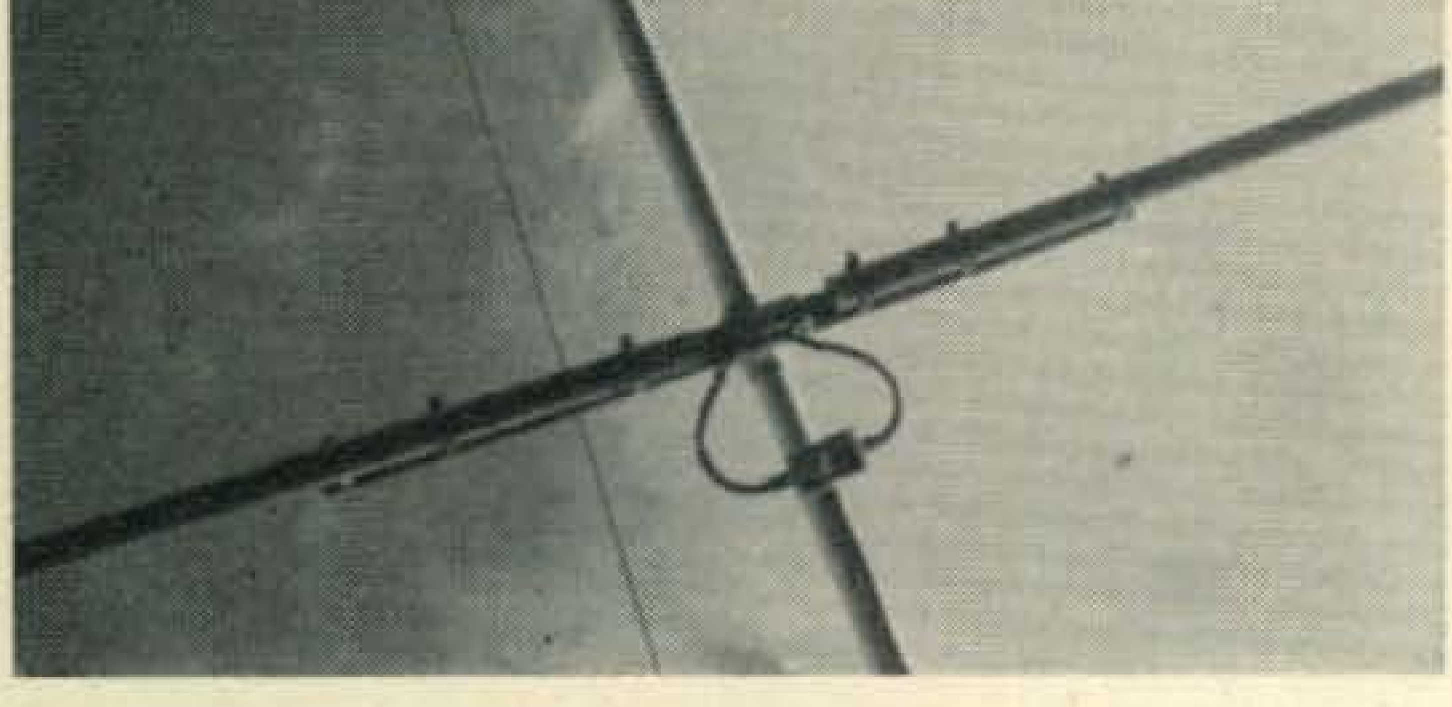


Fig. 1—The element lengths and placement for the 20 meter beam are shown above. Each of the elements are secured to the boom by NuRail crosses. The special mounting for the driven element is detailed in fig. 2.

The boom is mounted to the mast at the center of balance using either a home brew NuRail cross[1], or the Cesco boom mount. An element spacing of 10′ was chosen for the normal installation as shown in fig. 1.

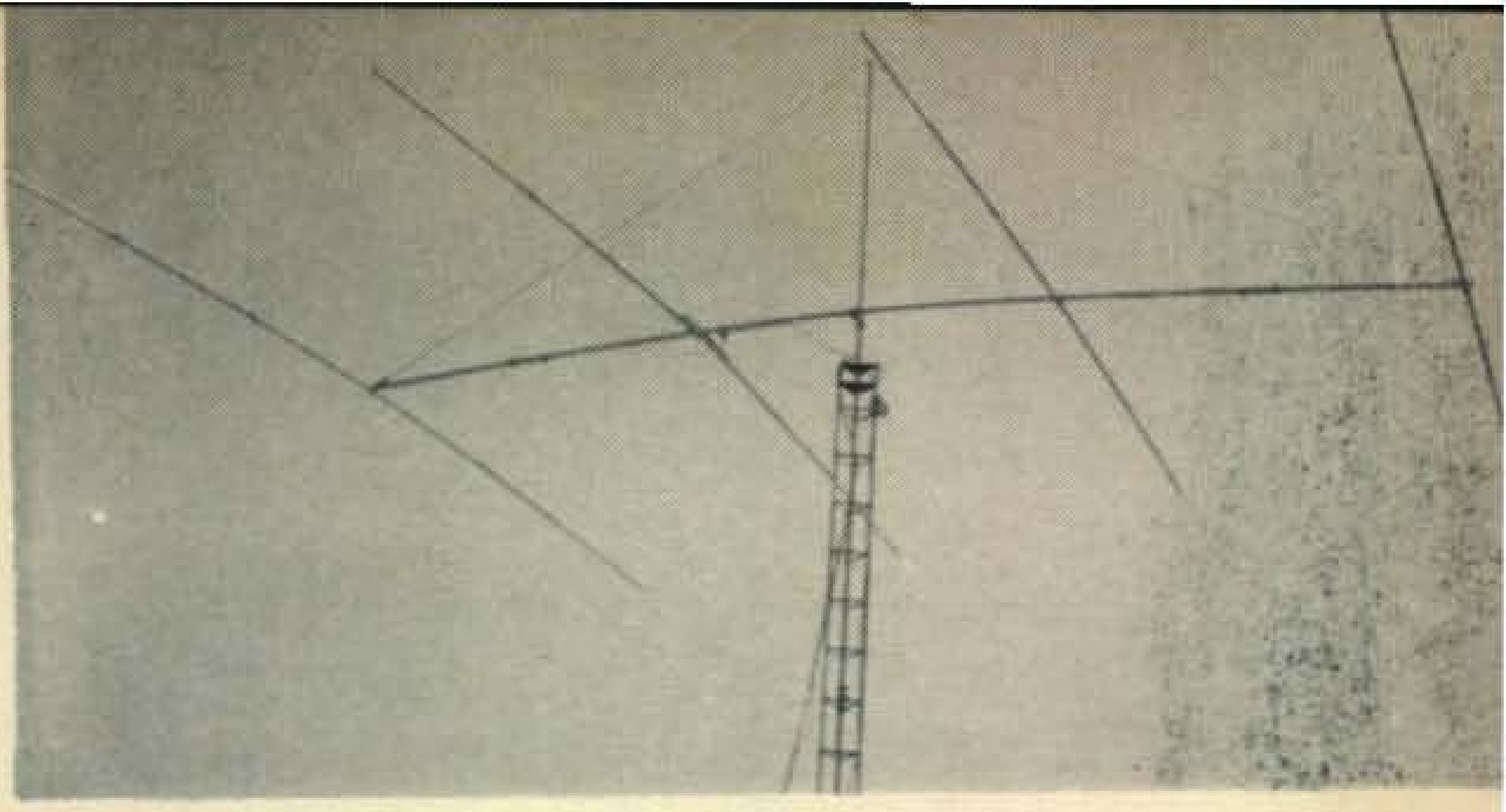
Director and Reflector

The director and reflector elements are constructed of aluminum tubing of 0.058″ wall thickness and telescoped to half wave dimensions. Two 6′ lengths of 1⅜″ tubing were inserted 1 to 2 feet into a 12′ length of 1½″ tubing. Where each element tube was telescoped, a lengthwise slit was made in the larger tube and securely fastened with hose clamps for a good mechanical



Looking up at the driven element of the 20 meter inductively coupled beam shows the coax entering the driven element and feeding the Minibox mounted on the boom.

[1]Available from Whitehead Metal Products, P.O.B. 102, Carteret, New Jersey.



View of the complete beam shows the six foot vertical mast above the 30 foot boom. This anchors the ⅜" nylon rope that supports the boom ends.

bond. A NuRail aluminum cross supports the elements at the center. Ten foot lengths of standard TV masting, 1¼" in diameter, were telescoped into the 1⅜" units and adjusted to electrical length resonant at the operating frequency. The lengths of the reflector and directors, as well as the spacings are shown in fig. 1.

Driven Element

The driven dipole element support presented a problem in home brew construction since the elements (unlike the directors and reflector) had to be lifted above ground. Several methods were considered and met with various degrees of success. For example, a 6′ length of 1½" diameter polystyrene rod was purchased for its insulating qualities. However, this method proved short lived because of the brittle nature of this material. The first strong wind found both elements on the ground since the strain was too great for this support.

Since the current is highest and voltage minimum at the point of feed, it was decided that wood might serve well because of its inherent strength. Although wood is an extremely poor insulator where high voltage is concerned, it has proven satisfactory in this high current application.

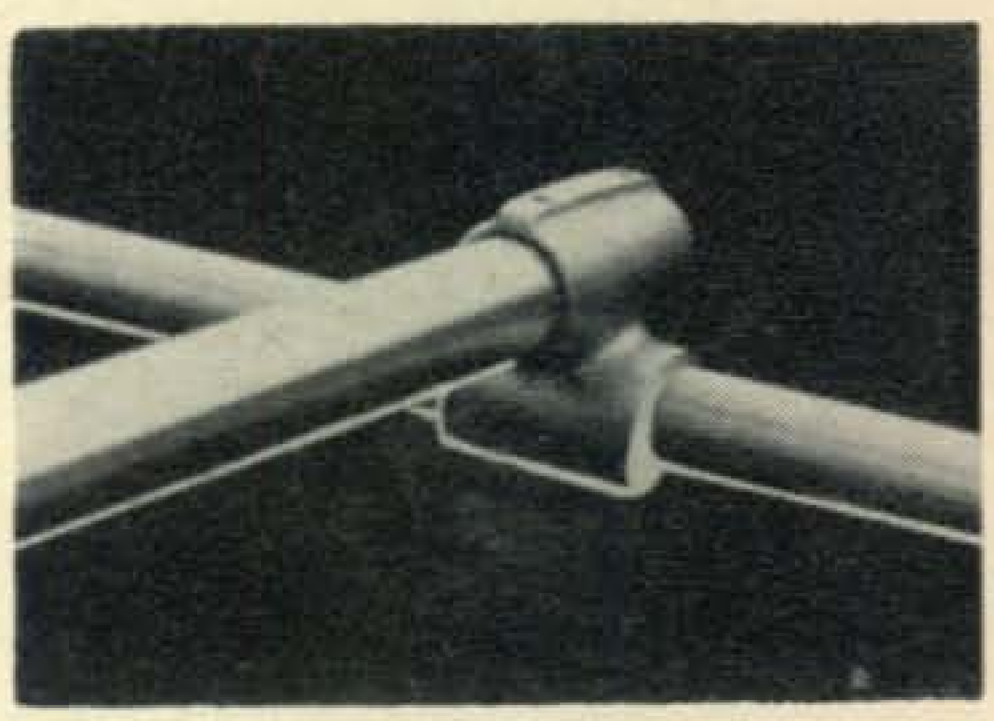
To preserve the wood, a coating of creosote was applied and later a heavy application of varnish further insulated the wood from the drying tendencies of the weather. This additional protection insured that the wood would retain its resiliency and strength.

A length of 1⅝" dowel (4 to 6′) was inserted in a NuRail cross so that it was secured at its center. A thin aluminum shim was forced into place to insure that the set screws of the cross would truly lock the wood in position without burrowing. Each dipole leg was attached to the wooden support using three spaced aircraft type hose clamps. This is illustrated in fig. 2.

The line to couple to the driven element is shown in fig. 3. It is 16′ long (approximately a ¼ wavelength) and is made from RG-8/U cable.

The shield and conductor at the two extreme ends are soldered together and covered with electrical tape. The shield, at the exact center of the stub, is cut through and peeled away into two separate connections. Care should be exercised to prevent the polyfoam insulator and center conductor from being damaged. The transmission line, from the transmitter, is terminated at these two separately gathered ends. A small minibox is attached to the boom and the gathered ends of the coax shield connected to the center conductor of two SO-239 connectors through short lengths of cable and PL-259 plugs as shown in fig. 2. A third SO-239 was insulated above ground by the use of polystyrene sheeting and short leads connected internally from the two center conductors of the SO-239's to the center conductor and shield of the third insulated SO-239. Subsequently, the transmission line was terminated at this SO-239. The Minibox was used for convenience and rapid disassembly, but can be eliminated should direct connection to the stub gatherings be desired.

The completed stub was slipped inside the driven element. No further connections were required. A thermos cork was fitted into the input ends of the driven element tubing and a hole drilled in each cork (½") to allow the coax to



View of the boom end with the director coupled on by the use of the NuRail cross. The cross, identified as a #10, is chosen for 1¼" pipe which provides openings of about 1⅝" in diameter.

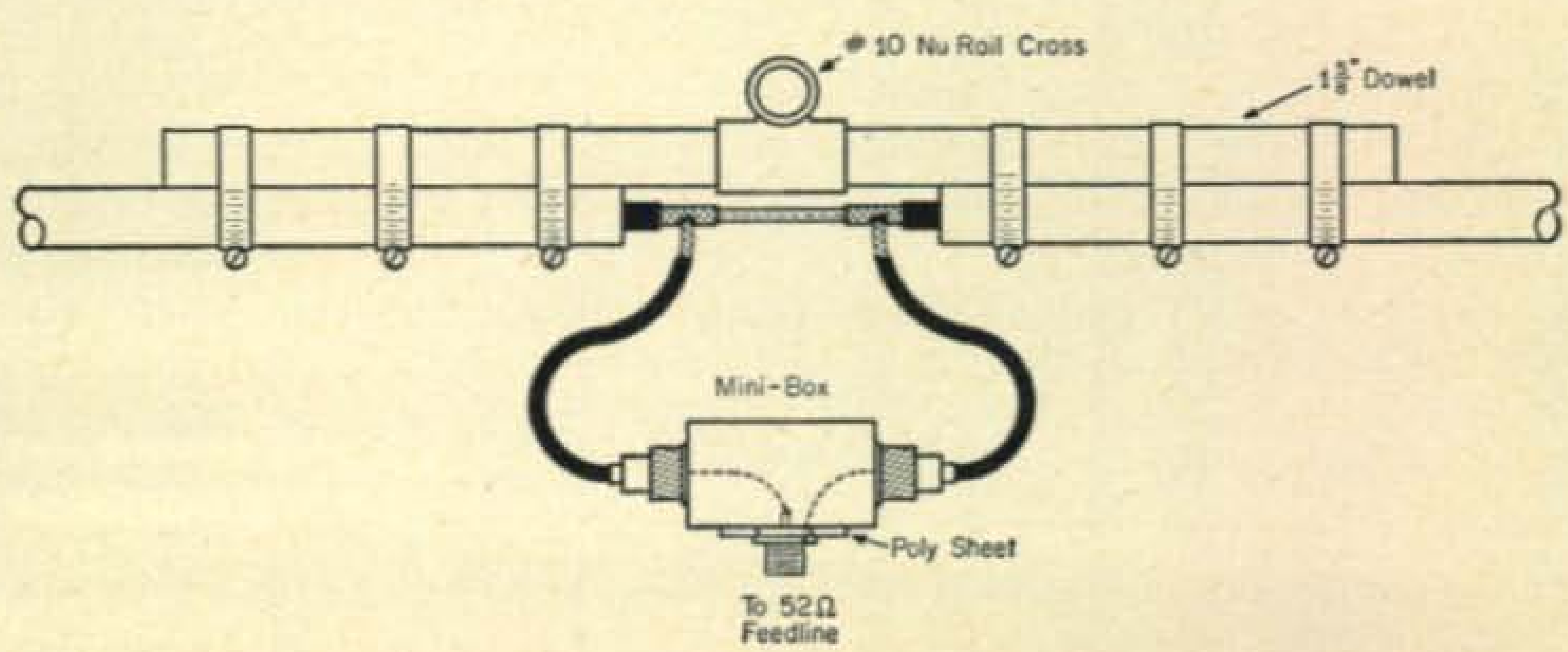


Fig. 2—The driven element is secured to a 1⅝" wooden dowel which is passed through the NuRail cross. This is approximately the outside diameter of 1¼" pipe (1.691"). The elements are secured to the dowel by aircraft type hose clamps. The inductive coupler, made from RG-8/U, is inserted into the driven element through ½" holes in the inside corks (not shown.)

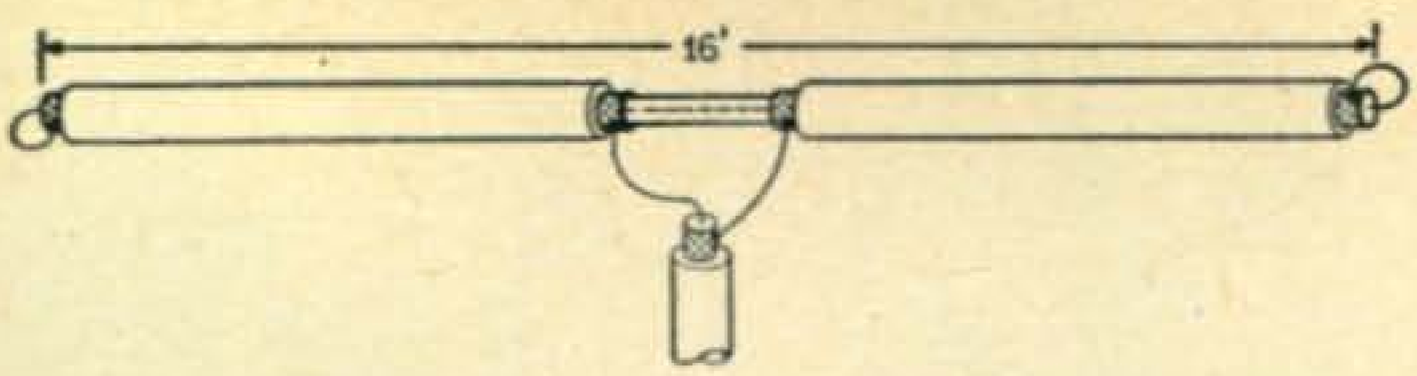


Fig. 3—Wiring and construction of the simple inductive element made from RG-8/U. The feed point may be connected directly to the coax or through a Minibox as shown in fig. 2.

pass through. The cork prevents water accumulation since the extreme ends of each element are also shut off with cork to reduce the wind noise and surface area wind resistance.

Conclusion

The input impedance reflects 50 ohms but varied slightly with respect to height above ground. Power transfer is extremely efficient due to the transmission line-antenna match. Since all r.f. is *induced* in the driven element, gradual antenna impedance changes, found in the gamma and T matches due to the corrosive tendencies of the weather on the physical connections, are of no concern in this installation.

The use of aluminum technique throughout keeps the weight to a minimum and results in an array far stronger than its commercial counterpart. Should smaller diameter tubing be contemplated, the *Q* of the antenna would naturally be affected. Thinner diameter tubing would necessarily reduce the antenna's bandwidth. Rapid s.w.r. change with minor frequency excursions results from decreasing the bandwidth.

Needless to say, the unit can easily be retelescoped for 10-15m operation when propagation favors this portion of the spectrum. The cost factor is much lower for the home brew unit and will provide the operator with that immeasurable satisfaction when questioned about the quality signal by the DX station. ■

Parts List

†4—lengths, 12′ × 1½″ × 0.058″ wall aluminum tubing.
†4—lengths, 12′ × 1⅜″ × 0.058″ wall aluminum tubing.
8—10′ lengths of 1¼″ TV masting.
†4—#10 NuRail crosses for 1¼″ pipe (5 required if cross mast mount is contemplated).
†1—20′ length 1⅝″ O.D. × ¼″ wall thickness aluminum pipe (for boom).
†1—12′ length 1⅝″ O.D. × ¼″ wall thickness aluminum pipe (for boom).
12—2¼″ aircraft type hose clamps.
6—3½″ aircraft type hose clamps.
10—Thermos corks.
1—Small Minibox (optional).
3—SO-239 connectors (optional).
2—PL-259 connectors (optional).

† Available from Whitehead Metal Products, P.O.B. 102, Carteret, New Jersey.

What's Your A.I.Q.?

BY KENNETH W. "JUDGE" GLANZER†, K7GCO

Think you know a bit about that most talked about piece of ham gear, the antenna? Well then, what say you tackle the little quiz below and compare your answers to ours. No cribbing allowed!

1. The basic impedance of a dipole is 72 ohms only at: (a) all quarter wave multiples; (b) all half wave multiples, above electrical ground.

2. If a dipole is at such a height where its impedance is 50 ohms what will the impedance be if the radiator is changed to a folded dipole, maintaining the same height?

3. With the dipole in Question 2, what will the impedance be if it is changed to a folded *tripole* (three wires)?

4. How much gain in db is realized from 2 half waves in phase? (a) 1.0; (b) 1.5; (c) 1.9; (d) 3.0.

5. What is the general range of the impedance at the center feedpoint of 2 half waves in phase? (a) high; (b) low.

6. If a quarter wave of open-wire line is connected to the center feedpoint of 2 half waves in phase, what configuration of antenna tuner will best match the impedance at the end of the feedline? (a) series (b) parallel.

7. What is the s.w.r. on a 50 ohm feedline that is terminated with a 100 ohm load: 1.0; 1.5; 2.0; or 3.0:1?

8. What is the s.w.r. on a 50 ohm feedline terminated with a 25 ohm load: 1.0; 1.5; 2.0; or 3.0:1?

9. Will an accurately calibrated s.w.r. bridge at the end of say 100 feet of feedline actually read this value?

10. Does tuning a feedline change the s.w.r.?

11. The most important point for impedance

*Antenna Intelligence Quotient.
†202 S. 124 St., Seattle 88, Wash.

matching insofar as transfer of power is concerned is: (a) at the antenna; (b) at the end of the feedline.

12. Is the reflected power as read on many s.w.r. bridges actually lost?

13. What impedance value will a bridge read at the end of a quarter wave of 300 ohm line if the other end is open (no load): (a) 75; (b) 150; (c) 300; (d) 450; (e) none of these.

14. When stacking beams vertically, increased gain occurs as a result of the plane pattern becoming sharper in the (a) vertical pattern; (b) horizontal pattern.

15. What is the approximate additional gain in db of stacking two 3-element beams at an optimum spacing of ⅝ wavelength: (a) 2.0; (b) 2.4; (c) 2.9; (d) 3.3.

16. If the vertical spacing of two horizontal beams is increased beyond the optimum spacing, the width of the main free-space vertical lobe decreases substantially. Does the gain increase?

17. We have two typical 2-element yagis, one with a large diameter low-Q parasitic element tubing and one with small diameter high-Q tubing. Both are tuned for maximum gain. Which one will have the highest gain?

18. If a cubical quad is fed such that the polarization is vertical, will its angle of radiation be: (a) higher; (b) lower, than if were horizontally polarized at the same height?

19. What is the approximate gain relationship in db of a cubical quad driven element compared to a regular dipole: (a) 0; (b) 1; (c) 2; (d) 3; (e) 4.

20. Does increasing the gain of a horizontally polarized yagi lower the angle of radiation?

21. If a dipole and a yagi are erected at the same height will they have the same angle of radiation?

22. The average ground is more lossy to: (a) horizontally; (b) vertically polarized waves.

23. Will the angle of radiation from two stacked beams be lower than that of the top beam alone?

ANSWERS

1. Actually both are right, but (a) is more right as 72 ohms is repeated every quarter wave in height.

2. A folded dipole will raise the impedance 4 times, or to 200 ohms in the case cited.

3. A folded tripole (three wires) will increase the impedance 9 times. Thus from Question 2 and 3, we see that the impedance rises as the square of the number of wires used.

4. (c) 1.9 db.

5. High impedance, as the feedpoint is at a current minimum and a voltage maximum.

6. Antenna feedpoint is a high impedance and feedline is quarter wave, thereby presenting a low impedance to the tuner. A low impedance series tuning configuration is required to match.

7 & 8. The s.w.r. is 2:1 in both situations since the existing mismatch is in a 2:1 ratio in both cases.

9. No, as resistive losses in the coax will decrease the amplitude of the reflected component and s.w.r. bridge will read a lower value of s.w.r.

10. No. Tuning a feedline is the process of matching the impedance at the end of a feedline with an antenna tuner or pi network. Actually all feedlines are tuned in one sense regardless of s.w.r.

11. At the end of the feedline. No matter how good the match is at the antenna, the antenna tuner or pi-network must match the impedance presented at the end of the feedline or no transfer of power will occur.

12. No. A small percentage of it is lost due to the I^2R losses in the feedline, which will vary. All the reflected power does is create standing waves on a feedline and if it were all lost there would be no standing waves.

13. (e) None of these. A dead short or zero ohms will be read by an impedance bridge at the end of a quarter wave line with no load at the other end.

14. (a) Vertical pattern. Vertical stacking sharpens the vertical pattern.

15. (c) 2.9 db.

16. No. The gain stays about the same even though the vertical pattern narrows. The side lobes increase in amplitude.

17. In parasitic arrays the highest gain is realized with the highest-Q parasitic elements but at the expense of bandwidth.

18. (b) Lower. In the ideal case, vertical antennas always have one lobe next to the ground. In the case of a lossy ground, phase shift suffered by the vertically polarized wave will raise the angle of radiation to about the same angle of the horizontally polarized wave when both are above a wavelength in height. However the vertically polarized wave is attenuated more at the point of reflection which results in the horizontally polarized lobe being stronger.

19. (b) 1 db.

20. Yes. Higher gain results in a sharper vertical pattern. Graphical analysis (multiplying the free space vertical pattern by the reflection factor for that height) will show a resultant lower angle of radiation.

21. No. Sharpness of the vertical pattern also controls the final angle of radiation for a given height.

22. (b) Vertically polarized waves.

23. No. For normal stacking distances the sharper vertical pattern of both will not lower the resultant angle of radiation as low as the angle of the top beam alone, but the top beam also has a high angle lobe of fair amplitude.

Scoring

0-5 Below average.
6-10 Average.
11-15 Good.
16-23 What did you say your name was . . . Kraus?

The Class C Linear Amplifier

BY D. O. MANN*, W6HLY/W3MBY

Part I

The Class C linear, also known as the ZL linear, was first introduced in the CQ Sideband Handbook but no detailed explanation of its operation was included. However, it aroused enough curiosity on the part of some amateurs to cause them to investigate further. Below, in Part I, are the theoretical results of W6HLY's experiments. Part II will cover the construction and adjustment of a Class C linear amplifier.

A COUPLE of years back the *CQ* Sideband Handbook introduced the Class C Linear amplifier, also referred to as the ZL Linear. The Handbook article was very modest in describing (almost naively) that some newcomer to s.s.b. hooked an exciter to his c.w. rig and found that it worked! W6TNS doesn't seem the type to be satisfied with such simplified reality, but for some reason no explanation of circuit was given. It did, however, serve to arouse the curiosity of several amateurs beside myself. Those who stuck with the idea long enough to solve the "debugging", considered it well worth the effort. Since most, if not all, of the sideband homebrew these days is confined to linear amplifiers, a quasi-technical discussion of the Class C circuit, its design and adjustment should have general interest.

What Is It?

Referring to fig. 1, it will be noted that this amplifier, a Class C Linear, is only a slightly modified version of the standard c.w. Class C power amplifier with clamp tube for key up condition or protection against excitation failure. Tube V_1 is a tetrode power amplifier and V_2 a tetrode clamp or screen grid modulator. Earlier versions of the circuit had triode clamp tubes, but in W6TNS's later articles the tetrode appeared and is superior to the triode in control of static current. The principal difference in the use of this circuit as a linear amplifier is that the clamp tube is never allowed to be cut-off, (determined by the settings of R_3 and R_4) as it is for c.w.

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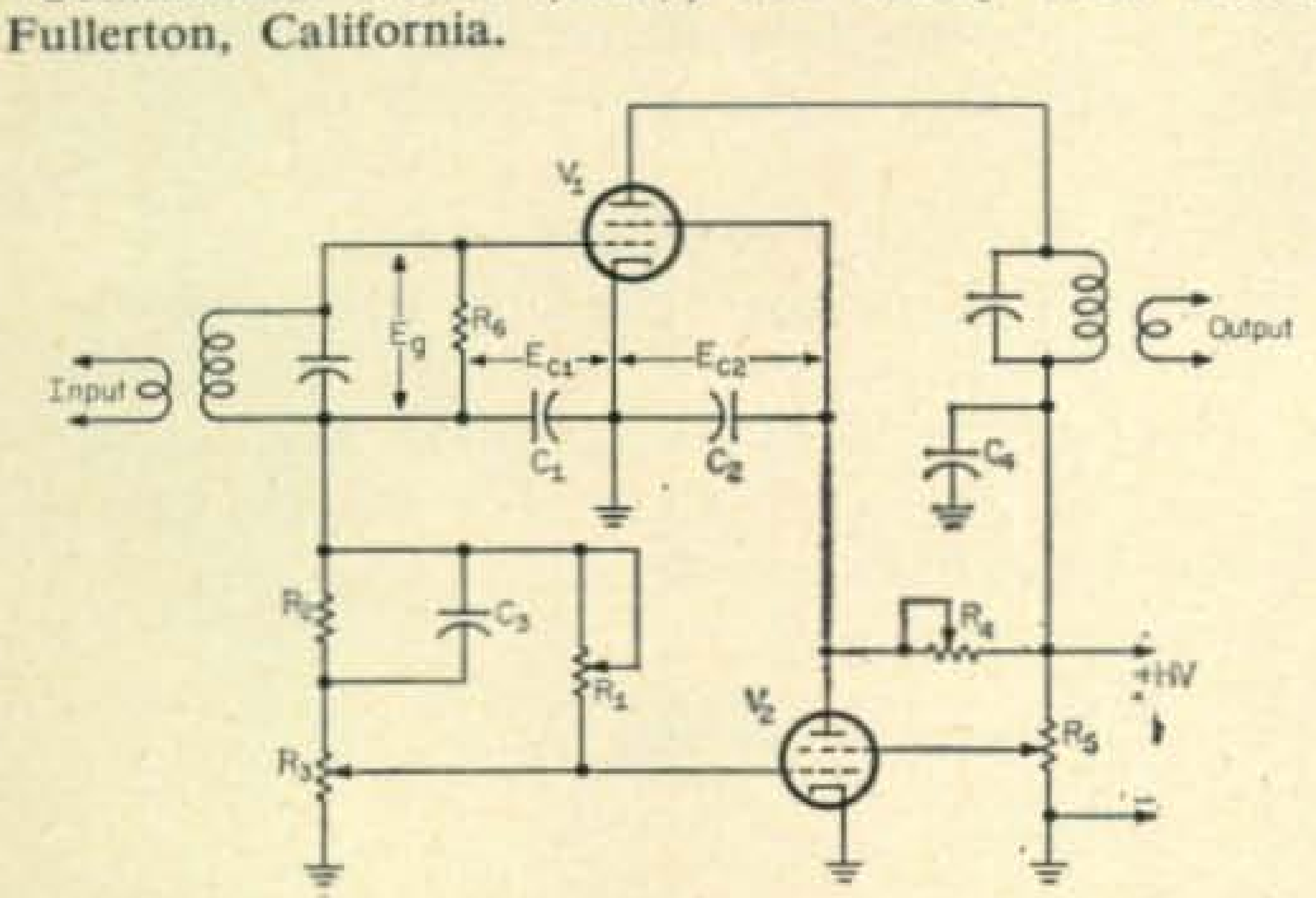

Fig. 1—Functional schematic of a Class C linear amplifier. Control R_1 allows adjustment of the bias for V_1 without disturbing the gain setting of R_2, for V_2. The functions of R_4 and R_5 are discussed in the text.

The principal advantages of the circuit over other linear amplifiers are: 1. High p.e.p. efficiency (80-85% plate efficiency); 2. Linear drive loading; 3. Does not require "stiff" regulated screen and plate supply voltages nor is a bias supply required. 4. Low driving power required (20 db nominal power gain); 5. Intermodulation distortion for two-tone drive is approximately 30 db below maximum p.e.p. when properly set up (without feedback per lab tests).

Advantage 5 simply states that these advantages can be had without any more distortion than other linears normally exhibit in amateur operation. Later on, it is hoped, the reader will understand and appreciate these statements more fully.

Circuit Operation

Believe it or not, from discussions on the air and with some associate engineers, there is considerable divergence of opinion on the operation and capabilities of this circuit. Much of the minor indifference and doubt is believed due to lack of familiarity with and to preconceived notions associated with Class C amplifiers. Most of these notions persist because, for the last 30 years or so, Class C amplifiers could *only* be used for c.w. or high level a.m. finals, harmonic amplifiers or oscillators, but *never* as linears! In other words, any amplifier biased beyond cut-off just won't respond to small signals and thus either is not linear or else it must actually be operating Class B, not Class C. None of these concepts are entirely wrong as we shall see, but they don't apply generally because we do not have the ordinary fixed bias, fixed screen voltage Class C case here.

For a brief run-through on the circuit operation refer to fig. 1 again. When no r.f. excitation is applied, no grid current in V_1 means no current in R_1, R_2, or R_3 so the grid of V_2 is at ground potential. Resistor R_5 is adjusted so the screen grid of V_2 is sufficiently positive to cause a large plate current through V_2. The voltage

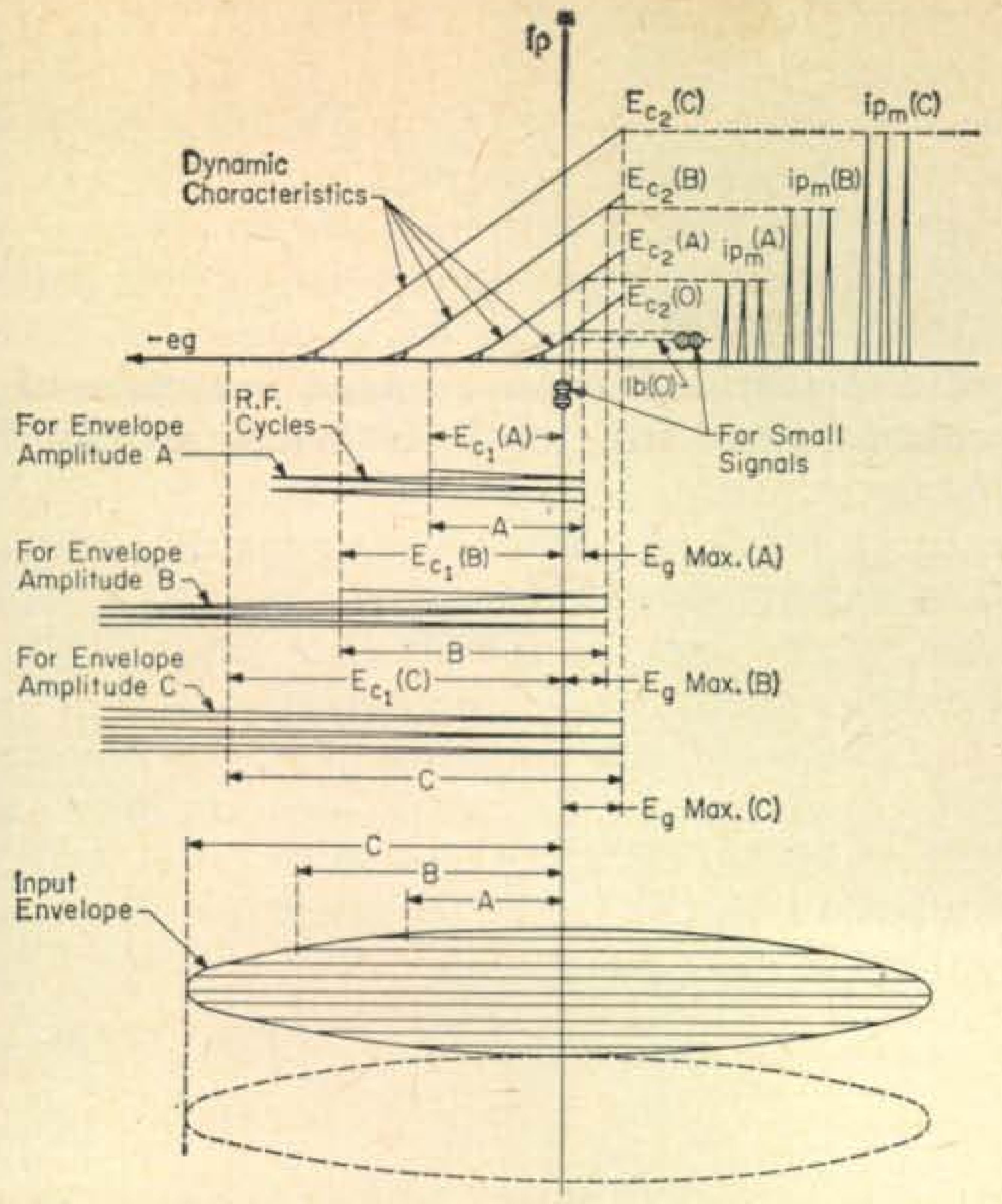

Fig. 2—Class C linear amplifier graphical dynamic characteristics.

drop, due to this current through R_4, results in a very low voltage at the plate of V_2 and the screen of V_1. With low voltages on both grids of V_1, a static plate current, similar to what V_1 would draw as a dual grid zero bias triode, flows.

Upon application of r.f. excitation, the voltage E_g drives the grid of V_1 positive, the grid current charges C_1 and builds up negative bias voltage, E_{c1}, which discharges (leaks) through the resistor network R_1, R_2 and R_3,—routine. A portion of the negative voltage, E_{c1}, from R_3, reduces the large plate current of V_2 and the drop across R_4 thus raising the screen voltage, E_{c2} of V_1. When the excitation is sufficient to develop a Class C bias, E_{c1}, with R_3 and R_4 adjusted to apply rated screen voltage to V_1, the amplifier can operate at maximum Class C ratings. This is so, provided the total resistance across C_1 is high enough, the proper plate voltage is applied and the tank circuit load adjustments are made.

So much for the brief run-through. We have hit the two end points, the static current and the maximum Class C condition, or key up—key down, if you please. But what happens in between; what about linearity? To explain this will require a little more technical insight, and fig. 2 is an attempt to adapt standard graphical amplifier analysis techniques to Class C tetrode linear operation. Figure 2 could be representative of the normal E_g-I_p dynamic characteristics for any tetrode, for several fixed screen grid voltages, $E_{c2}(0)$, $E_{c2}(A)$, etc. For a Class A or B, or the *ordinary* Class C amplifier, we would use only *one* of these curves corresponding to the fixed values of screen and bias voltages applied, say $E_{c1}(B)$ and $E_{c2}(B)$. But in the Class C Linear the clamp tube interconnects the control grid bias, E_{c1}, and screen grid E_{c2} voltages and *both* of these become variables which are a function of the signal input voltage.

In order to show how an input voltage results in amplifier plate current, several E_{c1}-E_{c2} relationships and their relation to the input signal are required as shown in fig. 2.

With this as a starter, let's examine the relationships of fig. 2 more closely by following through the response of the circuit to a two tone driving signal (the normal s.s.b. test signal). Near the origin of the i_p-e_g axis is the curve labeled $E_{c2}(0)$. The intersection of this curve with the i_p axis corresponds to the static plate current labeled $I_b(0)$. A small signal input will be amplified essentially Class A within the static current as shown about the $E_g(0)$ and $I_b(0)$ lines. This is entirely normal for all higher efficiency amplifiers as it is analogous to the "projected cut-off" bias for triode Class B amplifiers.[1] Such small signals do not have enough amplitude to develop appreciable grid current in V_1 or bias E_{c1}.

When a much larger signal is applied, as shown in the bottom of fig. 2, the condition of the circuit is indicated for three amplitudes of the envelope, A, B, and C If the amplifier is to operate Class C at all times, the resistor network in the grid circuit of V_1 must be large enough so that the bias voltage E_{c1}(A, B, C) developed by the grid current always places the operating point beyond cut-off for the corresponding screen voltage E_{c2}(A, B, C). This must be so in order that plate current flows less than a half cycle, *i.e.* less than 180°. If operation is to be linear, this operating angle *must* be constant throughout the range of input signal[2] which requires that a fixed proportion, or linear relationship, exist between E_{c1} and E_{c2}. This is shown as the first relation of parameters listed below and, interpreted literally, it says that if the input amplitude is A, B, or C, the ratio of E_{c1} to E_{c2} remains the same—constant. This also requires the clamp tube be linear, but this is Class A. These relationships are shown as only approximate because no practical circuit is perfectly linear.

$$\frac{E_{c1}(A)}{E_{c2}(A)} \cong \frac{E_{c1}(B)}{E_{c2}(B)} \cong \frac{E_{c1}(C)}{E_{c2}(C)} \qquad (1)$$

$$\frac{E_{g\,\max}(A)}{E_{c1}(A)} \cong \frac{E_{g\,\max}(B)}{E_{c1}(B)} \cong \frac{E_{g\,\max}(C)}{E_{c1}(C)} \qquad (2)$$

$$\frac{E_{c1}(A)}{A} \cong \frac{E_{c1}(B)}{B} \cong \frac{E_{c1}(C)}{C} \qquad (3)$$

$$\frac{i_{p\,\max}(A)}{A} \cong \frac{i_{p\,\max}(B)}{B} \cong \frac{i_{p\,\max}(C)}{C} \qquad (4)$$

---

[1]Projected cutoff is that bias value that would be obtained if the main part of the e_g-i_p curve were projected as a straight line. For further information see Terman's *Radio Engineers Handbook,* McGraw Hill, page 393.
[2]Everitt, W. L., *"Communication Engineering,"* McGraw Hill Book Co., Second Edition 1937, page 571.

The second approximate relation of parameters says that the ratio of maximum peak grid voltage E_{gmax} to the bias voltage E_{c1} is constant regardless of input signal amplitude. This, in effect, requires that the grid circuit of V_1 operate essentially as a linear diode detector, or envelope detector. For the values of Class C bias required, the range of grid current, and the time constant of C_1 and resistor network R_1, R_2, and R_3 (fig. 1) this condition can be fulfilled easily with practical tetrodes. The third relationship also states the same conclusion; *i.e.* the bias voltage, E_{c1}, is proportional to the input envelope amplitude. Both of these relations attest to the fact that the loading on the driving amplifier is linear, *i.e.* there is no point where the driving voltage abruptly overcomes a fixed negative bias and a non-linear grid current flows. In other words, a positive E_{gmax} exists essentially at all times with a high impedance in the grid circuit to nullify any non-linear grid voltage versus grid current problems normally encountered. In this connection it should also be pointed out that R_6 in fig. 1 is *not* a swamping resistor as might be supposed, but is recommended as a convenient method of broad band neutralization, in as much as a well constructed tetrode amplifier requires little, if any, formal neutralization unless the ultimate in low driving power is necessary.

When the first three approximate relationships of fig. 2 are applied to the i_p-e_g characteristics, a fourth, and most significant proportion results, showing that the peak value of plate current $i_{p\ max}$ is also proportional to the input envelope amplitude. It can be shown that the fundamental component of plate current (the current that produces r.f. voltage across the plate tank) is also proportional to the peak plate current $i_{p\ max}$ and this therefore means that the r.f. signal envelope across the plate tank of V_1 is proportional to the r.f. signal envelope across the grid tank.[3] This is called "envelope linearity" and is essentially identical to the performance of a Class A or B r.f. amplifier in this regard.

Even though the foregoing discussion comes out (as intended) to show the fundamental capabilities of linearity in this Class C circuit, it would be misleading not to point out some of the weak spots. Possibly the most troublesome source of non-linearity is the transition from the small signal Class A operation to Class C where the above proportions apply. The small signal or transition distortion can be controlled, but not completely eliminated, by not running the static current too low as with Class B. Fortunately it affects only small signals and so does not cause appreciable distortion with respect to the p.e.p. output level.

A second concern is the *RC* time constants, C_1, R_1, R_2, R_3, in the control grid, and C_2, R_4 in the screen grid of V_1, fig. 1. If either of these get too large the voltages E_{c1} and E_{c2} will have a time phase lag with respect to the r.f. input envelope and distortion results. To follow the envelope properly these *R-C* products should be less than $1/10 \times 1/(\text{bandwidth c.p.s.})$, or about 30 microseconds, maximum, for a 3 kc bandwidth signal.[4] The network R_2-C_3 (fig. 1) helps correct this envelope phase delay. Other sources of distortion are the common problems of all linears such as load impedance, parasitics, neutralization, etc., as well as linearity of the clamp tube.

Previously, it was stated that the angle of plate current flow must remain essentially constant to get linearity in this amplifier. To illustrate this condition in another way, and at the same time furnish an algebraic relationship which will aid in adjusting the amplifier, we start with an equation based on the "Linear Equivalent Circuit" of a tetrode Class C amplifier.[5]

$$E_{c1} = \frac{\dfrac{E_{c2}}{\mu_{sg}} + E_{g\ max} \cos\left(\dfrac{\phi_p}{2}\right)}{1 - \cos\left(\dfrac{\phi_p}{2}\right)} \qquad (5)$$

where: E_{c1}, E_{c2} and $E_{g\ max}$ are identified in figs. 2 and 3.

μ_{sg} — screen grid mu given in tube manuals.

$\dfrac{\phi_p}{2}$ — $\frac{1}{2}$ the angle of plate current flow in degrees.

By rearranging equation (5) we have:

$$\text{Cos}\left(\frac{\phi_p}{2}\right) = \frac{E_{c1} - \dfrac{E_{c2}}{\mu_{sg}}}{E_{c1} + E_{g\ max}} \qquad (6)$$

from which Θ can be determined from published tube data. Remember that the denominator is the peak grid driving voltage. By noting that the numerator of equation (6) is the difference between the control grid signal bias, E_{c1}, and the control grid bias for "projected" plate current cut-off, E_{c2}/μ_{sg}, it follows that if E_{c1} equals this cut-off bias, the $cos(\Phi_p/2)$ is zero and Φ_p is 180°, so the amplifier would be operating Class B, which is as it should be. This would be the condition where the ratio of E_{c1} to E_{c2} is always equal to the constant, μ_{sg}, in equation (1). A more general relation between these two voltages is the gain of the clamp tube, including the setting of R_3 in fig. 1. In simple equation form this is,

$$E_{c2} = A_c E_{c1} \qquad (7)$$

where A_c is the gain of the clamp tube circuit. Likewise, equation (2), in simpler form is,

$$E_{c1} = K_r E_{g\ max} \qquad (8)$$

where K_r is a constant which gets larger when the total resistance in the grid circuit is increased, (not affected by the setting of R_3). When both

[3]Terman, F. E. *"Radio Engineering Handbook,"* McGraw Hill, page 447.

[4]Care should be taken in calculating the time constant of the screen circuit of tubes that have bypasses built into the socket.

[5]*op.cit.*, Terman, page 452.

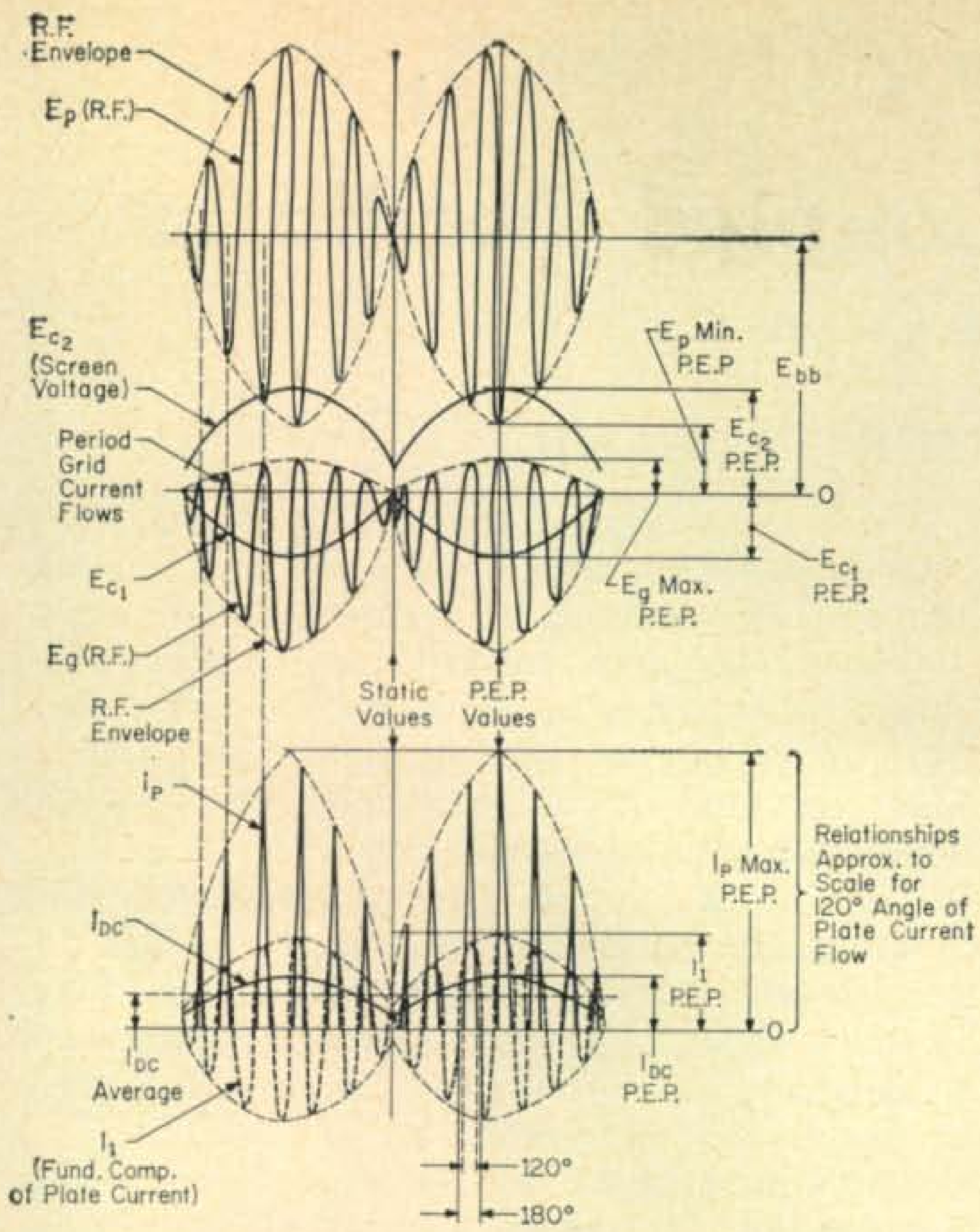

Fig. 3—Voltage and current relationship in a tetrode Class C linear amplifier for a two-tone signal.

of these relations, (7) and (8), are put into equation (6), we have:

$$\text{Cos}\left(\frac{\phi_p}{2}\right) = \frac{K_r\left(1 - \dfrac{A_c}{\mu_{sg}}\right)}{1 + K_r} \qquad (9)$$

$$= 1 - \frac{A_c}{\mu_{sg}}$$

(K_r would be about 10 for most tetrodes.) Two conclusions can be made; first, to the extent that K_r, A_c, and μ_{sg} are constant (reasonably true), the angle of plate current flow Φ_p is constant, and second, that for most tetrodes the gain of the clamp tube circuit (primarily the setting of R_3) *determines the angle of plate current flow.* The approximation of equation (9) is particularly true when the bias E_{c1} becomes an appreciable fraction of the peak driving voltage. It should also be noted that for the present case the cosine function decreases as Φ_p increases—which means that as the gain of the clamp circuit increases, Φ_p increases.

Another way of showing operation of the Class C linear circuit is the time, voltage and current diagrams for principal elements of the tetrode, fig. 3. In this diagram, time is indicated horizontally, with voltages in the upper section and plate current components in the lower section indicated vertically. The two tone envelope illustrated has the r.f. cycles expanded enormously in an attempt to show details of operation more clearly. On the left side, the various component functions are labeled, while on the right are indicated the p.e.p. values. Usually a diagram of this type shows only one r.f. cycle of the p.e.p. value spread out about to the size of the envelope shown here. Another distortion permitted for the sake of clarity is that $E_{p\ min}$ and $E_{g\ max}$ are slightly too large. For most efficient operation $E_{p\ min}$ should be no more than 15% of E_{bb}, the plate voltage, and $E_{g\ max}$ seldom would exceed 10% of E_{bb} in high transconductance tetrodes. Note that the maximum plate current flows at minimum plate voltage each r.f. cycle. This is also true in other amplifiers, but it is important to appreciate that the reason for higher efficiency in the Class C circuit is the smaller angle of flow, *i.e.* the greater proportion of current flow takes place at the lowest plate voltage. This sharp pulse of plate current, i_p, is shown as a solid curve in the lower portion of fig. 3. It is also well known that this pulse is equivalent to a d.c. current plus a special sum of the fundamental and harmonics of the recurrance frequency, the r.f. in this case. The two principal components of interest are the d.c. (solid, I_{dc}) and fundamental frequency (dotted, I_1) shown. As labeled at the bottom of the figure, the actual plate current i_p flows approximately two-thirds of a half cycle of I_1, or about 120°, and as discussed previously, remains essentially constant. For any fixed flow angle, the efficiency is of course at maximum where $E_{p\ min}$ is lowest, at the p.e.p. point, and drops off proportionally with envelope amplitude to zero at the static value. As the angle of flow is reduced the efficiency increases, but the possible input goes down, unless the drive is increased, and load impedances at 30 mc become impossible because tank capacities cannot be made small enough. So angles of flow from 100° to 120° are a good compromise between power output and efficiency.

In discussing how the efficiency of any ordinary linear is proportional to the input envelope amplitude, it is difficult to avoid pointing out how inefficient—yes *in*efficient the normal s.s.b. voice signal envelope is amplified, even in a Class C Linear with 85% p.e.p. efficiency. The normal s.s.b. voice envelope referred to is from

[*Continued on page 96*]

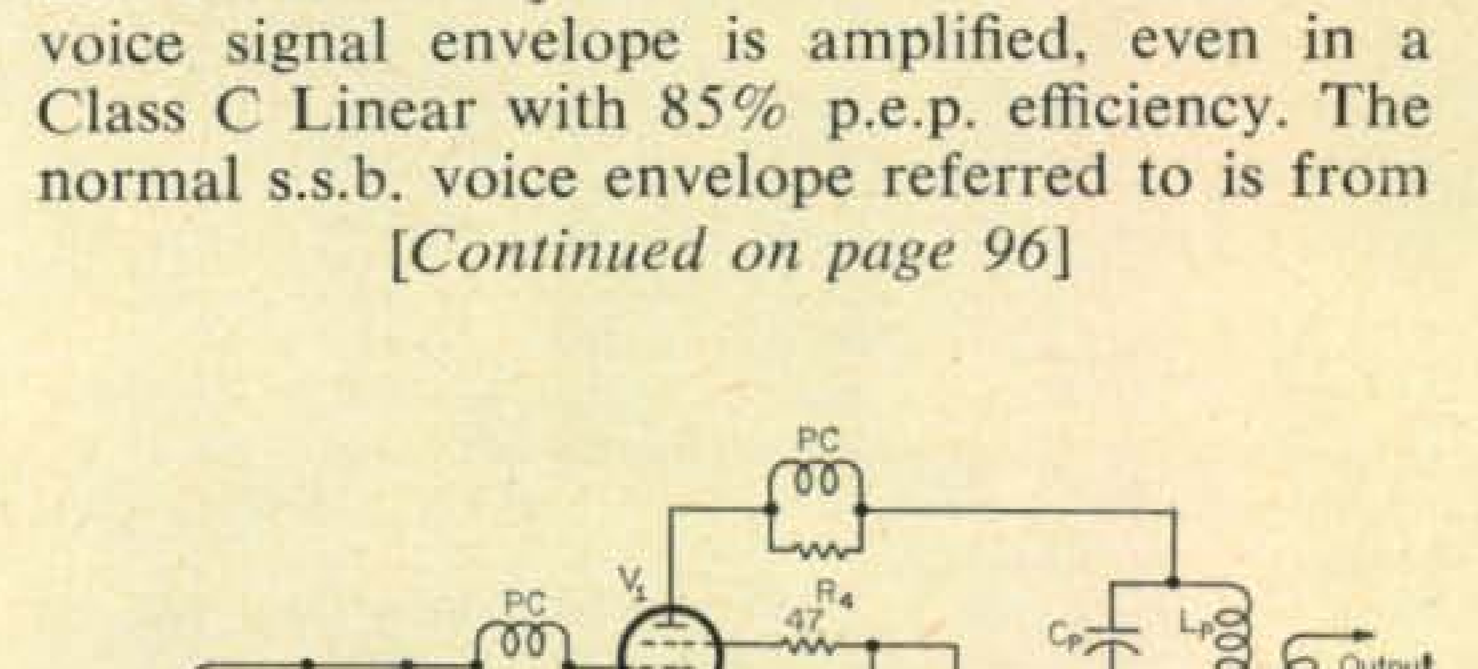

Fig. 4—Tetrode Class C linear amplifier with a cathode follower screen grid driver. (Courtesy of W6EDD.) All capacitors are in mf.

Reviewing The Radio Classics

The Dow Electron Coupled Oscillator

Number 12 of a Series

BY DAVID T. GEISER*, WA2ANU

A YOUNG Navy Lieutenant was working with electronics in the early Thirties. Another young man recently asked me, "What do you mean when you talk about the *Dow* electron-coupled oscillator?" It is high time that these two generations met each other. This is the story of a circuit that continues to have a great impact on amateur radio.

"My interest in continuously variable stable oscillators began in early 1930," says Jennings B. Dow. "This interest had its source in a problem shared by amateurs and almost every other user of radio communication equipment at the time, namely frequency stability. I was then W3TL in Arlington, Virginia . . . As a result of a lot of tearing apart and putting together of W3TL, a family of circuits came into being which it seemed appropriate to designate Electron-Coupled Oscillators."[1]

Perhaps this development, better than any other, signifies a way that the amateur, even in this day, can advance the technical side of radio. This was the beginning of a whole class of variable-frequency *and* crystal oscillators for the amateur and industry.

The Basic Oscillator

The vacuum tube oscillator was known long before Dow. It consisted of a triode, connected so that amplification caused by grid drive would be fed back from the plate in proper phase to drive the grid harder.[2] A simple noise pulse, such as a single electron striking the plate was sufficient to start the process. When the plates reached the point where it was drawing its maximum possible current, a single electron missing the plate was sufficient to reverse the process and make the plate current drop to zero. The rate at which this could occur was controlled by a tuned circuit, and the tuned circuit thus made the tube zig-zag back and forth between conduction and non-conduction. As this happened a fixed number of times per second, this "oscillation" occurred at a fixed number of "cycles per second." This is frequency as the amateur knows it. (Most frequencies of interest to amateurs are measured in millions of cycles, or megacycles, per second.)

The control given by the tuned circuit was not absolute. If power was taken out of the oscillation *in any way*, or if the input power was changed, the frequency also changed. Yet an oscillator that delivers no power has little value. It cannot drive an amplifier, it cannot drive an antenna, it cannot even act as the oscillator for a regenerative receiver or a superheterodyne. How was it ever used? It *was* used, and had been for some twenty-five years or more before Dow became interested in it, but it had drawbacks. These very drawbacks were a strong reason for the development of the quartz crystal.

Some of the common oscillators using triodes are shown in fig. 1, together with a crystal oscillator also using triodes. The advantage of a crystal was that it was more stable than a simple tuned circuit such as an amateur was likely to be able to build, and at the time of Dow's development, "amateurs were quite rapidly shifting to crystal-controlled transmitters." It has occurred to this reviewer that perhaps we amateurs owe the electron-coupled oscillator the privilege we possess to operate on different frequencies without having to purchase crystals for each frequency. It would have been so easy for a strictly regulatory agency to have said "Crystals are the best way; everybody must use crystals!"

Dow attacked the problem using the new

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[1]These are quotations from an unpublished letter from J. B. Dow to the reviewer. Though Mr. Dow has given permission to quote this letter, no approval of the review is implied.

[2]This explanation is intended only to show the trend. A subsequent review on regeneration in this series will deal with various levels of regeneration below and including oscillation. It will probably include the remarkably clear and concise explanation furnished this reviewer by Mr. Dow.

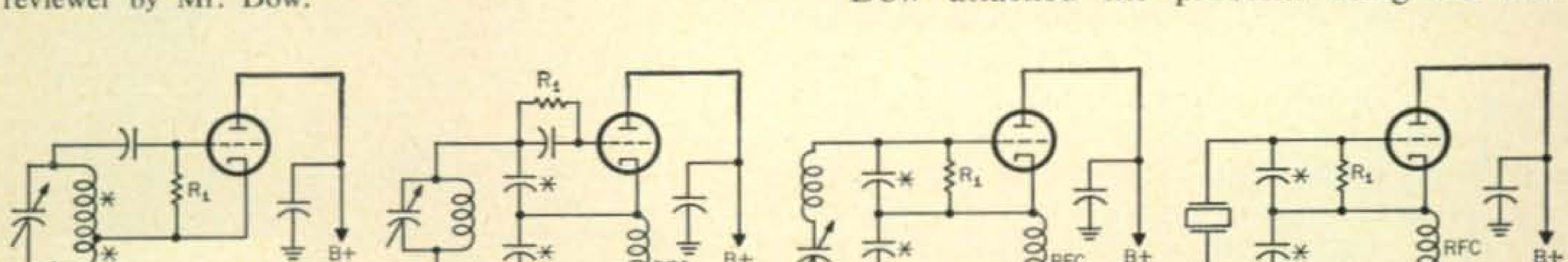


Fig. 1—Conventional triode oscillators not of the Dow electron coupled type. (A) Hartley, (B) Colpitts, (C) Clapp, (D) Pierce.

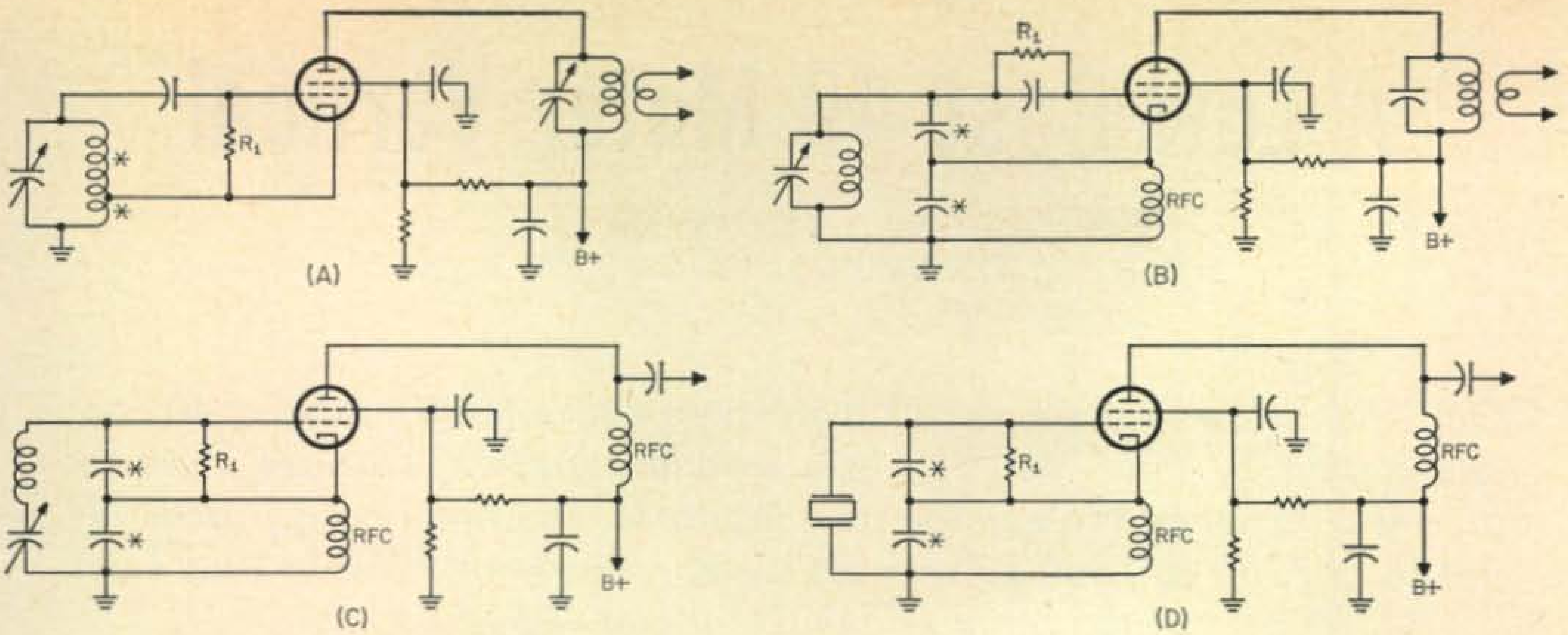


Fig. 2—Electron coupled versions of the oscillators shown in fig. 1.

screen-grid tube. There was a good chance that the undesirable effects of loading the oscillator were the result of capacitive coupling from the load to the oscillator circuit. After all, a capacitor *was* used for a part of the tuned circuit, and any more or less capacitance should be expected to detune the circuit. The screen-grid tube was designed to *reduce* capacitance from the plate to the grid. Now, if the screen grid could only be operated at r.f. ground potential to reduce undesirable coupling . . .

It could! Look at each of the oscillators in fig. 1! Each of the plates have B+ on them, yet each of them are bypassed to ground with a capacitor! If we let the *screen-grid* act like the plates of the oscillators in fig. 1, we have a whole new class of oscillators using the screen-grid instead of the plate as a feed-back element. But what about the plate circuit?

Reference to tube characteristic curves for pentodes and beam tetrodes shows that for given control-grid and screen-grid voltages the plate current changes only slightly with plate voltage. The screen thus acts like a source for a nearly-fixed number of electrons (current is proportional to the number of electrons/second). The better the capacitive screening, the less the current change.

As loading of a tuned plate circuit will change the plate potential, this "virtual cathode" that the screen has become does much to reduce the effect of loading on the frequency of oscillation. Thus, electron coupled oscillators may be made relatively free from the effects of loading in the output circuit, compared to triode oscillators. There must, for best results, be a careful choice of tubes, operating voltages, and components.[3]

Dow did a remarkably complete job. He checked the effect that changes in plate voltage and changes in screen voltage had on the oscillator frequency. A rising change in plate voltage could be counteracted by a rise in screen voltage, and the frequency would stay nearly constant! Soon it was found that over quite wide voltage supply change, the electron-coupled oscillator was stable. The trick was to find the right ratio of screen-to-plate voltage for a given tube. (This, incidentally, is a study that amateurs have woefully fallen down on—industry has not "checked" this effect on many tubes, and for obvious commercial reasons they cannot be expected to make a present of this information to their competition by publication.)

Even with the best screen-grid tube, there will be some feed-back between the plate and the input of the tube. Dow even proposed ways of neutralizing that effect. With well-screened tubes, the amount of feedback is very small. Other parts of the oscillator and output circuit may also interact, so it is best to try different methods of neutralization (including better shielding and filtering) if you have trouble. Perhaps the simplest way to minimize undesirable effects of feedback is to oscillate at one frequency in the grid circuit and have the plate tuned approximately to the second harmonic, the second harmonic being the desired frequency. This way, no other circuit in the rig will be tuned to the oscillator frequency, and the possibility of a *second* strong oscillating effect will be minimized.

The Electron-Coupled Oscillator Today

Each of the circuits of fig. 2 are working circuits. They are each useful provided *you* pick the right values. Just what those right values are is left for your determination. Here are a few hints, though.

Lower values of R_1 tend to give more power, higher values tend to give more stability.

Items marked with an asterisk affect the feedback in the cathode-control-grid-screen-grid circuit. When the higher reactance is near the grid, the percentage of feedback is higher.

Where inductance and capacitance is used to form the tuned circuit, the operating Q should be a minimum of 50. It may be helpful to have it higher.

Crystal oscillator circuits using tubes having a screen μ or amplification factor of less than

[*Continued on page 96*]

[3]This and the preceding paragraph are a paraphrasing and condensation of an explanation Mr. Dow gave the reviewer of the effect of the "virtual cathode." A limited number of copies of the original are available *from the reviewer* at no charge provided a stamped-self-addressed envelope is included with the request.

A Low Cost 40 Meter Vertical

BY REV. DRAYTON COOPER*, K4KSY

Outlined below is a simple 40 meter vertical antenna using a 40 foot telescoping TV mast mounted in a wooden cradle. The base insulator used is a scrounged telephone pole insulator. The antenna is practically flat from 7200 to 7300 kc with an s.w.r. of unity at 7250 kc and 1.3:1 at the band edges. Total cost — $14.75.

LET's face it: some hams like verticals, some don't. If you're one of the ones who do, or one of the ones who think you might, read on. If you have a closed mind about this type of antenna, and are already prejudiced to the point you believe that they're good for long-haul QSOs, but sorry for the average stuff, then kindly turn the page to the next article.

After spending some years in the broadcast business, it appeared to me that evidently the vertical is pretty good, or else it wouldn't be so universally accepted and required in that field. But true to form, I erected one horizontal after another, going along with the crowd. Then I started doing some 160 meter work, and heard the booming signal that W2FYT and others put in with their shortened verticals. Says I, "If a loaded mast will do that, what would a regular quarter-wave vertical put out?" And then the wheels started turning. Primary considerations here were low overall cost, availability of materials, simplicity of erection and efficiency.

*611, Kershaw, South Carolina.

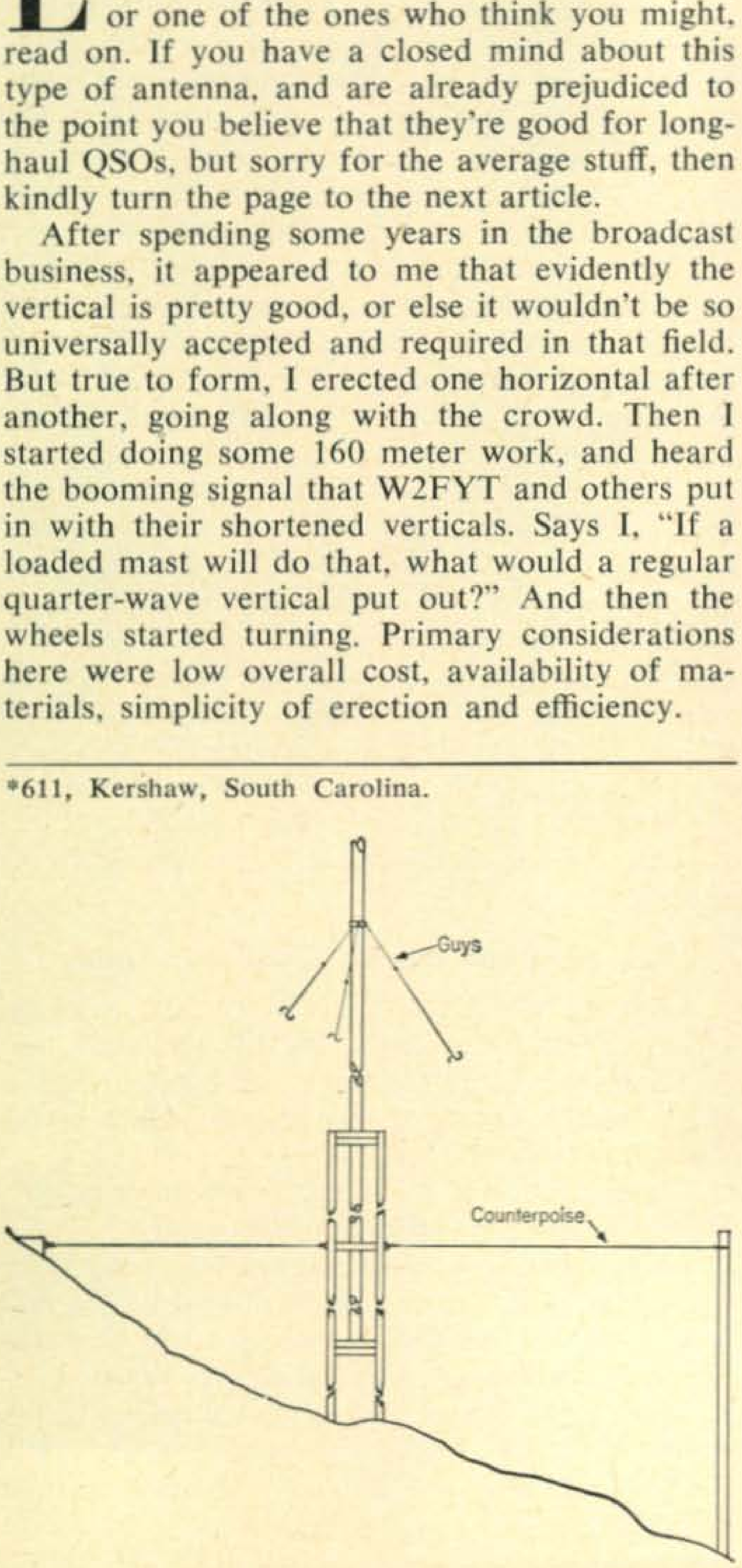


Fig. 1—Side view shows how the counterpoise for the 40 meter vertical is staked out on a slope so that the lines remain level.

Since the vast majority of K4KSY's operation is on 40, it was decided that this would be the band to try a vertical on; this frequency also lends itself to a full-sized vertical because a quarter-wavelength is only 30 odd feet. A 40 meter antenna will also work passably on 15 meters, the only other band which is utilized here to any great extent.

Beer-can type verticals were discarded as being impractical, and commercially-available loaded, or trapped, verticals were discounted because of their inherently lower efficiency as compared to a non-compromise quarter-wave.

This meant finding something that could project itself 35 feet in the air, and yet be strong and broadbanded. The choice boiled down between irrigation pipe and telescoping TV mast. The latter was chosen because it is universally available, was obtainable immediately at a TV repair shop in this small town, and could be lowered in the event of high winds.

When the clerk in the TV shop realized that his crew was not going to have to install the mast, he let it go for a paltry $11.00. This was for a 40 foot telescoping mast, complete with hardware and 250 feet of guy wire.[1]

Mounting The Cradle

With this problem solved, the next hurdle was mounting the stick. A roof-mount was definitely out of consideration, and a ground-mount presented insulation problems. Of course, it could always be shunt-fed, but this, too, seemed to be disadvantageous. Therefore, a wooden cradle was constructed, especially designed to support the base of the mast. This cradle stands six feet tall before placing it in position. It has four legs, although a three-legged variety could be used as well.

Basically, it consists of four 2″×2″×6′ strips braced at three vertical points into a 6″ square. One wooden plate, ¾″×6″×6″ was cut, and then a 2″ diameter hole was cut in the center of the plate. Another plate, exactly like this first one, was fashioned, and a third identical *except* for the hole, was made. Finally, 12 pieces of

[1]Allied Radio, Telescoping TV Antenna Mast, 40′, #92 CZ 103, $9.75.

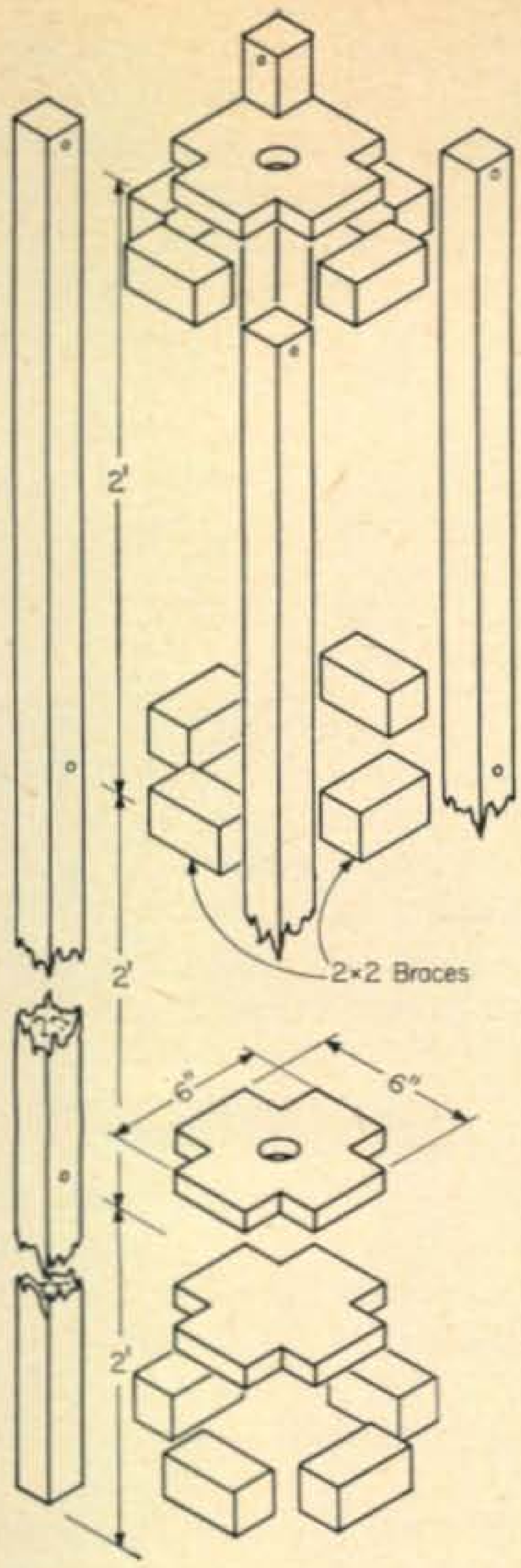


Fig. 2—Sketch shows the dimensions of the 40 meter vertical support cradle. The uprights and cross supports are made of 2" × 2" stock and the three plates of ¾" stock. The bottom 2 feet of the uprights are given a coat of creosote before the cradle is secured in the ground.

2"×2" stock were cut, four inches long each.

Assembly is a snap, and cost of the materials was less than $1.00 at a local woodworking shop. Each of the plates is notched on the corners to receive the 2"×2"×6' strip. Then one of the plates with a hole is screwed (after being glued) to the solid plate. This forms the bottom of the cradle, and supports the weight of the antenna.

Two feet from the bottom of the strips, this plate is mounted. Screw the legs (strips) into the plate. Two feet above this bottom plate, the four short pieces of 2"×2" stock are fastened into place between the uprights by securing with screws. Then, at the very top the remaining plate, one with the hole in it, is mounted. Both the upper and lower plates are further supported by the 4" 2×2 stock as shown in the photos.

When your cradle is completed, a good coat of creosote on the bottom 2 foot section of each of the legs is advised, and a heavy coating of deck enamel over the whole business is preferable. This will slow down the effects of the weather.

Naturally, the best possible lumber should be used as this cradle will be exposed to all sorts of temperature extremes, snow, rain, sleet, and what-have-you. I was fortunate in being able to get heart-pine, a variety of wood that is extremely tough.

Installation

Next in the process, dig a two-foot hole in the ground at the place where you intend to erect your mast. Set the feet of the cradle in it, tamp the earth down tightly, and let sit for a day or so (and hope it doesn't rain in the meantime).

Now then, to the antenna itself. Figure from the formula the length needed at the chosen frequency ($L=F(mc)/234$). If you plan to use metal guy wires as I did, you will find that because of the reactance from the guys, your calculated length will be six inches or so too long. But this is a minor discrepancy, and can be taken care of later.

Placing the collapsed mast on a level surface such as the ground, extend each section to its extreme length. Measure what you have; you'll find a 40-foot mast is actually closer to 37 feet long) and then adjust to the desired length. Then be sure you mark each section at its joint after it has been set for proper length. This will save you from a terrible headache later on.

Most masts have a little cloth sack thrown in them, fastened by a thin wire in the top section. If you'll open this little sack, you'll find a convenient chart telling you exactly how long the guy wires have to be, and the best places to secure them. Cut the guy wires, spacing them every three or four feet with egg insulators, and attach them to the guy rings before goings any further. When this is through, you're ready to go up with the mast.

Having already visited the local telephone company warehouse, I had a three-inch glass pole insulator handy. If you don't have one, make friends with a phone company lineman and chances are you'll be able to get this insulator free. Place it in the bottom plate of the cradle. It will fit snugly into the hole there, and needs to be secured no further.

Now get a buddy to help you do the rest. By all means do this, or be sure your hospitalization insurance is paid up. Raising a mast while standing on the top rung of a stepladder, without assistance, is pretty tricky. But if you're the chancy type, go ahead and play the odds by yourself.

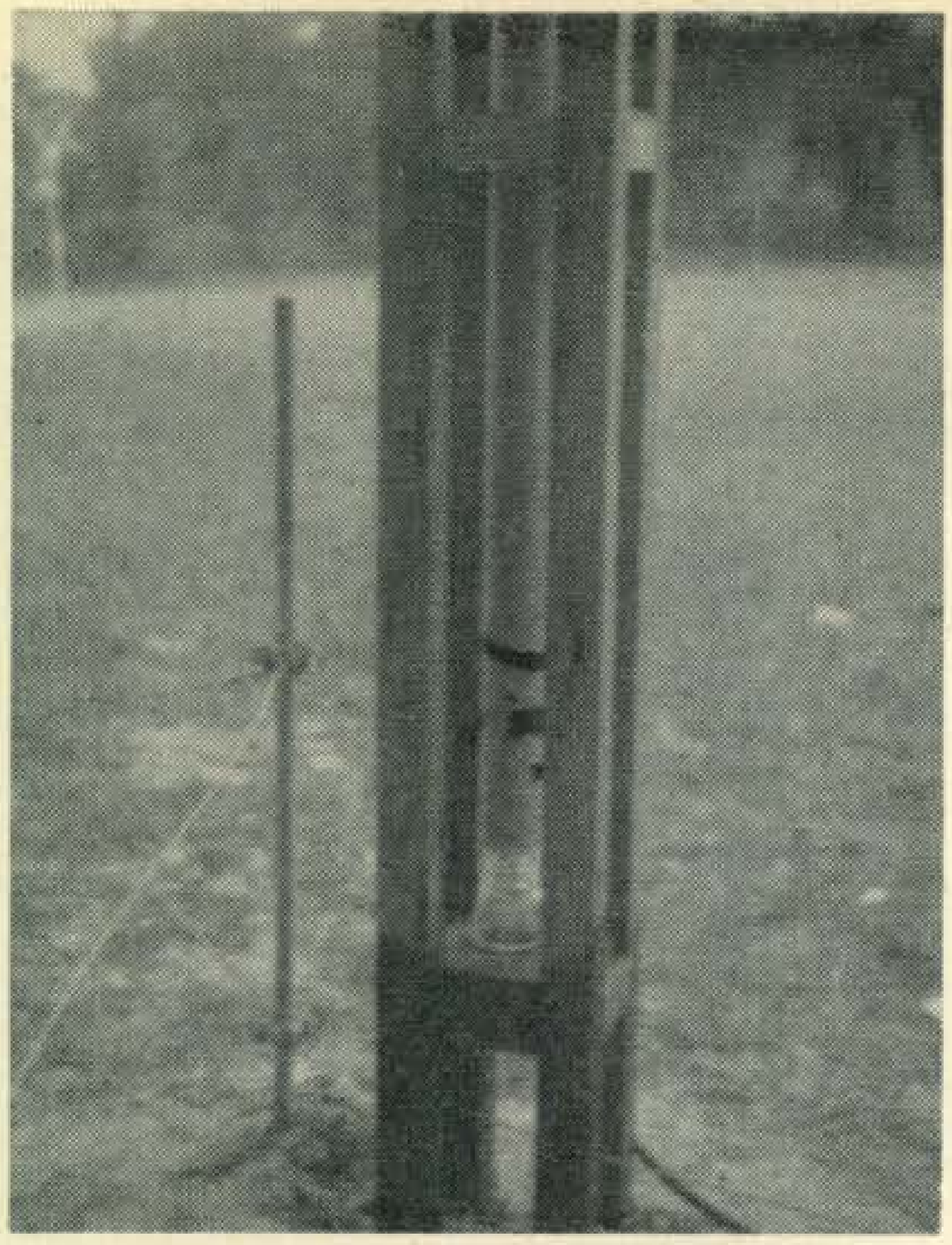
With the mast collapsed, slip it through the top plate of the cradle while your buddy helps you. Then one of you hold the base insulator in place, while the other lets the mast slowly settle down on it.

After this is accomplished, raise the mast, section by section, to the previously marked points, and tighten down on the set screws. When this is finished, you're practically through.

Secure the guy wires to the anchors which you have already set out at the proper places. I was fortunate in having large trees which could serve as anchors, but I did put in one "dead-man". Tighten up on the guys (I hope you remembered the turnbuckles!) and then step off and admire your beauty! Nice, isn't it?

Radial System

No quarter-wave vertical will work unless it has a good ground to be loaded against. A simple rod driven into the ground at the base will not be enough unless you happen to live in a salt-marsh. Either a set of buried radials, or a counterpoise, will have to be used. We chose the



A closeup view of the 40 meter vertical base support shows the mast resting on the telephone insulator. Note the 2 × 2 supports for the base plate supporting the insulator and weight of the vertical. The ground rod is clearly visible on the left.

latter because our lot happens to be on a hill, and burying radials would cause the tower to be higher above ground on one side than the other.

Ready-made radial kits are available, but we "rolled our own" by using left-over wire from some horizontal antennas we had taken down. Beginning with a ground rod at the base of the mast, we laid out six radials, 40 feet long each. These were in a fan configuration. They were all soldered to a clamp on the rod.

The dimensions of the radials are not actually critical. A lot of hams putting up this type of antenna simply use what wire they happen to have, and let the measurements fall where they may. Ideally, though, radials should be as near the length of the antenna as possible, or multiples of that length. However, one old saw is wise to remember here, "The more the merrier." Put down as many as you can, and make them as long as you can, and you won't have any trouble getting it to work.

With the counterpoise, the object is to get the radials above the ground. This saves a lot of digging, and it also will quickly discourage anyone from snooping around your mast in the dark. The real reason, of course, is to give you a stable and uniform ground. In our QTH, the earth is a pretty poor mixture of sand, clay and rocks, with an extremely poor conductivity rating.[2]

Stakes for the counterpoise were driven in the ground where the extremes of the radials would be placed. Since the lot here slopes from north to south, the stakes on the northern side of the mast are only six inches tall, whereas the southern stakes are approximately 10 inches high.

After running the radials out and fastening them to the stakes, a perimeter wire was run from radial to radial, joining them all at the far end. Again, these connections were soldered.

The feedline is, at last, connected to the antenna. Use 50 or 52 ohm coaxial cable. The inherent impedance of a grounded quarter-wave is in the neighborhood of 50 ohms; however, because of differences in ground conductivity and other variables, this figure may be somewhat off. But 50-52 ohm cable will match closely enough. If you're a nut for perfection, you can build up a coupling unit yourself.

Loading

The loading here is practically flat from 7200 through 7300 kilocycles. Only minor touching up of the final is necessary in a rapid QSY from 7203 to 7296. An s.w.r. bridge showed a 1.6:1 reading at band edges, and 1.3:1 at resonant frequency (7250). We adjusted the height downward a few inches, and the ratio dropped to unity at 7250, and less than 1.3:1 at band edges.

This antenna was designed particularly for 40 meters. With a little playing around with loading coils, it could be made to work pretty well on 75 meters, and also on 160. Any antenna will load on any band if you will take the time to work on a coupling network. A bit of coil stock, and some patience and the old "tap and try" method, and you'll have yourself a vertical for 160, 80 and 40, plus 15.

Another strong point in the favor of a quarter-wave vertical is the fact that a second one can be put up, and the two of them phased into a vertical array.[3] Or, for that matter, put up two more and phase the three of them, and you'll have an endless number of possible patterns you can devise with a good phasing network. And don't kid yourself, a vertical array will squirt a signal a long way!

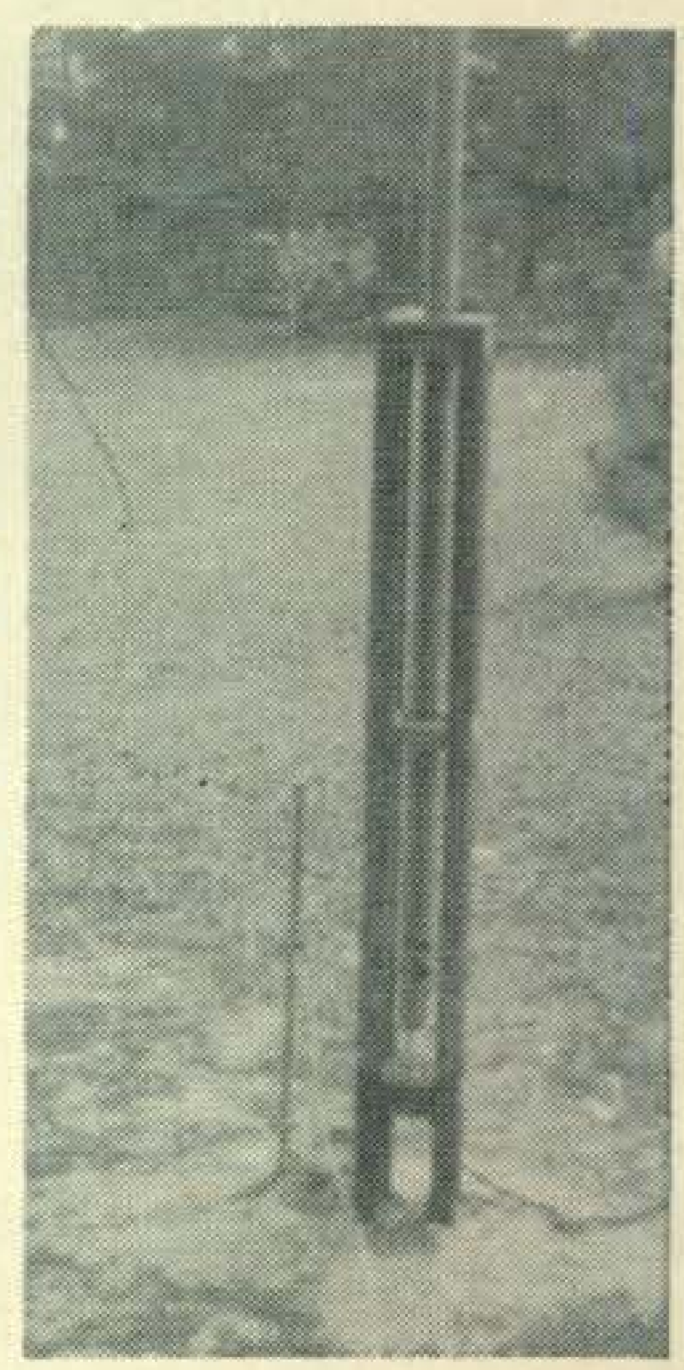
Results

We hams are a pragmatic bunch, and the proof of any system is in whether or not it will work

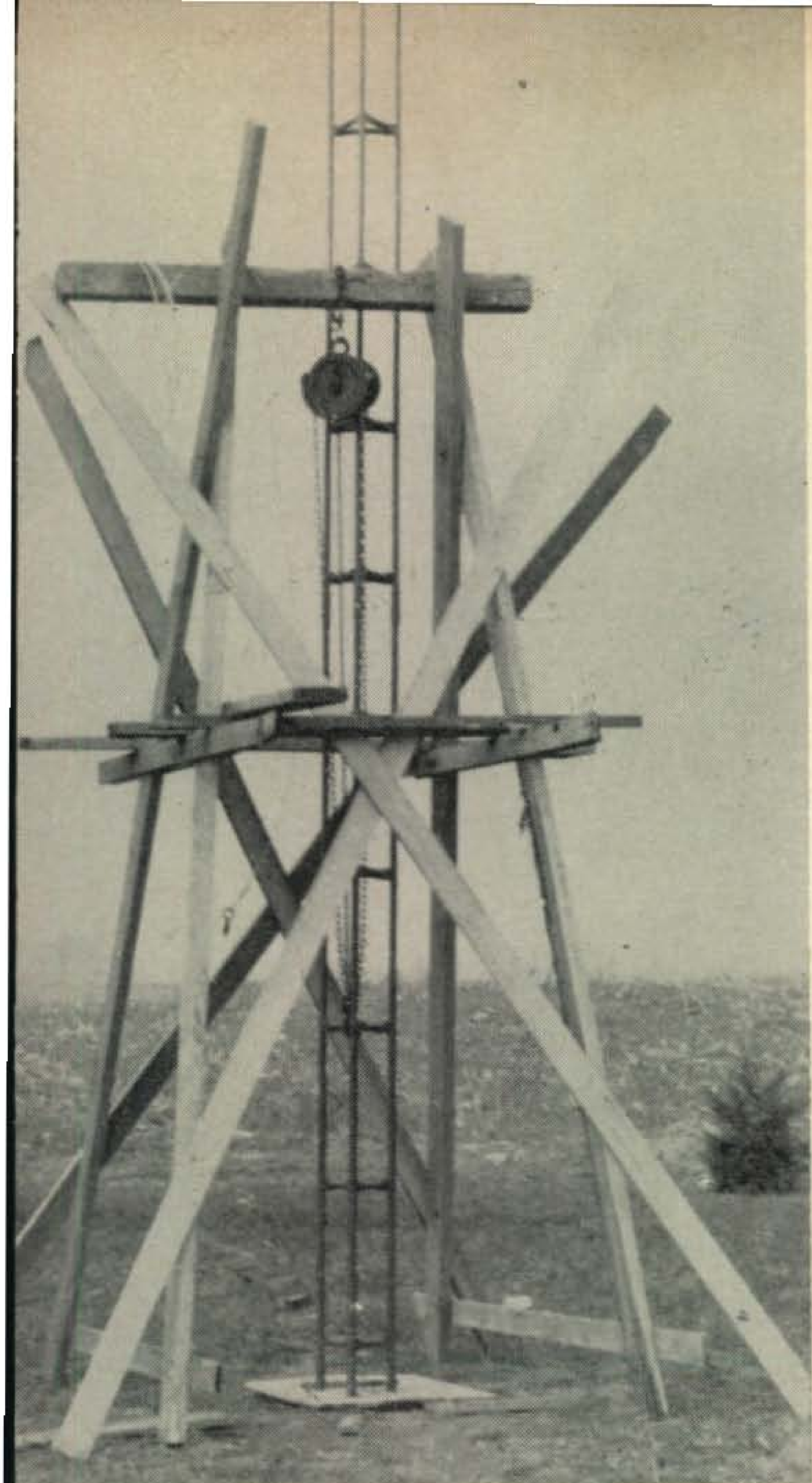
[*Continued on page 96*]

[2]The local broadcasting station frequently can provide data on ground conductivity. If the conductivity is good, radials may be used. If it is poor, use the counterpoise.

[3]Dixon, R. S., "A Forty Meter Vertical Beam," *CQ*, July 1962, page 52.



Overall view of the 40 meter vertical base shows the feed line running off to the right and the ground rod on the left of the support. One of the stakes supporting the counterpoise system can be seen in the background.



The reinforced A frame supports a 4 × 4 timber on top from which a chain hoist is suspended. A little above the half way mark on the A frame a platform holds a 2 × 6 plank used to secure the tower while the chain hoist is lowered to take a second "bite" on the ten foot sections. This photo was taken 12 years ago when the second vertical was erected.

A 160 Meter Vertical Antenna

A Different Approach to Vertical Construction

BY WILLARD W. WAITE*, W8GDQ

This 160 meter vertical, 137 feet high, is constructed of light weight triangular TV tower sections guyed at three levels. A unique ball and socket mount at the base provides a take-up for sway and protects the base insulator from strain.

THE 160 meter vertical antenna at W8GDQ has been of interest to the top-band fraternity. Possibly a description of this antenna and the unorthodox method used in its construction may be of interest to others. This is the second 160 meter vertical at W8GDQ; the first was built in 1939 at another location. It was of Parris-Dunn "Windcharger" units, was 135 high, and was destroyed in 1947 when a guy anchor failed.

The present antenna, completed in 1952, is 137 feet high and is constructed of 14 lightweight triangular tower sections of the type used for supporting TV antennas. The manufacturer lists it as being suitable for guyed heights up to 100 feet; but when asked about its use as a tower without an antenna structure, he stated that it should be good to 150 feet in such service.

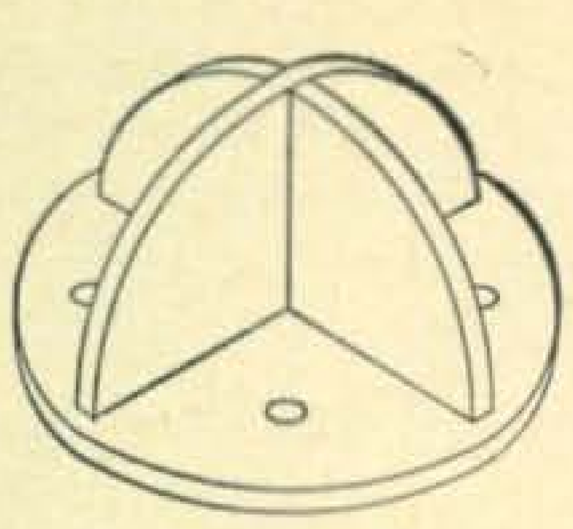
The tower is insulated from ground at the base, with a small tapered section and a porcelain insulator as shown in the photos. There are three sets of three guy wires, each insulated from the tower, and broken up by other strain insulators. Learning from past experience, commercial guy wire anchors of the malleable galvanized type were used instead of our former "home-brew". The guy wires used were made from quarter inch cable purchased from the local telephone company. The power companies used heavier cable than actually necessary for this light weight tower.

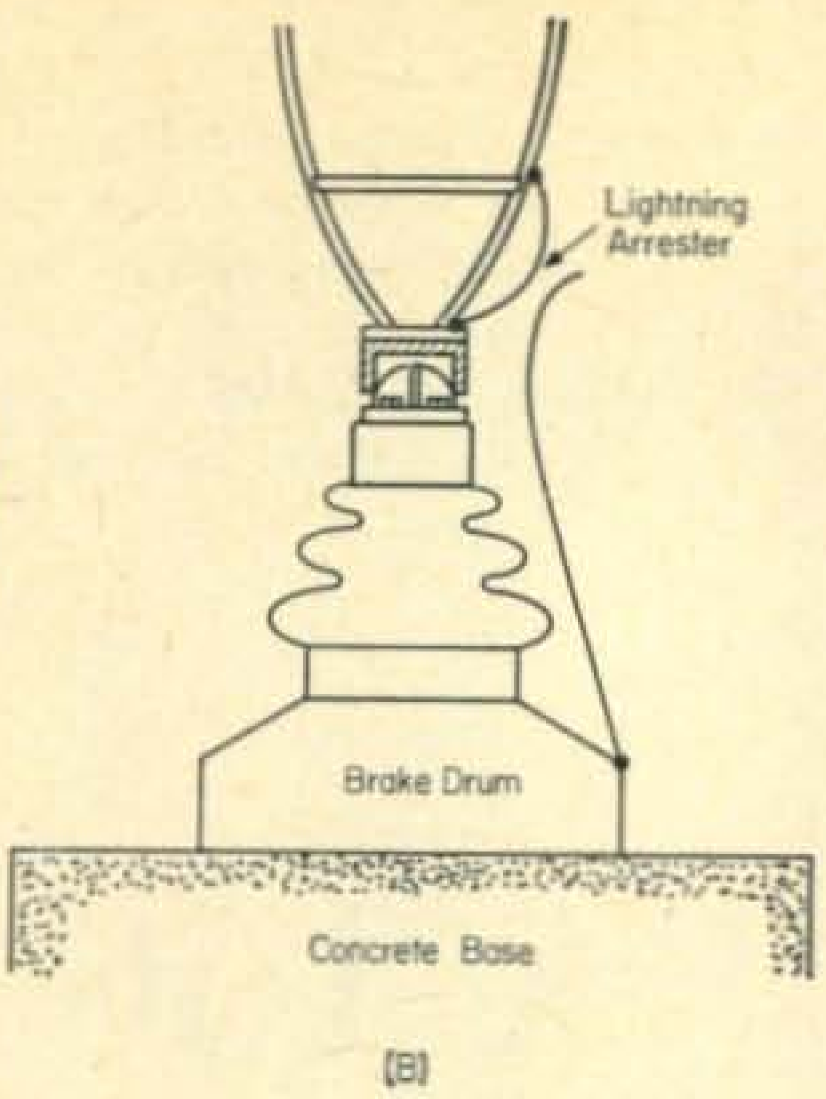
All sections were pre-painted, the guy anchors installed, and the guy wires cut to approximate length and the insulators installed, before erection was started. The guy wires are at about the 45, 85, and 125 foot levels.

Erecting The Tower

The tower was erected from the ground, with-

*RFD 1, Webster Road, Wellington, Ohio 44090.





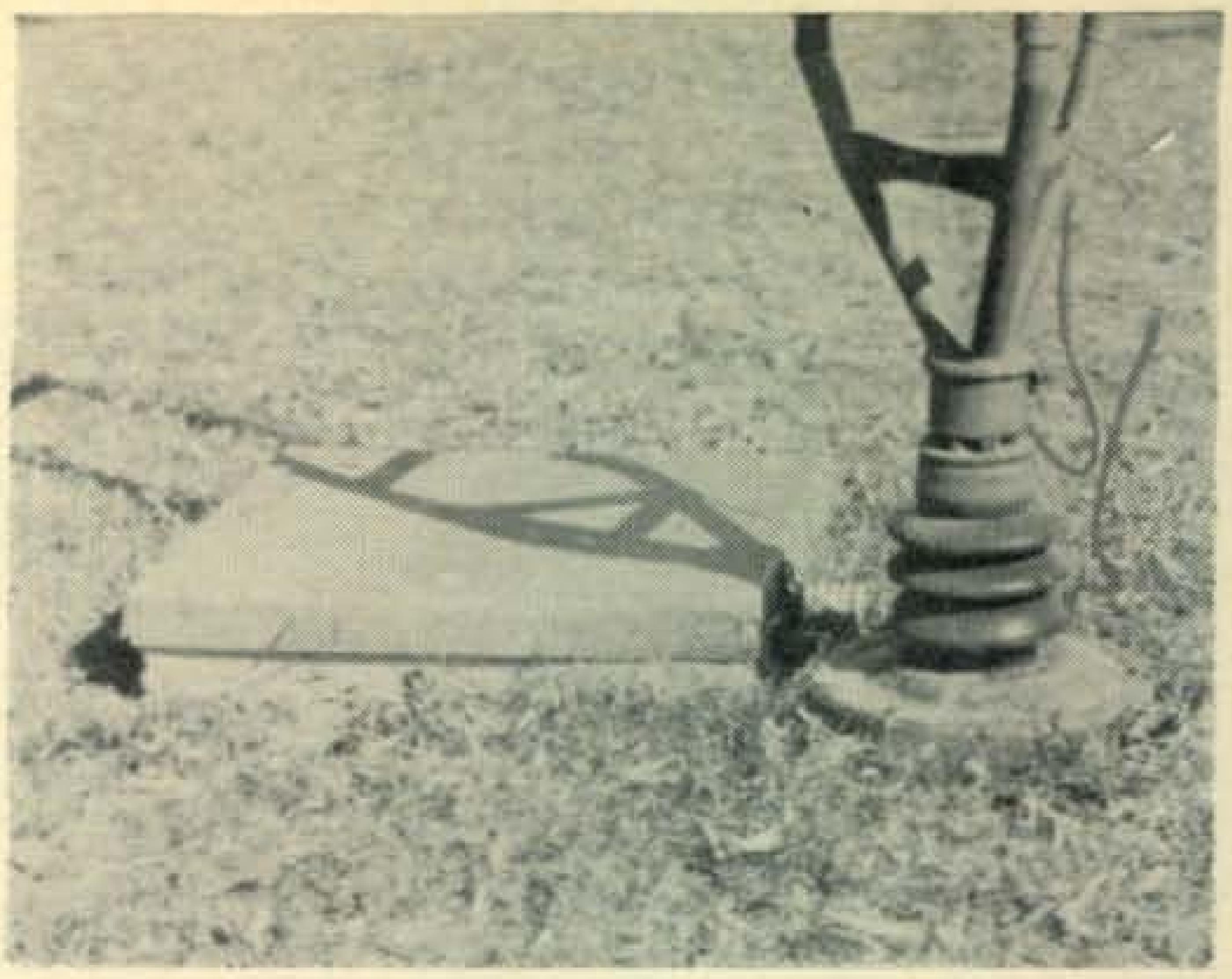


Fig. 1—(A) Construction of the ball-joint base. Sheet steel ⅜" thick is used and the pieces are welded together as shown. (B) Lightning arrester details.

Photo shows the actual installation. The concrete box to the left of the tower is for a contemplated 80 meter coupler and at present contains only the coax termination.

out a "gin-pole", without getting off the ground farther than the use of a stepladder. The photos show the method used.

First, the top three sections of the tower were bolted together, and guy wires attached about 10 feet from the top. This was then tilted up into a vertical position at the approximate location of the antenna. Then the "A-frame" shown in the photos was built of scrap lumber, cross braces attached, and a 4×4 put across the top and a chain-hoist attached. The next step is to lift the tower vertically, allowing a little slack in the guy wires, until there is enough room below the tower to insert another ten-foot section. The chainfall we borrowed wouldn't lift ten feet at one time, so the platform shown in the photo was used to support a 2×6 slipped through the tower to hold it until the chain could be let down for another "bite".

As additional sections are inserted below, the guys must be let out more and more. The 2 and 3 hole-clamps used by utility companies on their guy wires are very handy to "leap-frog" the release of the guy wires without danger of them getting away. By picking a calm day for erection, only one set of guys need actually be anchored—cement blocks can be attached to the others for stabilization. More time is used getting up and down the stepladder than in actual construction!

Antenna Base

After the antenna was built, a concrete base was poured, and the insulator mounted on an old brakedrum and installed thereon. A "ball-joint" was constructed so the movement of the antenna in the wind would not break the insulator, the antenna let down on it, and the "A-frame" removed.

The construction of the ball joint is shown in fig. 1A. A pipe cap of suitable size was secured to the base of the tower. Curved semi-circular plates were welded to a round base plate. Sheet iron, ⅜" thick was used. The ball joint was bolted to the top of the insulator which had four tapped holes (top and bottom).

After the mast was secured, the RG-8/U feed was connected, the outer braid to the base of the insulator where it is secured to the brake drum and the inner conductor to the base of the antenna. A lightning arrester is made with two lengths of #4 wire as shown in fig. 1B.

A radial system consisting of four 120 foot lengths and two 60 foot lengths was used. One of the 60 foot runs was terminated at the power company's ground at the shack. ■

Lt. Commander Winnette Relieved

Rear Admiral Bernard F. Roeder (right) Director of Naval Communications presented smiling Lt. Commander Charles Winnette with an autographed copy of the Tri-Service MARS emblem in appreciation for his contribution to Naval Communications and amateur radio. Chuck was instrumental in starting the Navy MARS Program, and served as Head of the Amateur Radio Liaison Branch. Lt. Commander Bob Mickley takes over where Chuck left off.

Broadbanding The Mark III Antenna On 80 Meters

BY COMMANDER PAUL H. LEE*, W3JHR

The Mark III, originally designed to cover the 3.8 to 4.0 mc portion of the 80 meter band can be made to cover the entire 3.5 to 4.0 mc. The article below illustrates the use of the Smith Chart to devise the corrective network that broadbands the Mark III.

An earlier issue of this magazine[1] described the Mark III DX Antenna. In the first three months after the appearance of that article in print, I received over two hundred letters from readers inquiring about various aspects of antenna design. Many readers wished to be able to use the Mark III over the whole 80 meter band, and wondered how the s.w.r. over the whole band could be improved. It was originally designed to cover only the 3.8-4.0 mc range. Some computation and a few neat tricks with that handy tool, the Smith Chart,[2] have resulted in the information contained herein.

Use of the Smith Chart makes the solution of a problem such as broadbanding the Mark III 80 meter feed quite easy. The input impedance of the Mark III 80 meter feed versus frequency is tabulated below (tuned for 3.9 mc):

Frequency	*Impedance*	*Normalized Value 51 ohm basis* $(R + jx)$
3.5	$6.64+j5.6$	$.13+j.11$
3.6	$11.20+j7.66$	$.22+j.15$
3.7	$18.30+j9.69$	$.36+j.19$
3.8	$29.60+j10.20$	$.57+j.20$
3.9	$51.00+j0$	$1.00+j0$
4.0	$58.80-j33.10$	$1.15-j.65$

These normalized values of $R+jx$ are plotted on the chart in fig. 1 as curve "A", giving a complete picture of impedance versus frequency in the range of interest. It may be seen that the 2.0:1 s.w.r. circle includes that portion of the curve between 3.8 and 4.0 mc, but that the s.w.r. at 3.5 mc is horrible, being about 7.5:1.

If the Mark III were tuned for 1:1 s.w.r. at the center of the band, 3.75 mc, the curve would lie wholly within a 4:1 s.w.r. circle. The high s.w.r. at the extreme portions of the band is due to the Q of the feed point of the antenna, which is about 12. We can do something to improve this s.w.r. situation by adding several components to the matching network, as we shall see. The techniques used herein are currently employed in the design of shipboard antenna matching networks for Naval use, where it is required that an antenna be matched to a transmission line over a very wide frequency range, with s.w.r. of 2.5:1 or so.

The equivalent circuit of the Mark III feed, as tuned for 3.9 mc, is shown in fig. 2A. As may be seen, it is a simple L network whereby the 9 ohm antenna feed point resistance R_a is matched to the 51 ohm line. The series inductive arm of the network is made of two parts as shown in fig. 2B. One of these is the positive reactance of the antenna feed point X_a, which is $+j113$ ohms. The other part is the negative reactance of the series capacitor, which at 3.9 mc is $-j93.4$ ohms Thus the series arm is the sum of the two, or $+j19.6$ ohms. The shunt arm of the L network is $-j23.8$ ohms. (These are true values, not normalized.)

Mismatching the L Network

Our first step is to intentionally mismatch the L network in order to raise its input impedance, by a factor of 1.9, to a new Z_o of 96.9 ohms. We also tune it for the center of the band, 3.75 mc. The reasons for this will be seen later when the shape and location of the final input impedance curve are plotted and seen on the Smith Chart.

The new values for the L network of input $Z_o = 96.9$ ohms at 3.75 mc are shown in fig. 3A and 3B. The antenna feed point impedance is $9 + j108.5$ at this frequency. Antenna resistance for all practical purposes remains at $R_a = 9$ ohms, whereas the reactance changes somewhat, with frequency. The negative reactance of the series capacitor must now be $-j78.5$ ohms, and that of the shunt capacitor must be $-j32$ ohms. The series arm of the L network is the sum of $-j78.5$ and $+j108.5$ ohms, or $+j30$ ohms, as shown in fig. 3A. The L network was computed from the formulae and charts in Terman's *Radio Engineer's Handbook.*

*5209 Bangor Drive, Kensington, Maryland.

[1]Lee, P. H., "The Mark III DX Antenna," *CQ*, December 1962, page 43.

[2]Smith, P. H., "Transmission Line Calculator," *Electronics*, January 1939. Amis, P. C., "Antenna Impedance Matching-Part I," *CQ*, November 1963 page 63, Part II, December 1963, page 33.

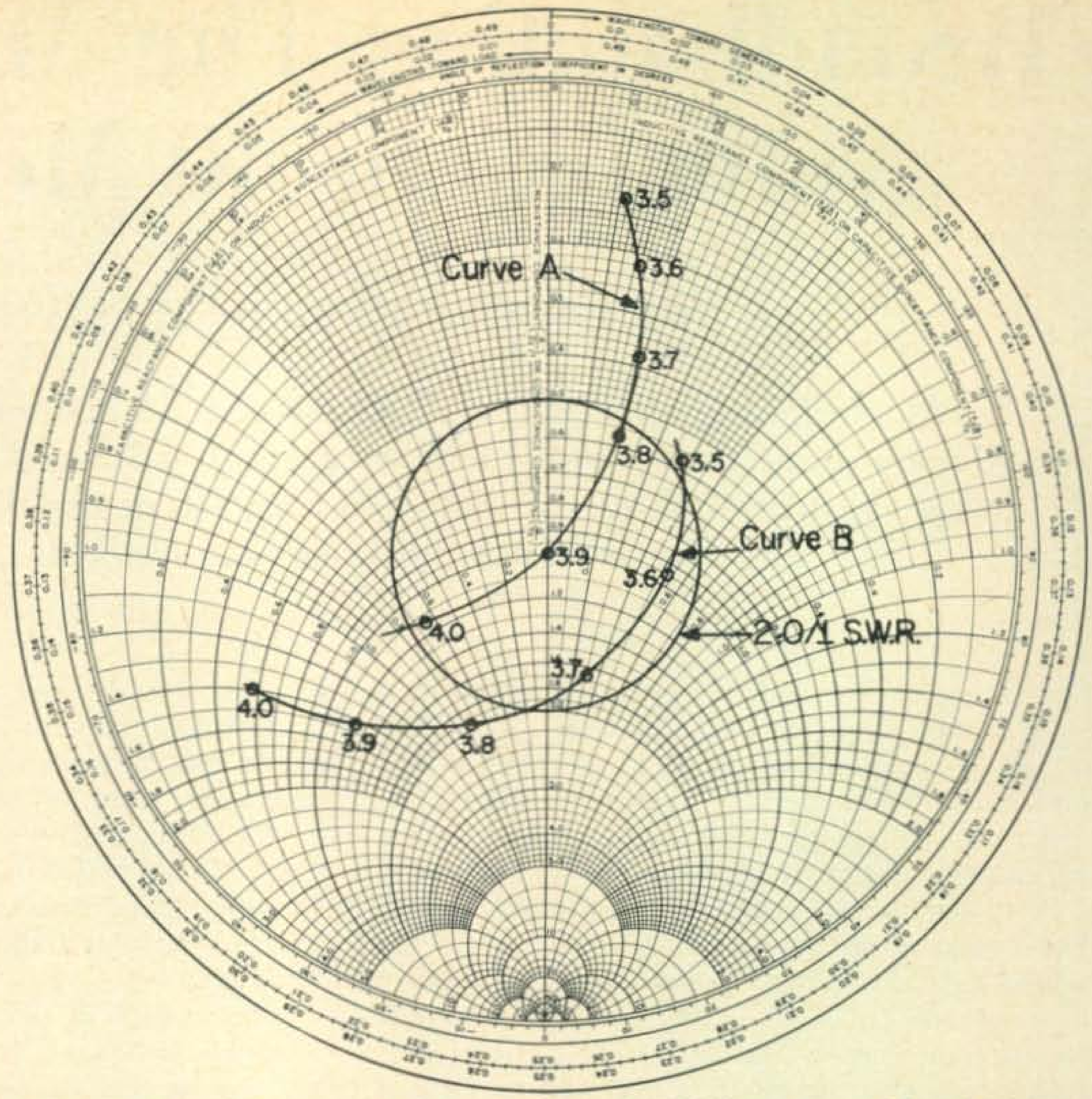


Fig. 1 — Curve A plotted on the Smith Chart above is with the Mark III antenna tuned to 3.9 mc. The 2:1 s.w.r. circle includes only frequencies from 3.8 to 4.0 mc. Curve B was developed with new values in the L network (fig. 3) and is positioned properly to be folded back on itself by the use of additional networks components.

These new values for the *L* network components produce a new input impedance curve as frequency is varied. This is curve "B" in fig. 1. Note that the resistance components at 3.5 and 4.0 mc are equal, at .57, and that the highest resistance component, 2.0, appears at about 3.77 mc. The impedance values are also shown here in tabular form:

Frequency	*Normalized Impedance*
3.5	$.57+j.38$
3.6	$.95+j.53$
3.7	$1.67+j.30$
3.8	$1.96-j.75$
3.9	$1.20-j1.42$
4.0	$.57-j1.39$

Bending the Curve

We now have a curve which is properly placed on the Smith Chart to be amenable to being twisted back on itself like a pretzel by the insertion of a series differential network consisting of series positive and negative reactance, of such values as to cause their sum to be negative at 3.5 mc and positive at 4.0 mc. It is our purpose to cause the ends of the curve to move within the 2:1 s.w.r. circle, and to bring the whole curve as close to 1:1 s.w.r. as possible. We cannot make it perfect, but it will be usable over the whole 3.5-4.0 mc band.

Inspection of curve B in fig. 1 shows that addition of $-j.55$ at 3.5 mc and $+j1.60$ at 4.0 mc will accomplish the desired result. The following set of simultaneous equations for the series network is used to compute the values of series X_L and X_C:

Where *a* is 4.0 mc; $+j1.60 = +jX_{La} - jX_{Ca}$, and *b* is 3.5 mc; $-j.55 = +jX_{Lb} - jX_{Cb}$

Taking the ratio of frequencies 3.5/4.0 into account and solving, we find that X_{Lb} is $+7.90$

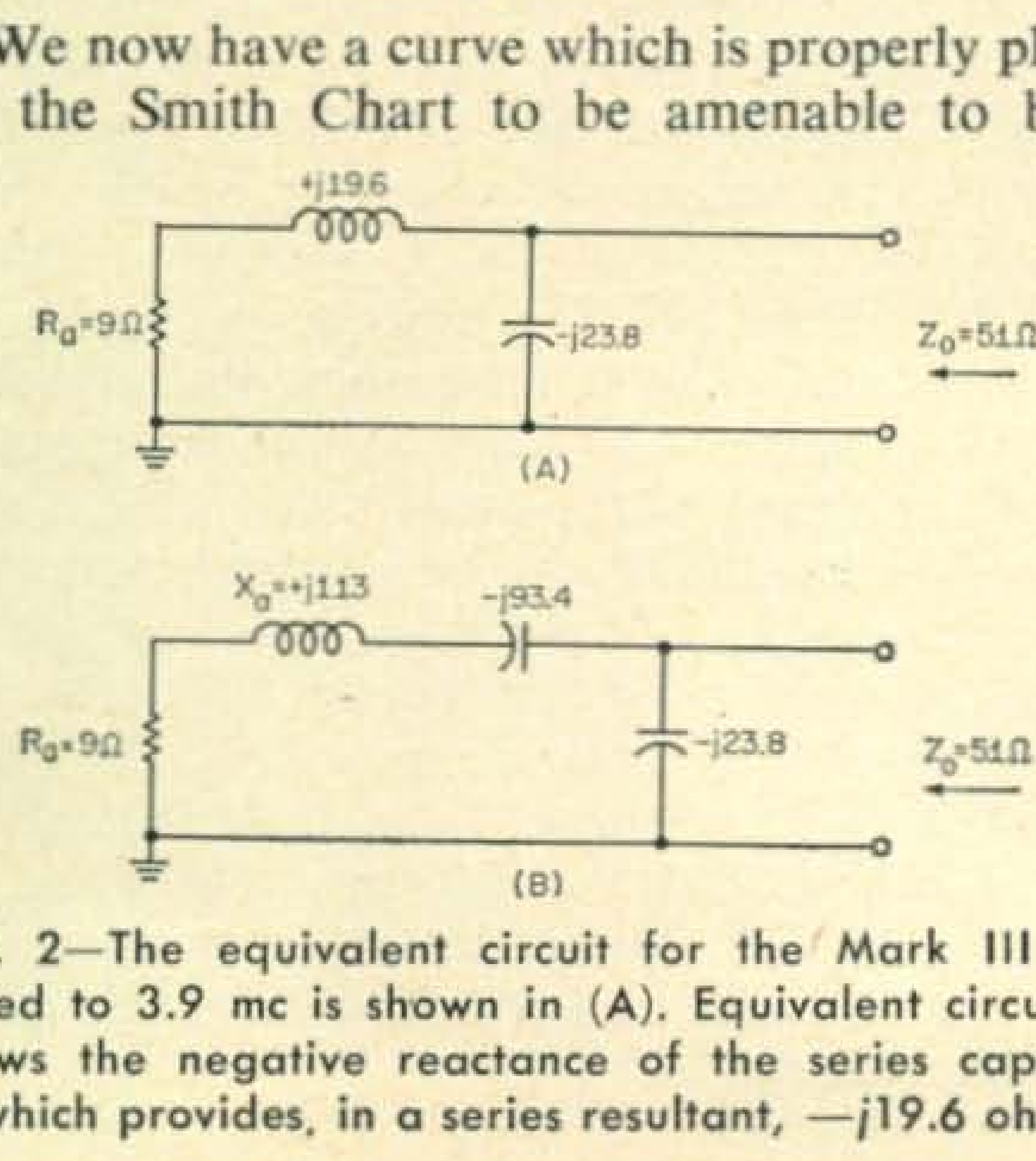


Fig. 2—The equivalent circuit for the Mark III feed tuned to 3.9 mc is shown in (A). Equivalent circuit (B) shows the negative reactance of the series capacitor which provides, in a series resultant, —j19.6 ohms.

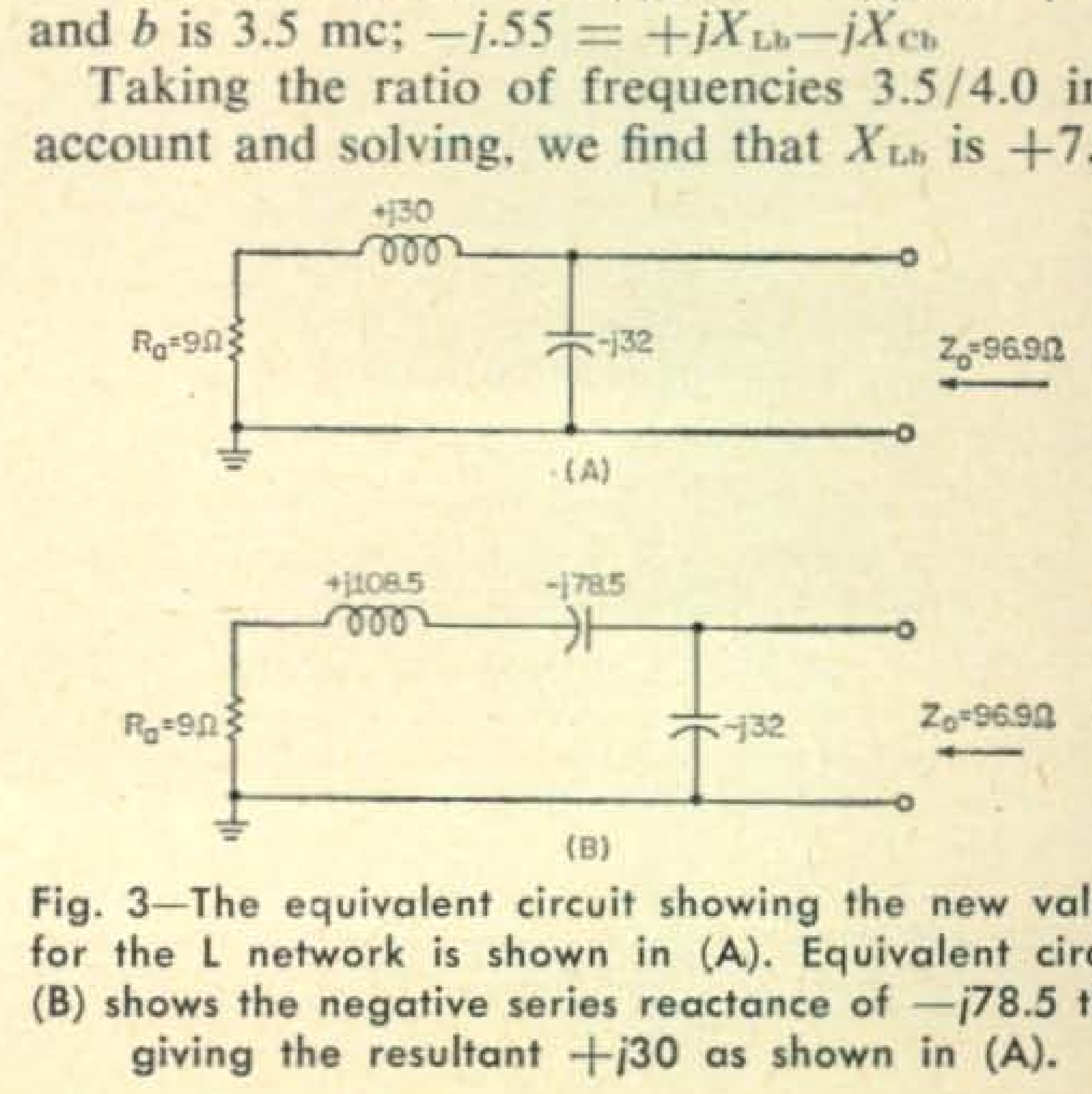


Fig. 3—The equivalent circuit showing the new values for the L network is shown in (A). Equivalent circuit (B) shows the negative series reactance of —j78.5 thus giving the resultant +j30 as shown in (A).

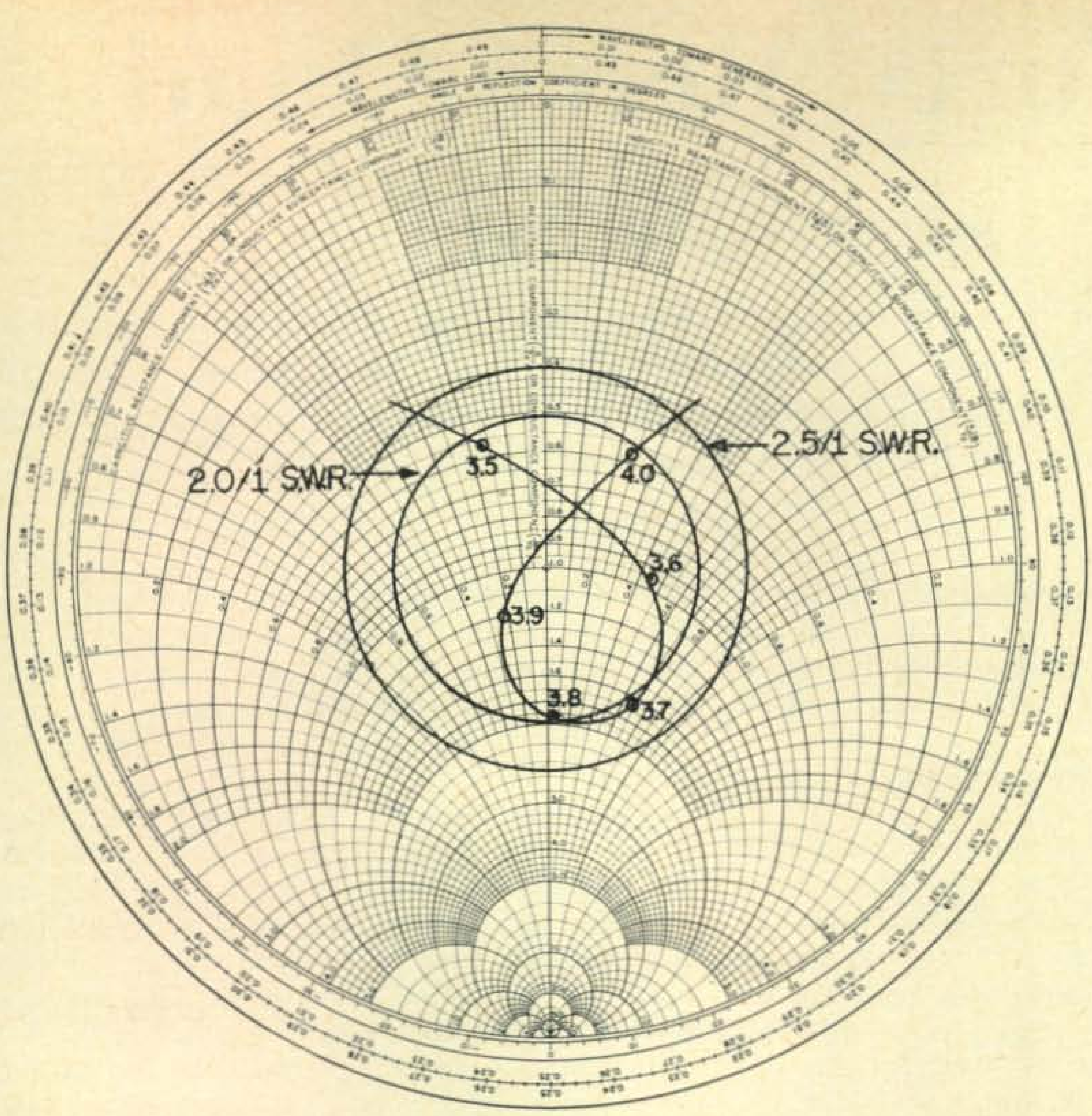


Fig. 4—Curve B of fig. 1 has been bent back on itself as shown above and the 3.5 to 4.0 mc portion lies completely within the 2:1 s.w.r. circle. While not perfect, it is usable over the entire 80 meter band and for those who wish to work outside the band (MARS) it is also usable.

and X_{cb} is −8.45. Computing them for all the frequencies of interest, we find the following:

Frequency	X_L	X_C	*Sum*
3.5	+7.90	−8.45	− .55
3.6	+8.12	−8.20	− .08
3.7	+8.38	−8.00	+ .38
3.75	+8.49	−7.89	+ .60
3.8	+8.60	−7.78	+ .82
3.9	+8.80	−7.60	+1.20
4.0	+9.03	−7.40	+1.63

Adding their sum to the values for curve B previously stated, we get:

Frequency	*Modified* Z_o
3.5	$.57-j.17$
3.6	$.95+j.45$
3.7	$1.67+j.68$
3.8	$1.96+j.05$
3.9	$1.20-j.22$
4.0	$.57+j.24$

These new values of Z_o are plotted in fig. 4, and one can see what has happened. The impedance curve is folded back on itself, and practically all of it lies within the 2:1 s.w.r. circle. Even the extremes at 3.5 and 4.0 mc are not too bad for those who wish to go outside the band limits for MARS operation. Now you can see why we raised the input Z_o, and balanced the curve about 3.75 mc.

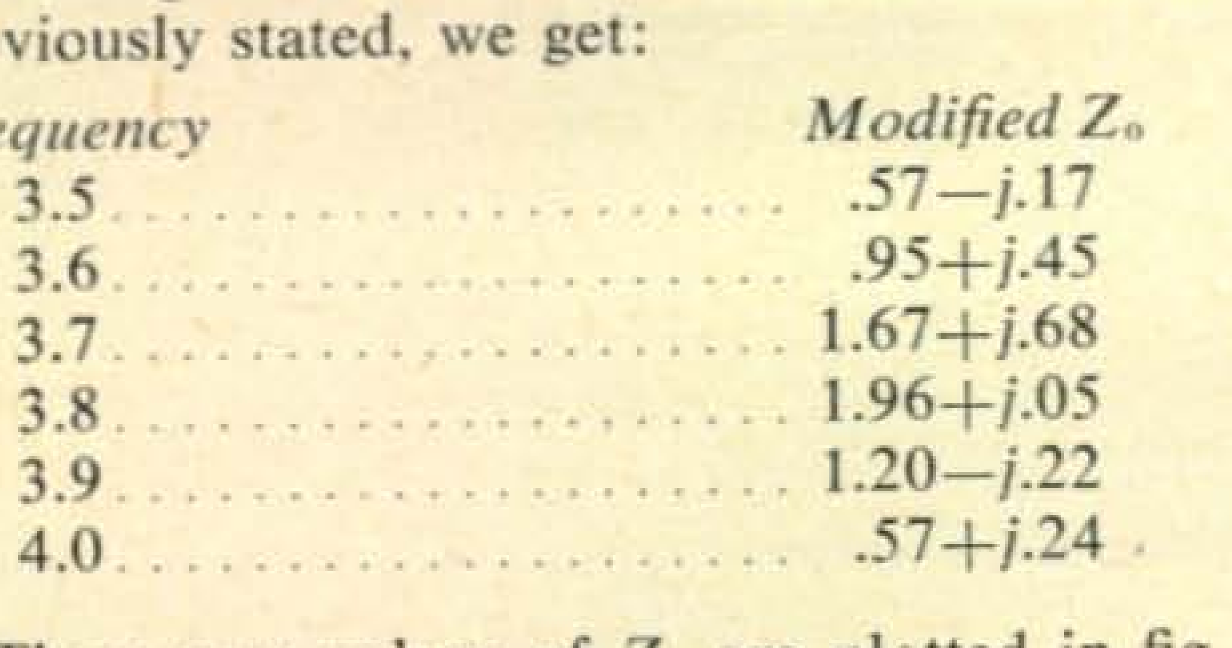


Fig. 5—The new matching network shown above will permit the Mark III to operate over the 3.5 to 4.0 mc band with an s.w.r. of less than 2:1 at any point. The true reactances and component values are shown.

New Circuit

Figure 5 shows the new circuit diagram of the matching network with both true reactances and component values indicated. The true reactances are obtained by multiplying the normalized Z_o values by 51 ohms, and the component values are based upon a center frequency of 3.75 mc as stated above.

For those interested in voltage ratings of components, it should be stated that the series capacitors in the L and differential circuits should be rated for at least 2000 volts if a power of one kilowatt is contemplated. The shunt capacitor

[*Continued on page 94*]

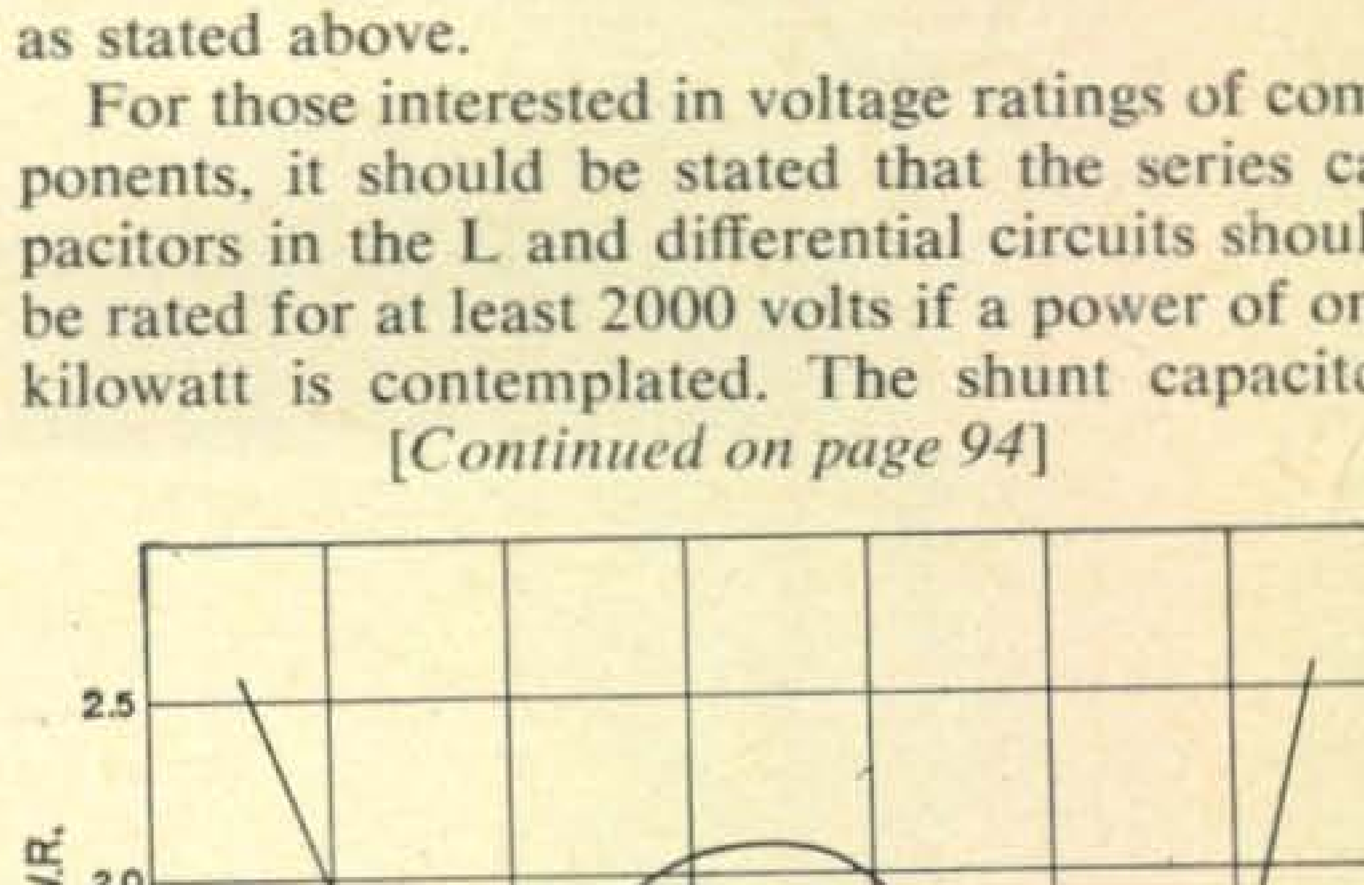


Fig. 6—A rectangular plot of the s.w.r. of the modified Mark III.

A Forty Meter Quad

BY DON MORGAN*, KØTAJ

Gain in a 40 meter antenna is easy to come by—if you've got the room. The average 40 m. yagi takes on monstrous proportions, but a quad, although still pretty hefty, is a lot more manageable and offers gain in addition to that all-important front-to-back ratio. Described below is KØTAJ's version.

How would you like a full sized forty meter quad for $100.00? The following are details for the construction of such a quad. The quad is in operation and has withstood 80 mile an hour winds and the DX is excellent due to the low angle of radiation and good front to back ratio.

With deteriorating conditions on the higher frequencies, a good antenna on 40 is going to be a benefit in the next few years. Anyone who has listened on 40 meters can certainly appreciate the advantages of side and back rejection of QRM.

Another feature on the plus side for this antenna is the comparitively low price for a full sized beam. Actually it isn't the monster that one might think. It doesn't take any more space to rotate than a full sized 20 meter beam.

Construction

Actual construction begins with the boom. Secure, from the lumber yard, one 24 foot straight grained 2″ × 4″ and one 14 foot 2″ × 2″. These are bolted together with 4 bolts to form the boom and painted with two coats of aluminum paint. The spider supports are made from 1½″ strap iron bent to fit over the end on the 2″ × 4″ beam, and back 6″ on top and bottom of the 2″ × 4″.

*305 East First Street, McCook, Nebraska.

The cross supports for the spiders are made of ½″ angle iron, 24″ long, welded onto the end of the strap iron as shown in fig. 1. The ends of these are tied together with ¼″ steel rods. A three inch piece of ½″ conduit, or any pipe, is welded to the end of the strap. Two holes are drilled at right angles to each other in the conduit near the end. A ¼″ rod is passed through these holes and welded to the ends of the angle iron. A duplicate is made for the other end and these are both given a coat of aluminum paint.

Next, the spiders themselves are constructed. This antenna was designed for the middle of the phone band. The standard formula for computing the length of the sides of a quad was used.

$$\text{Length in feet} = \frac{251}{F(Mc)}$$

I found each side to be 34′ 7″. The problem then

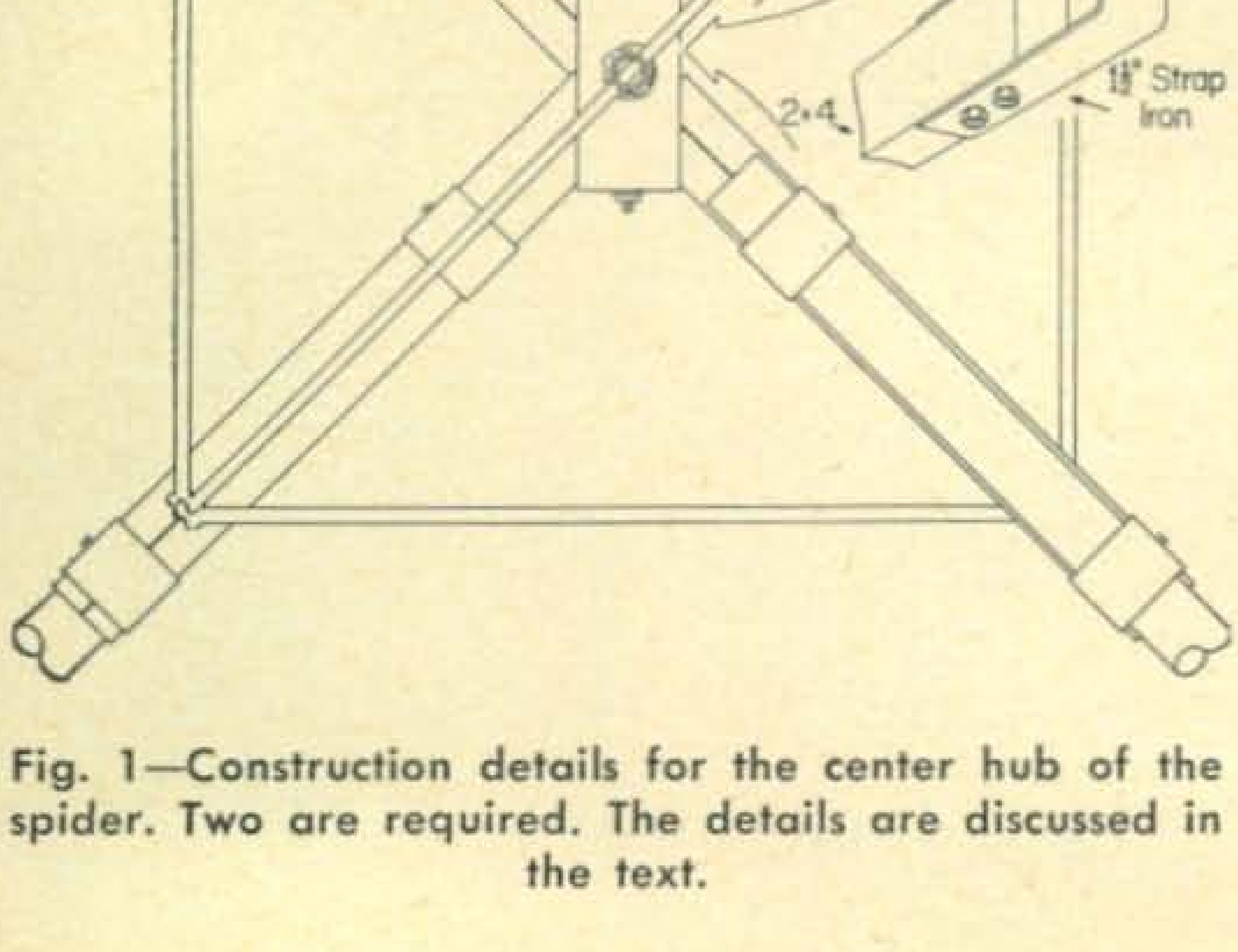


Fig. 1—Construction details for the center hub of the spider. Two are required. The details are discussed in the text.

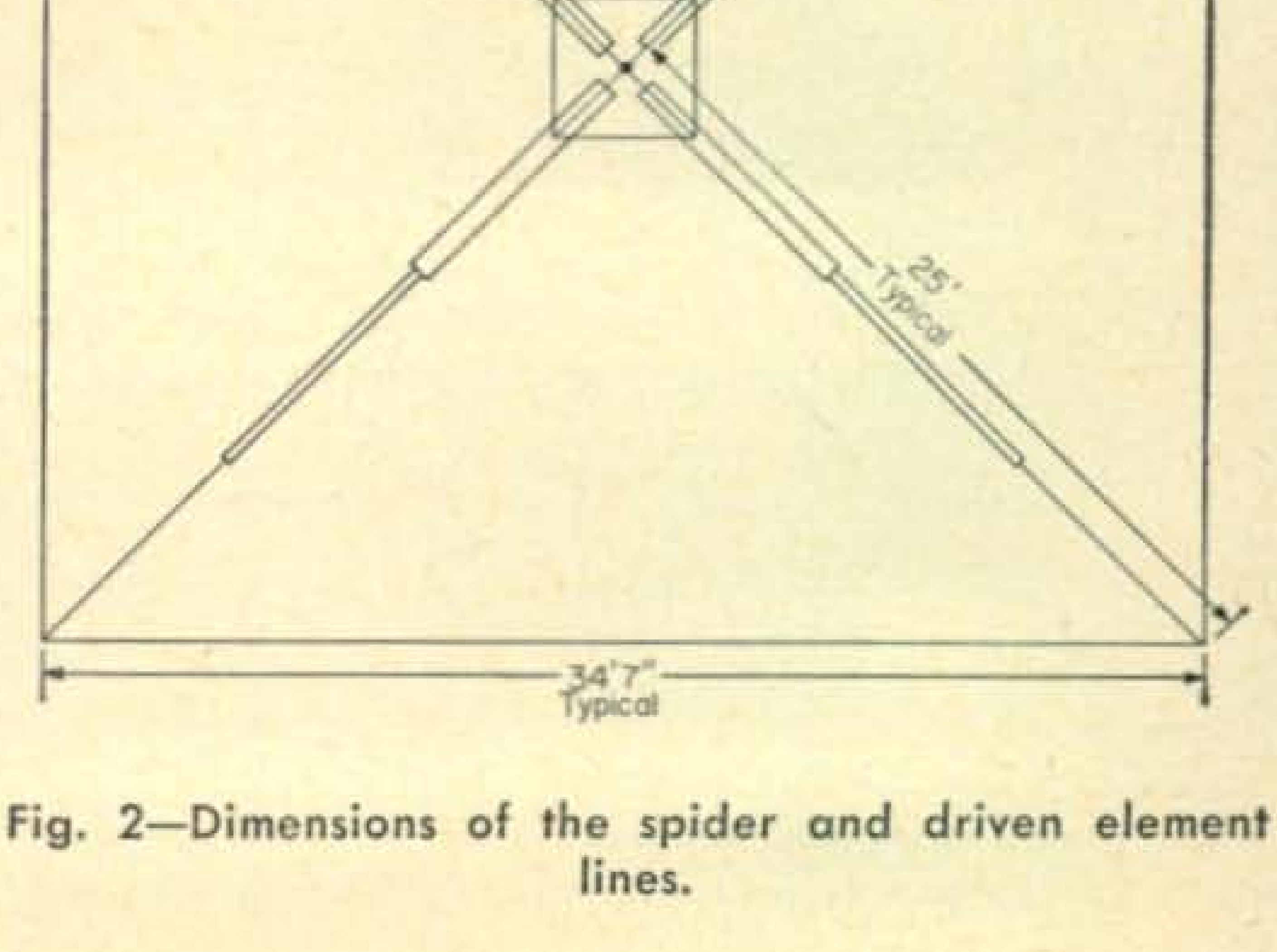
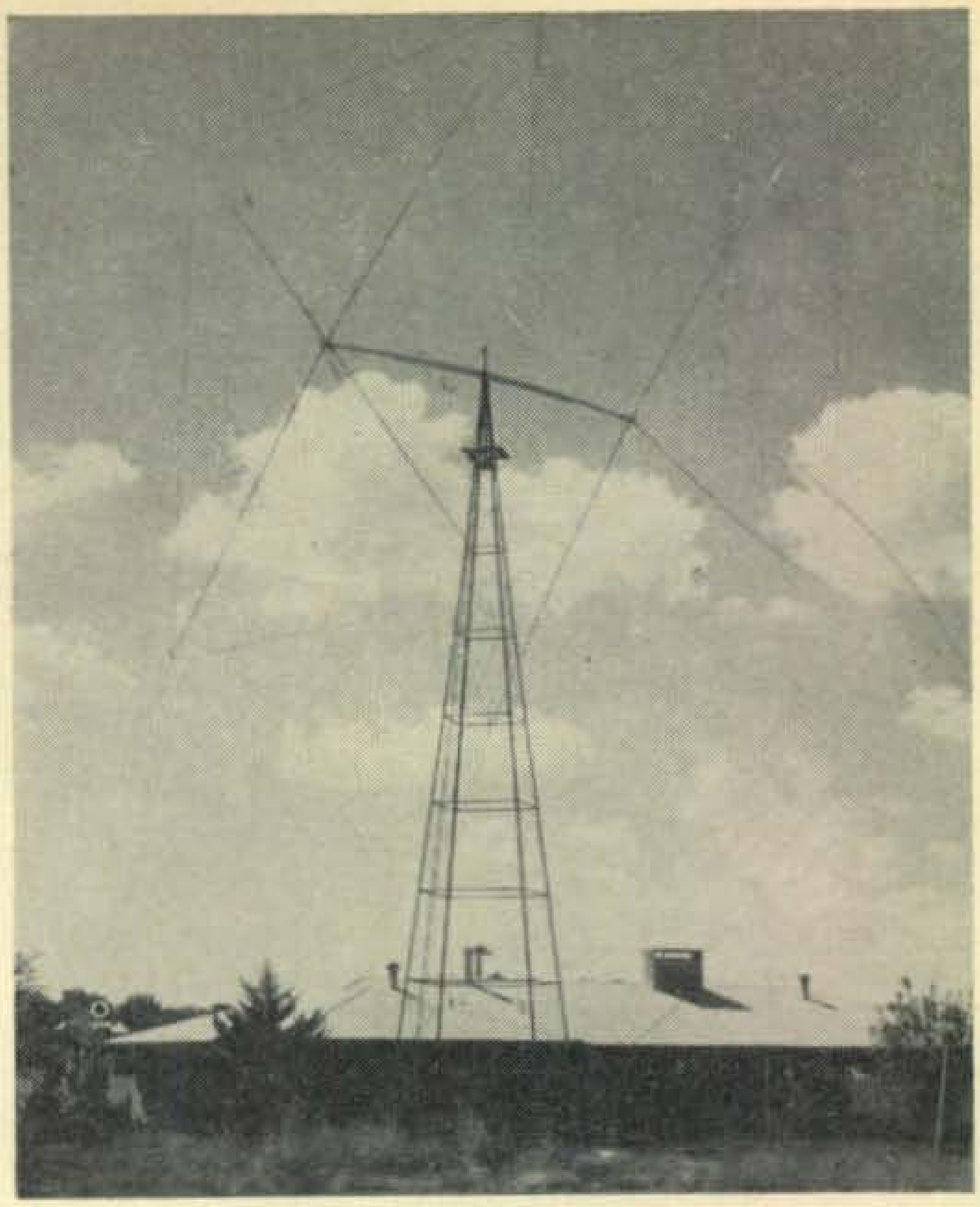


Fig. 2—Dimensions of the spider and driven element lines.

is to figure the length of the supporting spiders required to obtain 34′ 7″ on a side. A little high school geometry comes in handy here. In a right angle triangle the sum of the squares of the two sides is equal to the square of the hypotenuse. Thus $(34'7'')^2$ equals the total length of spider squared. This answer can be divided by two to obtain the length from the center. This comes out to 25 feet as shown in fig. 2.

The first 10 feet was made from T.V. masting of 1¼″ outside diameter. The last 15 feet is fiberglass. This was made from 20′ telescoping fishing poles.[1] The last five foot section was discarded. (This can be used for a mobile whip or a casting rod.) These telescoping rods are extended the full length and each section is taped with plastic tape to keep it extended. There is a tight fit anyway but this will assure them not pulling together in a heavy wind. The large end of these fiberglass poles will just fit comfortably inside the 1¼″ steel tubing. The end of the steel tubing is split back about four inches on four sides with a hack saw. The poles are wrapped with plastic tape to prevent chafing of the fiberglass and inserted into the steel tubes. A plated hose clamp is placed over the outside of the steel tube and clamped down tight to hold the fiberglass rod securely. This is done for all eight poles so that you end up with eight poles 25′ long.



The forty meter quad mounted on a 50′ windmill tower.

Mounting and Stringing

I intended to mount this antenna on a 60′ Vesto tower. I have installed a pulley on the mast at the top of the tower through which a ½″ rope is passed and on down to the bottom of the tower. A small length of chain is secured to the middle of the boom. The rope is tied to the center of the chain. The other end of the rope is pulled until the boom is about 10″ off the ground. By standing on a small step ladder the large end of each pole can be fastened to the spider with two hose clamps.

When all eight poles are secured we start to fasten the wire to the ends of the spiders. The end of the antenna wire is secured to the end of one of the bottom poles. The boom is rotated a quarter turn on its long axis to bring another end down where it can be reached from the ground and another 34′ 7″ length is secured to the ends of the poles. This process is continued until all the way around the quad on both the reflector and director.

At the corner of the driven element, where the two ends of the wire come together, fasten the coax, RG-58/U or RG-8/U. The center conductor is soldered to one end and the shield to the other end.[2] This is well covered with plastic tape. The coax is taped to the spider, led up to the boom and fastened to the boom over to the middle.

The reflector has six feet of extra wire added to each end. Plastic spacers are made three inches long. These are secured with tape to the spiders. A shorting bar is made and secured approximately five feet from the end of the poles.[3]

This completes the beam except for mounting. Two plates are made from ¼″ steel plating 7″ square. Holes are drilled for U bolts to hold the boom to the mast. Secure an old steel bed sted and cut off the ends. Bolt this to the middle of the boom to strengthen it. The boom is hoisted and bolted into position as shown in fig. 3. Good luck on forty. ■

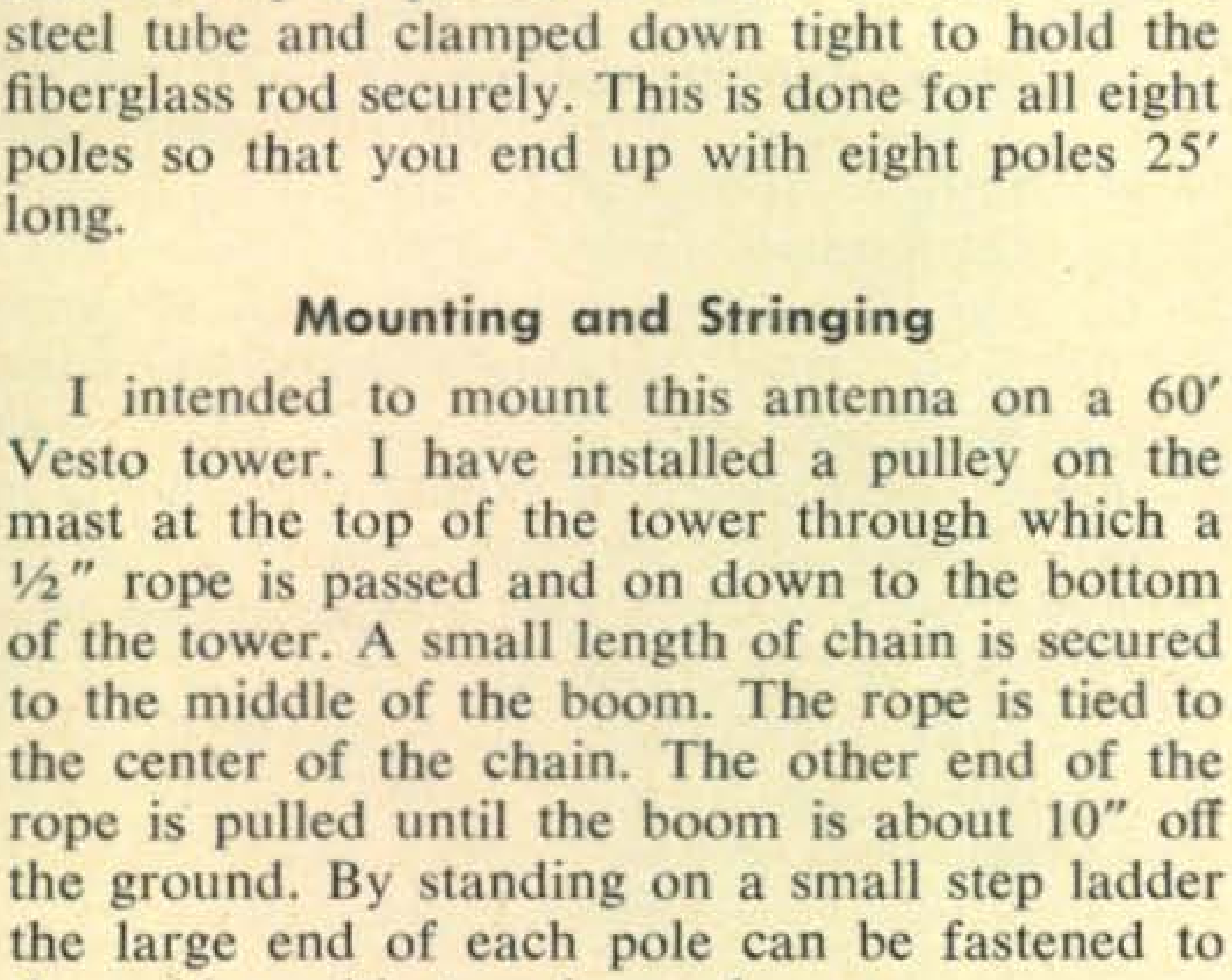


Fig. 3—Boom clamping details. The length of metal across the steel plate is the piece of iron bedstead mentioned in the text.

[1]These were obtained from Hecters Inc., Waseca, Minn.

[2]Feeding the beam in one corner will develop a polarization between horizontal (when fed from bottom or top) and vertical (when fed from either side) or about 45°. This may or may not be beneficial and can be determined only by operating results.—*Ed.*

[3]The location of the single stub in the corner of the reflector may cause unbalance, resulting in an offset beam pattern. The simplest solution might be to add the stub length and increase the overall size of the reflector.—*Ed.*

CQ Reviews:

The Hallicrafters SX-115 Receiver

HAVE you ever felt you wanted a receiver with just about everything in it? Well, if you have, the Hallicrafters SX-115 is an answer. This is a triple-conversion superheterodyne receiver for use on s.s.b., c.w., or a.m. featuring linear tuning with highly accurate frequency readout and stability together with five degrees of i.f. selectivity. It also is a top-class piece of equipment both as to quality and performance which measures up to or exceeds the manufacturer's specifications, so rather than just enumerating these, as well as the many other features, they will be discussed one at a time along with comments pertaining to the actual or measured performance of the unit checked for evaluation.

For those interested in the circuit arrangement, a brief description with a block diagram is given in fig. 1.

Frequency Coverage

First of all, the SX-115 is an amateur-band only type of receiver. No diddling around with a critical bandsetting dial is required. Each range is bandswitched, covering the following 500 kc segments: 3.5-4.0 mc, 7.0-7.5 mc, 14.0-14.5 mc, 21.0-21.5 mc, 28.0-28.5 mc, 28.5-29.0 29.0-29.5 mc and 29.5-30.0 mc. A separate range is also included for receiving WWV on 10 mc.

The main dial, which is semi-circular, is calibrated in 25 kc increments, while a vernier dial covers 25 kc per revolution and is linearly calibrated in 1 kc increments spaced 5/16" apart on the dial! This provides an exceptionally high degree of frequency readout and resettability which may be made to within 100 c.p.s. The drive ratio also is high, making it easy to tune in s.s.b. signals. The frequency is determined directly by adding the reading of the vernier dial to those of the main dial.

Crystal Calibrator

A 100 kc crystal calibrator is included and the vernier dial may be indexed to coincide with any of the 100 kc reference beats. This is done by means of CALIBRATION-SET control which locks the dial in position while the receiver is tuned to frequency. Then, after the dial is unlocked, it will rotate with the tuning knob and may be used for accurate reference. Unlike other arrangements sometimes used, this allows the hairline fiducial to always be set at the center of the dial window.

Calibration Accuracy

The linear calibration accuracy of the vernier dial is specified as better than 1000 cycles between 100 kc calibration points after indexing, but it was found to be greater than this. Checks at every 10 kc point over the entire 500 kc range of the v.f.o., after indexing at only one point (3700 kc), indicated the readout to be well within 200 c.p.s. (three points were out 300 c.p.s.). It was still better for readings obtained between adjacent calibrated 100 kc points. Besides this, thanks to an excellent gear-driven tuning mechanism, absolutely no backlash could be detected, the frequency readout being the same regardless of which direction the dial was rotated toward the reference point.

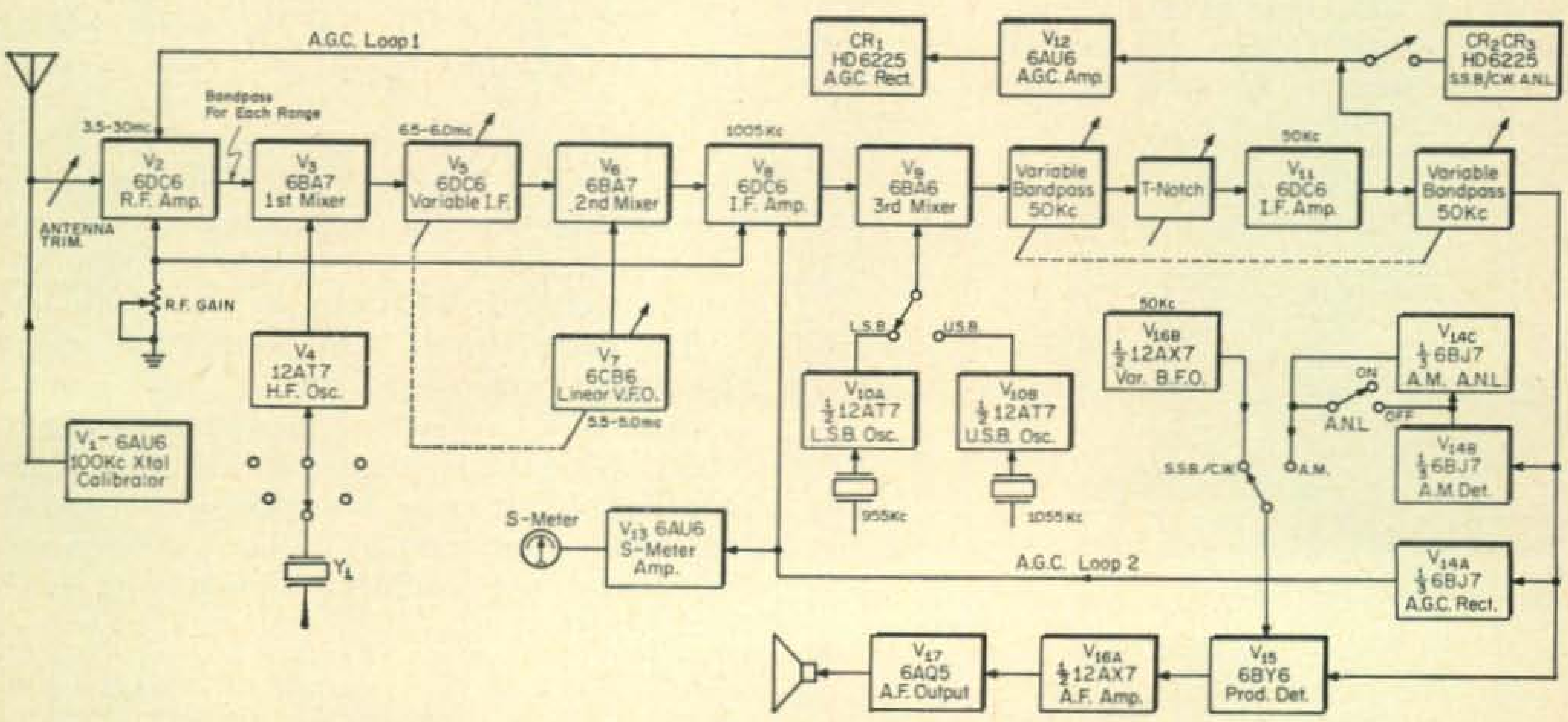


Fig. 1—Block diagram of the SX-115. Note that the control potential for a.g.c. loop 1 is obtained from a point prior to the selective circuit at the output of V_{11}, while that for a.g.c. loop 2 is obtained from the output side of the selective circuit. The selectivity of the two a.g.c. loops thus is different, increasing the selectivity when a.g.c. is used, as explained in the text. When a.m. is used, the b.f.o. potential is removed from the product detector, V_{15}, and the output of the a.m. detector, V_{14B}, is applied to V_{15} instead. The latter then becomes an a.f. amplifier. Frequency of Y_1 is 6.505 mc higher than the bottom end of each band range.

The Hallicrafters SX-115 Receiver. It is smartly styled with a symmetrical layout. The large knobs, each side of center at the bottom, are the BAND SELECTOR (left) and TUNING with the 1 kc incremental frequency dial (right). Other controls are conveniently located.

Stability

A transmitter-type v.f.o., with Hallicrafter's system of differential temperature compensation, is used. Stability is specified as better than 300 cycles after a 15 minute warmup period. It was found that, starting cold from a normal room ambient temperature, the frequency dropped 400 cycles after 10 minutes. Eight hours thereafter it had moved 600 cycles, equivalent to 75 c.p.s. per hour. Line potential variations of 10% affected the frequency only a few cycles.

A standby heating element (damp-chaser) is employed in the SX-115 which maintains a moderate amount of heat and a uniform degree of low humidity as long as the set is plugged into a 117 volt a.c. outlet. The power switch need not be turned on. This arrangement is designed mainly to cut down warm-up drift which was then found to be only 200 c.p.s.

Rugged construction also assures a high order of mechanical stability. Vibration and drop tests indicated no frequency shift, quivver, microphonics or other adverse effects.

Selectivity

The SX-115 is provided with five degrees of i.f. selectivity, namely: 0.5, 1, 2, 3 and 5 kc bandwidth at 6 db down. A special front-end a.v.c. loop is employed to improve the selectivity characteristics when the a.v.c. is in operation, so the instruction book contains two charts showing the i.f. response, one with the a.v.c. off, the other with the a.v.c. on. This is explained further during the description of the a.v.c. system.

The following table indicates the unwanted sideband suppression measured at 1 kc for three selectivity positions as determined from the a.f. output with the a.v.c. disabled.

Selectivity Position	*Sideband Suppression At 1 kc*
1 kc	—40 db
2 kc	—30 db
3 kc	—26 db

Suppression figures are not given for 5 kc, since this position is for use with a.m.

The 0.5 kc position is for use with c.w. In this case the response was down 20 db at 500 c.p.s. each side of the peak and down 40 db at 1 kc on each side. The nose of the peak was ±250 c.p.s. at 6 db down. Narrow band i.f. systems often ring from shock excitation due to strong adjacent-channel c.w. signals, but no such effect was experienced with the 500 cycle position in this receiver.

T-Notch Filter

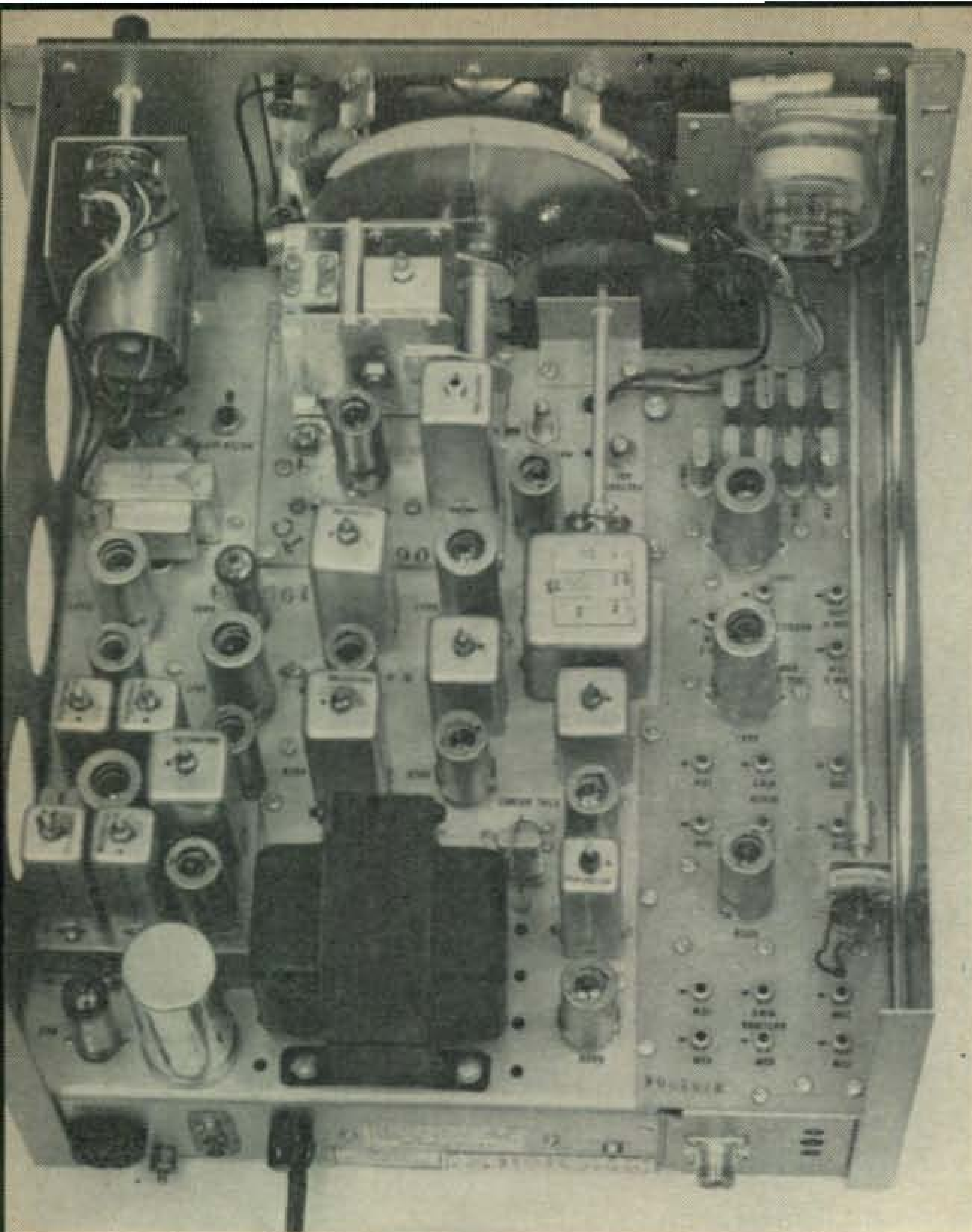
An excellent T-Notch filter very effectively rejects interference from a heterodyne or an adjacent carrier beat. Its performance checked with the given specifications of 400 c.p.s. bandwidth at 6 db down with a notch depth control of at least 50 db; however, the latter is dependent on the frequency at which the internal depth control was initially adjusted for maximum attenuation. Some deterioration will occur at other points in the passband. In this respect, it was found best to set the depth control for maximum rejection when the notch filter is tuned to reject a 1 kc beat, after which the attenuation at other points tuned in the passband will be fairly uniform.

The notch filter also may be used to make more pleasant-sounding reception of some of the strident-quality s.s.b. signals. This is done by varying the notch frequency control accordingly. It can also be used to advantage for exalted-carrier reception of a.m. signals. When used for taking out an unwanted beat, it should be noted that rejection is obtainable only throughout the normal passband of the i.f. system and therefore a signal on the unwanted sideband cannot be rejected.

Also, maximum rejection will be obtained only when the a.v.c. is turned off or when the r.f. gain is turned down. (Maximum sideband suppression also will be obtained under the same conditions).

Sensitivity

Sensitivity on a.m. is specified as less than 1 μv for a 10 db signal-to-noise ratio and less than 0.5 μv for s.s.b. and c.w. Measurements indicated this to be mostly on the "less" side except on 10 meters. The input impedance is 50-70 ohms.



Top chassis view of the SX-115. Some of the gear-drive mechanism may be seen at the center of the panel. The v.f.o. tuning capacitor is left of center. Heavy supporting brackets at the sides of the chassis enhance sturdiness and serve as convenient supports when the chassis is turned over in the event servicing is required.

Detectors and Noise Limiters

Separate detectors and noise limiters are provided for a.m. and s.s.b./c.w. operation. For a.m. a conventional diode detector and an automatic-threshold series-type noise limiter arrangement is used. For s.s.b. and c.w. a product detector is employed. The noise limiter for this mode is an i.f. type which is one of the most effective and simple ones yet devised for s.s.b. and c.w.[1] Key clicks and hard ac. action are also thereby minimized. The detectors and noise limiters may be switched individually.

S-Meter

The S-meter is calibrated in the usual fashion. Accuracy of calibration was found to be within 15% for 6 db per S-unit with the a.v.c. in operation and the r.f. gain set fully on. A 1 μv signal produced an average meter reading of S-4, and the average reading for a 50 μv signal was S-9. A band-gain equalization arrangement is used, so the indicated readings for each band were almost identical. The S-meter still functions when the r.f. gain is turned down or when the a.v.c. is disabled; however, the calibration does not hold and the indications are then only relative.

A.G.C.

A dual-loop a.g.c. system is used which improves selectivity when a.g.c. is used. The first a.g.c. loop derives an amplified control potential from the 50.75 kc i.f. amplifier at a point which is not as selective as the circuit to which the second a.g.c. loop is connected. The first loop controls the front-end r.f. stage, the second controls an i.f. stage and the S-meter.

When an adjacent-channel signal, stronger than the desired signal, is present, it will reduce the front-end gain, but as this drops, the r.f. potential at the second a.g.c. rectifier will also drop, thereby tending to increase the receiver gain. (Due to the higher selectivity involving the second loop, the adjacent signal will have little effect on its a.g.c. potential). The net result is a compensating action between the two a.g.c. loops which minimizes desensitization of the receiver and holds up the weaker signal. This effectively increases the dynamic selectivity (which actually can be measured) and lessens a.g.c. pumping and monkey-chatter by the strong adjacent signal. The action holds up to about a 50 μv signal input at which point a further increase in signal level (the desired one) brings the a.g.c. into play. It is a two-step action which is dependent on the ratio of the gain in the two a.g.c. loops and which contributes to smoothness of operation and minimizes desired-signal pumping and popping of a.g.c. In addition, the a.g.c. attack is fast, release is slow, making the overall action pleasant sounding.

The dual loop a.g.c. also cuts down desensitization of the receiver by short noise pulses, as also does the s.s.b./c.w. i.f. noise limiter which operates ahead of the a.g.c. system.

The a.g.c. figure of merit is given as 60 db. Tests showed that the a.f. output level increased with r.f. input level as follows:

Input Level Change (μv) *From*	*To*	*Level Increase* (db)	*A.F. Output Level Change* (db)	*Cumulative Total* (db)
1	10	20	9	9
10	100	20	3	12
100	1000	20	2	14
1000	10000	20	2	16

The total output level change was 16 db for an input signal increase of 80 db from 1 μv to 10000 μv, and 7 db for an input increase of 60 db from 10 μv to 10000 μv.

Image and Spurious Responses

I.f. *image* rejection is given as better than 60 db and i.f. *signal* rejection as better than 70 db. These specifications were confirmed with signal rejection running as high as 80 db on some

[*Continued on page 104*]

[1]Scherer, 20 Kc Filter Adapter and S.S.B. I.F. Noise Limiter for the Collins 75A-4 *CQ*, April, 1960, p. 32; "IFNL", An S.S.B. I.F. Noise Limiter, *CQ*, June, 1960, p. 42; "More on the IFNL," *CQ*, November, 1960, p. 62; Raguse "Variable I.F. Noise Limiter," *CQ*, November, 1960, p. 70.

Add RTTY Tuning To The Modulation Analyzer

BY R. M. BALDWIN*, K4ZQR

The Modulation Analyzer described in a previous issue of CQ[1] can easily be converted to an RTTY tuning indicator as outlined below.

ONE of the most useful station accessories is a scope to monitor your modulation, and the Modulation Analyzer described by WØBMW in a previous issue[1] is a dandy—because it not only lets you monitor your signal, but also the other fellow's. This latter feature makes it useful as a tuning indicator, and as WØBMW puts it you can use it to zero beat another station.

Shortly after we completed our Modulation Analyzer the RTTY bug bit at K4ZQR, and we were on the air with a Model 26 and a Twin Cities TU. The Twin Cities TU, in common with most other terminal units, has jacks provided for monitoring the *mark* and *space* signals on a scope, and for some months we pressed the regular bench scope into service. It worked well, but whenever we needed the scope for other purposes we had to disassemble the RTTY set up.

With the purchase of Byron Kretzmans' *New RTTY Handbook* we saw just what we wanted in the cross-type tuning indicator described under Accessory Equipment in Chapter 7. It even used the same 3BP1A c.r.t. tube, and we were just about ready to sacrifice the Modulation Analyzer when we got the idea that maybe we could have our cake and eat it too. To make a long story short, we now have a Modulation Analyzer that will monitor our own or the other fellow's wave envelope or trapezoid pattern, and at the flick of a switch becomes a cross-type RTTY tuning indicator. Interested?—well here's how its done.

Procedure

While the power supplies in the Modulation Analyzer and the RTTY tuning indicator are somewhat different in design, they deliver approximately the same high and low voltages. It was also obvious after studying the circuits that all of the other controls for the Modulation Analyzer could be used for RTTY tuning indicator without modification. This included VERTICAL and HORIZONTAL CENTERING, INTENSITY, and FOCUS controls.

What it boiled down to then was adding a 12AX7, two half-meg pots, two jacks, a three pole, two position ceramic rotary switch, plus a few resistors and capacitors. All of my own parts came from the well known junk box, but if yours isn't well stocked you still won't go broke in making this simple conversion.

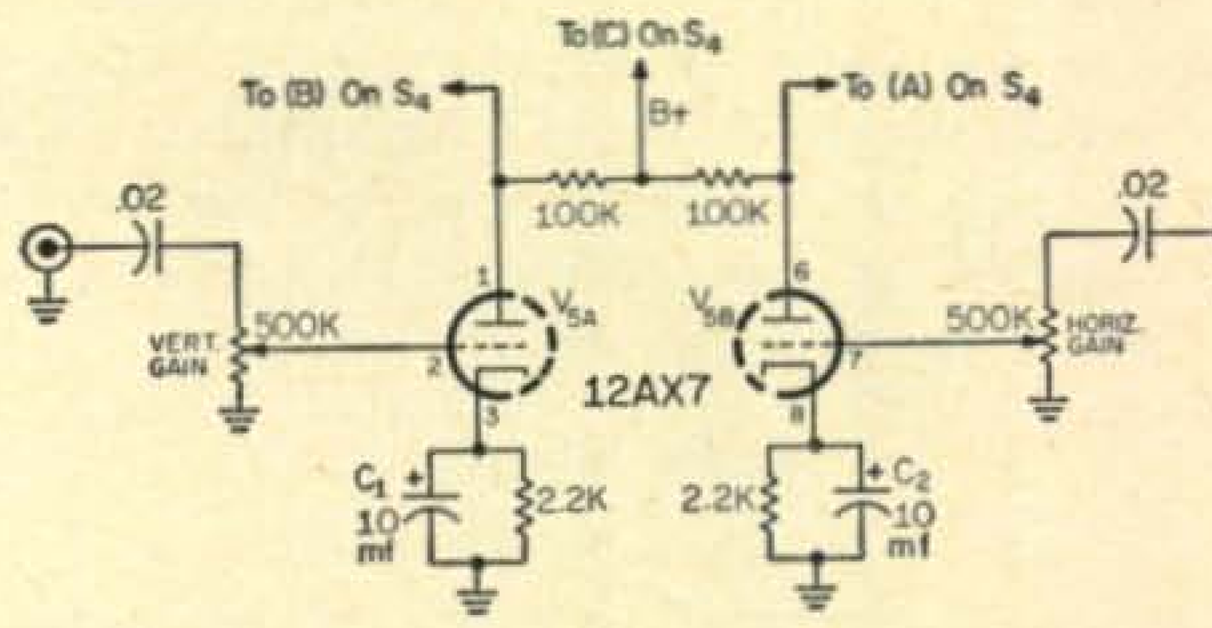


Fig. 1—Circuit of the vertical and horizontal amplifiers that can be added to the Modulation Analyzer to enable its use as an RTTY Tuning Indicator. All resistors are ½ watt and all capacitators are in mf.

Construction

If you have already built the Modulation Analyzer the addition of the 12AX7 is the first problem. In the event yours is a Chinese copy of WØBMW's layout, the 12AX7 can be located next to the 6BH6 on the rear of the chassis. The two pots and the input jacks (RCA type) are mounted on a vertical plate added to the side of the chassis. The switch, S_4, used to select the Modulation Analyzer function or the RTTY function should be mounted below deck with the shaft out to the side so the front layout is not changed at all.

After all the parts are mounted, wire the cir-

[*Continued on page 87*]

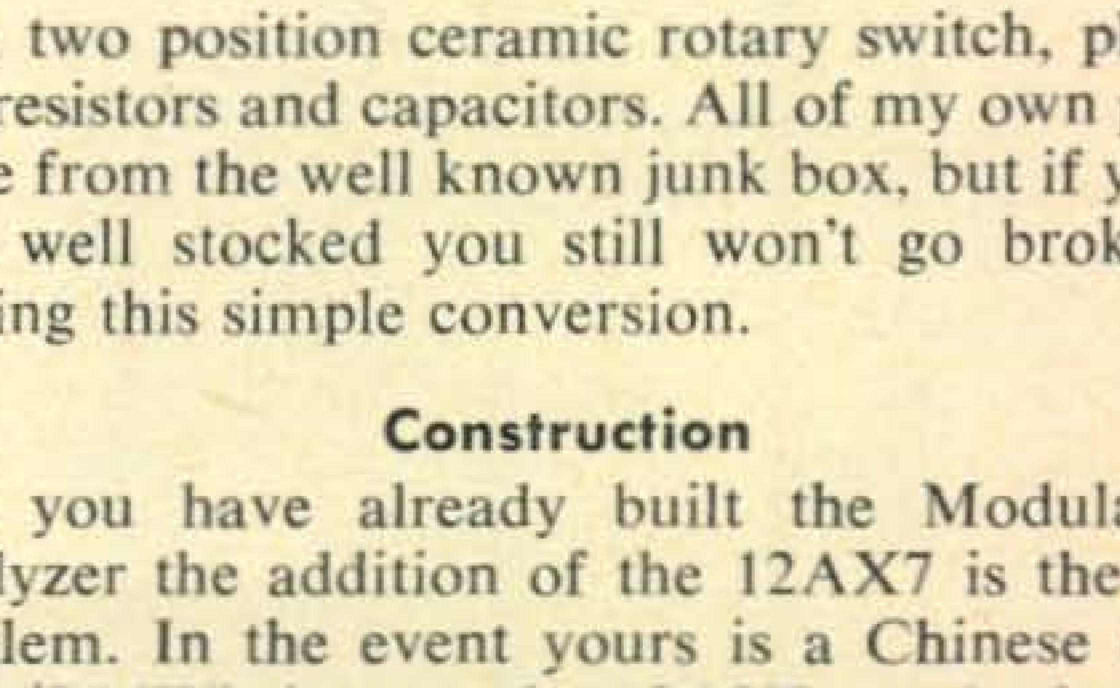


Fig. 2—Wiring of the switch, S_4, is shown above as described in the step-by-step procedure. The switch is shown in the MODULATION position

*409 Kaelin Drive, Louisville 7, Kentucky.

[1]Frederickson, D.G., "Modulation Analyzer," *CQ*, January 1961, p. 36.

D.C. to D.C. Power Supplies Using 400 C.P.S. Transformers

BY C. FITZHUGH GRICE*, W5KOF/5

D.C. to d.c. power supplies can be built using surplus 400 cycle filament transformers so plentiful on the surplus market. This article identifies the specific transformers employed and provides seven practical circuits in which they may be used.

An untold number of surplus 400 cycle transformers have probably gone into the melting pot because a good use could not be found for them. In an attempt to find a use for some of these 400 cycle transformers, a number of experiments were made using several different types of transformers in transistorized d.c. to d.c. power supplies.

Basic Theory

First, a basic review of a d.c. to d.c. converter: Figure 1 is a circuit illustrating the basic principle involved. If a means can be provided for cyclic operation of switches S_1 and S_2, and by using a rectifier across the secondary of the transformer, we have a d.c. to d.c. converter.

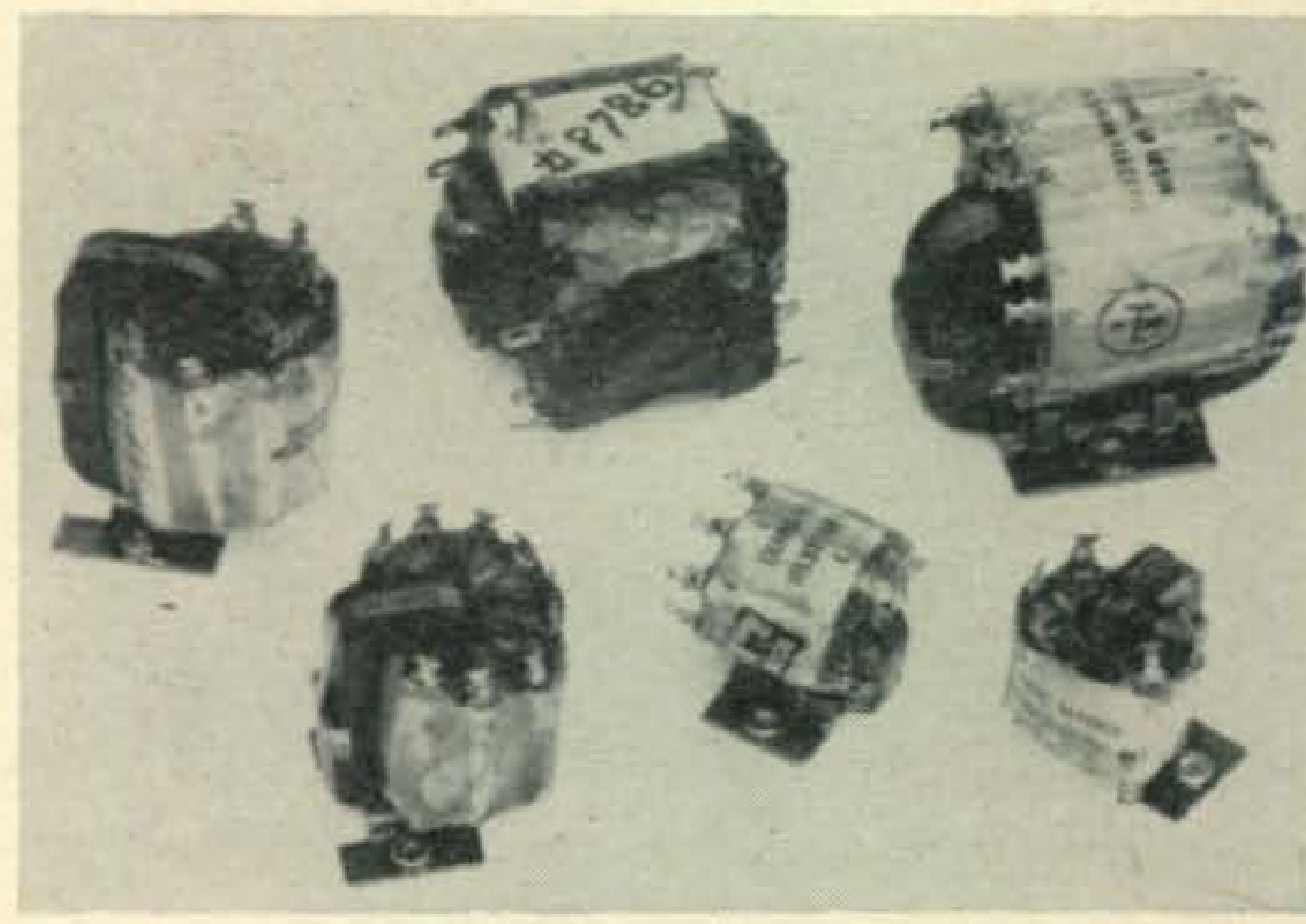
In fig. 2, we have substituted transistors as switches. The energy needed to operate the transistors as switches is supplied by feedback windings from the transformer to the bases of the transistors.

In order to cause the necessary switching action to take place, the flux in the iron core of the transformer must be driven to positive and negative saturation on alternate half-cycles. An iron core transformer will be saturated in essentially a square wave mode in accordance with the formula:

$$V_t = \frac{4\,B_s\,A N_1 f}{10^8}$$

Where V_t = voltage across ½ primary.
B_s = saturated flux density (lines/cm^2).
A = cross section area of core (cm^2).
N_1 = number of turns on one half of the primary.
f = frequency of oscillation.

The core of any transformer has certain magnetization characteristics. A curve representing these characteristics is called a hysteresis loop. This loop is a plot of the flux density, B, versus the magnetic force, H. H is equal to turns (N) times current, (i) : $H = Ni$. Figure 3 represents a typical hysteresis loop for a converter transformer. The desirable condition would be to reach B_s of a given core material using as little current as possible (hence H = small). Inspection of formula (1) shows that the larger B_s is, the smaller N_1 can be for the same frequency of oscillation. It then would follow that the best type of d.c.-to-d.c. converter transformer cores would be those with a reasonably large B_s and low H. This would be a "square-loop" material. The current (and hence power) needed to produce the necessary H to reach B_s is part of the core loss and one of the factors in determining the efficiency of the converter. As frequency increases, the top and bottom of the loop "stay put" and the sides move out; the loop gets "squarer" requiring a larger magnetic force, H, to reach saturation. Therefore larger core losses occur with increasing frequency.



Several 400 c.p.s. filament transformers designed to be used in military and airborne equipment. Top row (l. to r.), GA-50011 modified, #8786, GA-52164. Bottom row, GA-50021, GA-51810, and GA-50009.

*13114 Indian Creek Road, Houston, Texas.

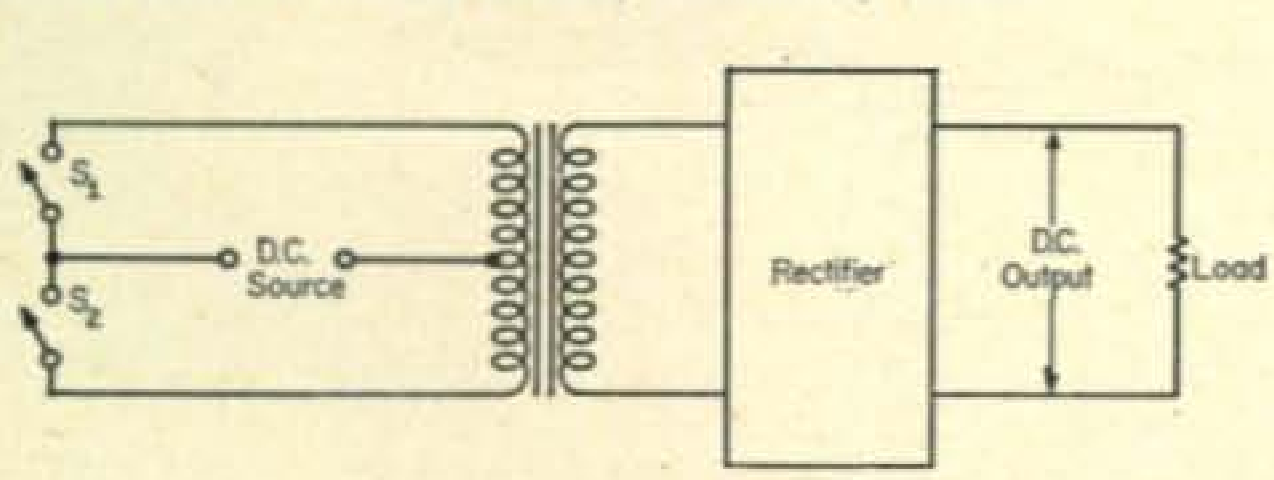


Fig. 1.—Basic d.c. to d.c. converter. When switches S_1 and S_2 are properly cycled, a pulsating d.c. is applied to the transformer primary.

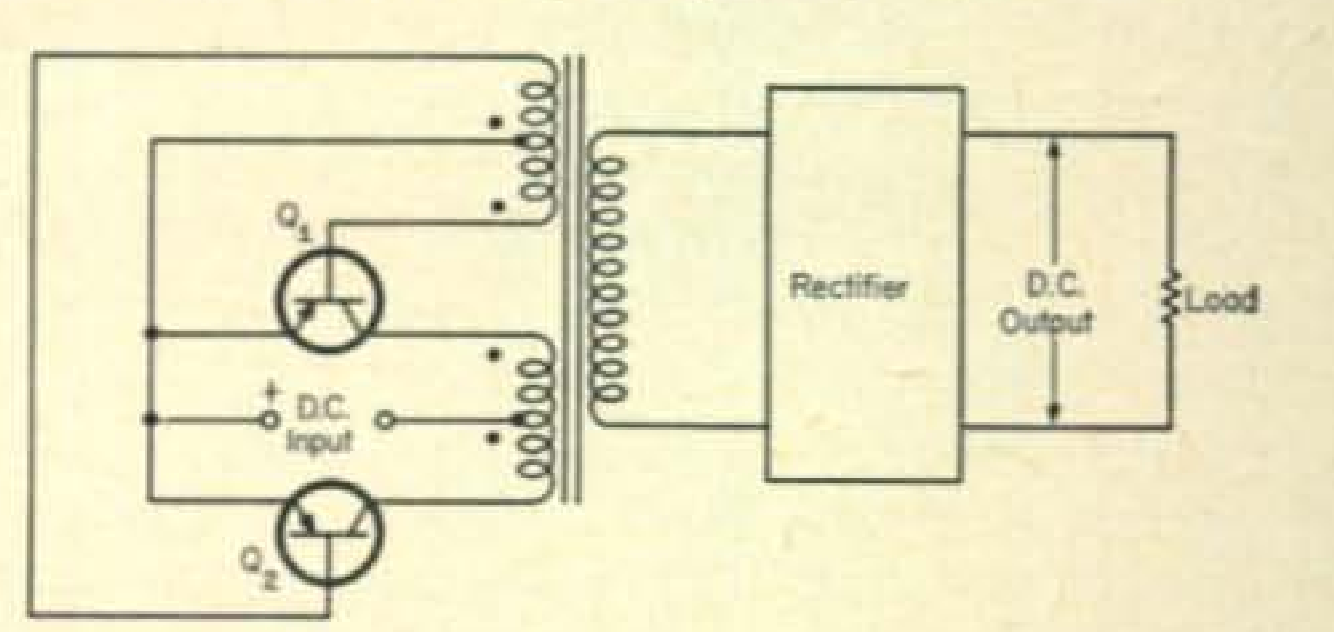


Fig. 2—Transistors are used to replace the switches of fig. 1 and are energized by the feedback voltages applied to the bases.

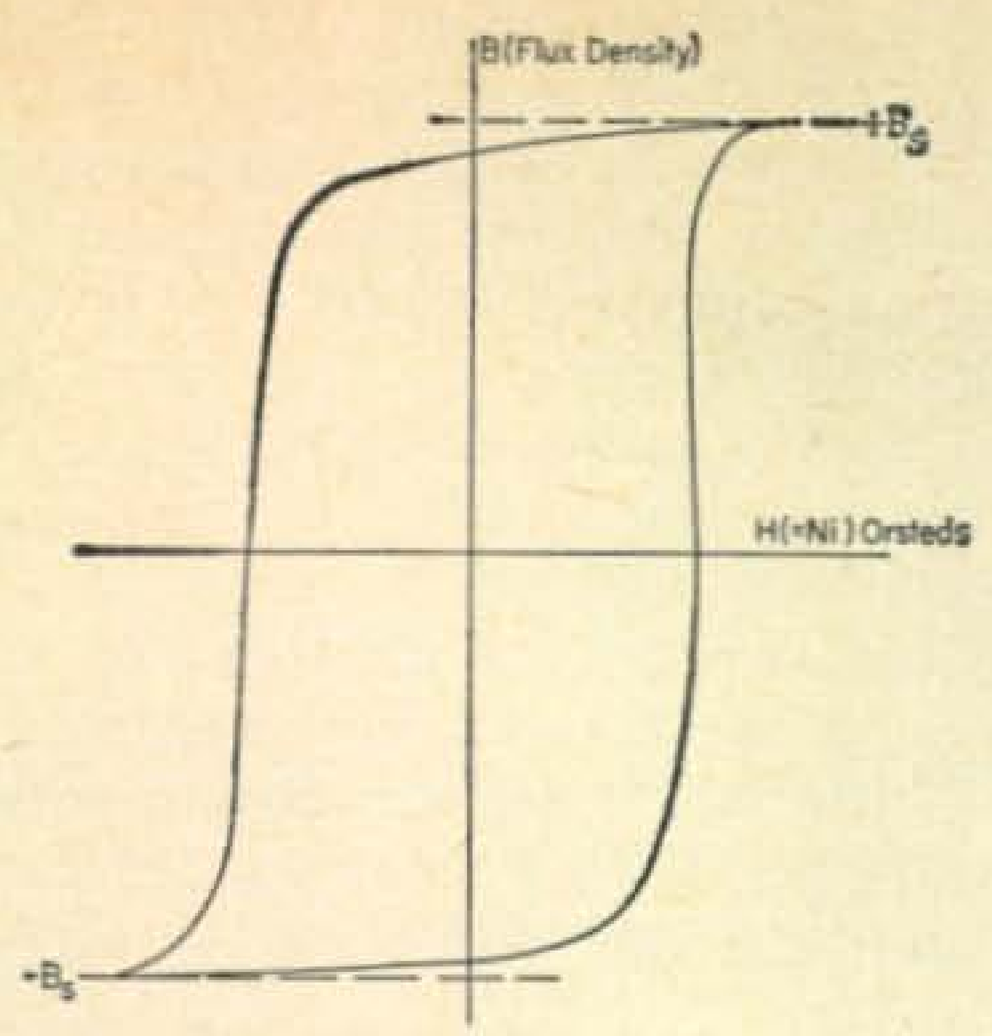


Fig. 3—A hysteresis loop for a typical converter transformer as explained in the text.

There are a number of core materials available which have high values of B_s with low values of H. Some of the trade names are Orthonol, Orthonik, Deltamax, Hipernik V, and 49 Square Mu. D.c.-to-d.c. converters can be and are built using transformers wound on toroid cores made of the above mentioned materials. As high as 95% efficiency can be obtained, but like most everything else in life, you don't get something for nothing, such cores are not cheap.

A number of silicon steel cores have reasonably good "square-loop" characteristics. Those sold under the trade names of Magnesil, Hypersil, Supersil, Microsil, Silectron, etc., are in this category. These materials have about the same, or slightly higher, saturated flux density, B_s as Orthonol, Deltamax, *etc*. Their core loss is higher due to a larger value of magnetizing force, H, required.

Types of Circuits

Most d.c.-to-d.c. converters will use one of three basic circuits; common collector, common emitter, and cross-base. Figures 4, 5, 6 and 7 illustrate the basic circuits.

Common Collector Circuit—Fig. 4 and 5: This circuit allows the transistors to be bolted directly to the chassis if the negative input to the converter is grounded, as is the case with most automobiles. The chassis then serves as a heat sink for the transistors.

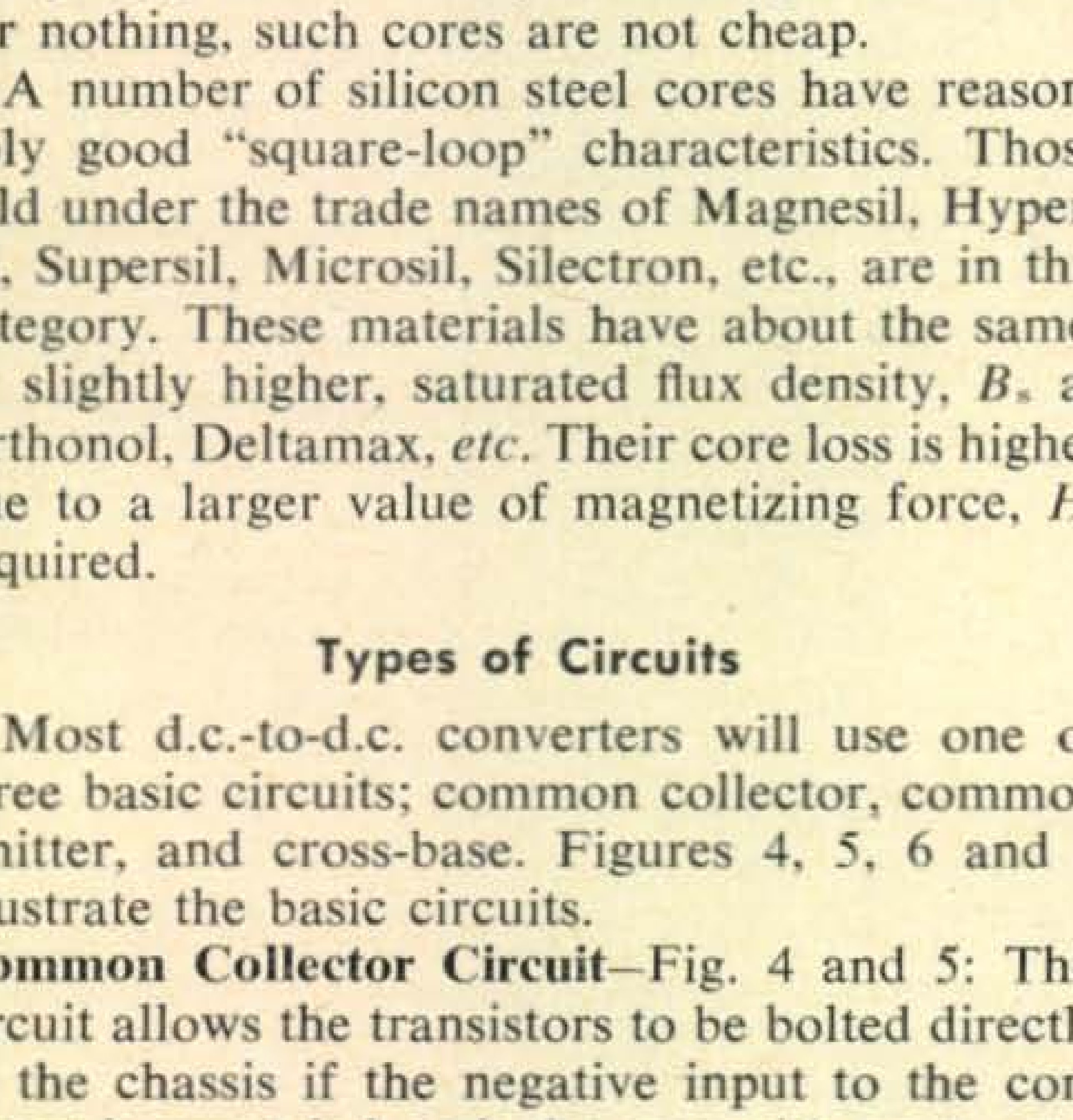


Fig. 4—Common collector circuit for use with a negative ground source voltage is shown above. The feedback winding requires a slightly higher number of turns than on the emitter-to-emitter winding. Resistors R_1 and R_2 form the bias network for starting but introduce a power loss.

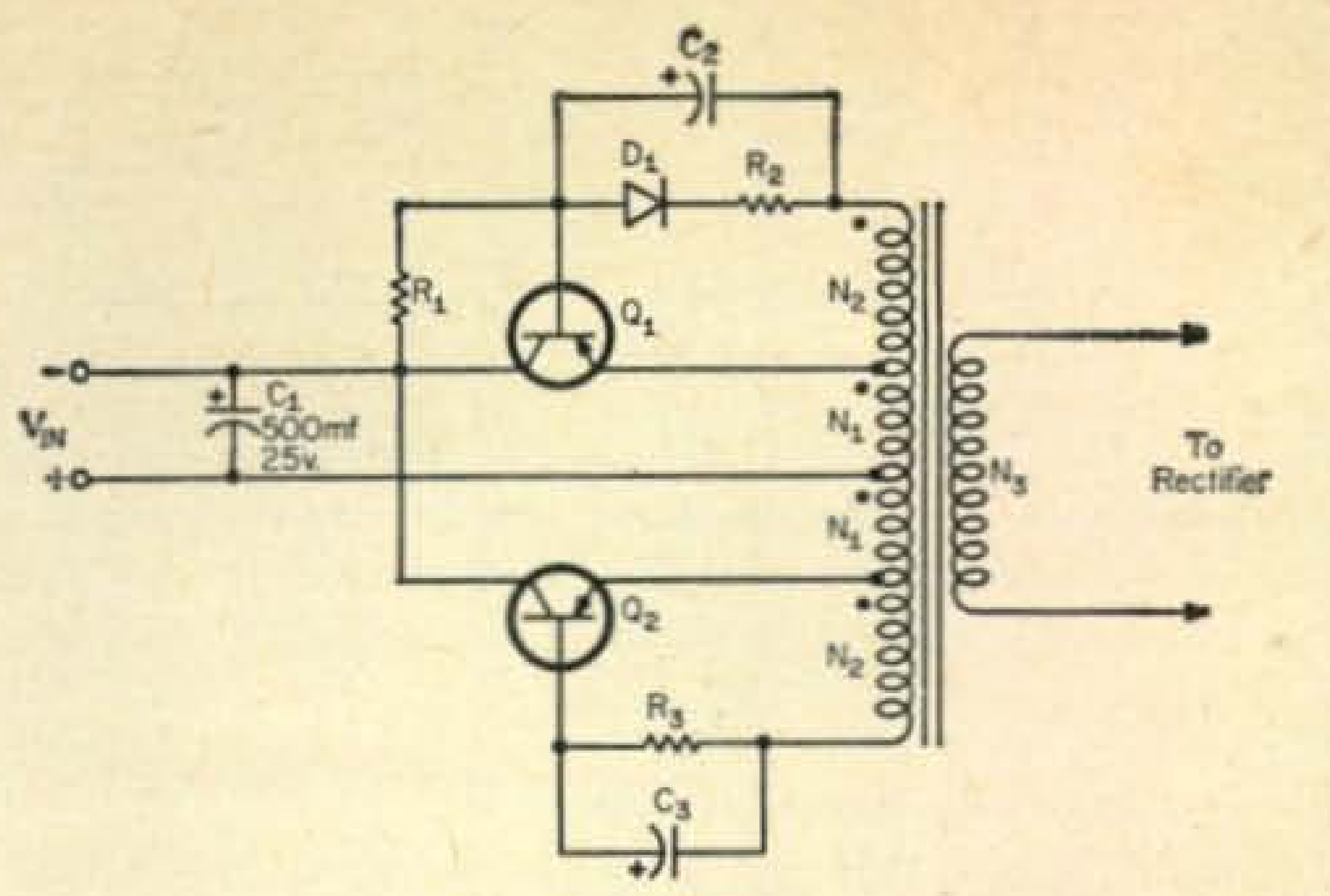


Fig. 5—A common collector circuit for use with negative ground input is shown above. The feedback is accomplished by an auto-transformer winding. The principle of operation is similar to the circuit shown in fig. 4 except for the starting bias. Diode D_1 (750 ma, 50 p.i.v.) insures starting by blocking current flow through R_1 and R_2, causing current to flow through the base-emitter circuit of Q_1. As soon as current flows the feedback winding supplies base voltage turning the transistor on "hard."

In fig. 4, the feedback winding N_2, must have sufficient turns so that V_{fb} is approximately 2 to 3 volts more than V_{in}.

Figure 5 is somewhat more efficient than fig. 4 because less power is wasted in the biasing resistors. Winding N_2 should be at least N¼ for good operation.

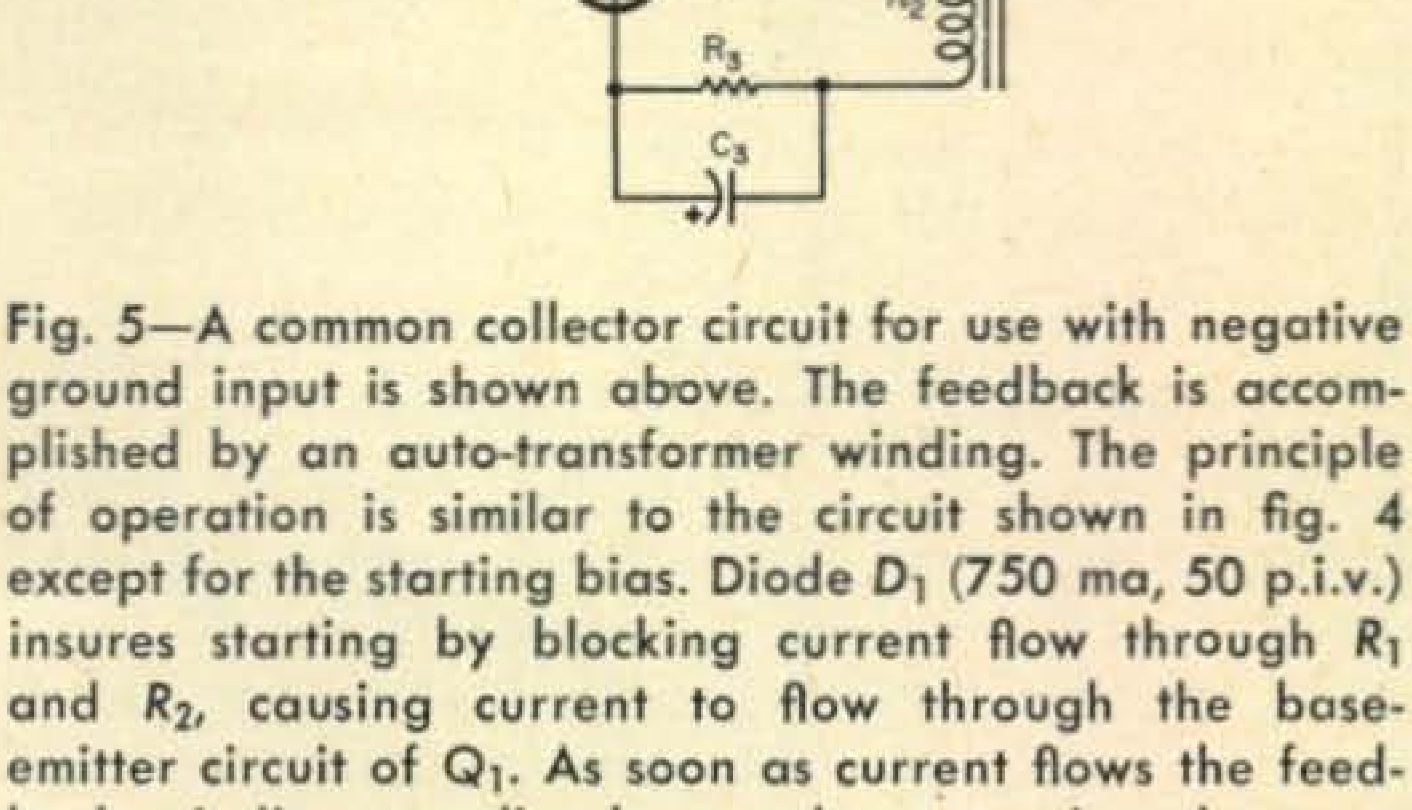


Fig. 6—This common emitter circuit is frequently used; it requires fewer turns on the feedback winding than the circuits of figs. 4 and 5. In this circuit the windings need supply only 2 to 3 volts, while in figs. 4 and 5 the feedback voltage must be in V_{in} plus 2 to 3 volts or a total of 14 to 15 volts. For the same voltage input, the transistors in this circuit can have lower voltage ratings than those of figs. 4 and 5.

Common Emitter Circuit—Fig. 6: This circuit allows use of a transformer with fewer turns on the feedback winding, N_2 V_{fb} should be at least 2 to 3 volts. The transistors must be insulated from the chassis.

Cross-Base Circuit—Fig. 7: For low power converters up to approximately 50 watts, a cross-base circuit can be used. The transformer does not require a separate feedback winding. The transistors must be insulated from the chassis and resistors R_1 and R_2 are necessary for good transistor stability with varying ambient temperature.

Most (or almost) all hams who either operate or plan to operate mobile would like a good cheap d.c. voltage supply for the rig—which

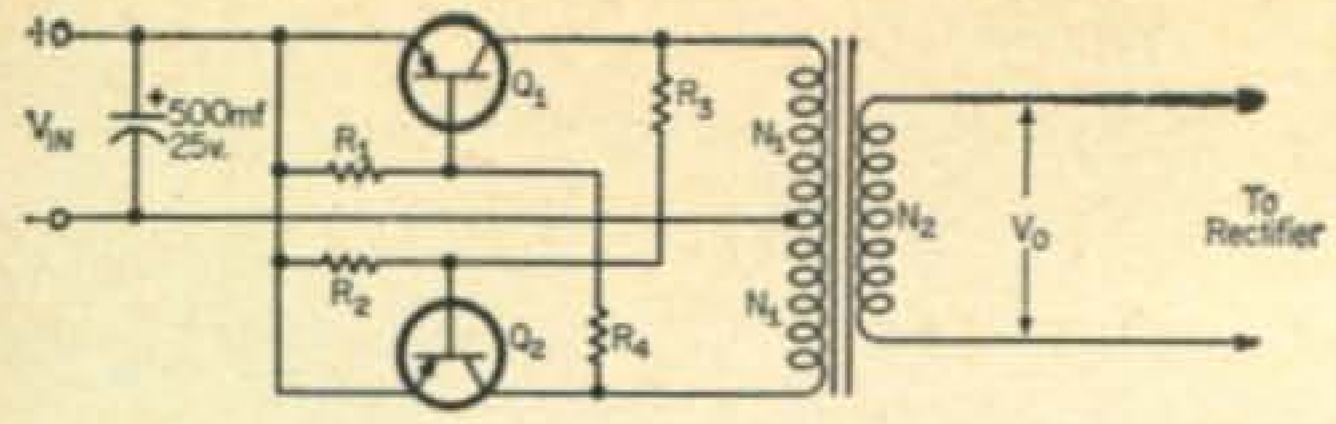


Fig. 7—This cross-base circuit is essentially a multivibrator with the feedback to each transistor supplied through resistors R_3 and R_4. This circuit is the least efficient and is not recommended for power levels above 50 watts.

finally leads us back to what we started to write about—using 400 cycle transformers as d.c.-to-d.c. converters.

400 Cycle Filament Transformers

Many 400 cycle (and higher) filament transformers used in military and airborne equipment are wound on banded "C" cores. Many of these cores are good high quality silicon steel cores such as Magnesil, Hypersil, etc., mentioned earlier.

At this point you might wonder how you can get good high voltage from a 115 v. to low voltage (6.4 v., 5.0 v., etc.) filament transformer. If a center-tapped winding, or two windings of equal voltage ratings, exist on a transformer, it can serve quite nicely as a converter transformer. First, take the case of a 115 v. to 6.4 v. (c.t.) transformer in a cross-base circuit with 12 v. input. See fig. 7. Here we are putting 12 volts across ½ of the original secondary winding. The turns ratio between N_2 and N_1 is $115/3.2 = 35.8$. Theoretically, the voltage output, V_o, would be $12 \times 35.8 = 415$ v. With a bridge rectifier we could expect somewhere in the range of 375 volts d.c. output voltage. The frequency of oscillation will be determined by formula (1). The fact that our present primary winding was originally intended to be a 6.4 v.c.t. winding does not matter if the wire is large enough to carry the current dictated by the output load. The fact that the frequency of oscillation is above 400 cycles does not particularly matter as most cores of this type are capable of operation up to 2000 cycles or so without excessive core losses as compared to 400 cycles. Example: Suppose a transformer was originally designed for 115 v. to 6.4 v.c.t. at 3 amps. Because current flows only during each half cycle using the 6.4 v. winding as a primary, we could draw 6 amps of input current. With a load of this amount, the current in the former 115 v. winding is in excess of the original rating. However, it appears from many hours of experimenting that the average military transformer is quite conservatively rated.

A filament transformer with two equal voltage center-tapped secondary windings could be used in fig. 6, a common emitter circuit. In this case the feedback voltage, V_{fb}, would be almost equal to the input voltage and R_1 would have to be made large enough to limit the base current to a safe value.

Suppose you have a transformer with four non-center-tapped secondary windings, two 6.4 v. and two 5.0 v. windings. This transformer could be used in the common collector circuit of fig. 4 if the two 5 volt windings are connected in series for the primary and the two 6.4 volt windings are connected in series to provide the feedback voltage. The a.c. output would be $115/5 \times V_{in}$, or with a 12 volt input, 277 volts. By using a voltage doubler, you will have approximately 500 volts of d.c. output.

Using the two 5 volt windings as feedback windings and the two 6.4 volt windings as the primary, as in fig. 5, the a.c. output with 12 v. input would be $115/6.4 \times 12 = 215$ v. With a voltage doubler you will have approximately 400 volts d.c.

Practical Applications

A number of different types of 400 cycle filament transformers have been tested in the different circuits. Of the transformers tested, eight different units, all with a GA 5 - - - - serial number, were tried in the basic circuits. Transformers of this series of serial numbers are all open-frame, banded "C" core transformers built with mica insulation between windings, apparently for high-altitude aircraft. One and perhaps more of the GA series of transformers was designed for 400 to 1600 cycles. All transformers of the GA series have a Faraday shield grounded to the core of the transformer.

The photograph of the transformers tested will perhaps help to identify "likely" units in the event any are seen in the "surplus" stock of radio supply stores. The largest open-frame transformer in the photograph is #GA-52164, originally designed for 400-1600 cycles. This transformer has a total of 8 non-center-tapped windings, four 6.4 v. and four 5.0 v. windings. By using the 5.0 v. windings as the primary and the 6.4 v. windings as feedback windings in the circuit of fig. 5, the transformer will supply approximately 500 volts d.c. with a voltage doubler rectifier and 12 v. input. A supply using this transformer has been loaded to 120 watts output.

The largest dark colored transformer in the photograph has a serial number 8786 on it. This transformer has four center-tapped 6.4 v. windings. A supply built with this transformer using the circuit of fig. 5, with 12 volts input and a voltage doubler rectifier, will deliver approximately 750 volts d.c. at 200 watts.

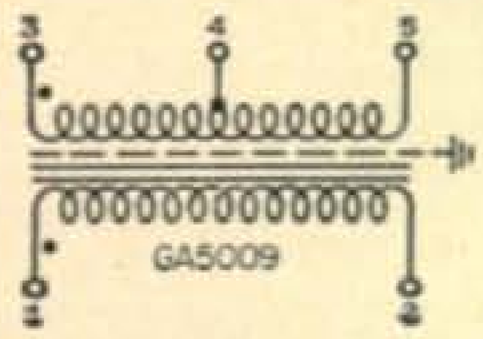
A number of different types of transistors were used while experimenting with the transformers. For simplicity and reasonably low cost, the Motorola 2N1554 and 2N1163 were selected. The 2N1554 has a 15 ampere collector current rating and the 2N1163 has a 25 ampere rating. Any good transistor with adequate collector current rating can be used *providing* the base-collector and base-emitter voltage ratings are not exceeded. For safety, a transistor with a base-collector rating of less than 40 volts is *not* recommended. The bargain-priced transistors appearing in many ads are not recommended for this usage. Usually the leakage current of these transistors is a little high.

Winding Polarity

On all transformers of the types tested, it appears that winding polarity follows the sequential numbering of terminals. For example, to correctly series a winding numbered 3 and 4 with one numbered 5 and 6, just connect 4 and 5. To correctly parallel the two, connect 3 to 5 and 4 to 6.

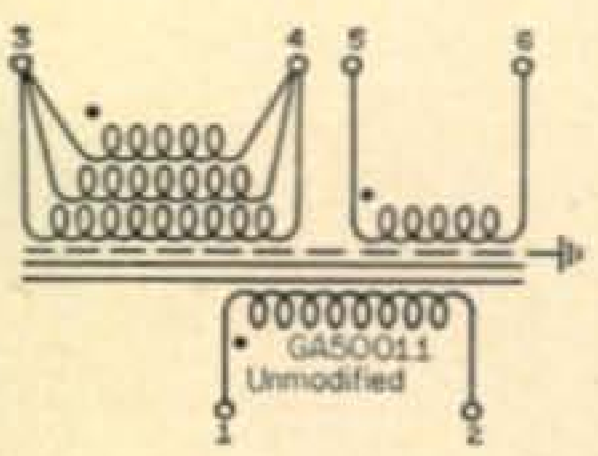
List Of Transformers

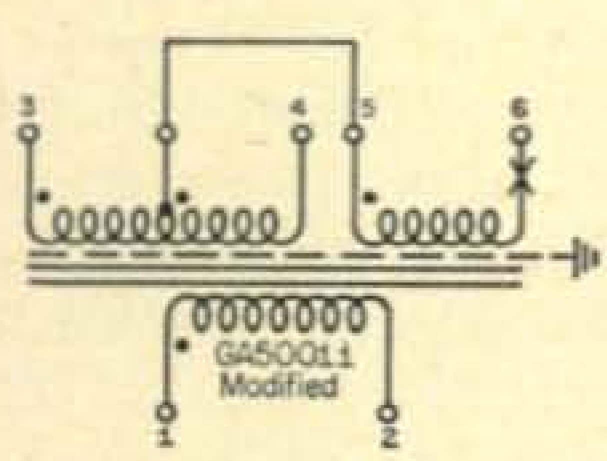
A list of some transformers tested with suggested uses and circuit values is as follows:



GA-50009–Small single winding transformer.

1. Use circuit of fig. 7.
2. Use with 6 v. input supply.
3. With voltage doubler across 1 & 2, d.c. output approx. 280 volts at 80 ma.
4. Transistors—2N1554.
5. R_1, R_2—7.5 ohms, 5 watts. R_3, R_4—50 ohms, 5 watts.

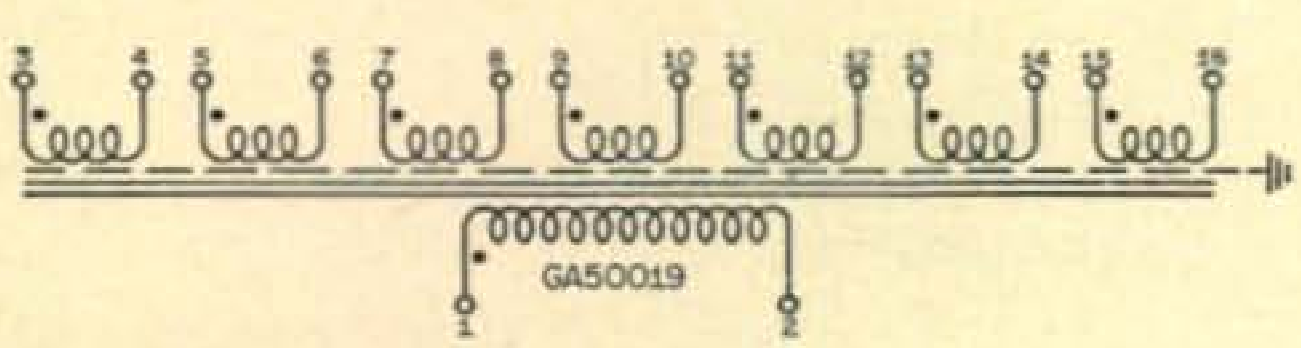




GA-50011–Requires modification. Good for 50 watt supply. Winding 3-4 is wound tri-filar. Separate wires at terminals. Connect two of the windings in series-aiding. Clip off ends of the winding left. Connect center-tap (formed when windings were connected in series-aiding) to terminal 5. Winding 5 and 6 is a low current winding and will not be used.

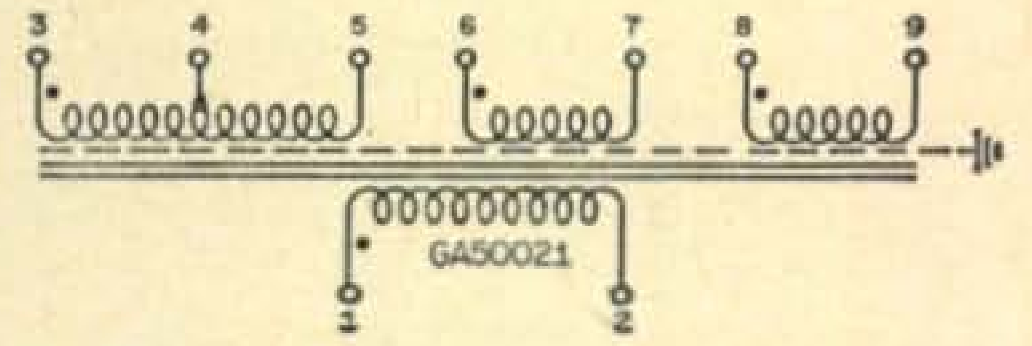
1. Use circuit fig. 7.
2. Use with 12 volts input.
3. With voltage doubler, d.c. output approx. 330 volts at 165 ma.
4. With bridge rectifier, d.c. output approx. 190 volts at 190 ma.
5. Transistors—2N1554.
6. R_1, R_2—15 ohms, 5 watts. R_3, R_4—100 ohms, 5 watts.

GA-50013 and GA-50016–Small transformers with low current filament winding plus low current high voltage winding. Not applicable for d.c. converter use.



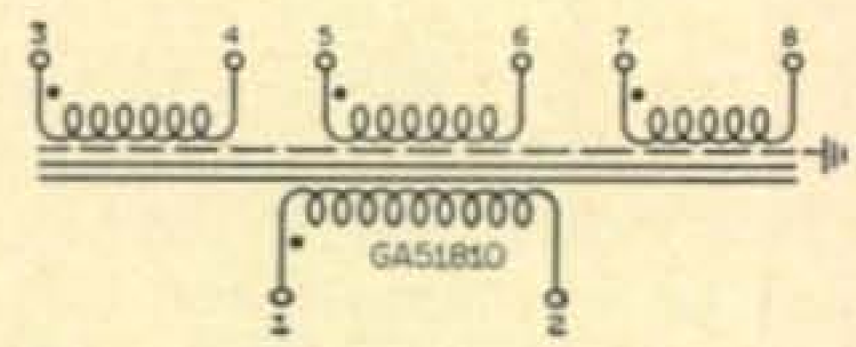
GA-50019—Transformer with 7 secondary windings, three 5 volt and four 6.4 volt windings. Series-connect 6 and 7. Terminals 5, 6-7 and 8 will be the primary terminals. Series-connect 14 and 15. Terminals 13, 14-15 and 16 will be the feedback winding terminals.

1. Use circuit fig. 4.
2. 12 volt input.
3. With voltage doubler, d.c. output approximately 450 v. at 200 ma.
4. Transistors—2N1554.
5. R_1—3 ohms, 10 watts. R_2—150 ohms, 10 watts.



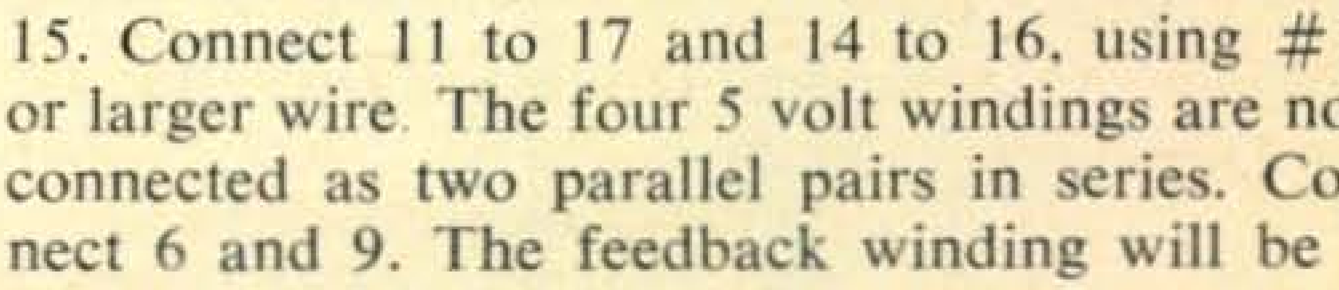
GA-50021—Small transformer with one center-tapped filament winding plus two low current filament windings.

1. Use circuit fig. 7.
2. 6 volt input.
3. With voltage doubler, d.c. output approximately 300 v. at 75 ma.
4. Transistors—2N1554.
5. R_1, R_2—7.5 ohms, 5 watts. R_3, R_4—50 ohms, 5 watts.



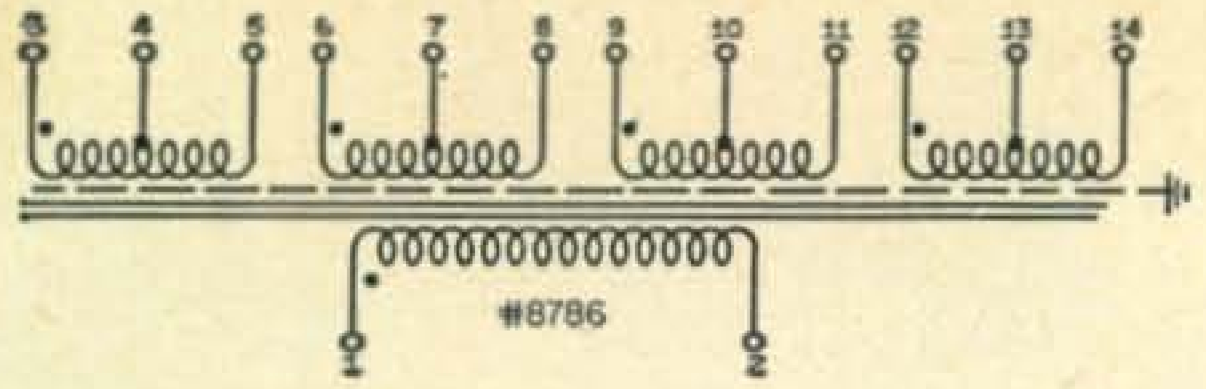
GA-51810—Small transformer with three low voltage windings. Connect terminals 4 and 5.

1. Use circuit fig. 7.
2. Use 12 volt input.
3. With voltage doubler, d.c. output is approximately 250 v. at 40 ma.
4. Transistors—2N669.
5. R_1, R_2—10 ohms, 5 watts. R_3, R_4—200 ohms, 5 watts.



GA-52164—Transformer with eight windings, four 5 volt, and four 6.4 volt. This transformer will make a good 120 watt supply. Parallel terminals 12 and 18, 11 and 17, 14 and 16, 13 and 15. Connect 11 to 17 and 14 to 16, using #14 or larger wire. The four 5 volt windings are now connected as two parallel pairs in series. Connect 6 and 9. The feedback winding will be 5, 6 and 9, 10.

1. Use either circuit fig. 4 or 5. If fig. 5 is used, connect 6 and 9 to the positive input terminal.
2. 12 volt input.
3. Transistors—2N1554.
4. In fig. 4, $R_1 = 2$ ohms, 10 watts, $R_2 = 100$ ohms, 10 watts. In fig. 5, $R_1 = 400$ ohms, 1 watt, R_2 and $R_3 = 3$ ohms, 10 watts, C_2, $C_3 = 5$ mf, 25 v.
5. Connect terminal 4 to 7. Terminals 3 and 8 may be connected to a voltage quadrupler for 120 volts for bias supply.
6. With voltage doubler across terminals 1 and 2, d.c. output is approximately 500 v. at 240 ma.



8786—This transformer has four 6.4 v.c.t. windings and makes a good 200 watt supply.

1. Use circuit fig. 5.
2. 12 v. input.
3. Transistors—2N1554 up to 180 watts input, 2N1163 above 180 watts.
4. Connect terminal 3 to 8. Connect terminal 5 to 12. Terminal 3 should be connected to the emitter of transistor Q_1 and terminal 5 to the emitter of transistor Q_2, using #14 or larger wire. Terminal 4 is the plus 12 volt input terminal. Connect terminal 7 to the base circuit of Q_1 and terminal 13 to the base circuit of Q_2.
5. $R_1 = 1000$ ohms, 1 watt. R_2, $R_3 = 10$ ohms, 10 watts. C_2, $C_3 = 5$ mf, 25 v.
6. A voltage quadrupler across 9 and 11 will give approximately 96 volts for bias.
7. With a voltage doubler across 1 and 2, d.c. output is approximately 750 v. at 250 ma.

This list by no means represents all of the 400 cycle filament transformers which can be adapted for use in d.c.-to-d.c. converters. A few simple checks can be made on an "unknown" transformer to help determine its suitability for converter use. Usually terminals 1 and 2 are the original 115 v. winding. With an ohmmeter, check the resistance of all the windings on the transformer. The resistance of the original 115 v. winding will usually be one to five ohms. (Possibly higher on small transformers.) With the ohmmeter, check the continuity sequence of the other windings on the transformer. Filament windings will usually have a very low resistance, showing practically zero ohms if the wire size is fairly large. If the transformer has a center-tapped winding which appears to be a filament winding, it will most likely work in the circuit of fig. 7.

If the transformer has two or more windings which appear to be filament windings, it will be necessary to determine if the voltage ratings of the windings are the same. *Do not* attempt to put 115 volts 60 cycle across the primary to check the voltage across the other windings. This will result in a burned-up transformer or blown fuse, or both. Six to twelve volts from a 60 cycle filament transformer applied across the primary of the "unknown" will give enough voltage across the other windings to determine if the voltage ratings are the same.

Equal-voltage windings can be connected in series to provide new primary and feedback windings. If the current ratings of the windings are known, even approximately, windings can be paralleled to obtain a higher current capacity for the new primary.

Once the winding configuration of the transformer has been determined, the most appropriate circuit can then be selected. When a transformer is first tried in any circuit, and the transformer does not switch, reverse the base connections to the transistors.

In figs. 4 and 6, safe resistor values to try initially would be 5 and 100 ohms for R_1 and R_2. The final value of the resistors will be determined by the starting load requirements. Resistor R_1 may have to be reduced in value if the converter has to start under full load.

In fig. 5, a safe value for R_1 would be 300 to 400 ohms, and safe values for R_2 and R_3 would be 5 ohms. It may be necessary to reduce the value of R_2 and R_3 if the starting load is heavy. A good value for C_2 and C_3 is 5 mf at 25 v.d.c. Always use a 500 mf capacitor across the input terminals.

In fig. 4, 5 and 6, the base resistors should be 10 watts for safety.

In fig. 7, R_1, R_2 and R_3, R_4, values of 5 to 10 ohms and 100 ohms at 10 watts are suggested for initial trials.

A base current of 600 to 700 ma for the 2N1554 and approximately 1 ampere for the 2N1163 transistor will be satisfactory. This current can be metered. If the converter is not being built for a high power output, the transistor base current can be reduced in the interest of better efficiency. If the regulation of the supply holds up reasonably well under the required change of load, the base current (hence base drive) is probably adequate. If the regulation seems to go to pot under load, the transistors may have inadequate base drive.

A word about the voltage doubler used. Values of doubler capacitors larger than 16 mf are not recommended. About 8 mf seems to be large enough. A large value of capacitor will result in an extremely large initial starting current for the supply due to the charging current requirements of the capacitors.

One final word of caution about using these transformers in d.c.-to-d.c. converters. A banded "C" core is fairly easy to take apart to remove and replace windings. However it is almost impossible to "re-band" them with sufficient force without a tool made especially for the job. A "hand re-banded" core will very seldom work in a converter circuit.

Modulation Transformers

Another use of 400 cycle filament transformers is for modulation transformers in a transistorized modulator. The turns ratio between windings can be determined from the voltage ratings of the windings. The impedance ratio would then be equal to the square of the turns ratio. Example: The modulator has a collector-to-collector impedance of 28 ohms. Input to the r.f. final is 250 volts at 80 ma. Thus $Z = 250/80 = 3130$ ohms. The impedance ratio is $3130/28 = 112$. A filament transformer with two 5.0 volt windings connected in series will give a ratio of $N_2/N_1 = 115/10 = 11.5$. The impedance ratio will be $(N_2/N_1)^2 = 11.5^2 = 132$. This is fairly close to the requirement of 112. ■

DX DX DX DX D

URBAN LE JEUNE, JR.*, W2DEC

The following certificates were issued between the period from December 6th, 1963 to and including January 5th, 1964:

CW-PHONE WAZ

1884	DL3TW	Gunter Pfannkuche
1885	KP4RK	José Toro
1886	UI8AG	Galim Gadyamow
1887	UA2KAA	Kaliningrad Pioneers House
1888	UA4PW	George Kh. Khodjaev
1889	W5ARJ	R. I. Vaughan
1890	W6WX	David P. Baker
1891	K1SHN	George C. Banta
1892	W2VUF	Fred W. Kilburn
1893	LA3UF	Arne L. Sangwill
1894	W4NJF	Gay E. Milius
1895	JA1BRK	Tachio Yonemura

ALL-PHONE WAZ

215	K6CYG	S. C. Shallon
216	VE4XO	Chas. E. Johnson
217	K5MDX	David L. Thompson
218	LA8LF	Anders M. Thorrud
219	W5IYU	H. E. Taylor
220	PAØZD	Dr. H. ten Herkel
221	VE8RG	Reginald J. Beck
222	EP2AG	Geo. H. Buchanan
223	K2JGG	T. A. Hughes
224	W5JWM	Frank Montgomery

TWO-WAY SSB WAZ

204	K6CYG	S. C. Shallon
205	LA8LF	Anders M. Thorrud
206	W5IYU	H. E. Taylor
207	W9JYJ	Fredrick B. Williams
208	VE8RG	Reginald J. Beck
209	W9UZC	J. H. Carnett
210	W5KFT	Bryan Edwards, Jr.
211	SM5IC	Tore Dahlberg
212	W5QVE	Col. Carl H. Hatch

CW WPX

507	W3ZHQ	Stephen J. Wolfhope
508	K1RTB	C. LaMar Ray
509	PY4ZI	Ibsen Drumond
510	OK1SV	Vladimir Srdinko
511	WA5CBL	Clarence E. Longstreth
512	G3HRY	Kenneth Douglas Halsal'
513	UA4IF	Alexander F. Kamalagin
514	UL7CH	Yuri Philipienko
515	DJ1UE	Erich Fleig
516	W9KXZ	Steve Eyer
517	K1HTV	Richard Zwirko

PHONE WPX

104	G3NFV	Robin Sykes
105	ZL4BO	V. Roy Jackson
106	I1SF	Serafino Franchi

SSB WPX

151	VE8RG	Reginald J. Beck
152	VE7PU	Dick McQuillan
153	K8LSG	Roger W. DeBusk, M.D.
154	ON4UN	Devolders Johan
155	VP7NS	Don R. Thompson
156	WA6ESB	L. T. Evans

MIXED WPX

82	W3NKM	Stanley S. Springer
83	LA5S	Emil Standal

WPX ENDORSEMENTS

	Mode	*Continent*	*Band*	*Endorsement*
K1NOL	CW			350
K1SHN	CW			350
K2OUS	CW	E		350
WA2EOQ	SSB		14	
	Phone		14	
W3GJY	CW	F		
W4HUE	CW			350
W5LGG	CW	O, F		
	Mixed	O, F		
W6CHY	Phone		28	
W6KG	CW	A		
K8LSG	CW			350
K8ONV	Mixed	E		
	CW			350
W8TTN	CW		21	350
DJ1UE	CW	E		
DJ3CP	SSB		14	
	Phone	E		
DJ5VQ	CW			350
DL7CS	CW	E, F	14, 21	
IT1AGA	CW	F		
LA3UF	CW			350
OK1SV	CW	E, A, F	14	
OK3EA	CW		21	
ON4UN	SSB	E	3.5	
ST2AR	CW		14, 21	
UB5FY	CW	E		
VK3RJ	CW			350

A-Asia; *E*-Europe; *F*-Africa; *N*-North America; *O*-Oceania; *S*-South America.

VS6AM

It is with deep regret that I report that another old-timer from VS6 has passed away suddenly. A. M. Houghton, VS6AM, known to all as "Tiny" died suddenly at sea off Bankok on November 10th, 1963, age 63. His body was flown back to Hong Kong for burial and he was buried near to his old friend Pat, VS6AE, who had predeceased him by only a few weeks. Many Hong Kong amateurs and CR9AH from Macau attended the funeral.

"Tiny" was a ship's engineer, starting in the old Kowloon Docks about 1928. He sailed on the *San Nam Hoi* on the West River using the cal' AC1SN in the early days and was, in fact, the first operating amateur in the region. At that time, his land-based contacts were Pat O'Brien (then AC1PA), John Alvares (then AC3JJ) and John Cotton (then AC4HW). During this period "Tiny" was awarded a medal in connection with the capture of pirates in this area. In 1930 "Tiny" was issued the call VS6AM and was

*Box 35, Hazlet, New Jersey 07730

CW WPX

W2HMJ	685
W8KPL	652
W5KC	647
W2AIW	617
W2EQS	605
W4OPM	600
W6KG	596
ON4QX	579
W2NUT	571
W8LY	570
W9UXO	566
K6CQM	565
W5OLG	564
W2HO	563
W5LGG	558
W9DWQ	556
DL1QT	552
K2ZKU	552
W1EQ	549
W1IJB	546
K2UKQ	546
W9YSX	544
W9GFF	538
IT1AGA	536
SM7MS	534
G2GM	526
OK1SV	517
K9AGB	515
KP4CC	515
W6WO	511
DJ2KS	511
W2KIR	511
W2GT	510
K9EAB	510
DL3RK	509
W8RQ	505
W9UZS	505
PAØLOU	505
G3EYN	503
YU1AG	503
W3GJY	503
W6YY	502
DL7CS	502
K2CPR	501
W9SFR	501
W2EMW	500
W2FXA	500
W2MUM	495
W1WLW	494
LA3QB	491
OK3DG	488
SM5CCE	488
W4BYU	487
W8PQQ	481
ON4FU	479
W4HYW	478
W8IBX	476
W5BUK	475
WØMCX	472
SP6FZ	468
W3OCU	466
K6SXA	464
PY4OD	462
JA2JW	461
VE4OX	461
W9WIO	460
W9WCE	458
W3BCY	457
W7HDL	457
OE1FF	457
F9MS	457
OK3EA	456
UC2AR	456
K4TEA	451
W3PGB	450
DL1YA	450
DL9KP	450
W8JIN	449
W8KSR	449
W3AYD	443
W6UNP	442
VK3XB	439
W3BQA	437
LA5HE	437
VE3ES	433
G3HIW	433
W8UMR	429
WØAUB	429
W2RA	428
K5LIA	428
OK1MB	428
W3CGS	426
W1EIO	425
OE3WB	425
KL7MF	424
SM5WI	424
WØPGI	420
W7ABO	419
HB9TT	419
KH6BLX	418
UA4IF	417
K2PFC	415
VK3XB	415
W1DGT	415
W5AWT	412
W5DA	412
WA2DIG	411
W2PTD	411
K5LZO	411
W4DKP	410
W1CKU	408
K4IEX	408
K4JVE	407
W5AFX	407
W4CKD	407
SM5AJR	406

Phone WPX

W9WHM	605
CT1PK	603
W8WT	589
G3DO	583
CT1HF	565
MP4BBW	506
DJ3CP	473
W9YSQ	471
W9UZC	462
PAØHBO	453
G3NUG	451
K9EAB	450
W6YY	448
G8KS	430
VK6RU	421
W3AYD	420
F8PI	418
PZ1AX	413
K2CJN	409
DL3TJ	404
OE1FF	404
W1ORV	404
W1UOP	402
W6USG	400
VE3BQP	386
SP7HX	381
TG3AD	381
DL6VM	376
W3DJZ	374
PAØSNG	369
G3FKM	366
W8UMR	363
SM3AZI	362
DL2UZ	361
SM3EP	361
W1DGJ	358
W5ERY	358
W6CHY	358
W8JIN	356
G3GHE	356
CX2CN	354
PY2CK	354
5A5TO	353
LA5HE	351
ZS6IW	350

SSB WPX

W4OPM	506
MP4BBW	462
HB9TL	452
W3NKM	451
G8KS	450
K9EAB	439
G3AWZ	428
G3DO	424
G3NUG	423
W3MAC	403
W1ORV	370
W2HXG	359
TI2HP	356
W6YMV	354
I1AMU	346
PZ1AX	345
K1IXG	344
W6RKP	343
VE3BQP	334
W4RLS	322
W2VCZ	320
W1UOP	318
W2YBO	318
W8PQQ	315
WA2EOQ	315
K4PUS	305
DJ3CP	304
WA2SFP	300
K2TDI	300
W3VSU	300
W4NJF	300
KØRDP	300
VE3BKL	300
K1SHN	300
K2POA	300
WØCVU	291
GI6TK	278
K5OGP	277
K8ONV	275
VE3ES	274
K2JFV	266
K2MGE	263
W3AYD	262
W4EEU	262
DL1PM	257
XE1CV	256
G3FKM	255
UR2AR	255
W1EQ	253
W6USG	252
K2ZKU	251

Mixed WPX

W4OPM	658
G3DO	624
W9YSX	622
W8WT	621
K9EAB	606
W8JIN	605
W3NKM	605
W3OCU	588
W9DWQ	571
W6YY	570
W5LGG	565
W4BYU	557
K2ZKU	555
W3AYD	552
YU1AG	552
HB9EU	551
WØMCX	529
W2GT	528
DL3RK	525
DJ2KS	524
G8KS	520
OE1FF	519
K9AGB	510
PAØLOU	510
HK3LX	508
W4BQY	505
W3KPD	501
W8UMR	500
LA5HE	500
KP4AOO	500
ST2AR	489
JA2JW	480
W3CGS	475
W9FVU	474
G3HDA	469
G3FKM	463
DL1YA	456
W1ORV	455
VK2DI	454
WØZBQ	452
G3NUG	452
GI6TK	450

known to many oldtimers under this call.

After the second World War, Tiny sailed on the *Kwong Sai* and used the call CR9AM for a period between 1946 and 1953. After 1953 he was employed on foreign vessels and had to confine his operating as VS6AM to his short periods between voyages.

"Tiny" will be sadly missed by all members of the Hong Kong Amateur Radio Transmitting Society and by many other friends throughout the world, especially the oldtimers. Our sympathies go to his widow and children in their tragic and sudden bereavement. *Thanks Hong Kong Amateur Radio Transmitting Society.*

SSB DX HONOR ROLL

W2ZX	288	W6RKP	265	WA2IZS	240
W8PQQ	288	W3LMA	261	W1AOL	238
TI2HP	283	PZ1AX	261	PJ2AA	232
PY4TK	279	G8KS	261	W7DLR	232
K9EAB	279	G3FKM	261	K8NZD	232
K4TJL	279	W5IYU	260	WØCVU	229
W2VCZ	279	DL1IN	258	OZ7FG	228
W2BXA	278	MP4BBW	256	K4AJ	226
W8EAP	278	W3MAC	254	G2PL	225
WØQVZ	278	G3NUG	253	W4UWC	225
K8RTW	276	W6BAF	252	WA6EYP	222
W2TP	276	WØUUV	251	WØPGI	221
VQ4ERR	275	K1IXG	250	WA6HOH	219
K2MGE	272	G2BVN	249	W3VSU	217
W2FXN	272	W6WNE	248	W4RLS	210
W6UOU	270	W6PXH	247	DJ3CP	207
HB9TL	269	W8YBZ	246	W1ICV	205
WØQVZ	268	K6LGF	244	OH2NB	204
W4OPM	265	K6ZXW	243	W9SFR	203

ENDORSEMENTS

W2BXA	200	W2BXA	100	K1AFC	50
W2RGV	200	F2KC	100	W1PLJ	50
K8ONV	200	PAØKF	100	W2KXL	50
W8WT	175	ZL9CT/ DL9CTA	100	K3CNN	50
KØTJW	175	W2EVV	75	W5CK	50
DL3RK	175	K2HOE	75	K6UTO	50
K5FLD	150	W5VSQ	75	W7VKO	50
W6REH	150	F2KC	75	EI9AE	50
KØTJW	150	KA2RJ	75	ON4UN	50
K3BNS	125	ON4UN	75	PAØPOB	50
K5FLD	125			UA3FU	50
W6REH	125			ZS6LW	50

DXer of the Year

The Virginia Century Club has awarded the 1963 DX Certificate to W4ECI, Ack Atkerson, of Birmingham, Alabama, for his outstanding contribution to the advancement of DX during 1963. Ack's energy, enterprise, and efforts have been responsible for the success of the greatest DXpedition of all times which has been in progress for over a year and a half with the sole DXpeditioner, Gus Browning, W4BPD, at the helm. Without the man behind the scenes, the DXpedition would have bogged down and amateurs would not receive benefits therefrom.

The handsomely engraved plaque was presented at the Club's annual dinner on January 16th in Norfolk, Virginia. The 1962 award went to Gus Browning himself for his part in extending the international handclasp of DX to little known parts of the world.

The runners-up for the award were W4BPD, W2CTN, HB9TL, and UA3CR. Their part in the great activity in DXing is recognized and appreciated.

WAZ and WPX

The WAZ and WPX certificates are awarded by the *CQ* DX department. WAZ is issued for proof of contact with the 40 Zones of the world as shown on the official WAZ Zone Map. WAZ is issued in three classes, *i.e.* Any mode, all phone and all s.s.b. For complete rules, see the January, 1962 *CQ*, page 50.

WPX is issued in four classes, *i.e.*, all c.w., all phone, all s.s.b. and Mixed. The number of prefixes required are: C.w.-300; Phone-300; s.s.b.-200; Mixed-400. For complete rules, see January, 1962 *CQ*, page 52. WAZ applications, Zone Maps and WPX applications may be obtained from the DX Editor at the address shown at the head of this column. Please send a self-addressed, stamped envelope or a self-addressed envelope and an IRC. All applications should be sent directly to the DX Editor.

Here and There

VQ9HB DXpedition: Word from Les, G8KS, to the effect that Harvey will leave on February 14 for Chagos, followed by Rodrigues and Agalega or St. Brandon. QSO information as follows: On s.s.b., will transmit 14,115 and 21,400 and will listen 14,250-60 and 21,405-450, respectively. On c.w., he will transmit 14,010 and 21,010 and will listen 14,020-30 and 21,020-30, respectively. 10 meter operation will depend on band conditions, but no operation is contemplated on 40/80 meters. QSLs go via Les Hill, G8KS. "Rivenhall," Holwood Park Avenue, Farnborough, Orpington, Kent, England. Contributions will be highly appreciated to help cover up the expenses, which are estimated at around $1,250.

Malaysia: G3HCL will QSY to both East and West Malaysia in March or April and will operate all bands and modes. *(Tnx WGDXC)*

CEØXA San Felix: Be on the lookout for this one in late March or early April.

CEØ Easter Island: Oscar, CEØAC, has been active working contest-style with a T8C note. He is usually around 14,055 from 1300 GMT. *(Tnx WGDXC)*

CR4 Cape Verde Island: CR4AD reported working s.s.b. from 14,125 kc saying he will be there several months. *(Tnx WGDXC)*

CR8 Portuguese Timor: CR8AD has been somewhat active on 14,040 kc. His name is Bar and he may be on anytime between 0800 and 1300 GMT. *(Tnx LIDXA)*

ET3 Ethiopia: ET3CC is very active most mornings on 14,051 c.w. between 1400 and 1500 GMT. *(Tnx LIDXA)*

FH8 Comoro Island: FH8CD, ex-FB8CD, will reactivate this station for the third time. Andre will be there for a year. *(Tnx WGDXC)*

FU8 New Hebrides: FU8AG has been active on 20 meter c.w. moving between his two crystal frequencies of 14,040 and 14,015 kc. *(Tnx LIDXA)*

HBØ Lichtenstein: Any HB9 station operation portable in Lichenstein will now use the HBØ prefix. *(Tnx VERON)*

KL7 Shemya Island, Alaska: K1MAT, WA8-KCZ, WA5IJX and WA6BLK have put an amateur station on the air. They acquired some gear from Anchorage and erected antennas and then for three months worked on getting the gear to work and on the air. The equipment used is as follows: Eldico SSB-100 as an exciter to a Johnson Kw. The receiver is a HQ-160 and the antenna is a sloping V headed right down the center of the USA. At present, the only men left to operate are Mike, WA8KCZ; Charlie, K1MAT; and Stu, WA6BTK. They are on 20 and 40 every day from 0200 to 0500 using the club call of KL7EFN.

Where is Shemya Island? It is 35 miles east of Attu which is the end island on the Aleutian Chain. The coordinates are 174° East 53° North. They operate on Bering Sea Time.

They would like phone skeds with the states at any hour the band may be open. Generally though, the band folds when the sun goes down. Look for the boys around 7,240 kc and 14,250 on SSB. *(Tnx WA6BTK)*

W6FAY/KP6AZ swinging his bug at Palmyra Island. Jay will repeat his performance from Navassa Island (KC4) and Swan Island (KS6) during the spring of 1964.

LA Bouvet: Jack, ZS1OU, reports via the LIDXA that the South African Government is trying to establish a weather station on Bouvet. The island belongs to the Norwegian Government. If possible, a ham will go there to operate the station.

TT8 Chad: For the information of *CQ* readers, I would like to give a few details of my operation as TT8AJ and TT8AN at Fort Lamy, the Chad Republic. My initial work from Fort Lamy was under the call K6LVB/TT8, where I made a few c.w. contacts using the rig of a local amateur, until the KWM-2 and 30L-1 arrived. This was from October 15 to October 23. On October 24, the Collins equipment arrived and I operated two more days /TT8, until the *CQ* WW DX Contest of the 26th-27th. During the contest, I operated at TT8AN, and including a few days afterward, about 500 QSOs were made. From October 31 to December 4, I operated at the station of TT8AJ, where I made about 700 more QSOs, mostly on 20 s.s.b., but there was a little 20 c.w. as well as 15 s.s.b. activity also.

The QSL address I gave was always the same:

Stu Meyer, W2GHK (left) presenting some equipment to John Gayer, HB9AEQ, President of the International Amateur Radio Club, 4U1ITU. Stu is founder of the Hammarlund "DXpedition-of-the-Month."

Two of Switzerland's most popular hams are Ralph, HB9EO, on the left and Felix, HB9MQ on the right. Both Ralph and Felix have been on both ends of the DX pileups. *(Tnx K8ONV and W2GT)*

WØLYQ, Boulder, Colorado. However, some confusion may have arisen, since some of the local amateurs also operated the station, giving the address of their QSL manager, K2UYG. Anyone who worked Tom under any of the TT8 calls mentioned above, must QSL to WØLYQ or directly to me at the address given below to receive a return QSL card. I have received several hundred QSLs already and will answer all that have included s.a.s.e. or coupons. There may be a little delay, since I am very busy, but all will receive cards in due course.

I might also mention that the primary purpose for my visit to Chad was not an amateur DXpedition and that the relatively small number of QSOs was due to the fact that I had a considerable amount of other work to keep me busy. I met five other amateurs in Ft. Lamy, all of whom extended to me their warmest hospitality. Unfortunately, none of them operate s.s.b. or speak very much English (French) but they are very competent technically, and are anxious to get at least one s.s.b. rig on the air. All of their operation at present, however, is low-power a.m. (mostly French) and c.w. Their calls are TT8AC, AN, AJ, AM, AP.

My total score during my visit ran something like this: 1,200 QSOs, 115 countries, 36 zones, 42 states. I always used a vertical ground plane antenna, except for a little operation on 15 with a very crude cubical quad.

Thanks to Tom, WØIFQ, for the letter. Tom's home QTH is T. M. Georges, WØIFQ, 741 Ithaca Drive, Boulder, Colorado.

UA1 Franz Josef Land: UA1KED has been active on 14 mc c.w. around 1800 GMT.

VKØ Heard Island: VKØVK, who is now home in Australia, was unable to stop at Heard on the way home from Antarctica.

VO1 Newfoundland: The following is from Chris, WB2CDB/VO1: Our limitation is the antenna situation. The prevailing winds of the Argentia, Newfoundland area prevent us from keeping our beam or quad up for any length of time. We lost our beam and we have had our quad blown down twice. It soon will be put up again for another try when new radials for it arrive from Nova Scotia. There are about 20 active members in the Argentia Amateur Radio Club and we all operate on 20 most of the time. We stray from 20 to meet the Newfoundland net at 2230 GMT and then return to 20 'til is closes. A reminder to certificate hunters that we issue the Codfish Certificate for a 10 point score resulting from contacts and phone patches with Argentia area stations. Any QSL cards for Argentia area stations which include places such as Argentia, Placentia, Dunville, Freshwater, should be sent to the Argentia Amateur Radio Club, Box 12, Navy 103, Fleet Post Office, New York, N. Y. 09597.

VP2K Nevis: Ken, VP2KJ, is back home at Nevis Island and active on 15, 20 and 40 s.s.b. and c.w. Ken has a new HT-32, Drake 2B and TA-33 jr. He hopes to put some of the other VP2 spots on in the near future. *(Tnx W4SSU)*

VP7 Bahamas: Harold, VP7CX, has taken to 6 meter DXing and has already worked 40 states as well as FG7, FP8, HI8 and KP4.

VP8 South Sandwich: Ken, VP8HF, will be active ashore on South Sandwich for a period of three weeks during March. 20 meter s.s.b. and c.w. will be used with a possibility of 15 meter s.s.b. 15 and 40 meter c.w. will also be used. Ken is a terrific operator so this should really be a good one.

VQ1 Zanzibar: VQ1IZ has been active on 21,030 c.w. between 1700 and 1800 GMT. *(Tnx NCDXC)*

VR1 Ocean Island: VR1G is very active on 14,100 and 14,300 s.s.b. between 0600 and 1100 GMT. *(Tnx FDXC)*

VS1 West Malaysia: I would like to thank Dave, K7GCM, for the following information on VS1MB. Dave is Ted's QSL Manager.

Ted, VS1MB, operates nearly every day sometime between 0100 and 1700 GMT, but mainly from 1130 to 1500 GMT. During the latter

SIR GUS BROWNING PhD (X), W4BPD

Barring any unforeseen last minute happenings, Sir Gus will be Guest of Honor at the North Jersey DX Association's W2-DX Banquet at Schrafft's County Restaurant, Scarsdale, N. Y. on Saturday, March 21st. Festivities begin at 3 P.M. and tickets, at $7.50 per person, are available from the Ticket Chairman, Bob Stankus, W2VCZ, 30 Pitcairn Ave., Ho Ho Kus, New Jersey, Seating is limited, so order early!

part of November and the first part of December, the gulf states have been consistently hearing him from 1130 to 1300 with the peak coming around 1230 GMT. The east coast has also been working him, but as anticipated for this time of year only a limited number of west coast stations are working him.

Ted is a convert to 20 meter s.s.b. and operates mainly between 14,250 and 14,280. He sometimes operates from 14,105 to 14,125, however, I am requesting him to acknowledge US c.w. stations on frequency so that he will know that he is being heard stateside.

He recently moved out of the city of Singapore where his electrical noise level was high due to air conditioners. He now has a more suitable location with a temporary vertical antenna.

Ted is a Captain in the Royal Corps of Signals and has held the calls G3NJM, and DL2GA. He has been in the service for 14 years and is a member of RSGB. He is married with three children and is not new to the DX type of operation.

QSL Information: Ws and DX stations send s.a.s.e. to: David R. Brush, K7GCM (with GMT), 15929 Main Street, Bellevue, Washington, for all contacts after July 29, 1963.

VU2 Andaman Island: VS1LS will operate from Andaman Island for ten days in April. *(Tnx NEDXC)*

XEØ: K6ICS hopes to obtain permission to operate XEØICS from March 14 to March 29. Both fone and c.w. will be used.

XW8 Laos: The following letter is from Chas, XW8AU, via the LIDXA: "At present there are only 3 legal stations in Laos, XW8AL, AU and AV. Of course, a Laotian call is permanent so it is remotely possible an already licensed amateur might return, but it is doubtful. I will keep you posted on the activity here.

"The HS-stations have formed an amateur society and are taking the necessary steps to have Thailand removed from the banned list.

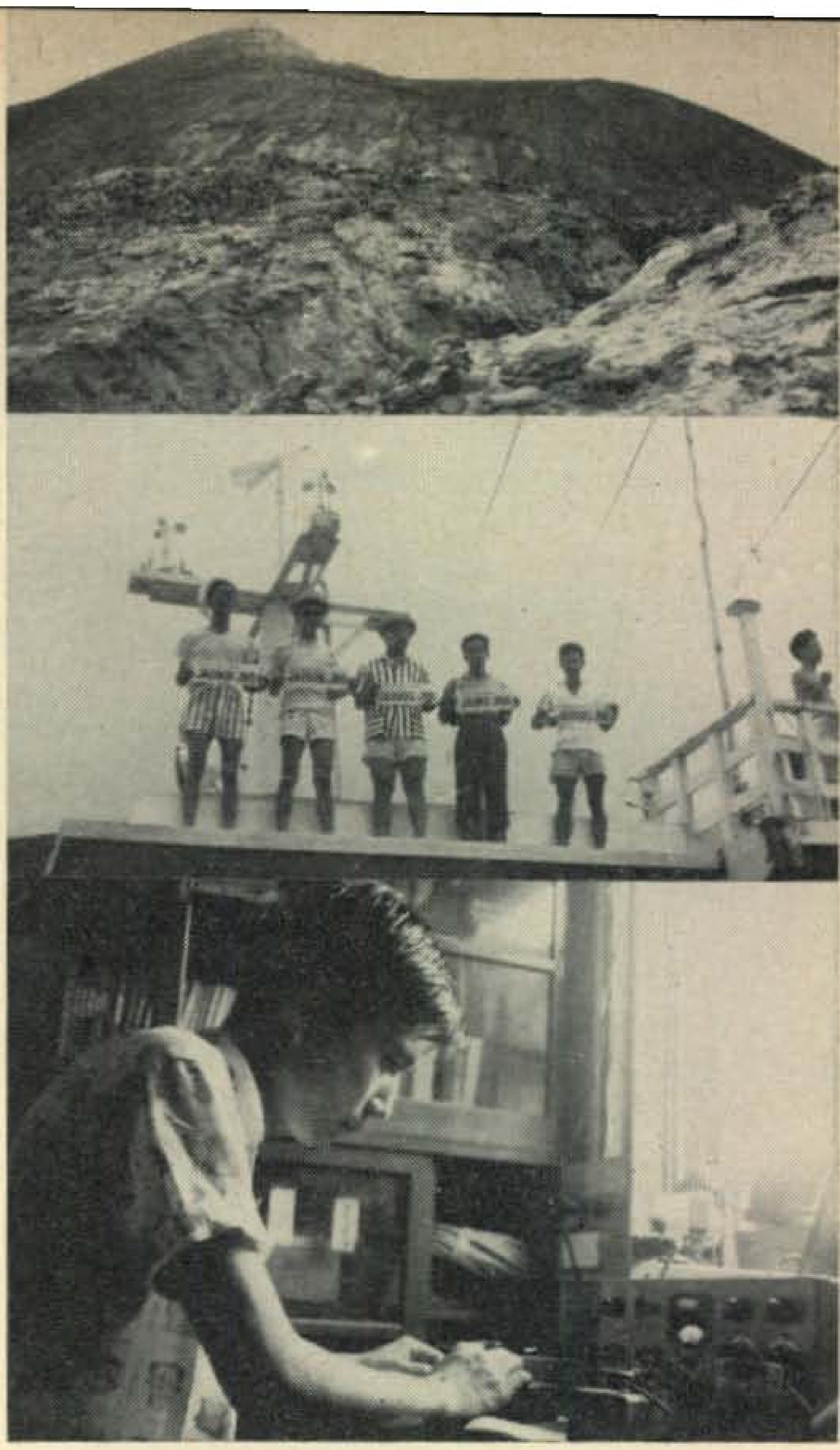
"VS4RS, Ron, is active on 14,300, crystal controlled, but should have additional crystals soon. Incidentally, he emphatically *doesn't* appreciate stations sending him cables and letters requesting skeds.

"There is a move underway for a DXpedition by VS1LX and group to Brunei, North Borneo, Sarawak, and perhaps one or two other spots.

"I am working with XW8AL, Phanh, on a DXpedition to Cambodia next year. Frankly, I don't hold much hope for approval." Sincerely, Charles Swain, XW8AU/KL7MU, K4GTZ.

YA Afghanistan: Dick, K4UTE, is now in Afghanistan. He should be getting on the air about April 1st. Dick hopes to do some traveling around the area and operate from several different countries. Glen Ward, ex-9N1GW, now K4KMX, will act as Dick's QSL Manager. Dick will be in the YA area for twenty-two months.

ZL3 Chatham Island: ZL3VB has been active around 0300 GMT on 14050 kc. His chirpy note is easily identifiable. ZL2GX is sending an s.s.b. rig to ZL3VB. *(Tnx VERON and FDXC)*



This is Torishima Island; site of recent JB8 activity. Operators (center) are, from left to right: JA1HQF/JB8, BRK/JB8, HQG/JB8 WU/JB8, and KHG/JB8. *Bottom,* JA1BRK picking one out of the 20 meter c.w. pileup. *(Tnx JA1BRK).*

ZS2MI Marion Island: Ray, ZS2MI, will QRT at the end of March. His relief man is not interested in ham radio. Ray is active daily on 14,055 kc between 1300 and 1500 GMT.

ZS9 Bechuanaland: ZS9A is a new station and will be there for a year. Presently active on 14,080 with 50 watts and a dipole. *(Tnx NCDXC)*

4W1 Yemen: 4W1Z is the legitimate and validly licensed call letter of Angus Murray-Stone. Angus will activate this station when his business calls him to that area. *(Tnx WGDXC)*

5U7 Niger: Yves, 5U7AC, has purchased the s.s.b. equipment of 5U7AH. Yves has been very active on s.s.b. on both 15 and 20 meters. *(Tnx K9EAB)*

5Z4 Kenya: 5Z4 replaces VQ4 as the official prefix for Kenya.

6W8 Senegal: 6W8AC has been very active on 14,010 kc around 1400 GMT. *(Tnx FDXC)*

9G1 Ghana: Drew, 9G1EX, is looking for N. Dakota, S. Dakota, Idaho, Montana, and Wyoming to complete his WAS. He is on 21,415 until band folds, then 14,280 kc.

9M2 West Malaysia: 9M2DQ has been very active between 14,100 and 14,120 kc s.s.b. between 1200 and 1300 GMT. *(Tnx WGDXC)*

[*Continued on page 98*]

CONTEST CALENDAR

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

FRANK ANZALONE*, W1WY

CALENDAR OF EVENTS

Feb. 29-Mar. 1		R E F Phone.
Feb. 29-Mar. 2		YL/OM Phone.
March	14-16	YL/OM c.w.
March	14-15	ARRL DX Phone.
March	23	Pakistan DX.
March	28-29	ARRL DX c.w.
April	11-12	*CQ* W.W. DX S.S.B.
April	18-19	Helvetia 22.
April	25-26	PACC c.w. & Phone.
April	25-27	Missouri Party.
May	2-3	*CQ* Spring VHF.
May	9-10	USSR DX C.W.
May	9-10	OZ CCA C.W.
May	9-11	Georgia Party.
May	16-17	OZ CCA Phone.
May 29-June 1		CHC/HTH/FHC Party.

Results 1963 USSR DX Contest

United States		W1CKA	600	W1RWU	42
W6VSS	9672	WA2RUB	330	K5FTB	20
KH6IJ	3122	W4HOS	320	W5MCC	18
W6HJT/		W4RXY/1	312	K7JRE	10
KH6	2996	K3CUI	204	*Canada*	
W9EWC	2407	W3QLW	190	VE8RH	979
WA6SBO	2314	W3SQX	180	VE3AU	476
W7UXP/		W7BTH	150	VE6MC	108
KH6	2100	W3YUW	98	VE8WN	8
W2WZ	731	W4ZQK	49	VE2IL	6

R E F Phone

Starts: 1400 GMT Saturday, February 29.
Ends: 2100 GMT Monday, March 1.

The c.w. section is long gone, but you phone men should be able to make this one in time. The January CALENDAR tells you how to figure out your score.

Send your log to: Reseau des Emetteurs Francais, BP 42 01, Paris R.P., France.

YL/OM

Phone—Feb. 29-Mar. 2. **C.W.**—Mar. 14-Mar. 16.
Starts: 1800 GMT Saturday.
Ends: 0500 GMT Monday.

The YLs got short-changed on their dates this year. If you fellows want to help them out and stir up some activity, check Louisa Sando's YL Column in the February issue.

ARRL DX

Phone—Mar. 14-15 **C.W.**—Mar. 28-29.
Starts: 0001 GMT Saturday.
Ends: 2400 GMT Sunday.

Above dates are for the 2nd week-ends. The first section was in February. We gave you a brief rundown of the rules in last month's CALENDAR.

If you need more details, check the January issue of *QST*. Logs go to ARRL, 225 Main St., Newington, Conn. 06111.

*14 Sherwood Road, Stamford, Conn. 06905.

Pakistan

Starts: 0000 GMT Monday, March 23.
Ends: 2400 GMT Monday, March 23.

This is the 2nd annual Pakistan DX Contest sponsored by the Tigers Amateur Radio Club. It is held on March 23rd each year in celebration of its Republic Day. Here is your opportunity to work some of those rare East and West Pakistan stations, condx permitting.

1. Activity is limited to the 7 and 14 mc bands.

2. Both c.w. and phone, or mixed contacts are permitted.

3. Serial numbers will consist of four and five figures, RS or RST report plus your zone number. (Same as *CQ* contest.)

4. Each completed contact with an AP station counts 3 points; incompleted contacts 2 points.

5. The same station can be worked twice, once on each band.

6. Although logs are solicited for the entire 24 hour period, only contacts made during a continuous 12 hour period will count.

7. A certificate will be awarded to the single operator scoring the most contact points in each country and each call district in countries of large areas (USA, Canada, Australia and *etc.*). Awards will also be made to leaders in each zone. A single operator having the highest score both in his country and zone will be awarded a special certificate. (From the above it would seem that operation is limited to single operators only.)

Mailing deadline is March 30th and it is requested that 12 IRCs be included with each log.

Your logs go to: The Awards Manager, Mr. Mohd, AP5CP, Tigers Amateur Radio Club, Dacca Signals, Dacca 6, East Pakistan.

CQ W.W. SSB

Starts: 1200 GMT Saturday, April 11.
Ends: 2400 GMT Sunday, April 12.

With the ever increasing switch to s.s.b., this activity is destined to be one of the most popular of all phone contests.

This year's rules have been modified and streamlined.

The extra point credit for contacts on the lower bands has been dropped.

The contest period has been extended to 36 hours, but the popular "rest period" has been retained and modified.

These and a few other minor changes are explained in last month's CALENDAR. The rules in detail will be found on page 44 of the February issue.

A large addressed and stamped envelope will get you a supply of log sheets.

Your request as well as your logs should go to: *CQ* W.W. SSB Contest Committee, 300 West 43rd Street, New York 36, N.Y.

Helvetia 22

Starts: 1500 GMT Saturday, April 18.
Ends: 1700 GMT Sunday, April 19.

The popular H 22 Contest should have easier going this year. Their dates are in the clear and if they get a break on conditions they should have the full compliment of Cantons active in one week-end. Rules are the same as last year and are as follows:

1. All bands are allowed, 1.8 thru 29.7 mc, c.w./c.w. or phone/phone.

2. Serial numbers will be the usual five and six digits, signal report plus a progressive 3 figure contact number, starting with 001.

3. Each contact counts 3 points and the same station can be worked once per band, on c.w. or on phone.

4. The multiplier is the sum of Swiss Cantons worked on each band, c.w. or phone, making a possible multiplier of 22 per band.

5. Your final score therefore will be the sum of QSO points on all bands, multiplied by the number of Cantons worked on each band.

6. Use a separate log sheet for each band and only one side of the paper.

7. Certificates will be issued to the highest scorer in each country, and each call district in the United States and Canada.

8. Your logs must be postmarked no later than April 30th and go to: USKA Traffic Manager, HB9ZY, Meggen LU, Switzerland.

The 22 Cantons are:

ZH	Zurich	ZG	Zoug	TG	Thurgovie
BE	Berne	FR	Fribourg	TI	Tessin
LU	Lucerne	SO	Soleure	VD	Vaud
UR	Uri	BS	Basle	VS	Valais
SZ	Schwyz	SH	Sclaffhouse	NE	Neuchatel
NW	Unterwald	AR	Appencell	GE	Geneva
GL	Glaris	SG	St. Gall	GR	Girsson
		AG	Argovie		

P A C C

Starts: 1200 GMT Saturday, April 25.
Ends: 1800 GMT Sunday, April 26.

It's the world working the Netherlands in this one. This year the c.w. and phone contests have been scheduled on the same week-end, although they are two separate activities (a good move). Besides certificate winners in the contest, there is also an added incentive. Contest contacts can be applied toward the PACC Award, and the VERON has promised to have at least 100 different PA stations active.

1. Use all bands, 1.8 thru 30 mc. On 160 m, PA stations operate between 1.825 and 1.835.

2. The usual 5 and 6 digit serial number, RS or RST report plus a progressive QSO number starting with 001.

3. Each completed QSO counts 3 points and the same station can be worked once on each band.

4. The multiplier for stations outside of the Netherlands is determined by the number of provinces worked on each band. There are 11 provinces, making a possible maximum multiplier of 66. PA/PI stations will use the DXCC country list for their multiplier. In addition, the call areas in the following countries will be considered a multiplier: W/K, VE/VO, PY, VK, ZL, ZS, CE and JA.

5. The final score therefore will be the sum of QSO points from all bands, multiplied by the sum of the multiplier on each band.

6. Certificates will be awarded to the highest scorer in each country and each call district as indicated above.

7. Your log should show in this order: date and time in GMT; station worked; province worked; multiplier for each band; serial number sent; serial number received; QSO points.

8. The PA stations will identify their province by two letters after their serial number. The Provinces, 11 in all are:

GR	Groningen	UT	Utrecht	NB	Noord-Brabant
GD	Gelderland	ZL	Zeeland		
ZH	Zuid-Holland	DR	Drente	OV	Overijssel
FR	Friesland	NH	Noord-Holland	LB	Limburg

Include a summary sheet with your log and a signed statement that all rules and regulations have been observed.

Logs must be postmarked no later than June 15th and go to: Mr. P. v. d. Berg, PAØVB, Contest Manager VERON, Keizerstraat 54, Gouda, Netherlands.

Editor's Note

A reminder to you Rotarians, don't forget the "World Understanding Week" from March 15th thru the 19th, sponsored by "El Rimac" and the Radio Club Peruano. Details were outlined in

[*Continued on page 100*]

PROPAGATION

GEORGE JACOBS*, W3ASK

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for March

Days	*Forecast Rating and Quality* (4)	(3)	(2)	(1)
Above Normal: **9, 18**	A	A-B	B-C	C
Normal: **2-3, 5-6, 8, 10-11, 15-17, 19-20, 22-23, 29-30**	A-B	B-C	C-D	D-E
Below Normal: **1, 4, 7, 12, 14, 21, 24, 27-28, 31**	C	C-D	D	E
Disturbed: **13, 25-26**	D	D-E	E	E

HOW TO USE THESE CHARTS

The following is an explanation of the symbols shown above, and instructions for the use of the *CQ* propagation predictions:

1—Enter Propagation Charts on following pages under appropriate band and distance or geographical area columns. Read predicted times of band openings at intersection of both columns.

2—Following each predicted time of band opening is a forecast rating which indicates the relative number of days the band is expected to open during each month of the forecast period. The higher the rating, the more frequent the opening, as follows: (4) band open more than 22 days each month; (3) between 14 and 22 days; (2) between 8 and 13 days; (1) less than 7 days.

On the "Short-Skip" Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. Note the forecast rating for later use.

3—With the forecast rating noted above, start with the numbers in parentheses at the top of the "Last Minute Forecast" appearing above Read down the table for a day-to-day forecast of propagation conditions in terms of Above Normal (WWV rating higher than 6); Normal (WWV rating 5-6); Below Normal (WWV rating 4); Disturbed (WWV rating less than 4). The letter symbols (A-E) describe reception conditions (signal quality, noise and fading levels) expected for each day of the month and have the following meanings: A—excellent opening with strong, steady signals; B—good opening, moderately strong signals, little fading and noise; C—fair opening, signals fluctuating between moderately strong and weak; D—poor opening, signals generally weak with considerable fading and noise; E—poor opening, or none at all.

4—This month's Propagation Charts are based upon a transmitter power of 75 watts c.w.; 150 watts s.s.b., or 300 watts d.s.b., into a dipole antenna one quarter-wave above ground on 160, 80 and 40 meters and a half-wave above ground on 20, 15 and 10 meters. For each 10 db increase above these reference levels, reception quality shown in the "Last Minute Forecast" will improve by one level; for each 10 db loss, reception will become poorer by one level.

5—Local Standard Time for these predictions is based on the 24-hour system.

6—These Propagation Charts are valid through April 30, 1964. These Charts are prepared from basic propagation data published monthly by the Central Radio Propagation Laboratory of the National Bureau of Standards, Boulder, Colorado.

MARCH is an interesting month from a propagation viewpoint. On March 21 the Vernal Equinox occurs. This is the day when the sun crosses the equator as it travels northward along its apparent ecliptic. On this day, the hours of daylight and darkness are of equal duration throughout the world. This phenomenon has its related effects upon high frequency radio propagation conditions throughout March and the spring months. In the northern hemisphere, daytime usable frequencies are expected to be lower than during the winter months, while nighttime usable frequencies should be somewhat higher. Atmospheric noise levels and ionospheric absorption also generally increases in the Northern Hemisphere during March and the spring months. In the southern hemisphere, opposite effects are noted during this period.

During March and April, propagation conditions on long circuits between the northern and southern hemispheres (for example, to Australia, South America and South Africa, *etc.*), are generally at their best. This results from an "equalization" of conditions which occurs when it is spring in one hemisphere and fall in the other. A similar situation also occurs during September and early October, when the Autumnal Equinox takes place.

Twenty meters is expected to be the best band for DX openings from sunrise to sunset during March. Some fairly good openings are predicted for 15 meters during the daylight hours to southern and tropical regions, but the band is not expected to open frequently to other areas of the world. Few, if any, 10 meter DX openings are likely to occur during March.

During the period from sunset to sunrise, 40 meters is expected to be the optimum band for DX propagation. Signals are likely to be exceptionally strong during some openings. Good DX openings to many areas of the world are also predicted for 80 meters during the hours of darkness, despite an expected increase in the static level on this band. Some 160 meter openings should also be possible during the hours of darkness, with the possibility of the band opening between Australia, South Africa and other areas in the southern hemisphere.

For specific times of DX openings for each

*11307 Clara Street, Silver Spring, Md. 20902.

amateur band 10 through 160 meters during March, refer to the DX Propagation Charts which appeared in last month's column. This month's column contains Short-Skip Propagation Charts for March and April.

Auroral activity usually increases somewhat during March, and this is likely to result in an increase in v.h.f. auroral-type openings. Check the "Last Minute Forecast" for days that are predicted to be "disturbed" or "below normal," since these are the days on which auroral activity is most likely to occur during March. Meteor-type v.h.f. ionospheric openings may also be possible during the period March 10-12 and 20, when minor meteor showers are expected to take place.

Sunspot Cycle

The Zurich Federal Solar Observatory reports a mean sunspot number of 12 for December, 1963. This is the lowest level of mean sunspot activity observed since April 1955. From December 27-31, the face of the sun was completely clear of spots, with daily counts of 0. The mean sunspot number observed during December results in a smoothed number of 28, centered on June 1963. A smoothed sunspot number of 16 is forecast for March 1964. For the latest prediction of the date the present sunspot cycle is expected to reach a minimum, see "A Look At The Remainder of The Sunspot Cycle" appearing elsewhere in this month's issue of *CQ*.

Anniversary

This month's column marks the beginning of my fourteenth year as PROPAGATION Editor of *CQ*. I have found conducting this column a very stimulating and interesting sidelight to my deep interest in amateur radio. I want to thank all of you, whom, over the years have taken the time to drop me a line expressing an interest in radio propagation and in this column in particular. I also feel that special recognition is due the Editors and Publishers of *CQ* for recognizing the importance of familiarizing radio amateurs with propagation forecasts and the correlations that exist between shortwave radio conditions and ionospheric variations. During the years ahead it is my intent to continue to keep radio amateurs advised of propagation conditions in this column and to explain some of the behavior patterns of the natural phenomena that make shortwave communications possible.

73, George, W3ASK

CQ SHORT-SKIP PROPAGATION CHART

March-April, 1964

Band Openings Given in Local Standard Time

AT PATH MID-POINT (24-HOUR TIME SYSTEM)

Band (Meters)	*50-250 Miles*	*250-750 Miles*	*750-1300 Miles*	*1300-2300 Miles*
10	*NIL*	*NIL*	08-20 (0-1)	08-20 (1-0)
15	*NIL*	09-16 (0-1)	09-13 (1) 13-16 (1-2) 16-20 (0-1)	09-11 (1) 11-13 (1-2) 13-16 (2-3) 16-18 (1-2) 18-20 (1)
20	*NIL*	07-12 (0-2) 12-16 (0-3) 16-18 (0-2) 18-07 (0-1)	07-08 (2) 08-10 (2-3) 10-12 (2-4) 12-16 (3-4) 16-18 (2-3) 18-21 (1-2) 21-07 (1)	06-07 (1-0) 07-08 (2-1) 08-10 (3-2) 10-14 (4-3) 14-16 (4) 16-18 (3-4) 18-20 (2-3) 20-21 (2) 21-22 (2-1)
40	06-08 (0-1) 08-10 (1-3) 10-16 (3-4) 16-18 (2-3) 18-20 (1-2) 20-06 (0-1)	06-08 (1-2) 08-10 (3) 10-15 (4-3) 15-16 (4) 16-18 (3-4) 18-20 (2-3) 20-22 (1-2) 22-06 (1)	06-08 (2) 08-15 (3-1) 15-16 (4-2) 16-18 (4-3) 18-20 (3-4) 20-22 (2-4) 22-02 (1-3) 02-06 (1-2)	06-08 (2-1) 08-15 (1-0) 15-16 (2-0) 16-18 (3-1) 18-20 (4-2) 20-22 (4-3) 22-02 (3-4) 02-05 (2-3) 05-06 (2)
80	06-08 (1-2) 08-10 (3-4) 10-18 (4) 18-20 (3-4) 20-22 (2-3) 22-01 (1-2) 01-06 (1)	06-08 (2) 08-10 (4-1) 10-16 (4-0) 16-18 (4-2) 18-20 (4-3) 20-22 (3-4) 22-01 (2-4) 01-06 (1-2)	06-08 (2-1) 08-10 (1-0) 10-16 (0) 16-18 (2-1) 18-20 (3-2) 20-01 (4) 01-05 (2-3) 05-06 (2)	06-08 (1-0) 08-16 (0) 16-18 (1-0) 18-20 (2-1) 20-22 (4-2) 22-01 (4-3) 01-05 (3) 05-06 (2-1)
160	05-07 (4-2) 07-09 (3-1) 09-17 (2-0) 17-19 (3-1) 19-20 (4-2) 20-05 (4)	05-06 (2-1) 06-07 (2-0) 07-09 (1-0) 09-17 (0) 17-19 (1-0) 19-20 (2) 20-22 (4-3) 22-03 (4) 03-05 (4-3)	05-06 (1) 06-19 (0) 19-20 (2-1) 20-22 (3-2) 22-03 (4-3) 03-05 (3-2)	05-06 (1-0) 06-19 (0) 19-20 (1-0) 20-22 (2) 22-03 (3-2) 03-05 (2-1)

ALASKA TO:

*Openings Given in Alaskan Standard Time**

	15 Meters	*20 Meters*	*40 Meters*	*80/160 Meters*
Eastern USA	12-14 (1)	10-13 (1) 13-15 (2) 15-17 (1)	20-04 (1)	*NIL*
Central USA	12-15 (1)	10-13 (1) 13-16 (2) 16-18 (1)	20-05 (1)	23-02 (1)
Western USA	12-16 (1)	09-11 (1) 11-13 (2) 13-16 (3) 16-18 (2) 18-20 (1)	20-22 (1) 22-03 (2) 03-07 (1)	22-02 (1) 02-05 (2) 05-06 (1) 03-05 (1)†

HAWAII TO:

Openings Given in Hawaiian Standard Time‡

	10/15 Meters	*20 Meters*	*40 Meters*	*80/160 Meters*
Eastern USA	08-12 (1) 12-15 (2) 15-16 (1)	04-06 (1) 06-08 (2) 08-12 (1) 12-14 (2) 14-16 (3) 16-18 (2) 18-20 (1)	18-19 (1) 19-21 (2) 21-00 (3) 00-02 (2) 02-03 (1)	19-21 (1) 21-00 (2) 00-02 (1) 22-00 (1)†
Central USA	08-10 (1) 10-12 (2) 12-15 (3) 15-16 (2) 16-17 (1)	04-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-18 (3) 18-19 (2) 19-21 (1)	18-19 (1) 19-21 (2) 21-01 (3) 01-04 (2) 04-05 (1)	19-21 (1) 21-01 (3) 01-02 (2) 02-03 (1) 22-01 (1)†
Western USA	12-14 (1)§ 07-09 (1) 09-10 (2) 10-11 (3) 11-14 (4) 14-16 (3) 16-17 (2) 17-18 (1)	04-07 (2) 07-10 (4) 10-13 (3) 13-16 (4) 16-17 (3) 17-19 (2) 19-23 (1)	17-19 (1) 19-20 (2) 20-23 (4) 23-05 (3) 05-06 (2) 06-07 (1)	19-20 (1) 20-21 (2) 21-04 (3) 04-05 (2) 05-06 (1) 20-22 (1)† 22-02 (2)† 02-04 (1)†

*Alaskan Standard Time (from Skagway to 141° west longitude), is 4 hours *behind* EST; 3 hours *behind* CST; 2 hours *behind* MST; 1 hour *behind* PST and 9 hours *behind* GMT.

†Possible 160 meter openings from Hawaii and Alaska.

‡Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST and 10 hours *behind* GMT.

§Possible 10 meter openings from Hawaii.

SPACE COMMUNICATIONS

GEORGE JACOBS*, W3ASK

THE following is the complete text of the second of two documents submitted by the International Amateur Radio Union at the recent ITU Space Communications Conference held in Geneva, Switzerland. The text of the first document, number 107, appeared in last month's column. Document number 84 is presented this month because it summarizes officially where amateur radio stands in the space age today. It is also further tangible evidence of the very useful work an international organization representing radio amateurs is capable of doing.[1] Documents 84 and 107 played a key role in swinging the great majority of the delegates representing the 70 countries attending the conference to vote in favor of a worldwide exclusive allocation to amateur radio for space communications between 144-146 mc, in the 2 meter band.[2]

OSCAR Space Satellite Program of the IARU

The International Amateur Radio Union (IARU) is an affiliation of 60 national societies of amateur radio operators in as many administrations around the world.

The IARU and member societies believe that the Amateur Radio Service can contribute most usefully to the communication art when maximum freedom for experimentation and communication exists in the Service, with minimum restrictions imposed on the activities of the radio amateurs. In addition, the belief is held by the IARU that radio amateurs should be free to undertake within their allocated bands whatever experimental programs that may challenge their interest and ingenuity, without creating interference to other Services.

OSCAR is such a program. OSCAR stands for "*O*rbital *S*atellite *C*arrying *A*mateur *R*adio." These unique electronic devices are space satellites built entirely by radio amateurs, and launched by administrations having launch facilities. The home-made satellites are used by radio amateurs world-wide for experimental purposes, or for random communication between themselves in the bands of the Amateur Service. Among the administrations that have the national amateur society belonging to the IARU are two that presently have satellite launching facilities: the USA and the USSR.

To date, two amateur radio satellites have been successfully launched into orbit and a third satellite is being completed and is expected to be launched in 1964. In each case the entire electronic package—internal assemblies, shell, power supply, and fabrication and testing thereof—was purely radio amateur in concept, design fabrication and execution. The two satellites (OSCAR I and II) were almost identical in appearance and had the following electrical and mechanical characteristics:

Physical Configuration:

Approximate size: 12" × 14" × 6".
Approximate weight: 15 pounds, of which 11 pounds are battery weight.
Material of construction: Case-aluminum and magnesium. Insulation-epoxy foam.
Antenna: Monopole whip, 19" long.

Transmitter:

Frequency: 145.0 mc.
Power Output: 0.1 watt.
Identification Signal: Morse Code letters H I (the friendly international radio amateur greeting).
Radio Circuitry: Transistor oscillator (72.5 mc), crystal controlled, transistor amplifier, diode frequency multiplier (145.0 mc).
Keyer Circuitry: Transistorized timing generator (multivibrator), five "scale-of-two" transistorized dividers, diode matrix pulse selector.
Telemetry Circuitry: Timing generator is temperature sensitive and keying rate is a function of internal heat of the satellite. The ground observer determines temperature by counting time (seconds) it takes for the satellite to send ten (10) H I's.
Satellite life: Determined by battery life (about 28 days, maximum).

Environmental Test Conditions:

Temperature test range: −35°C to +65°C.
Shock: +50 G (gravity).
Acceleration: +50 G (gravity).
Altitude: Over 200,000 feet.

Orbital Data (Typical for OSCAR I):

Life: Approximately 300 orbits.
Orbital period: 92 to 89 minutes.
Perigee: 153 miles.
Apogee: 268 miles.
Inclination to equator: 81.2°.
Maximum satellite temperature: +53°C.
Maximum radio tracking range: 1400 miles (2400 km).

The cost of construction of these satellites is difficult to estimate, as all work was voluntary and on a trial-and-error basis. Cost of electrical and mechanical components was less than 100 dollars each—far less than the cost of a good amateur short-wave receiver.

The result of the first two radio amateur space experiments has been to create an intense interest in space communication among radio amateurs and citizens throughout the world. Observations made of the two satellites were carried out by radio amateurs in over 30 countries. A total of more than 950 radio amateurs in all continents provided 7,000 individual tracking observations, which are made available to all radio amateurs on a world-wide basis. A survey shows that an additional 10,000 radio amateur observers intercepted the satellite transmission, but did not submit formal reports.

Results of the two OSCAR radio amateur satellites show that amateurs can extract scientific data from their

*11307 Clara Street, Silver Spring, Md. 20902
[1]See ZERO BIAS for February 1964.
[2]Jacobs, G. "Amateur Radio and the 1963 ITU Space Communications Conference," *CQ* pp. 43-45, Jan. 1964.

satellite, can generate orbital data from observations, and put this information to use in a self-educational program covering space techniques.

OSCAR experiments are in keeping with the definition of the Amateur Service, which imposes no restrictions upon techniques and equipment, but which encourages experimentation and ventures into new communication fields. OSCAR is not an exclusive US program, although the US contributed the first two launch vehicles. Other OSCAR satellites are now being designed and built by European amateurs, and preliminary plans are under way by an Australian amateur group.

The purpose of the first two radio amateur satellites was to introduce amateurs to techniques of outer-space signals and to provide data for the forthcoming OSCAR III "active repeater satellite," described herewith.

The Proposed OSCAR III Space Satellite

OSCAR III will receive a 50 kc segment of the internationally-assigned 144-146 mc band and instantly retransmit this segment at the opposite end of the same band. Thus, an amateur station transmitting to the satellite on (for example) 144.1 mc and listening to the satellite on 145.9 mc may communicate with a second radio amateur via the satellite. The second amateur, who may well be beyond the "radio horizon," transmits near 144.1 mc and receives near 145.9 mc.

OSCAR III is thus a "free access" random communications satellite. All licensed radio amateurs worldwide will have access to the satellite and to information derived therefrom.

In addition to the translator equipment, OSCAR III will carry a 0.01 watt beacon transmitter on 145.85 mc to assist observers in acquiring the satellite as it comes over the horizon. Estimated life of the satellite is about 3 weeks. The output power is about 1 watt peak, divided between the number of signals passing through the equipment. With one ground signal, maximum satellite output is achieved when the ground signal delivers 500 watts into a +13 db antenna, producing 40 db over 1.78 microvolts into the satellite receiver at a distance range of 1000 km (20 db over internal noise of satellite).

Practical amateur stations, therefore, of 50 to 250 watts run no danger of overloading the satellite. Minimum satellite receiving level is adjustable within the equipment.

A preliminary version of the OSCAR III satellite is in operation, and radio amateurs are experimenting with this ground-based equipment, using a.m., s.s.b., and c.w. signals in communication through the equipment.

OSCAR III will enable radio amateurs of all administrations to co-operate in a joint communication and experimentation program. It is a tool and a catalyst that encourages participation in space communications by the younger generation of radio amateurs in particular, who will be the scientists and leaders of tomorrow. Self-education and advancement in the newest science among radio amateurs is the philosophy of OSCAR and the IARU.

As amateur radio is a hobby of communication, it seems proper that radio amateurs keep abreast of this art as they have in the past. Space communications stand today where radio communications stood in the day of the spark transmitter and the crystal detector.

Two-way radio amateur communication via radio amateur satellite may open new fields of experimentation and answer scientific problems yet unposed. Radio amateurs are capable of fulfilling an important role in this great adventure. Numbering over 350,000 scientific-minded, naturally curious individuals, radio amateurs have left their mark on the history of communications to date. Further work devoted to the peaceful use of space will benefit not only the radio amateur, his country, but all of mankind as well.

Moonbounce Progress In Great Britain

Ralph C. Taylor, G2HCJ, reports that work is progressing steadily in the development of equipment for 2 meter moonbounce experiments in Great Britain.

Good progress is being made by G3KCB in designing and building a 600 watt 2 meter transmitter for the experiments. The exciter, as well as the power supply for the final amplifier is already completed, and the final amplifier itself is in a fairly advanced stage of construction. Push-pull 4X500 A's are being used in the final to develop an output power of 600 watts. The transmitter circuitry will also include a high power reflectometer designed by G3KCB.

While, for the most part, the receiver is still on paper to date, G2HCJ reports that synchronous detection has given way to thoughts of a locked oscillator system. Experiments conducted recently at the British radio astronomy station at Jodrell Bank indicate that such a detection system may have as much as 3 db gain over synchronous detection. Work is expected to start soon on a parametric amplifier, and Ralph is striving to obtain a final design for a moonbounce receiver that will permit a noise figure of 3 db and a bandwidth of 5 cycles or less.

For an antenna system, present plans are to use circular polarized Yagi arrays with a total gain of 20 db. The antenna will be mounted on a surplus anti-aircraft gun mounting so that it can be rotated in altitude and azimuth. In order to track the moon accurately and automatically, G2HCJ plans to develop a program by graphing the position of the moon for a period of about a week in dark black ink on paper strips. The paper strips, driven by clocks, and passing through photo-transistors for detection, would guide separate servo systems for positive altitude and azimuthal control of the antenna system.

Although the choice of frequency for the British moonbounce experiments has not yet been finalized, 145.8 mc is being seriously considered. This choice would presumably permit the equipment to be used with OSCAR III experiments as well.

G2HCJ and the British moonbounce gang welcome technical assistance from US amateurs interested in moonbounce transmission. They would especially like to hear from amateurs having suitable equipment for eventually participating in trans-Atlantic 2 meter experiments using the moon as a passive reflector of radio waves. His address is: Ralph C. Taylor, G2HCJ, 822 Warrington Road, Rainhill, Liverpool, England.

73, George, W3ASK

PLEASE . . .

WHEN writing to *CQ* authors, remember that they may have many more letters to answer than just yours. Be courteous and include a self-addressed stamped envelope; they will like it and you will probably get a much faster reply, too.

the USA-CA PROGRAM

CLIF EVANS*, K6BX

DECEMBER was unusually good for rooting out rare counties. Otts Beyer, K8CIR, and John Hawkins, W5EHY, bagged USA-CA-1500 numbers 5 and 6 respectively. Both were for mixed operations.

Bill Morgan, KØDEW, and James Stahnke, KØIDV, came in at USA-CA-1000 level for numbers 20 and 21, which also were for mixed operations.

USA-CA-500 winners numbered 20 and brought the New Year's total this level to 324. Of the 20, 16 were for mixed operations and 4 for all c.w. operations.

USA-CA HONOR ROLL

		1500			
		K8CIR	5	W5EHY	6
		1000			
		KØDEQ	20	KØIDV	21
		500			
W9KSE	305	WA5ALB	312	W2JMF	318
WA5BSV	306	W1PLJ	313	WA8EZW	319
WA8BIC	307	WA8EOH	314	WØKZZ	320
W9HGP	308	K2MYW	315	WØQWS	321
K2PBU	309	K9MMA	316	W8LAU	322
W9CHD	310	K4TVE	317	W5ZBC	323
W9JCV	311			K1IIK	324

USA-CA Rules

For complete USA-CA Program Rules see November issue of *CQ*. A copy of the Rules may be obtained from K6BX for s.a.s.e. In answering questions which seem to keep popping up, we reiterate, there are no date restrictions for USA-CA. All contacts with different counties for which one holds QSL cards are valid regardless of one's change of call *or* QTH. There are no restrictions on portable, or mobile (including aeronautical mobile) operations; to the contrary, mobile and field-day operations are encouraged. In mobile operations, it is only required that the county be identified on the QSL card or in lieu thereof a city or town by which the county may be identified. For contacts with independent cities or parks and reservations not legally within counties, one may take credit (one time only) for any, repeat *any*, adjacent county of one's choice. It is not the purpose of USA-CA to create or deal with technicalities; the rules are simple, use common sense and avoid exceptions and/or contradictions.

*United States of America Counties Award Custodian, Box 385, Bonita, California 92002

Pictured here is the colorful (6 colors) Trans-Canada Award sponsored by the Ontario DX Association for specified contacts after WWII. Requires 5 contacts with each of the 8 VE call areas (40) plus 5 contacts with VO1/VO2 (any combination of 5) plus 1 contact with VEØ maritime mobile. Of the 5 VE8 contacts, 1 must be in Yukon Territory and 1 must be located in the off-shore islands of the N.W.T. Send GCR list, $1 or 8 IRC to Custodian, VE3BQP, Bill Wragg, 127 Castlewood Rd., Toronto 12, Ontario, Canada.

Recently we have been plagued with clarification inquiries some of which were motivated by humor and others seeking the unusual. One lad stated his all band antenna was hooked up at one end to his house in one county and at the other end legally in a second county. His argument was that he paid taxes to both counties and his antenna radiated from both counties so he should give out double county contacts. Another mobileer inquired if he could park front wheels in one county and rear wheels in a second, could he give double county contacts . . . yet several others came up with the bright idea that why not, on field days string a long-wire looping through maybe two or three counties and give out multiple contacts. Naturally we turned down all these humorous bids for fame on basis it was the operator who made the contacts and not the automobile or antenna . . . we are still smarting . . . one enterprising lad said he agreed with me so next time he was going to sit on county line with one foot one side and other foot in second county . . . final answer is still a flat no . . . there is only one situation in the United States where USA-CA recognizes one can make more than one county credit per contact and that is from "Four Corners," the only place where four states (and four counties) come to a common corner and which is marked by a monument. The states are New Mexico, Utah, Colorado and Arizona. Four Corners is located on the Navajo Indian Reservation far out in the wilderness. Several clubs make annual field-day trips to Four Corners. The Totah Radio Club, P.O. Box 24, Farmingham, N.M., issue the Four Corners 5Ø7 award for contacting a Four Corners station. To get this award, send the QSL card and 50¢ to the above club.

Awards and Public Relations

Amateur Radio awards and related QSO parties are used by all major hamdom organizations and publications as instruments or vehicles upon which publicity and public relations are built to sell the sponsor or his programs. The same applies to similar programs by individual clubs. A great majority of these programs in varying degree give publicity to the participation of amateur radio in the affairs of our society and in support of the public interest.

The USA-CA Program was purposefully designed to encompass and support the several hundreds of United States awards programs. It also was designed to promote bettered international good will and especially toward the United States. The unparalleled success of the USA-CA Program is testimonial that beams the world over are now turned toward the U.S. seeking contacts with Americans.

Some states have highly active amateur radio organizations using both awards programs and state QSO Parties to enhance local, city, county and state publicity before the world. A few states have absolutely no amateur radio public relations programs of significant note. Next issue we will bring you a breakdown of awards publicity programs by states.

Awards, by their very nature, are international in scope. Awards rules should reflect accommodation to world-wide competition on fair basis. Some awards requirements too obviously discriminate against DXers. Some sponsors change Custodians every time there is a local election not realizing this irritates many who might otherwise seek such award. We have often stated there are no ridiculous awards; there are only ridiculous sponsors. Awards are intended for purpose of generating good publicity and public relations; if there are ridiculous features in awards then from standpoint or PR, it is best they not be sponsored.

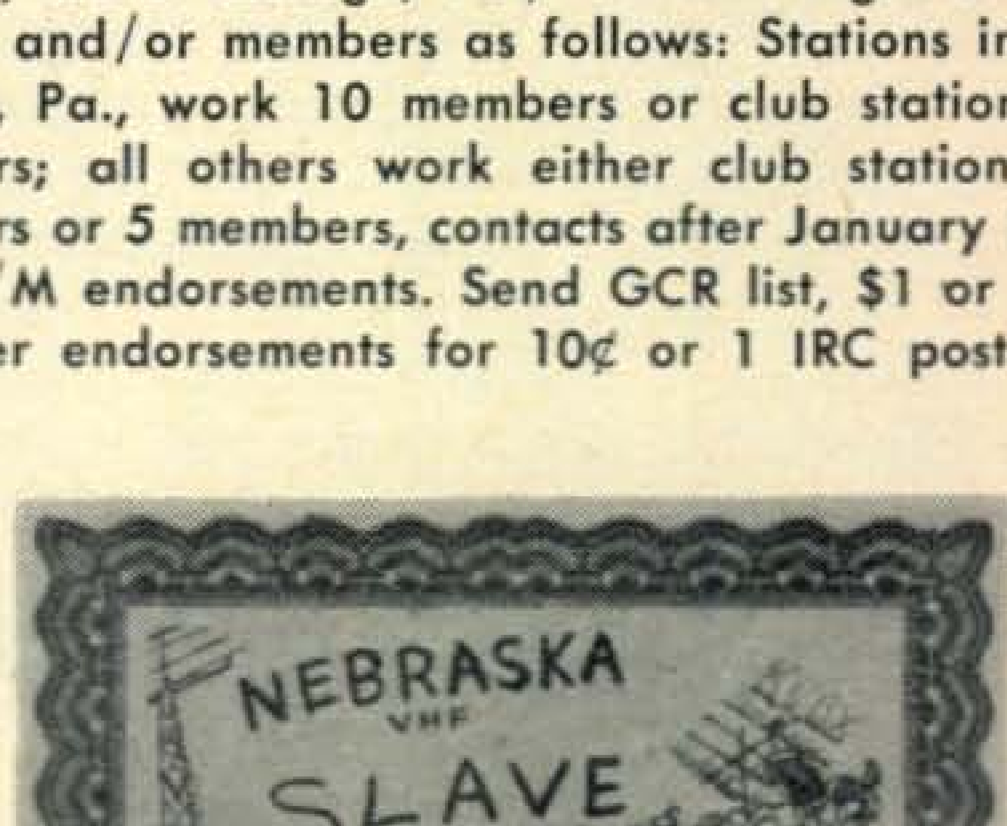
Virginia Counties Expeditions

Nine Virginia Net members have organized to sponsor expeditions into Virginia's rare counties. Interested county hunters wishing information of pending county expeditions should notify Earl Savage, K4SDS, 113-A Apple Tree Road, Charlottesville, Virginia. Give full QTH and telephone number. Return notification will

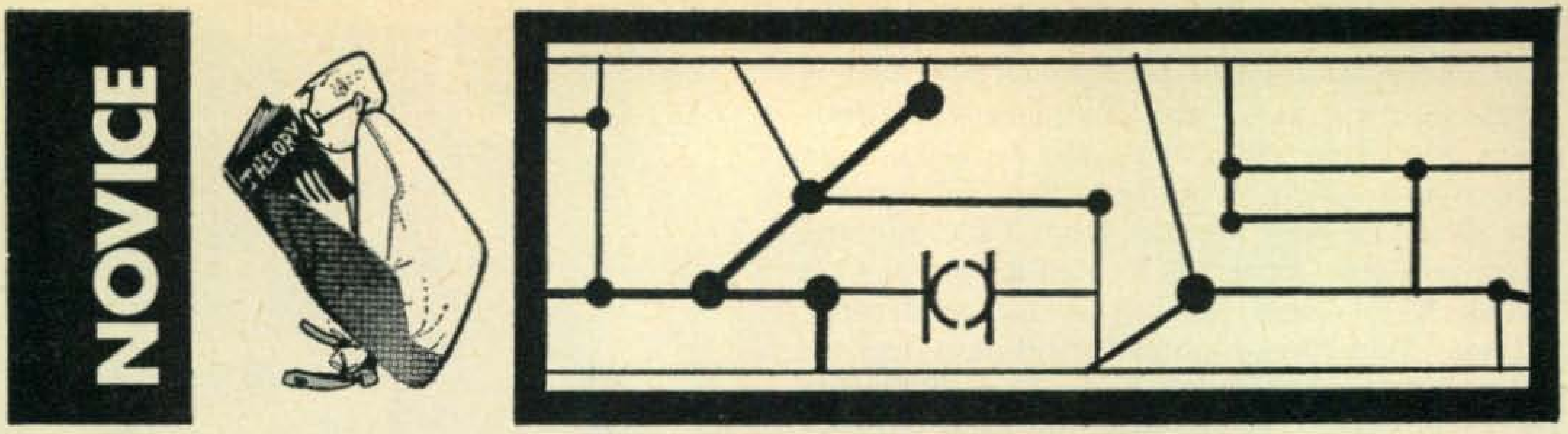
[*Continued on page 94*]

Above is the Worked Birmingham Award by the Birmingham ARC for working stations in Birmingham/ Jefferson County, Alabama; stations within 100 miles work 25; other W/K/VE work 15; DX work 5. No charge, but 25¢ postage appreciated. Send full log data to Custodian, Jerry Fiore, K4HPR, 1711 South 11th Place, Birmingham 5, Alabama. The award shows air picture of the city of Birmingham.

Here is the NARC Award by the Nittany ARC, P.O. Box 60, State College, Pa., for working club station K3HKK and/or members as follows: Stations in Centre County, Pa., work 10 members or club station and 7 members; all others work either club station and 3 members or 5 members, contacts after January 1, 1960. AOMB/M endorsements. Send GCR list, $1 or 10 IRC. Later endorsements for 10¢ or 1 IRC postage.



Here is the Nebraska VHF Slave certificate for working 10 "slaves." It is sponsored by the AK-SAR-BEN Radio Club, Inc., custodian, WØCCD, Grandma Lou (Chief Slave Driver) 3635 Olin Drive, Omaha 5, Nebraska. Send list and 10¢. Member "slaves" are KØFAI, UIY, TVD, WVF, KQI, YWY, ETA, UCL, YRY, ABI, KEO, PQP, MSS, SBV, CFI, OTL, ZVN, JBL, RWX, LYO, UIA, VVK, LHZ, PMR, UIX, SCE, ZPX, ZLB, JKW, JBV, MEQ, JQQ, WVE, PQR, SNO, JBS, CVE, GHK, GOC, KKB; WØCCD, CQX, RMB, WRT, YZV, VZJ, FNB, DEQ, FFG, CES, BGH, ETB, HAQ; WAØBMJ, BVY, DGA, DQH, DJK, EEM, EBX, CBC, EIM, EBW, BKJ, EYE, FHH, HNW; WA2SAZ, WA2SNT, WA2CXI, K5TKI, K5CBN, K7MAC, K8QLT, W8FKO, and W9DIO.



WALTER G. BURDINE*, W8ZCV

THE weather for the first part of 1964 has given us many chances to demonstrate the advantage of having independently powered radio equipment to provide communication when an emergency occurs. The b.c. radio just announced that a large group of motorists were snow bound in Illinois and amateur radio was the only communication from them telling their folks that they were safe. This doesn't mean too much to anyone unless one of their loved ones is in that group. It's odd that tragedy only affects those directly involved. This, then, is a direct method of promoting amateur radio as a hobby.

Another thing, emergency equipment in the making is of absolutely no benefit, it must be working *when needed.* Efficient operational equipment should be able to be put into operation within a matter of minutes. Don't forget, you most likely won't have line voltage for operation of a soldering iron in an emergency. By the way, a transistor radio is a nice piece of equipment to have in your emergency equipment, be sure that you have extra batteries or cables made up to connect to your automobile battery. This cable can be made simply by turning out a dummy battery of wood with the ends fitted with wood screws that connected to a cable terminated by a plug to fit the cigarette lighter. Let's all be ready should the time come that we are needed.

The Simple Six Meter Converter

Many letters are received asking, "How simple can you build a 6 meter station and still be able to work out with it?" or "How can I get on the air on six meters without it taking up a lot of space and costing a young fortune?" Well it *is* possible. First, read everything you can get on the subject. Plenty of six meter information can be obtained at your library; local amateurs are also good sources and many manufacturers have information for the asking. Many booklets are printed especially for the v.h.f. enthusiasts and a good one can be bought from the *CQ* Ham Mart. Plenty of information is available for the serious minded experimenter.

A converter can be built with only an oscillator-mixer circuit feeding into a following receiver. This would usually take one dual purpose tube or two single tubes. An r.f. amplifier of almost any type would improve the operation of the converter, but this would require the use of a minimum of two tubes. General Electric recently came out with a new line of tubes called Compactrons, with two or more tubes in one envelope. This makes it possible to construct a good converter with only one tube, still having three stages. The G.E. 6D10 has the equivalent of 1½ 12AT7's in one envelope.

The converter to be described uses a 6D10 as a grounded grid r.f. amplifier, feeding the signal to the mixer stage. An overtone crystal oscillator is coupled by a gimmick to the capacitor mixer. This converter was designed to be used with the low-priced war-surplus BC-455 receiver so a 42 mc crystal with the i.f. at 8 mc was chosen. Thus, 8 mc on the BC-455 becomes 50 mc in conversion.

The grounded grid r.f. stage provided useful gain as well as providing valuable isolation between the antenna and the mixer stage.

Construction

This converter was constructed on a 4¼ × 2¼ × 1½" Mini-box. I actually used the Premier PMC-1016, finished in grey hammertone to make a nice appearance on the operating table. Input and output connectors, as well as power connections should be chosen to suit the needs of the constructor. Parts layout is not

Thomas W. Schropp, RR 6, Salem Road, Clarksville, Tennessee has spent 2 years building this station, now for the license, read his letter, it has some good advice in it.

*R.F.D. 3, Waynesville, Ohio 45068.

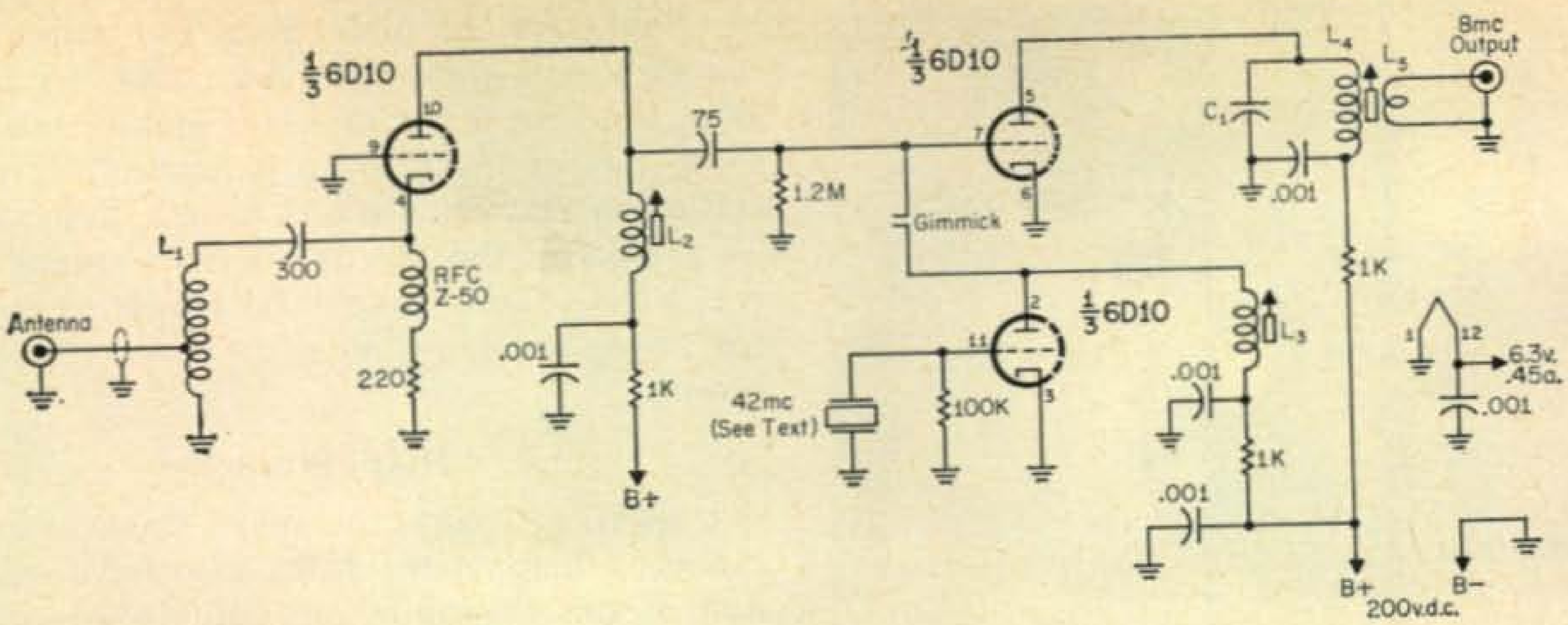


Fig. 1—A simple 6 meter converter using a single 6D10 Compactron. All resistors are ½ watt. All capacitors greater than one are in mmf; others are in mf.

C_1—Less than 47 mmf as needed to resonate L_4.
L_1—11t. #24e. close wound on ⅜" iron core slug tuned form. Tap 3t. from ground end.
L_2—9t. #24e. close wound on ⅜" iron core slug tuned form.
L_3—14t. #24e. close wound on ⅜" iron core slug tuned form.
L_4—Approx. 50t. #30e. close wound on ⅜" iron core slug tuned form, or use CTC ⅜" dia 10 mc coil LS-3.
L_5—6t. #30e. at cold end of L_4.

critical but care should be taken to place parts so that neat construction can be done. Keep the oscillator coil and the crystal in one corner and keep the r.f. and mixer coils separated as much as possible to prevent coupling between them. Use good construction practice and you will be proud of this simple converter. This would make a good first building project.

The power needed is 6.3 volts at 0.45 amp. and about 100 volts at 18 ma. This can best be taken from a separate power supply or it can be taken from some receivers. I used a small power supply built on a chassis of the same dimensions as the converter and use a v.r. tube to give me 108 volts.

Connecting The Converter

The converter should be connected to the receiver with coaxial cable, making sure that the input terminal of the receiver is well shielded to prevent feedthrough of signals at the intermediate frequency (i.f.), in other words, the receiver should be capable of being tuned through the entire dial without receiving any signals within the receivers original tuning range with the converter turned off. The feedthrough will cause unwanted heterodynes and annoying squeals when receiving six meter signals.

Changing I.F. Frequency

If you desire to use this converter at some i.f. other than 8 to 12 mc, you can change it by changing the crystal and coils L_3 and L_4. The crystal frequency can be figured by taking the tuning range of the receiver (the low end) from 50 mc. The result is the crystal frequency. Coil L_3 must tune to the crystal frequency while L_4 must tune to the difference frequency or i.f. Higher frequencies will require fewer turns of wire and lower frequencies will require more turns of wire to hit the frequency needed.

This is my simplest workable six meter converter and the cost is very small. Try it, you may be surprised.

Letters

Sometimes the letters received here have more advice in them than I would put into the same amount of space if I wrote it myself. Here is just such a letter, from Thomas W. Schropp of Clarksville, Tenn.:

"Dear Mr. Burdine, I have been reading your material in *CQ* for a considerable time. I read the other articles and the ads first and then when I have a quiet moment I read your NOVICE column. All material, and your comments, are most reassuring and helpful to one who aspires to the amateur ranks. In my case I have spent almost two years in building a complete station consisting of a Knight-Kit R-100 receiver, a 150 watt a.m. c.w. homebrew transmitter, and an assortment of antennas and station accessories. The equipment has been tested with good results and I am now ready for my license. I am 53 years old and like others, I have to earn my daily bread, so I will have only a moment now and then to devote to my hobby. For this reason I got the station set up before applying for the license, so that nothing will stand in the way of my progress toward the General license.

"In learning the code, I used records to give me the receiving practice. This is an excellent way to learn as these records are about the best teaching device I can think of, in that the transmission is perfect. Now comes a comment that I feel should be made for the benefit of everyone. When I had learned enough code to begin copying from the air I became much disappointed in the quality of many Novice and General class c.w. transmissions. It appears that some of these persons had forgotten the end result was that sending should result in a clear readable message and not a lot of hash and corrections. I find that this is my result when I try to exceed my speed limit. I am sure that many operators are beating the air in vain, berating atmospheric conditions and their equipment when really it is their poor sending procedures

Gordon Wolford, WN8JXF, 318 S. Adams Street, New Carlisle, Ohio has worked 29 states with this fine low powered station. He passed his general the last Friday in December. The receiver is the 3 tube superhet from July *QST* and the transmitter is an Ameco AC-1. He is looking for contacts with the western states. Good luck, Gordon.

that keep other amateurs from answering their CQ. I am sure that you know more about this subject than I, but I feel that it might be a good comment for your column for some future date. Maybe some of our friends will review their operating habits.

"Keep up the good work in *CQ*. It has been a great help to me and when I get that important piece of paper I shall talk to you again. 73 es cul, Thomas."

Thanks for the letter Tom, I am sure that you are right in everything you say. I have known many Novices that have spent most of their license period getting the station set up so that they can get on the air and during that time they had failed to keep practicing the code. Result: rotten signals and most of their time gone. I wish more newcomers to our wonderful hobby would read this letter and heed its teachings; they would be farther ahead in the game.

Wes Bell, W7QB, P.O. Box 118, Lewistown, Montana sends this helpful note for those needing Montana:

"Dear Walt, Montana QSOs are rare and I intend to help the Novices make such a contact. During the Spring months I'll be on 21.1 mc c.w. starting at 1700 GMT on non-DX contest weekends, both Saturdays and Sundays. I'll skip around with my receiver in the Novice bands so that everyone will have an equal chance.

"In order that I may work as many as possible, I request that short calls be used and that the gang give only the RST and handle followed by BK. I will not listen on my own frequency or answer any one who "tailends." By tailend, I mean calls on the frequency before the other chap has finished. When I say KN I mean it. I'll send SK when I'm through with a station and ready to listen for more calls.

"After the QSO, send me a note or card of confirmation plus self addressed stamped envelope (s.a.s.e.) and your card will come back promptly. Always use GMT for time of QSO. 73, Wes."

Thanks for the offer, Wes, I'm sure many of the gang will appreciate your offer. By the way Wes, I'm sure that I met you many years ago at a meeting of the Dayton Amateur Radio Association in Dayton, Ohio. I believe that you gave us a talk on the Sterba Curtain antenna. You see, I am a fan of yours and I want to think you for giving me some ideas on antennas and low-power.

Help Wanted

I want to thank the many hams who have extended help to the folks who have asked for help in this section of our column. Many letters have been received here stating that this section was helpful in licensing many of our newcomers. I have always said that to enjoy our hobby more we must help someone else enjoy it also. I guess you could say "Happiness shared is more endeared." If you can help those listed below, I'm sure it will be appreciated. Those needing help this month are:

J. F. Gallagher, 12, 139 Billerica Road, Chelmsford, Mass. Please contact this young fellow and offer your help. Thanks.

James G. Plimpton, Box 68, Colman, South Dakota needs help to get his amateur license.

John E. Seiersen, 1034 Clark Road, Aiken, South Carolina needs help with code and theory. John, the tips on passing the amateur test have been given many times in the publications pertaining to the electronic trade. Those devoted to amateur radio have had the dictionary of terms and abbreviations in them, and most handbooks also have a list of these. Your local radio store has or can get any publication needed, or a letter to *CQ* will bring a list of their amateur publications. They cover almost all phases of amateur radio from the Novice to the Teletype enthusiast to s.s.b.

Alfred Davis, 3 Noblesville Road, Carnegie, Pennsylvania, 15106, Phone 276-4372, would like to have someone nearby to guide his studies for a ham license. He should know most of the theory, he is a graduate of the National Radio Institute and he knows the code.

Well, fellows that just about does it for this month. I am now snowed in with 10 inches of snow on the level and my lane is ¾ mile long with snow drifts up to 49 inches and the Ferguson plow just won't push that snow out that deep. I have just made contact for the 3216 day of v.h.f. contacts and 90 percent of them have been made with 5 watts or less. I'll try to keep it up for ten years and I aim to make the last year with a station that runs less power. The FCC says use the least amount of power needed for the contact, so why can't more hams try to see how much it would relieve the QRM situation. Keep watching, I'll show you how to do the job and if you live near a city you'll be able to do the same. Can you furnish some new ideas for the column?

Thank you for your help in the past and let's make this column the best for the newcomer.

73, Walt, W8ZCV

HAM CLINIC

CHARLES J. SCHAUERS*, W4VZO

NOT too many years ago it was relatively a simple matter for one in the radio-electronics field to be able to keep up with the state of the art by subscribing to a few technical publications and participating in organized technical group activities, but this is not the case anymore.

Because of the great and rapid strides made in radio-electronics during the last 20 years, the generalist has had to turn specialist in order to survive. What with transistors, s.s.b., digital and analog computers, the Laser and Maser, transceivers, solid state rectifiers, atomically controlled frequency standards, telemetering equipment, TV, special instrumentation and radar—to name a few—one can readily see that no one man could be a specialist in them all!

The radio amateur on the other hand, if he has maintained his interest and proficiency by reading available technical literature and operating his station, will have had little difficulty keeping up with the newest in the ham radio field.

Those of us who must of necessity keep up with the latest developments not only subscribe to ham publications but also to those technical journals which contain information allied to our specific technical effort. Sometimes however, we are fortunate enough to receive publications through our many contacts which the average ham never sees. One such publication is a Final Report of a Panel of Experts convened at Geneva in June 1963 in accordance with Resolution No. 3 of the Administrative Radio Conference of 1959 and published by the International Telecommunication Union. The implications in this Report are *prophetic* as far as the radio amateur is concerned, and I wonder why *no* ham publication has mentioned them!

Adoption of SSB and ISB

The Report is devoted to the technical and operational recommendations for improvement in the use of frequency bands between 4 and 27.5 mc. Space does not permit the reproduction of the Report, but we shall give you some of the highlights. To conserve space we shall paraphrase wherever possible.

As we all know, one of the problems affecting all radio services throughout the world today is the availability of sufficient radio frequencies, especially in the h.f. bands.

In the first paragraph of the Report of the Panel of Experts (POE), it reads: "One of the most important and rewarding methods of achieving economy in the use of the HF spectrum is the replacement of double-sideband (a.m.-d.s.b.) transmission systems by single-sideband (s.s.b.) systems. In addition, the use of s.s.b. confers many technical and economic advantages as compared with d.s.b. systems."

The Report goes on to point out that a s.s.b. system occupies only one half the spectrum space required by a comparable d.s.b. system, and that the use of s.s.b. instead of d.s.b. will reduce the congestion in the h.f. spectrum. Furthermore, the quality of the s.s.b. circuit is improved over the d.s.b. circuit; there is an increase in the signal-to-noise ratio, a reduction of distortion due to selective fading and the reduction of interference from various causes.

For a given signal-to-noise ratio s.s.b. permits a very considerable reduction in transmitter power. Operating costs are reduced because of power reduction and it is emphasized that a.m. equipment need *not* be replaced, but can be converted to s.s.b.

The report states that where two or more radio-telephone circuits are at present being operated on separate radio circuits between two points, appreciable economy in the use of the h.f. spectrum can be affected if those channels are transmitted over a single radio circuit using the independent-sideband (i.s.b.) technique.

Of course, the use of i.s.b. by commercial stations for multi-channel telegraphy and mixed systems, *i.e.*, a radio telephone circuit on the upper s.s.b. channel and many telegraph channels on the lower s.s.b. channel, will do much toward alleviating the congestion in the h.f. spectrum.

January 1970 Changeover

The POE noted No. 465 of the Radio Regulations (Geneva '59) which urges the communications administrations of all countries to discontinue d.s.b. in the fixed service in the bands below 30 mc if possible by January 1, 1970. The POE, however, feels that it is desirable that d.s.b. transmissions be discontinued at an earlier date.

The Report then continues on and contains

*c/o *CQ*, 300 West 43rd St., New York, N.Y. 10036.

recommendations, the most important being Recommendation No. 1: "D.s.b. transmission systems shall be converted into s.s.b. systems or i.s.b. systems with suppressed or reduced carrier by the following dates: Jan. 1, 1967 for d.s.b. transmitters with an average power of 100 watts or more; Jan. 1, 1970 for d.s.b. transmitters with an average power of less than 100 watts."

A total of 38 recommendations were made by the POE. These covered a large number of subjects such as the use of directional antennas, automatic control of output power of h.f. transmitters, compression of bandwidths, use of control tone for a.g.c. of receivers in s.s.b. radiotelephone systems in the h.f. maritime mobile bands, frequency control and assignments by administrations, use of space communications systems for alleviating the h.f. spectrum congestion, use of tropospheric scatter instead of h.f., *etc.*

The Amateur Bands?

The recommendations made by the POE did *not* specifically consider the h.f. bands now used by radio amateurs; however, in this writer's opinion many of the recommendations made to relieve commercial h.f. spectrum congestion are equally applicable to the ham bands.

It is my feeling that this report, when analyzed by the various communications administrations throughout the world, will result in action which will require radio amateurs to use s.s.b. instead of d.s.b. within certain power limits. Each country's administration (including our own FCC) can decide to adopt the recommendations of the POE if they so desire and feel that the change-over from a.m. to s.s.b. will enable better communication in the ham bands—which I believe it will.

I should like to point out that if the FCC does decide to require radio amateurs to change over to s.s.b., the change will require hams to adopt one "new" operating technique, and improve their equipment. If four stations use the same frequency (two on upper and two on lower sideband) for communication, a certain amount of coordination will be required. The equipment bandwidth will have to be as narrow as the state of the art allows, with better carrier and sideband suppression.

What do you think?

Questions

Silicon Replacement Rectifier—"Tell me, can you recommend a silicon high voltage rectifier to replace the following tube rectifiers: 5Y3, 5U4 and 5W4?"

Yes. Try the tested International Rectifier Corp. Type ST-14 silicon h.v. rectifier. It can replace the tubes you mention, plus the 5T4, 5V4, 5Z4, 5AU4, 5AW4 and the 5AZ4. See the photo. The ST-14 requires no warm-up time, has high reliability, reduced loading on the power transformer and generates very little heat. Before you buy one, however, obtain Bulletin SR-209-D covering the unit. A dropping resistor (externally mounted) may be needed for some tubes. Write the company at El Segundo, California.

A quick and easy substitute for many rectifier tubes is this International Rectifier ST-14 silicon rectifier replacement unit, handling the 5Y3, 5U4, 5T4, 5AW4, 5Z4, etc. Some applications may require external voltage dropping resistors.

Broadband Linear 600-L—"I own a Central Electronics Model 600L broadband linear r.f. amplifier. I drive it with an HT-37. When I first got the 600L it worked okay, but I note that the output (as read on the meter) has dropped about 50%. I replaced the final 813 and it worked for about an hour, then returned to its old output reading. Any hints?"

Yes. First check the four swamping resistors R_{20} in the grid of the 813. Next, check the screen voltage on the 813. Adjust the screen voltage to the proper value with R_{14}. Then make sure that you are not over driving the linear. If the above measures do not help, then check the 812A used as the series screen regulator tube, and the regulator control tube (6AQ5). Check your bias with plate voltage off and on. You may have trouble in the bias circuit. Make sure all relay contacts are clean, especially in relay B.

HT-33B—"I use a Hallicrafters HT-33B linear which has given me real fine service, but lately the 5 amp. fuse blows after the set has warmed up for about 15 minutes. Where should I look for the trouble?"

The 5 amp. fuse in the HT-33B protects the filament, bias and blower circuits. If it takes 15 minutes for the fuse to go your set must have a thermal short of some kind. Check the HI-LO blower switch first. Then as soon as the fuse blows pull the PL-172 and check for shorts with an ohmmeter. Next, check the solid state rectifiers in the bias circuit. Also check the 16 mf capacitor in the bias circuit, C_{26}. A thermal short is often hard to locate. One other thing, look for a possible shorting of R_{21}, the bias adjust pot. The HT-33B is a terrific linear, but like any other piece of electronic gear can develop trouble—no electronic part has an everlasting life. Although a transformer winding may short out after heating up, I doubt very much that this is your trouble. To check this, pull all tubes, measure the d.c. resistance of the primary and secondary windings when cold. Then, when the fuse blows, measure again. Be careful! The high voltage in this set goes up to 2700 volts! Be sure to measure between winding ends as well as from the windings to ground.

Viking Adventurer—"What causes L_3, the parasitic choke, to burn up in my Viking Adventurer?"

Operating the set into an antenna system having a high s.w.r. Don't try to use the set on 10 meters using say a 75 meter dipole.

Collins 30L-1 ALC Meter—"What causes the exciter meter to deflect to the left when the 30L-1 is on and the p.t.t. is actuated?"

The 1N252 diode in the metering circuit may develop a reverse leakage which will permit some of the positive delay bias to appear in the exciter a.l.c. circuit. This causes left deflection of the meter.

To correct the condition simply replace the 1N252 with a 1N458 which has a much higher voltage capability and will block the delay bias completely.

B&W 5100-B Talk-Back—"What causes modulation transformer talk-back in my B & W 5100B?"

A small amount of talk-back is normal. If it is excessive, this is due to a loose lamination in the transformer core. This can be cured in most cases merely by tightening the end bell bolts. In severe cases the end bells should be removed and a small wooden wedge driven between the center section of the core and winding. Be sure to tighten the mounting bolts too.

HQ-145-X Gain Control—"The sensitivity of my HQ-145-X receiver seems to have dropped off. The gain control does not seem to have the wide control it had before. What do I do?"

First check V_4, the 6BA6 tube. If ok, check R_{18}, the 10K ohm pot in its cathode circuit. Also check R_{16} and R_{14} in the same circuit.

KWM-2/2A "Off-frequency" Tuning—"Sometime ago you asked if anyone had come up with a practical idea for 'off frequency' tuning of the KWM-2. Any answers?"

Only one, from the Waters Mfg. Co., Wayland, Mass. They manufacture a Channelator® for the KWM-2/2A which resolves the transceiver tuning problem. The unit sells for $75.00 and is worth it. With the Chanellator you can operate normal p.t.o. or split channel. It can be installed in a few minutes without set butchering. Write the company for details. HAM CLINIC recommends it.

Correction—In Dec. '63 *CQ*, p. 61, correct fig. 3 by adding a connection from the top of the 10K resistor to the center of the two 50 mmf capacitors.

Multi-Band Vertical Antenna — "Where can I obtain some practical information on a multi-band vertical antenna?"

Obtain a copy of the September 1959 issue of *CQ*.

HQ-140X Updating—"What issue of *CQ* contains information on up-dating the HQ-140X receiver?"

The January 1960 issue.

5 Watt Transistor—"What transistor do you suggest I use for a final on 50 mc to obtain 5 watts of r.f.?"

Try Pacific Semiconductors type DPT657, also known as the 2N2887. The price is presently high for only one unit, but it is worth it if you do not want to be bothered with high voltage supplies.

Selecting Oscilloscopes—"I'm one of the engineers (also a ham) who reads *CQ*. The information I seek is not for my ham work but I would appreciate your help. I've been given the task of selecting a couple of scopes for our lab, and I was wondering if you could refer me to *recent* information in capsule form which would assist me?"

Sure. Write Tektronix Inc. P.O. Box 500 Beverton, Oregon. Ask for their compilation of two articles (in booklet form) entitled "Fundamentals of Selecting and Using Oscilloscopes." This is the best information I have seen in brief form printed during the last couple of years. My *Ham Scope Book* will contain similar info when and if ever published.

Thirty

As we have said before, most manufacturers of ham equipment cooperate with HAM CLINIC by furnishing instruction books, service sheets, etc., without much prodding. There are however, still a few (of the newer manufacturers) who do not realize how much we actually help hams all over the world with their technical problems. We do (in many cases) lessen the correspondence load on service managers and placate a number of irate customers. In a large number of instances we have helped hams who have received *no* replies from manufacturers—some of which have since gone out of business.

Again we solicit your patience and answer all mail in the order received. If you have not yet received a reply, you will.

73, Chuck

"He says we're making S7 on peaks . . ."

RTTY

BYRON H. KRETZMAN*, W2JTP

RTTY Operating Frequencies

Nets centered on frequencies given; operation usually ± 10 kc on h.f.

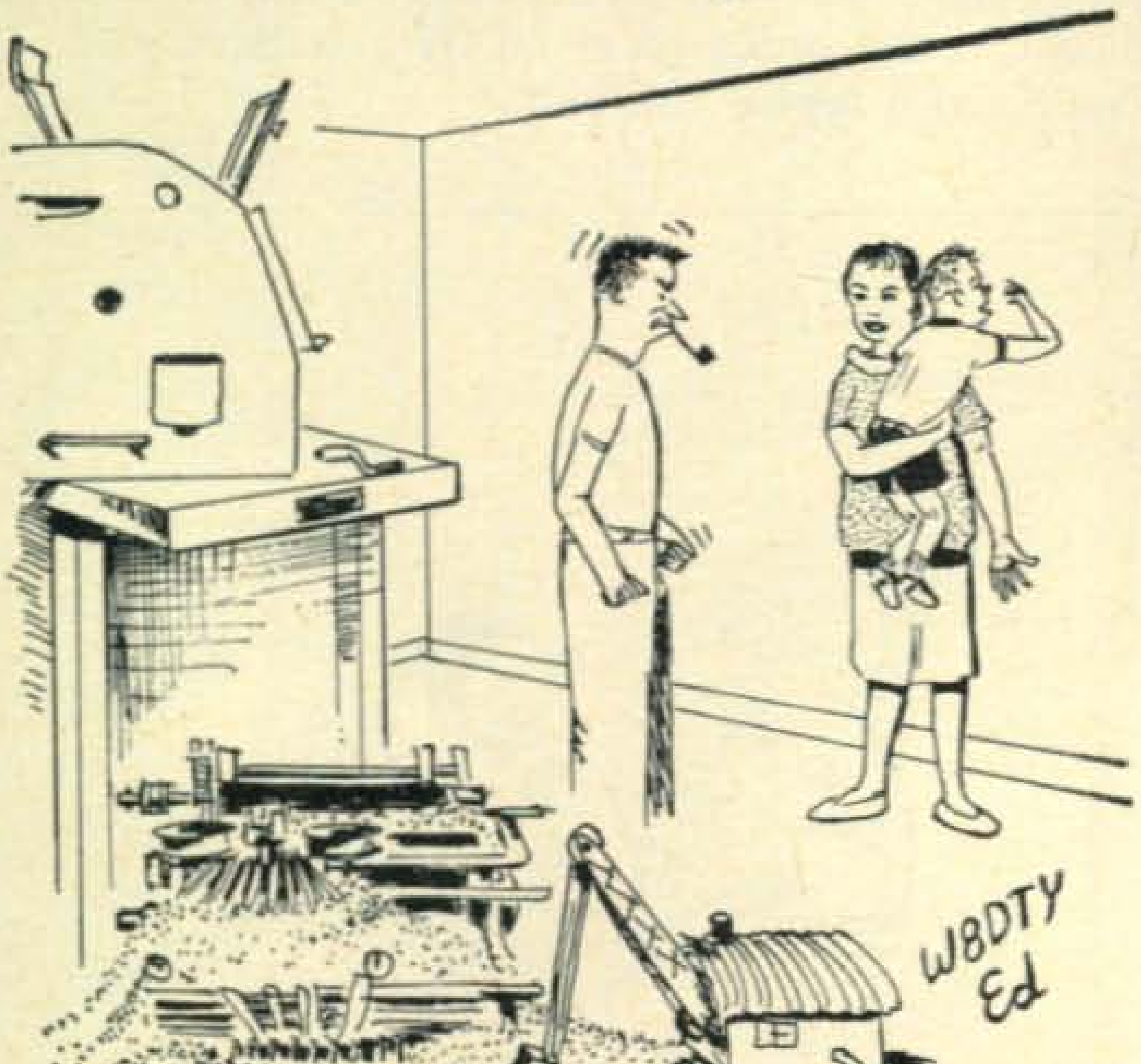
80 meters	3620 kc
40 meters	7040 kc
20 meters	14,090 kc
15 meters	21,090 kc
6 meters	52.60 mc
2 meters	146.70 mc

Mercury relays, specifically those of the 275 and 276 type are fast gaining in popularity in radioteletype circles. They are practically trouble-free, and since they are sealed, their adjustment cannot be played-with. More and more are becoming available in surplus, and of course they are still used by many of the operating telephone companies in certain carrier systems.

This type of mercury relay, made by Western Electric, consists essentially of a switch within a solenoidal coil contained in a metal tube shell with an octal base. The 275-type relays are about the size of a metal 6V6 and the 276-type relays are similar except that they are a bit longer. The switch provides a transfer consisting of two front contacts, two back contacts, and a single swinger (armature) which are continuously coated with mercury and enclosed in an atmosphere of hydrogen in a sealed glass tube. *(DANGER! Don't try to open!)* At the usual telegraph and/or teleprinter keying rates there will be a period during the transfer in either direction when all switch contacts will electrically connected or "bunched." The bunching interval is not expected to exceed one millisecond by the manufacturer. By the way, it is required that these relays be mounted in a vertical position, or at least within 30 degrees of vertical.

*431 Woodbury Road, Huntington, N. Y. 11743

RTTY The Hard Way... No. 30



"After all, dear, it's only sand. . . ."

Characteristics

Table I lists the essential characteristics of the 275 and 276 mercury relays. Note that some of the relays have one winding while others have two windings, like the 255A polar relay RTTYers are most familiar with. In this case, to differentiate, one winding is called the primary and the other the secondary. It is recommended that they be operated on 2.5 to 5 times the "operate" current listed. Coil resistance should be within 10% of the values given, except the low resistance coil of the 275E relay is within 15%, and the coils of the 276T are within 5%.

No d.c. operate and release current characteristics are given for the 276E and 276K relays. The manufacturer states that a 60-cycle 18.5 volt r.m.s. sinusoidal voltage applied to the single winding of either of these relays will cause the armature to transfer from one pair of contacts to the other pair of contacts, 60 times a second, with approximately equal time of dwell (zero bias) on the front and back contacts. No current characteristics are given for the 276C either as this relay has unknown "special requirements." Note that the 276L relay has its switch electrostatically shielded.

FRXD Corrections

Last month there were some errors in the diagrams associated with the description of the FRXD tape equipment. In the schematic diagram of the reperforator transmitter distributor, the wire from the top of the s.p.s.t. section of

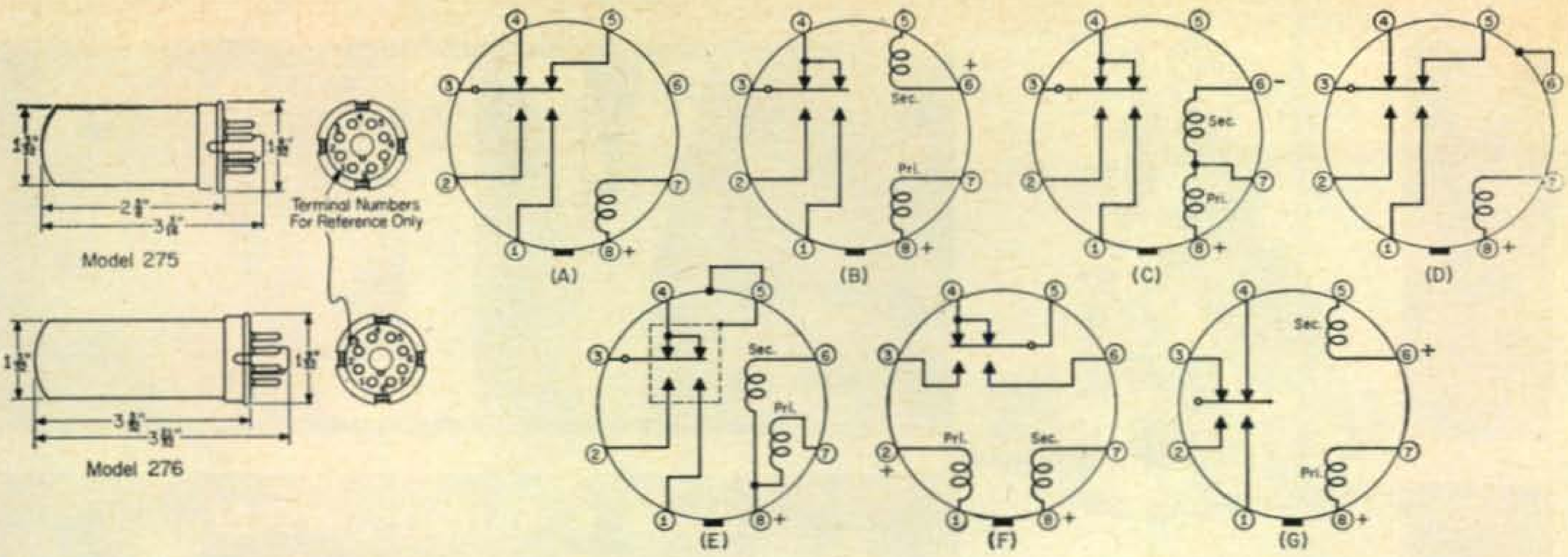


Fig. 1—Western Electric 275 and 276 mercury relays, outlines and connections.

the universal contacts also connects to terminal 27B and to pin 33 on the Jones plug. The FRXD selector magnet circuit shown in fig. 2A did not indicate clearly the actual wiring as it is in the machine, so a revised diagram is included herewith. Also, the CUTOUT SWITCH in the FRXD motor circuit, diagrammed in fig. 2B last month, is normally closed instead of open as it was shown.

News Item

An RTTY Dinner and get-together will be held in New York City Monday March 23rd (This is during the IEEE Show) at Patricia Murphy's Restaurant, 260 Madison Ave. An informal rag-chew will begin at 5:30 and dinner will be at 7:00 P.M.

Send reservations as soon as possible, at $6.50 each, to Elston Swanson W2PEE, c/o IFI, Inc., 101 New South Road, Hicksville, New York.

On the Bauds

K1YZG of Ridgefield, Conn., is on 80 f.s.k. and on 2 a.f.s.k. W1AOH of Darien, Conn., works 20. W1OUG of Stamford, Conn., uses tape on 80. K2DCY of New York, N. Y., has three 6-channel TD's for sale for $30 each. WA2WAU of Delhi, N. Y., is looking for a TU to go with his 200V. W2JAV of Hammonton, N. J., works narrow shift Sunday mornings on 7140 kc. W2OQI of Center Moriches, L.I., is getting a Model 15 into shape. W2KQP of Huntington, L.I., is on 80.

W3UCY of Stroudsburg, Pa., is on 80 with a kw. W3UQX of Allentown, Pa., is on 80 with 75 watts and very narrow shift code ident. K4QVD of Melbourne, Fla., runs 800 watts to a pair of 4CX250B's and uses a 4-transistor TU. K4IBX of Kershaw, S.C., has a BP-114/210 machine. *(What is it? Let Jess know if you have any dope on it.)* WA4GTA of Portsmouth, Va., is on 80 after working mostly 20.

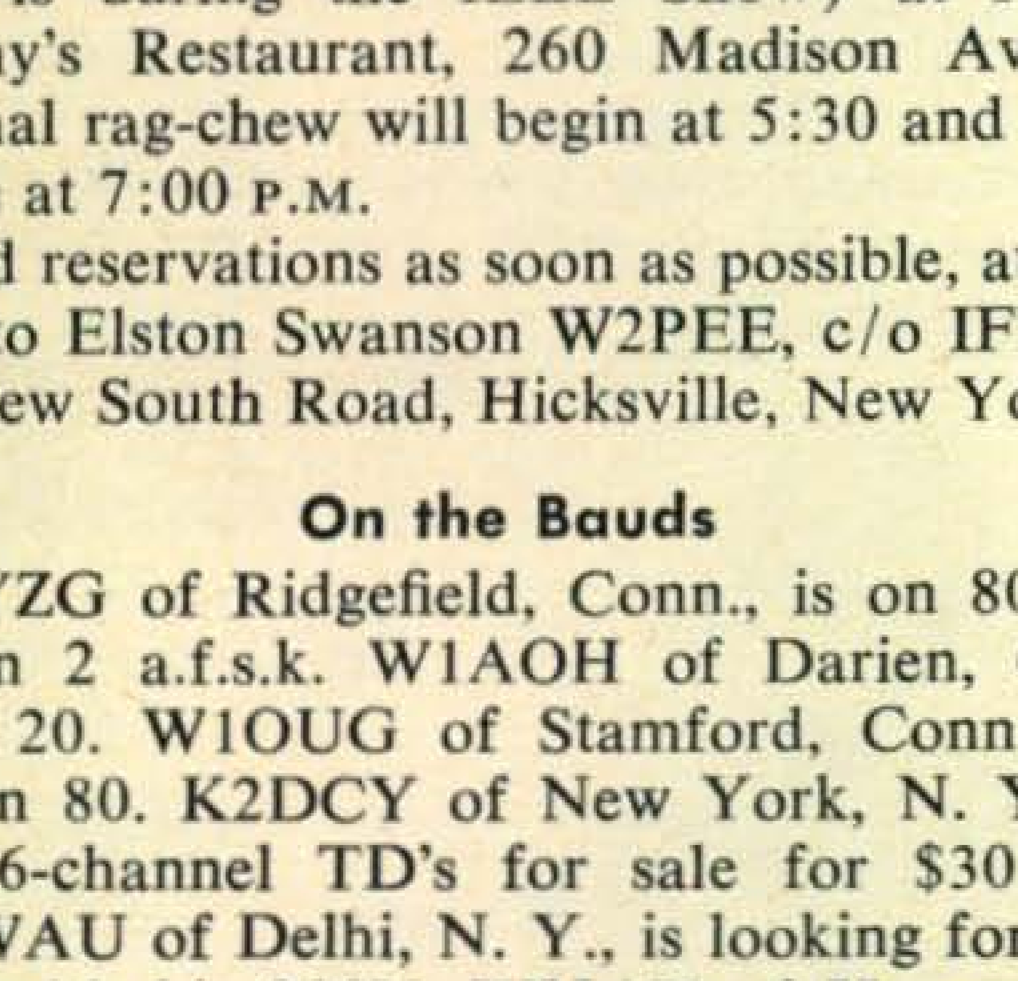


Fig. 2A—FRXD selector magnet circuit shown exactly as in the machine, wired for parallel operation. For series operation, move the black wire (BK) to terminal 2, and the red wire (R) to terminal 3.

WB6DBD, ex-W7LVR, and W6CEM, both of Santa Barbara, Calif., both work 20. W7ZSB of Salt Lake City, Utah, is on 20. K7EIS of Portland, Oregon, needs a keyboard plate for his Model 15. K8JWC of Flint, Mich., has built a W2JAV transistor TU and is looking for a way to modify his Drake TR-3 for f.s.k. *(Can anyone help?)* K8DKC of Ann Arbor, Mich., was heard on 80 with Dave as the operator. K9LBA of Indianapolis, Ind., works narrow shift on 7140 kc Sunday mornings. K9HNG of Homewood, Ill., was heard on 80.

KØJPJ of Springfield, Mo., high-speed c.w. operator, is now on RTTY, on 80 mostly, with a modified HT-37 and Warrior amplifier, Models 15 and 19, and a 75A-4. WØQWY reminds us that his article in August '63 *CQ* covers RTTY

[*Continued on page 102*]

Table I—Mercury Relay Characteristics

Type	*Fig.*	*Windings*	*Ohms*	*Operate* (ma)	*Release* (ma)
275A	A	Single	2500	10.1	4.5
275B	A	Single	4000	8.1	3.6
275C	B	Pri.	700	32.0	14.2
		Sec.	3300	12.9	—
275D	A	Single	700	20.0	8.9
275E	A	Single	2	315.0	140.0
275F	F	Pri.	120	55.0	24.5
		Sec.	125	80.0	—
276A	A	Single	90	16.0	1.3
276B	A	Single	4000	3.0	0.2
276C	A	Single	4000	—	—
276D	A	Single	4000	1.5	−1.5
276E	A	Single	4000	—	—
276F	A	Single	1000	5.6	0.4
276G	C	Pri.	700	14.2	2.8
		Sec.	3300	5.7	—
276H	A	Single	90	32.0	15.0
276J	A	Single	4000	4.7	1.7
276K	D	Single	4000	—	—
276L	E	Pri.	1020	14.0	5.9
		Sec.	970	16.0	—
276M	A	Single	4000	5.9	2.8
276N	C	Pri.	700	6.0	−6.0
		Sec.	3300	2.4	−2.4
276R	G	Pri.	100	13.0	−13.0
		Sec.	1100	4.5	—
276S	A	Single	34	90.0	—
276T	B	Pri.	2500	6.7	0.5
		Sec.	2500	7.8	—

YL

LOUISA B. SANDO*, W5RZJ

YLRL Members...

YLRL's Treasurer for 1964 is Barbie Houston, K5YIB. Send your YLRL membership dues, $2.50 ($3 for DX), to her at P.O. Box 652, Richardson, Texas.

Once again, special congratulations to Joyce Polley, KØIKL, who, for the second year in a row, made a clean sweep of all the top awards in YLRL's Anniversary Party (the 24th A.P., held Oct. 23-24, Nov. 6-7). To her high score of 8220 earned on phone she added 2565 points on c.w. for a combined high score of 10,785, thus winning both the phone and c.w. cups, and the Corcoran plaque. These are the top scores:

1st c.w.—KØIKL, Joyce Polley 2,565
2nd c.w.—WA6OET, Jessie Billon 2,465
3rd c.w.—K1UOR, Doris Young 2,145
1st phone—KØIKL, Joyce Polley 8,220
2nd phone—WA4FJF, Ellen Ackerman . 8,000
3rd phone—K4RNS, Marge Campbell .. 7,791

Corcoran Award

KØIKL, Joyce Polley 10,785

District High Scores

Phone		KØIKL	8,220	WA6OET	2,465
K1UOR	3,700	K4COB/		K7OFX	1,800
W2OWL	1,150	VE6	146	K8ONV	1,803
W3MDJ	2,175	VE7ADR	3,046	W9MLE	1,350
WA4FJF	8,000	KZ5TT	3,002	KØIKL	2,565
K5OPT	6,370	*C.W.*		VE3BII	260
WA6OET	7,420	K1OUR	2,145	VE6ABV	1,800
W7RVM	4,945	W2EBW	336	VE7ADR	1,519
K8MZT	3,610	K3PKI	1,523	JA1YL	99
WA9ENB	3,760	WA4FJF	1,236	G2YL	37

Public Service

Public service is the "meat" of ham radio, so it's always FB to learn of YLs in there pitching in an emergency.

Ellie, K4RHL, had rewarding experiences handling emergency traffic, first with YN3KM in "Operation Mad Dog," and later with EL2E after the assassination of President Kennedy. On both occasions Ellie was on the YL International SSB Net. On Oct. 30, YN3KM called with emergency traffic. Two small girls had been bitten by a dog suspected of rabies. Their fathers, both doctors, wanted "anti-immune" rabies serum, which must be administered within 78 hours. While Ellie was working on it two more girls were bitten. Ellie was unable to locate the serum in Florida, but learned the only way to get serum to Nicaragua in time was on a plane out of New Orleans. Mabel, K5SGJ, also on the net, offered to help. W1AOL, a doctor and friend of Ellie's, broke in to give the name of another doctor in New Orleans who would know how to locate the serum. Mabel did locate it, then had to arrange to get a prescription for it and also permission from the Nicaraguan Consul to ship it to Nicaragua. With much phoning and arrang-

[*Continued on page 101*]

*4417 Eleventh St., N.W., Albuquerque, New Mexico 87107

Ellie Horner, K4RHL, operating s.s.b. at her Ft. Lauderdale QTH, enjoys handling emergency traffic. Licensed in 1960, her OM is K4YBL and a son is WN4BGM. Other hobbies include several grandchildren, photography, raising orchids, fishing and boating.

Euride Busti, I1WAS, operates c.w. and phone mainly on 40 and 20 meters, from Milano, Italy. Photo courtesy of Chuck, W4VZO/HB9, editor of CQ's Ham Clinic, who met her on his travels around Europe.

Vol. 6, No. 3—March, 1964

VHF AMATEUR

BOB BROWN, K2ZSQ

EVEN though during the past few months we have devoted a considerable amount of magazine space to the K3IOP case,[1] we still continue to receive correspondence on the matter. Amid these letters, one arrived from Robert Halley, K8YMI, that might throw a new light on the case. We, of course, do not fully concur with his remarks, since our findings to date strongly contradict his, but in all fairness to the importance of determining and reporting the truth, Bob deserves to be heard. Whether the picture be black or white, our purpose is to inform. You be the judge.

". . . I was raised in Elizabeth, Pennsylvania, and though I moved after W.W. II, my family still lives there and we visit with fair regularity . . .

". . . When I first heard that severe interference was occurring, I assured my friends that 'the ham involved recognizes the importance of helping people eliminate such problems, even if the transmitter and related equipment meets all the requirements set forth by the FCC. Certainly he will cooperate to the fullest to help solve the problem.' As time passed, though, it became evident that this young boy (16 years old) was *not* going to cooperate. In fact, it appeared that he was being poorly advised and *encouraged* to be unpleasant to the Borough Council, for his equipment did meet standards and he couldn't care less what interference he was accomplishing . . . because he felt he was 'clean.'

"Congressman Holland was brought into the affair because this young man was a 'public nuisance' and under existing laws there was no way to deal properly with him . . . The boy was heard on a TV to say, 'Boy, we sure fixed them tonight,' and this was just after a particularly bad round of interference.

". . . The talented boy must recognize his responsibility as a citizen. The citizenry of Elizabeth must also recognize that throwing rocks and garbage and name calling likewise are not the marks of responsible citizenship."

* * * * * *

Switching topics somewhat, obviously public relations still play a major role in amateur radio. In this connection we'd like to show you a form letter that is attached to other interference material distributed to those experiencing TVI in the Philadelphia area.

[1]See Dec., 1963, p. 69; Jan., 1964, p. 77; Feb., 1964, p. 77.

The Cause and Cure for TVI

The present day television receiver is a wonderful example of American ingenuity, design and construction, developed over a long period of years to its present state of perfection. However, as is true with much mass-produced apparatus, it still leaves something to be desired. One inherent shortcoming of most present TV receivers (including the expensive color sets) is their inability to reject a strong unwanted local radio signal. These signals which the receiver permits to slip through may cause lines or streaks, either light or dark, to appear on the picture screen or, in varying degrees remove the picture, or replace, in part or completely, the sound of the TV program with some other's sound or voice, thus reducing or even destroying your TV viewing pleasure. Why? Because the TV receiver is not designed to handle this situation. Although there are many types of television interference, the kind we are most concerned with is that believed to be caused by radio transmitter. Actually, in well over ninety percent of these cases this is not TV "interference" but rather TV "interception," inasmuch as the TV is intercepting a radio signal which it was not designed to receive.

In over seventy percent of these cases the interception can be eliminated by the *proper* installation of the correct high-pass filter on the TV receiver. In another fifteen percent two or sometimes three inexpensive components are required. Only in the remaining less than five percent is any extensive work required. *Word of caution:* There are many high-pass filters on the market, but not all of them will eliminate interception of radio signals on frequencies between 44 and 52 mc.

Many people have been told by their service technician that nothing can be done about their particular case of TVI. This is not necessarily so. In practically all cases *something* can be done.

If you are sincerely interested in eliminating television interception, please write to:

FEDERAL COMMUNICATIONS COMMISSION
Engineer In Charge
1005 U.S. Customs House
2nd and Chestnut Streets
Philadelphia, Pa. 19106

[If you desire, you can make copies of the above for your own use, but remember to put in the address of *your* nearest FCC office.] ■

Five Half-Waves in Phase on 144 Mc

A "Gain" Antenna for 2-Meters

BY BYRON H. KRETZMAN*, W2JTP

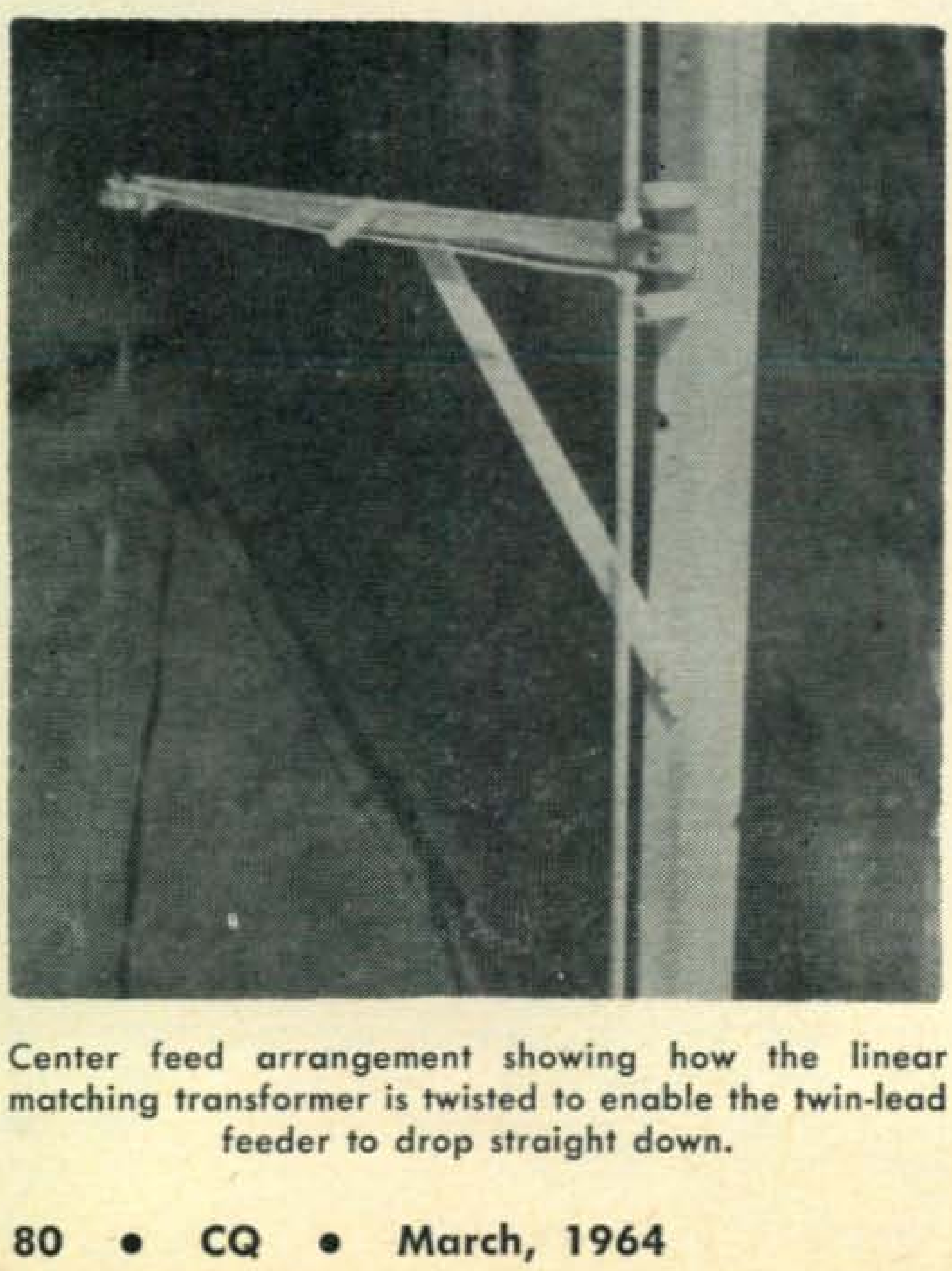
On two meter mobile and f.m., the vertical antenna still holds the edge on popularity with its omnidirectional characteristics and simplicity. Add to this, though, a little omnidirectional gain on the order of 5 db and the vertical begins to look even more enticing than ever.

In case you didn't know it, not all 2-meter activity consists of DX-chasing, meteor scatter, contests, *etc.* In many areas, I'll grant you metropolitan and suburban for the most part, local and extended-local communication exists on a highly reliable day-in and day-out basis. Mobile operation, quite naturally, is a regular part of this activity. This harkens back to the days of the old 5-meter band where such v.h.f. operation began. As the result, hamming in these areas becomes a much more personal thing; everyone soon gets to know everyone else. It becomes easy to round up a gang to help put up a tower or a beam for another band.

Keeping in mind that working mobiles is a requirement, you can see that vertical polarization is a must. Secondly, those who have tried beams quickly realize that, in these centers of high activity, beams are impractical. Too much can be missed off the back end. An omnidirectional antenna characteristic therefore becomes an additional requirement.

Omnidirectional antennas for 2-meters usually fall into two classes: the ground-plane or the coaxial-type. Both of these normally provide no gain in performance over a reference half-wave doublet, with the possible exception of the stacked coax antenna. What we are searching for is a 2-meter antenna which is vertically polarized and which will give us a power gain in *all* directions. Bear in mind, too; any gain achieved in the antenna system also results in increased range of reception. And, lastly, a high gain omnidirectional vertically polarized 2-meter antenna should be easy to construct at low cost. (This lets out the stacked coax unless you have the facilities of a machine shop available.)

*431 Woodbury Rd., Huntington, N. Y. 11743.



Center feed arrangement showing how the linear matching transformer is twisted to enable the twin-lead feeder to drop straight down.

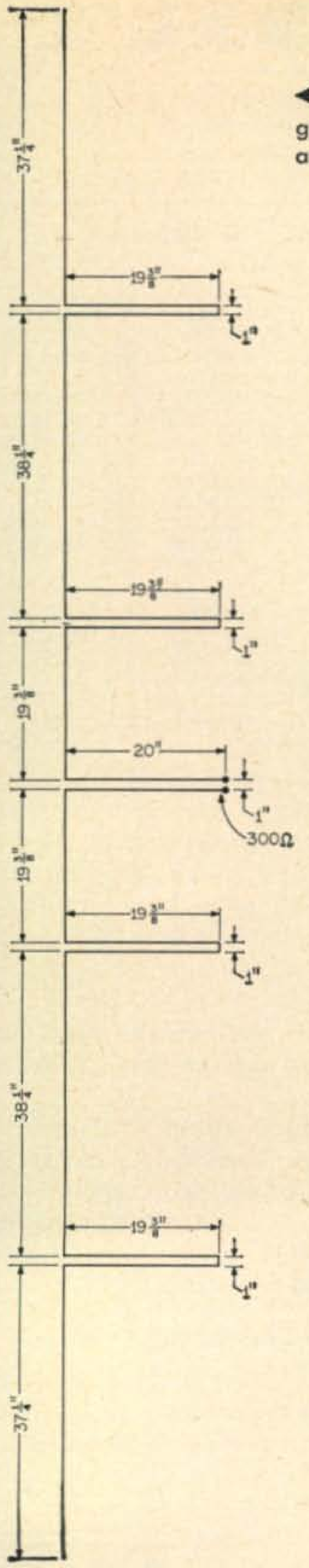
Theory

Gain in an omnidirectional vertically polarized v.h.f. antenna is realized basically by stacking half-wave elements, one above the other. The trick is to phase them properly and to feed them efficiently. This is nothing new. Twenty-five years ago this was called the "Franklin" antenna. Today a somewhat similar antenna is described in the ARRL *Handbook.*

From page 703 of the 4th edition of *Reference Data for Radio Engineers* (ITT), the gain of an omnidirectional stacked array is approximately equal to $2L/\lambda$ over the theoretical isotropic radiator, where L is the length. If we build an antenna of 5 half-waves in phase, the length, in terms of wavelength, is 2.5λ. Putting this into the above formula, the power gain is then 2(2.5) or 5 times. Since a half-wave dipole is considered to have a gain of 1.64 times the isotropic radiator, the antenna will therefore have a power gain of 5/1.64 or 3.05. This, then, is an effective gain of 4.84 db.

A Practical Antenna

Figure 1 shows the schematic diagram of



← Fig. 1—Schematic diagram of the 2-meter gain antenna. (Antenna cut to 147 mc.).

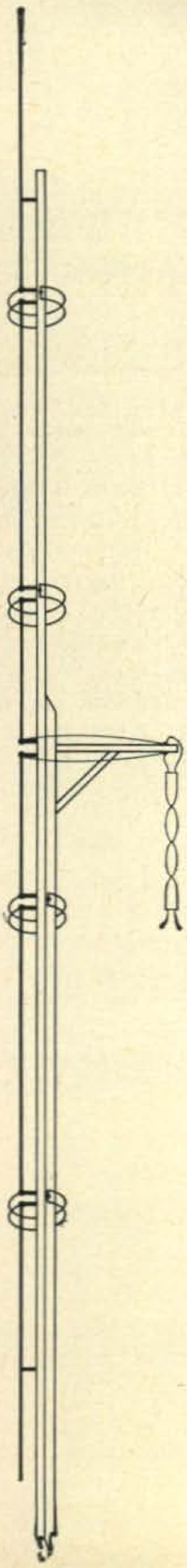
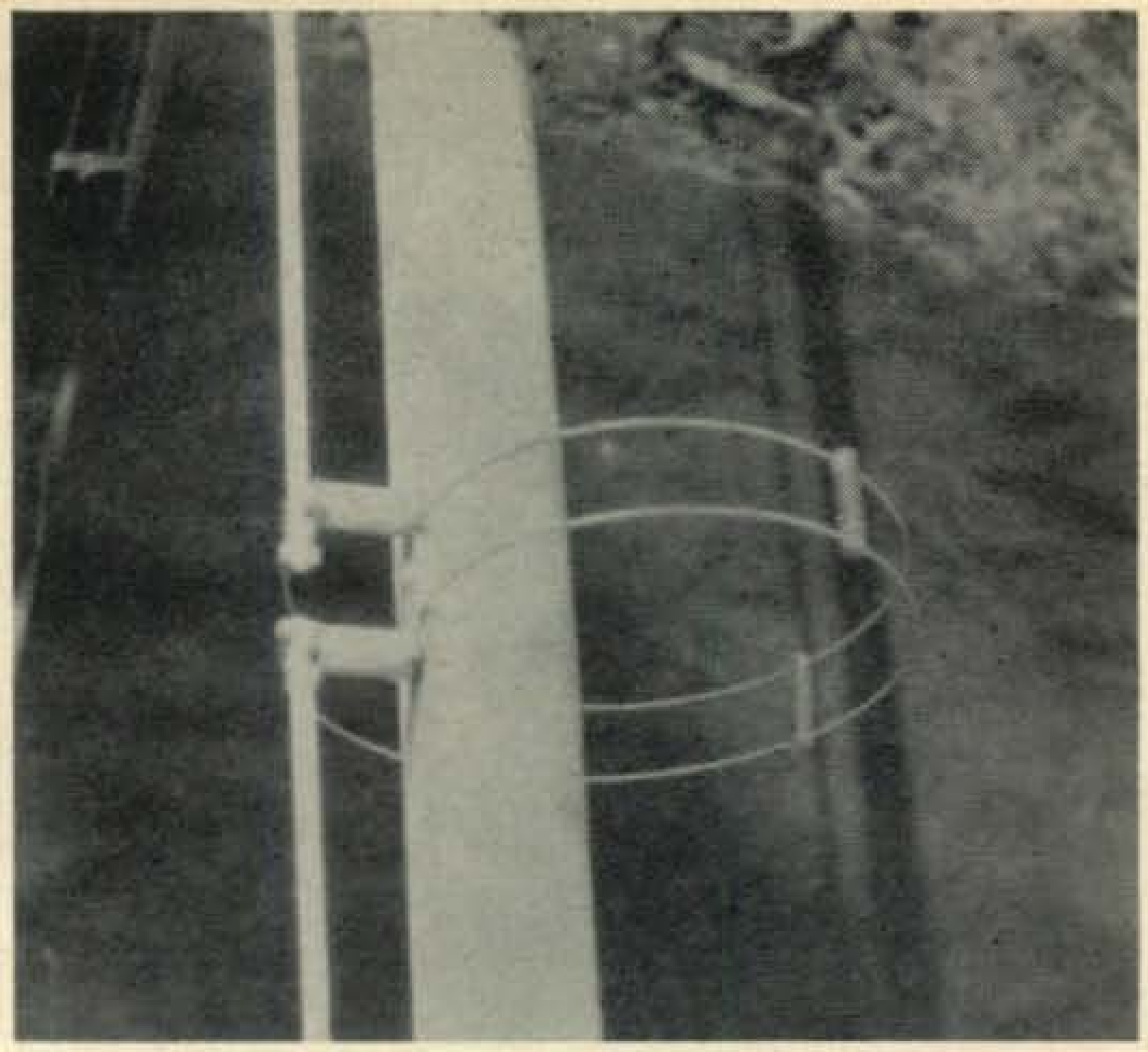


Fig. 2—Perspective view of omnidirectional antenna.→



One of the four quarter-wave matching stubs. Note how it is curved around into a halo about 6" in diameter.

our 2-meter "gain" antenna. As you can see, it consists of five half-waves in phase, one above the other. There are quarter-wave matching stubs in between each element, and the feed point is at the center of the middle half-wave element. *(Feeding this array in such a balanced manner is one of the tricks in getting efficient operation.)* The antenna feeder is ordinary 300-ohm TV "twin-lead." *(Horrors!?)* This was done for several reasons. First of all it is low cost, as compared to coax. Secondly, its losses are less than ordinary coax; and, thirdly, because it is a mechanically simple balanced transmission line with readily available inexpensive (TV) supporting hardware.

Our antenna was cut to about 147 mc, and like any co-linear array it is reasonably broad, having a low s.w.r. out to at least 1 mc either side of that frequency.

You *could* feed this antenna in the center of the middle element directly with the 300-ohm twin-lead, that is if you don't mind a standing wave ratio of about 2 to 1. We did, so a quarter-wave linear matching transformer was installed at the feed point. The results were extremely gratifying. Its installation brought the s.w.r. down to 1.1 to 1.

Just one more point: Note that, in the interest of balance, the matching transformer is brought away from the feed point at a right angle; and, consequently, the twin-lead feeder is brought down at least a quarter-wave from the lower sections of the antenna thereby little affecting the feed impedance.

Construction

Our 2-meter gain antenna is built on wood. *(Horrors, again?)* Using wood greatly simplifies construction and reduces cost. You can't buy 2 × 2's twenty-four feet long but you *can* buy a 2 × 4 that long. Just a little sweet-talkin' to the lumber yard man and he will rip-saw it right down the middle for you. Of course you should get him to let you pick out a length as straight-

[*Continued on page 85*]

VHF REPORT

an exclusive feature of The VHF Amateur

BY BOB BROWN*, K2ZSQ

Of all the various certificates and awards available to the v.h.f. operator today, *CQ*'s VHF Century Club Certificate still ranks among the most sought after. Although no magazine publicity has been given the CCC for well over a year, scarcely a day goes by when the mailbag doesn't bring some new six and two meter applications. Just as ARRL's Rag Chewer's Certificate is an integral part of any low frequency amateur station, the CCC over the years has become the new v.h.f. operator's number one objective. Just what is the *CQ* VHF Century Club all about?

The certificate was originated in March, 1958, to promote activity in the v.h.f. bands, an award idea borrowed from successful British amateur endeavors in the past. Presently our membership consists of certificate holders the world over who operate the bands above 50 mc. Awards are issued to those holding the required amount of QSL cards confirming contacts all made on a *single* v.h.f. band within any *one* 365-day period. There is no limit on the amount of certificates you can amass, as long as each application is accurate. Every so often as space permits new members will be announced in this column, as well as club notes. Each certificate bears a different number, but this figure is just a classification digit and does not necessarily reflect order of issuance or priority.

The number of QSL cards required to have been accumulated within the 365-day period varies with the frequency operated. On 50 megacycles 150 QSL cards are necessary; on 144 mc, 100 cards; on 220 mc, 50 cards; on 432 mc, 25 cards. Separate application must be made for additional awards.

Application Data

1. Clearly print your name (as you want it shown on the award), call letters, and mailing address.
2. Plainly indicate the band used.
3. Arrange your cards chronologically and neatly list each, showing its number (beginning with one), call of station contacted, and the data worked.
4. Have two other amateurs inspect your cards and check them against your completed list. Both amateurs must sign a statement similar to the following:

"We, the undersigned, hereby verify that the above named applicant displays the QSL cards listed herein from actual on-the-air contacts."

SIGNATURE AND CALL ____________________

SIGNATURE AND CALL ____________________

The VHF Amateur, 300 W. 43rd St., New York, N. Y. 10036.

New Members: VHF Century Club

Six Meters

VP7CX	184	WA9FIH	198	WA2UWJ	215	WA4FVD	230
K8CEN	185	WA5DXV	199	K3NXH	216	K1TOL	231
K8QAD	186	K7TGI	200	WA4ISC	217	WA2ZHB	232
WA9FXX	187	K2PBU	202	K8RZN	218	K3VRZ	233
K9TWF	188	K2PBU	203	W4YEL	219	K1ZGH	234
K4WKB	189	K2PBU	204	K8RSH	220	WA2GFP	235
WA9AHZ	190	K2PBU	205	WA2QCQ	221	WA9AZO	236
K8RZN	191	WA9BYF	206	K1PYX	223	WA8BXS	237
K8RZN	192	WA9EEG	207	K7GAT	224	WB2CDZ	238
K8RZN	193	WAØBBR	208	WA8EEP	225	WA2VLR	239
K4UVD	194	WA4EEZ	209	WAØBVL	226	K9CIF	240
K8ZSY	195	WA9AOK	210	WAØDAC	227	K9CIF	241
WA4EEZ	196	K8DCR	211	WAØCOR	228	K8JZW	242
WA4IRX	197	K1YLU	212	K7QFW	229		

Two Meters

WA6UPX	136	WB2BQJ	141	WA2ZSB	146	DJ4BG	151
WA9AHZ	137	WA8EWT	142	W9OKM	147	DJ2QZ	152
K6HIT	138	K2SJN	143	K2UKQ	148	DJ8KF	153
WV2SYI	139	DM2ADJ	144	DJ4KH	149	OK1VCW	154
WA4FLU	140	K8YWF	145	DJ4AH	150	DL9MC	155

Do *not* send us your QSL cards. No special endorsement is made to those who do, and these people must pay the expenses for their return. We will occasionally spot-check applications and request that you send us twenty or so cards (that we will select at random from your list) to be returned to you after processing. These spot-checks are made periodically and do not signify any skepticism on the part of the committee.

All awards are mailed within 30 days. (There is no charge for this certificate.) Address all applications and related club correspondence to: VHF Century Club, *CQ*, 300 West 43rd Street, New York, N. Y. 10036. NOTE: Official applications are available on request.

See U After The Contest, OM!

[*Guest editorial by K9HPB*] Recently I participated in a v.h.f. contest operation on two meters. In almost every case a contact with another station ended like this: "You're 59 plus, see you after the contest, OM." How many people listened to the band the day after the contest? I did not hear even one station on the air. I aired several calls with my 59 plus signal, but no

The CQ VHF Century Club Certificate, available since March, 1958, to qualified QSL collectors. See text for full details and requirements.

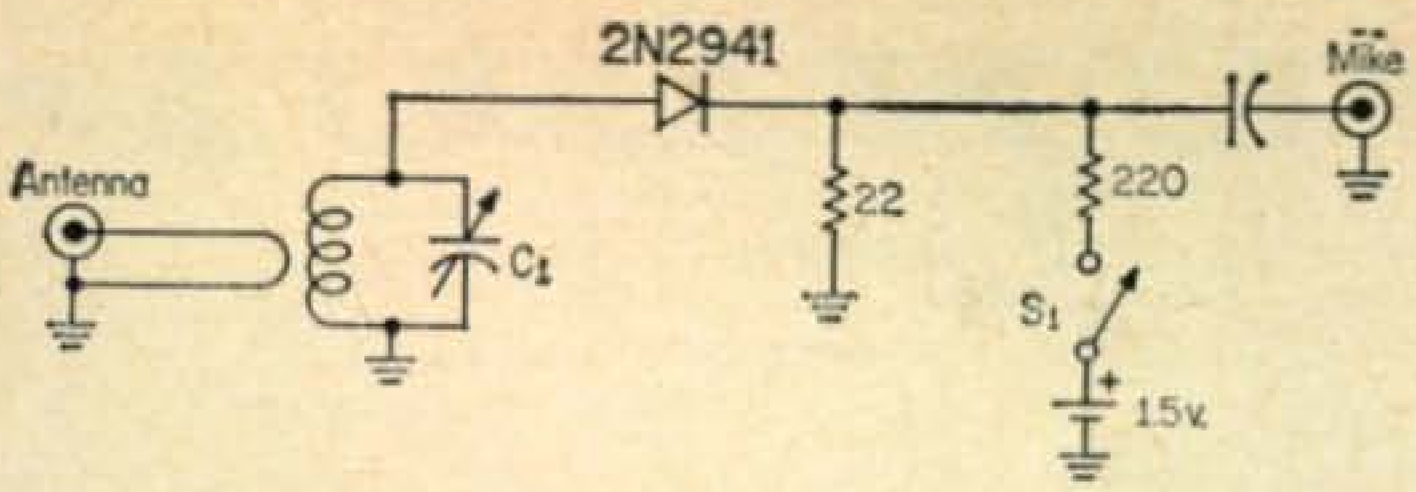


Fig. 1—W8HHS's tunnel diode v.h.f. oscillator. F.m. can be achieved by inserting a mike at J_1 where indicated. Both resistors are ½ watt. (Thanks to *VHFER* for the circuit).

C_1—1.5-9.1 mmf miniature variable. E. F. Johnson 189-4.
L_1—12 t. B & W 3003 stock with 1-turn link on cold end.

answers. I began to wonder if perhaps my gear wasn't working right. Or maybe the other station's equipment "went west"? From listening during a contest you know that hundreds of hams in the local area are capable of putting their stations on two meters. And most seem to have contest kilowatts in light of all those S9 plus signals. Everyone seems to have a super low-noise receiver/converter setup that will put every weak one out of the mud (the ones I hear are, at least) and convert him to Voice of America proportions. And what about those built-in contest S-meters? (This is the type with S7 marked at the far left of the face.) You can also assume from their remarks that all of these stations are going to be on the air all the time.

Well, *I have* listened to the band almost every night since the contest and very seldom do I hear any of these stations. Is all this two meter equipment just gathering dust? If so, it is a mighty big waste. Did everyone go back to the lower bands because of the lack of QRM on two? Come now, boys, let's reactivate two meters. Let's keep it going all the time.

Also, if you have some 220 mc gear lying around, blow the dust off, apply the juice and listen. Quite a few new stations are getting in on the 220 act. So, see you in the next contest, OM, and after, too. Jump in . . . the water's fine!

Miscellaneous Tech

Tunnel Diode Oscillator: Here is a quickie project for dyeowdie addicts which will always be useful around the v.h.f. shack. As outlined in fig. 1, this little oscillator circuit will tune from 49 to 76 mc, making itself available for converter and antenna adjustments when placed several hundred feet from the antenna system (especially when local signals are not available). If you wish to hit two meters, dust off the grid dipper and trim up the L_1-C_1 combination. This handy gadget can be built into a 2¾" × 2⅛" × 1⅝" aluminum Minibox, equipped with a whip antenna and turned on and off with a small slide switch. A penlite cell with appropriate clip would be just the ticket for the d.c. supply. Try it.

VHF News and Reviews

For those following the recent mobile logging efforts down South, take note that the FCC denied the petition for rule making by Jack W. Bazhaw (no call), of Dallas, Texas, to amend Sec. 12.136 by deleting logging requirements entirely for amateur mobile stations operating on frequencies above 50 mc. This denial was released to the press December 11.

From what we hear the Six Meter Mobile Association of Western New York's Annual Indoor Picnic was another whopping success. Held on January 18 at the Club Commodore in Buffalo, the response and attendance indicates strong competition in the near future with the Syracuse VHF Roundup gang. Keep your eyes on this group. (You can contact WA2TRT for membership details.)

K8TFL would say we saved the best for last. The VHF High Banders, Inc., of Marion, Ohio, recently enjoyed another Christmas Party, celebrating another phenomenal year for the group. One of their incentive programs is the issuance of monthly DX certificates and an annual revolving trophy for DX man of the year. Write K8TFL, 795 W. Center St., Marion, Ohio, 43305, for a copy of *The Highbanders Log*.

DX Doings

Things have been rather slow on two meters recently, at least if our mail is any barometer. Out Indiana way comes word from K9WZB in New Carlisle that during the winter the weekends seemed to have held the periods of maximum 144 mc activity. In spite of wintry conditions, solid contacts were made throughout December with W8DQK, Toledo; W8YLD, Dayton; W8SPJ, Cincinnati, and W9DHV, Watertown, Wisc. Gary would like schedules on 145.008 mc c.w. to Tennessee and Maryland on Sunday mornings. Any takers? Word from upstate New York has it that W2LWX has a new f.m. repeater operating under that call on 146.94 mc from Bald Mountain. Will try to have more info on this installation next month. (Tnx W2JTP).

Scattered six meter reports, on the other hand, enthusiastically report the perseverance of *E* openings throughout the month of December and continued good tropospheric conditions in the northeastern states. K1WYS, 261 Raynor Ave., Whitman, Mass., beams South frequently and would appreciate skeds to Long Island and Connecticut as well as into Maine, New Hampshire and Vermont.

From Wilmington, North Carolina, WA4KBP reports good tropo into Richlands (N.C.) on December 1st with K4VPZ (5 × 5 sigs). He skeds Jere every Sunday at 1930 EST on 50.25. Breakers invited. Two days later WA4KBP spanned 1,091 miles via Sporadic *E* to WA5VNY, Dallas, with S9 sigs. The fifteenth of December proved to be a big day for WA4MYH in Owensboro, Kentucky. John caught the skip into Minot, N. D., (WØDRJ) for his longest haul, although York Beach, Maine, was also contacted thru K1VUU. The skip was in for John between 1615 and 1832 EST. The next day, Dec. 16th, he snagged K4LLN in Norfolk, Va., via tropo inversion. Nice job!

[*Continued on page 85*]

UHF ROUNDUP

an exclusive feature of The VHF Amateur

BY ALLEN KATZ*, K2UYH

EXCUSE us if we get carried away with the topic of amateur TV this month. The majority of our correspondence has dealt with the subject lately, and only a few hours ago Ben, W2HUD, called to tell us of his efforts to start an amateur TV club in Northern New Jersey. If anyone could interest you in ATV, it is Ben. Besides which, what he said about the need for a club really made sense.

You know many of the great amateur advances have been made as a club effort. Take for instance the first two-way moon-bounce contact. Here was a feat which appeared too great a task for a single ham, yet the project was achieved when a group of amateurs pooled their knowledge and resources. The same kind of joint effort is used by high scoring club stations in v.h.f. contests.

Although the contribution of this type of organization can not be denied, clubs of this kind are not the answer to u.h.f.'s problems. Interest or lack of technical skills among amateurs are not the difficulty, the problem is faith. The type of club needed is one which will *encourage* and help its individual members to get on with their *own* equipment; one which will provide an answer to the question, "Who is on up there?" . . . "We are!"

When we first got on ATV from Verona there were very few television signals to be found on 440 mc. A group project was started among several of the fellows for the local RACES. Five flying spot scanners later, there were some buzzing signals on 440 mc. Now, what Ben is trying to do is get some of the smaller groups together. His is not a new idea, the Chicago Microwave Club has been doing a fine job in this field, and we cannot forget to mention the work being done by the many microwave groups on the west coast. But these clubs are not enough. We here at *The VHF Amateur* are always ready to help, if you wish to start a group in your area. But we must hear from you first. Who knows, if enough clubs get started, possibly we can organize a nation-wide ATV network. Now that would really be something!

Amateur TV Technical Tips

Al, K7VQI, has sent in a list of commonly available surplus transmitters which he has found are easily convertable to the 420 mc band. All the transmitters mentioned are of the self excited variety making them undesirable for serious type u.h.f. phone work. However, for 6 mc wide video operation, the lack of stability of these units offers no problem. The most interesting pieces of gear among the bunch are the APT-5 and APQ-7, both of which have built in video modulators, need no r.f. conversion, and cost less than 25 dollars. Al does not mention their power levels.

Here in New Jersey a favorite transmitter seems to be the ART-26 from which 60 watts of video output can be obtained on 440 mc, with little more than the addition of a power supply. W2HUD has been able to poke a TV signal over the 30 mile path from his home in Clifton to Long Island amateurs with just such a transmitter. Some of the fellows are also going on crystal control. This system does have the advantage that another crystal controlled transmitter 4.5 mc higher in frequency can be used to supply the audio. With a self-excited transmitter the audio must be injected into the video by a 4.5 mc reactance modulator.

Another interesting hint comes from K3ADS of Bryn Mawr, Pa., who is just about ready to go on 440.001 mc with 40 watts of video signal power (crystal controlled). In his letter Larry stresses the importance of proper video signal composition. A good way to accomplish this is to monitor your video output on a scope (sweep rate 7587 c.p.s.). A trace should be obtained similar to the one shown in fig. 1, if you are

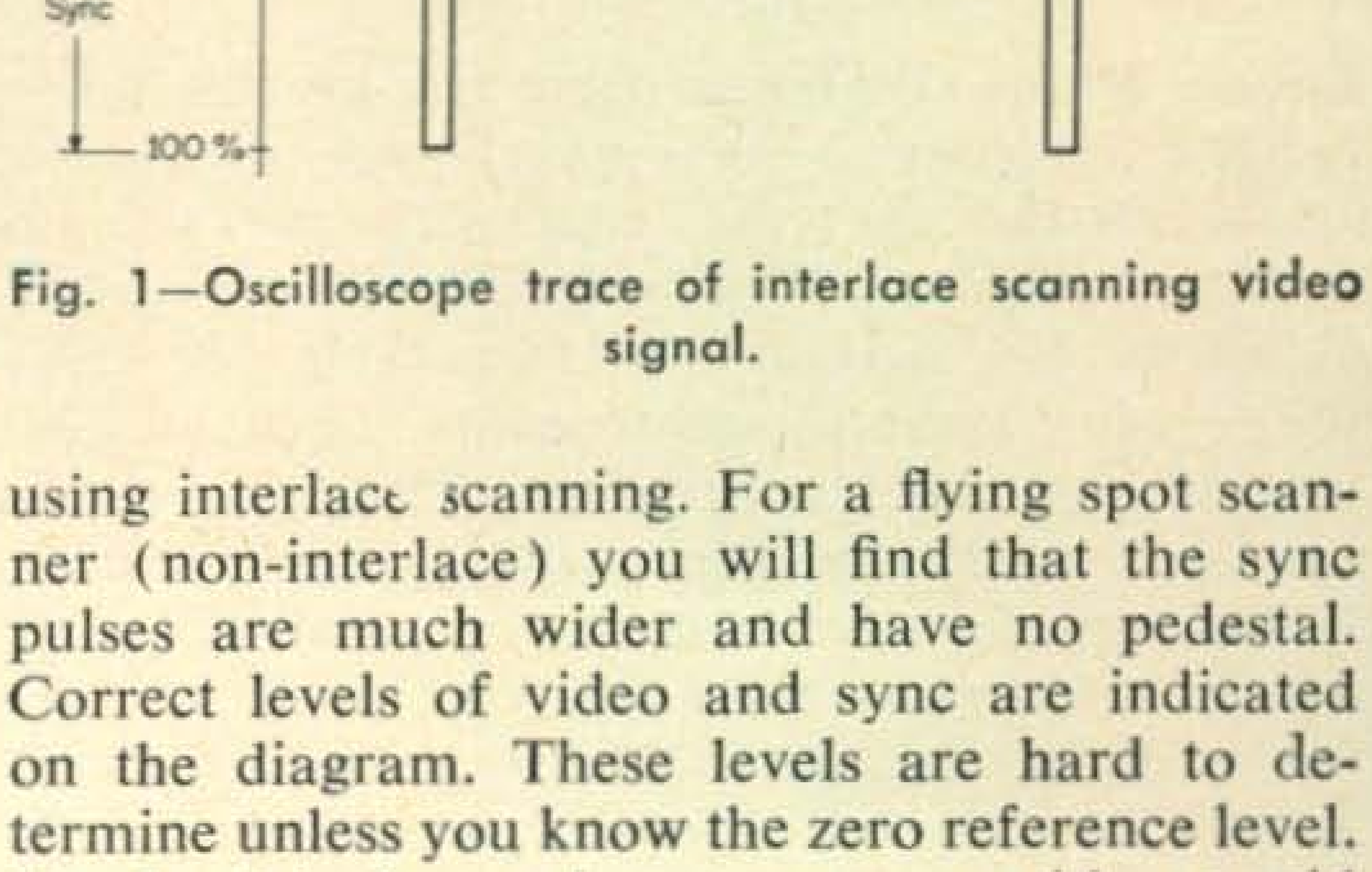


Fig. 1—Oscilloscope trace of interlace scanning video signal.

using interlace scanning. For a flying spot scanner (non-interlace) you will find that the sync pulses are much wider and have no pedestal. Correct levels of video and sync are indicated on the diagram. These levels are hard to determine unless you know the zero reference level. To do this Larry has come up with an old broadcast trick, that of using a 24 v.d.c. relay with its contacts shunting the oscilloscope input. When 24 volts a.c. is applied to this relay, it acts as a chopper and produces a zero reference level on the scope in the form of a wavy line.

73, Allen, K2UYH

*48 Cumberland Avenue, Verona, New Jersey, 07462.

VHF Report *[from page 83]*

Memphis, Tennessee, seems to be the best place for winter skippers. Between December 14 and 17 alone, WA4IRX logged thirteen hours of DX worked. His four day catch included the states of Calif., Colo., Kans., Md., Mich., N.C., N.J., N.Y., N.M., O., Okla., Pa., S.C., Tex. and Wisc. This brought Al to 43 states with 204 counties confirmed.

Vince Varnas, K8REG, reports in this month from Dayton, Ohio, with news of his December DX. In addition to a list of states worked between Dec. 12 and 16 similar to WA4IRX's above, Vince worked WA6FQB on the 14th for a good 2,000 miler. Signals throughout the period averaged a few db over S9.

And to wrap up coverage of the *E* session, WAØDXZ checks in from Iowa City, Iowa, to tell of his DX heard on December 15th. Bob logged 50 mc stations in Ala., Ga., Iowa, Mich., Mo., N.J., N.C., Tenn., W.Va., and Wisc. Peculiarly enough, most were heard around 53.40 mc! By the way, WAØDJA and WAØDXZ will soon be sharing a six element 50 mc Yagi and a Clegg Thor VI.

Pre-Contest Reminder

Don't forget the Spring *CQ* V.H.F. Contest scheduled for the weekend of May 2-3. Our suggestion: make your plans now. Rules are identical to last year's Spring affair. Check page 32 of the March 1963 issue. See you in the contest!

73, Bob, K2ZSQ

Two Meter Vertical *[from page 81]*

grained and as free from knots as possible. Total cost? Less than $3!

After you get your lumber home, select the half most free from knots for the top section. A few minutes work with a carpenter's plane on the corners will save you from splinters while you are handling the antenna. It's time well spent. The remaining half we sawed in two to make the bottom of the classical "A" frame of hamdom. You could gain another 12 feet or so of height if you were to splurge and buy another (ripped) 2 × 4. We didn't.

The antenna elements themselves we recommend be made of aluminum to keep down the weight. We found some 3/16" solid rod in surplus, but almost any kind of aluminum rod or tubing up to about ⅜" in diameter can be used. Old discarded TV antenna elements, for instance. Another good possibility is #8 or #10 aluminum clothes-line wire. (This hard-drawn wire is stiff compared to the bare aluminum "ground wire" sold in TV parts stores.) Since we used the relatively stiff solid rod, only two ceramic one-inch high stand-off insulators were used with each element. The element was fastened to each insulator with nylon cable clamps, available in parts stores for pennies.

No doubt you have noticed that the quarter-wave matching stubs between each element have been curved around and have had their "shorting

For further information, check number 21, on page 110

bars" screwed down directly to the wood mast. *(Horrors, thrice!?)* Well, curving around these stubs makes the whole array lots easier to handle than if they were sticking straight out. No difference in performance was discernible when they were curved back, by the way.

The actual stubs were made of a continuous piece of #14 wire, so there were no mechanical problems with a "shorting bar." Spacing was 1", and three spreaders made from ¼" diameter plastic rod were slipped on the wires. The squared-off "shorting-bar" end was directly screwed down to the wood mast since this is "cold" in so far as r.f. is concerned. This resulted in a fairly sturdy halo about 6" in diameter.

The quarter-wave linear matching transformer at the feed point is much simpler to construct than to describe. This "*Q*-bar" section, 20" long, is made from #8 aluminum ground wire spaced at 1". One spreader was installed in the middle. To facilitate the dropping-down of the twin lead feeder, this matching section is given a 90° twist so that the junction point of the section and the twin-lead is horizontal. This junction point terminates on a square bakelite block screwed to the braced strip of wood used to bring the feed point out at right angles to the antenna.

To forestall any possible electrolysis problems and to prevent any loosening of hardware which might be caused by wind vibration, we brushed coil dope on each screw, bolt, and nut, and on the spreaders on the matching stubs. This is real good insurance.

Guying

Wire guys should come no closer than a quarter-wave (about 20") from the end of the bottom element. This leaves about 15 feet of the mast free to whip around slightly in the breeze. If you live in a windy part of the country you should add an additional set of nylon guys, fastened about at the center matching transformer. Ordinary nylon fishing line is very good for this purpose.

Performance

We installed our 2-meter "gain" antenna about 20 feet from our "reference" dipole and about the same height. The reference antenna was fed with about 85 feet of foam-type RG-8/U coaxial cable. The antenna was fed with about the same length of cheap 300-ohm TV twin-lead. A coaxial balun, used to transform the balanced line to the unbalanced coax input of the transmitter was installed right at the transmitter. A Knight-Kit P-2 bridge was installed between the balun and the transmitter. The s.w.r. on the reference antenna was 1.5 to 1. On the gain antenna it was 1.1 to 1. About a 2-to-1 increase in signal strength of stations received was noted. Stations worked immediately noted the increase in our signal. Mobiles especially could now be worked out to much greater distances.

All in all, the week-end we used to put together this antenna was well worthwhile. Since initial tests the wood mast has been lashed to the top of a tree, elements above the tree tops, at a height of about 90 feet. The feeder length is now about 125 feet. Mobiles (f.m.) operating on eastern Long Island have been reliably worked out to distances of 30 to 40 miles. And we run only 60 watts input. ■

RTTY Tuning [*from page 51*]

cuit shown in fig. 1. All that remains now, is to wire in the selector switch, S_4. A step by step procedure is outlined below because this involves modifying some of the original circuitry. The switch contacts, as referred to, are shown in fig. 2.

1. Disconnect the wire from the arm of S_2 in the Modulation Analyzer which connects to pin 8 of the 3BP1 through a 0.01 mf capacitor, and connect this to the arm (wiper) of S_{4A}. Leave the 0.01 mf capacitor in the circuit.

2. Determine which position of S_4 you want for modulation, and run a wire from the appropriate contact of S_{4A} back to the arm of S_2.

3. Connect the remaining contact of S_{4A} (RTTY) to pin 6 of V_{5B} (fig. 1).

4. Disconnect the wire from the junction of C_3, S_1, and pin 6 of V_1 of the Modulation Analyzer which runs through a 0.01 mf capacitor to pin 11 of the 3BP1. Connect this to the arm (wiper) of S_{4B} leaving the capacitor in the circuit.

5. Connect the modulation position contact of S_{4B} to the junction of S_1, C_3, and pin 6 of V_1.

6. Connect the remaining contact of S_{4B} (RTTY) to pin 1 of V_{5A} (fig. 1).

7. Break the low voltage B plus line from the 6X5 after the 15 mf output filter capacitor and connect to the arm (wiper) of S_{4C}.

8. Connect the modulation contact of S_{4C} to the B plus line of V_1 and V_2.

9. Connect the RTTY contact of S_{4C} to the B plus line of V_{5A} and V_{5B} (fig. 1).

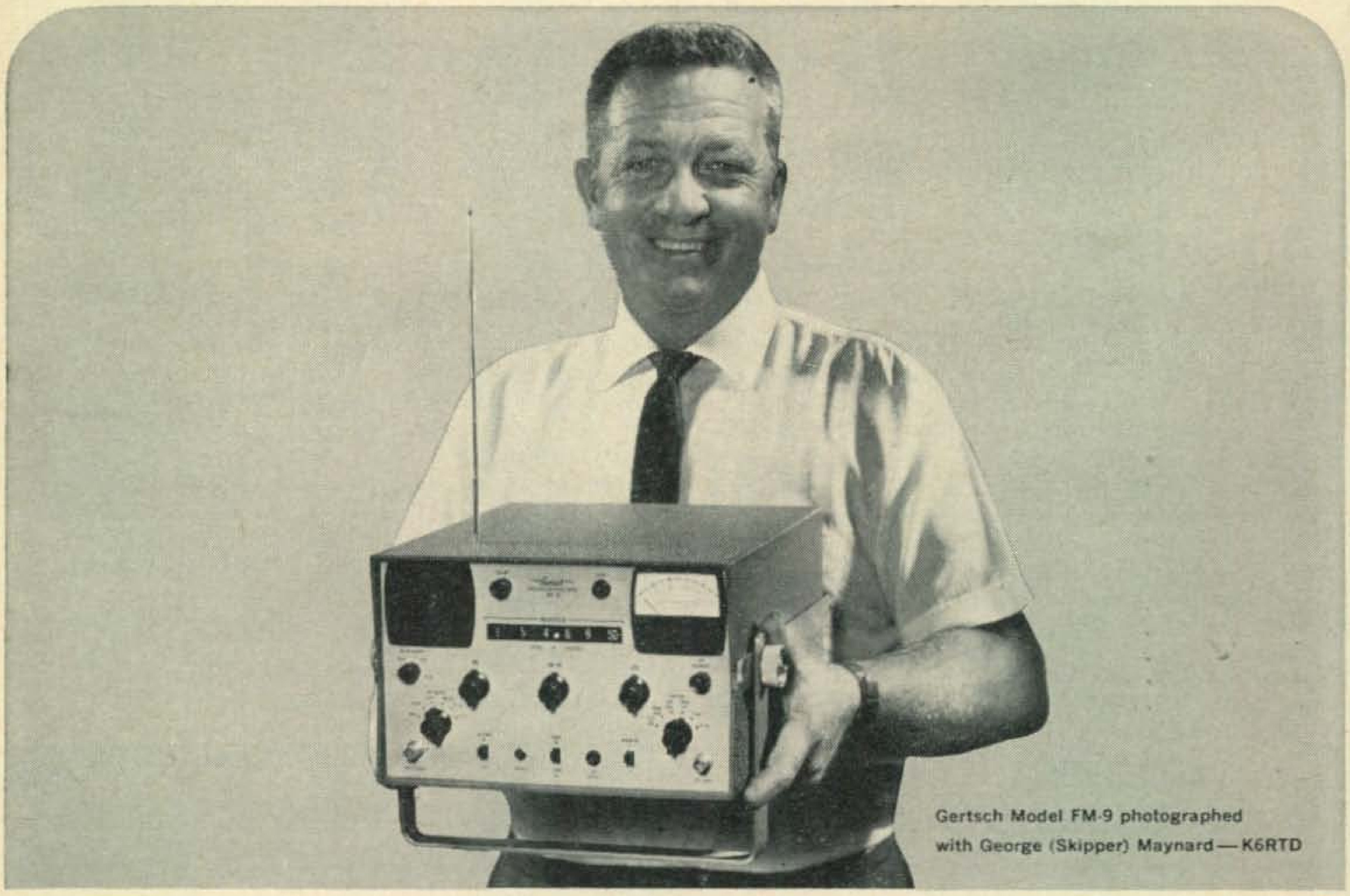
The addition of RTTY tuning is really much simpler to add than to describe. If you haven't already built the Analyzer, then perhaps this will inspire you to do so, for you will find it both a very useful and decorative piece of equipment for the shack. Then some day, perhaps, you'll join the gang on the green keys, and convert your Modulation Analyzer for double duty as an RTTY tuning indicator. ■

For further information, check number 26, on page 110

For further information, check number 6, on page 110

For further information, check number 27, on page 110

For further information, check number 29, on page 110


Gertsch Model FM-9 photographed with George (Skipper) Maynard—K6RTD

For further information, check number 11, on page 110

Announcing [*from page 18*]

be transmitted by that method and only the call sign of the transmitting station need be transmitted by either telephony or telegraphy using the International Morse Code.

International Mobile Rally

An international Mobile Rally will take place on August 30, 1964 in the Belgian Ardennes. Location will be the Hotel Rochers du Herou, 55 kilometers southeast of Namur and half way between La Roche en Ardennes and Houffalize. Stations will operate on 80 and 2 meters and the tour will start at 11 A.M. American amateurs planning to attend may receive licenses by applying well in advance to: Monsieur le Directeur General des Radiocommunications de la R.T.T., 42, rue des Palais, Brussels 3, Belgium. A photostatic copy of your license should accompany the request as well as an indication of the dates for proposed stay. It should be noted that this Rally takes place close to the Battlefields of Houffalize and Bastogne and participants may easily visit the American War Memorial at Bastogne.

Correction

An error occurred in the parts list for the 15 watt six-meter transmitter on page 69 of the January issue. The inductors should read: L_1—10 turns, #24 enamel, close wound on ⅜" slug-tuned form (iron core); L_2—9 turns, #24 enamel, close wound on a ⅜" slug-tuned form (iron core); L_3—6 turns, #16 tinned wire, ⅝" diameter, spaced over one inch. Please make note of these corrections.

W8NAI points out that the comment made on page 79 of *CQ* for January, relative to forward and reflected power are in error. Since the s.w.r. reflectometer is a voltage indicating device and s.w.r. is always determined on the basis of the ratio of *voltages* or *currents* the power indicated will be proportional to the *square* of this indication. In the case indicated ¼-scale would indicate $(1/4)^2 \times 100$ watts or 1/16 of 100 watts and the reflected power would be 6.25 watts—*not* 25 watts.

USA-CA *[from page 69]*

be transmitted via messages through the National Traffic System.

The nine members of the Net are K4PQL, K4MYO, K4ITV, W4JUJ, W4NLC, K4SDS, K4YNJ, W4ZAU and K4WVT. They are spread out over Virginia. Members will operate portable and mobile on weekends. Normal frequencies will be near 3537, 7030, and 14,075 kc. QSLs will be handled by K4MYO and s.a.s.e. will be required.

Good Will Acknowledgement

Last month we told a story of the need of the 30 members of the Harstad Radio Club, north of Arctic Circle in Norway, for books and magazines for their library . . . our thanks to Charles Folkes, Jr., Van Nuys, Calif., for sending the boys a complete back set of *CQ* to 1951. That's a lot of good reading material . . . like the man said . . . this USA-CA Program has international good will as one of its major purposes. And let's not forget in these trying hamdom times, we could stand a bit better local good will.

What's Cooking Department

Being worked out are details for a top-level Centennial and counties award program for state of Washington. It is expected the governor will affix his stamp of approval. In interim, start collecting all possible Washington counties in 1964 with possibility credit will be given for those worked during 1963. Here will be another example of CHC'ers working to achieve the highest amateur rapport with local, county and state officials to bring world-wide publicity and good will toward all who participate. More next issue. Old Man, K6BX

Mark III Antenna *[from page 45]*

does not require such a high voltage rating, but it should be rated to carry at least 6 amperes at 4.0 mc. I have had many inquiries about my use of variable vacuums. I used them because they were available to me, and they are very stable under all conditions. Air variables may be used in the Mark III tuning unit, provided they are in a completely weatherproof box.

In the above computations we have neglected losses in the coils and capacitors. This is perfectly legal if we use good quality components. To allow for stray capacities, however, we should make the components variable over a portion of their range. Their approximate values may be found by measuring with an impedance bridge. The final adjustment will have to be made by use of either a General Radio r.f. bridge to check the input impedance, or with an s.w.r. meter which can be operated under power.

Summary

This technique of altering the input impedance of a tuning network or an antenna and twisting the curve back on itself like a pretzel on the Smith Chart can be applied generally to other antennas and matching networks, with certain

limitations. The input impedance of the load being altered must be of *positive reactance at the lower frequency*, and of *negative reactance at the higher frequency*, like that in curve *B* of fig. 1. The differential series network which folds up the curve over itself can only be applied if such is the case. (A network of series X_L and X_C always looks more capacitive as frequency is lowered, and more inductive as frequency is raised.) If the load impedance is not as stated above, it must first be reversed in sign by a suitable transformation network before the series differential reactances can be applied.

A rectangular plot of s.w.r. versus frequency for the modified Mark III 80 meter feed is shown in fig. 6. At no time is the s.w.r. exactly 1:1, although it approaches it closely at several frequencies.

Inasmuch as the Mark III is already sufficiently broadened on 7 and 14 mc, even enough to permit MARS operation on frequencies at some distance outside the bands, no changes have been made in the feed for those two bands. The only other change in the Mark III since the original article has been the removal of the 21 mc feed. The vertical pattern was not good for DX on that band. Removal of the 21 mc feed caused the feed point for 14 mc to move down the mast about 3 feet. This is the only change. The antenna has performed well for 20 months as of the date of writing, and no further changes are contemplated. ■

40 M. Vertical [*from page 40*]

out. One week after loading ours up for the first time, we had worked 12 countries and numerous stateside QSOs on 40 meters. A check of the reports given by all contacts since the vertical went into operation shows an average signal strength of 8-plus. Unimpressed? Well, maximum power here is 135 watts p.e.p.

Perhaps the greatest satisfaction has arisen from saying "Antenna here is a quarter-wave vertical with a counterpoise ground system, all home-brew, OM." To which the guy will reply, "Tell me more, Dave, it sounds interesting." And you've got a good QSO sewed-up. Total cost here, $14.75. How can you miss? ■

Class C Linear [*from page 35*]

a strictly linear exciter—no compression, clipping, or a.l.c.[6] *etc*. More than half the time, not counting pauses, such an envelope has a peak to r.m.s. power ratio 8 db or greater. Since 8 db is about a 2.5 amplitude ratio, if the peak is at the p.e.p. (*i.e.*, no flat-topping), the same r.m.s. value is produced by a constant signal of 1/2.5 of the peak amplitude where the efficiency is also 1/2.5 or 40% of the p.e.p. efficiency. For these very unfavorable conditions (existing most of the time) this amounts to average efficiencies of approximately 40% of 30% (p.e.p. eff.) or 12% for Class A, 40% of 60% or 24% for Class B, and 40% of 80% or 32% for a Class C linear. It's been said many times before but bears repeating—i.e. by comparison, a two-tone signal, which has a 3 db peak r.m.s. ratio, would show 21% for Class A, 42% for Class B, and 56% Class C average efficiencies which look (and are) *lots* higher than voice signals! A.l.c. and/or audio compression will help keep the peaks up at the p.e.p. level, but they can't beat the 8 db Peak/Ave. ratio down because they can't change short interval envelope shapes. A good clipper is the most immediate, practical way to reduce the peak to average envelope ratio, and a good one improves *both* intelligibility and efficiency. The efficiency pay-off for clipping & a.l.c. is greatest of course in the Class C case due to the higher p.e.p. efficiency.

An alternate form for the Clamp tube of fig. 1 is shown in the circuit of fig. 4. A similar version of this was also in the *CQ Sideband Handbook* section (page 154). The 6BL7, V_2, is a dual triode with the first half as a d.c. amplifier, the second as a cathode follower d.c. screen driver or modulator. W6EDD has recently developed this circuit to drive a pair of 4W300B's in a Class C Linear. Its use solves an objection to the circuit of fig. 1 by eliminating R_4 because it has to be a rather husky resistor since the current is high under static conditions. A second problem solved is that if the filament should burn out in the fig. 1 case, or V_2 inadvertently left out of the socket, full screen voltage is applied to the amplifier tube which would certainly be rough! Still another advantage is that the cathode follower of fig. 4, being a low impedance device, will give better assurance of linearity against any non-linear screen grid loading.

Part II of this article will cover the construction and adjustment of a Class C linear amplifier.

[*To be continued*]

[6] A.l.c. does not normally affect envelope shape (linearity) providing the time constant is greater than 50 ms.

The Dow ECO [*from page 37*]

20 may endanger the crystal. Find out from either a smart old-timer or a smart newcomer what tubes this applies to. Also, operate the screen of electron-coupled crystal oscillators at a maximum of 100 to 150 volts unless special precautions have been taken in the design.

Check the oscillator against a stable standard, such as a continuously-running crystal oscillator or the b.f.o. of a stable receiver. If it is good, use it and enjoy it. Yet, in honesty, remember that much of what you have done was pioneered by Lieutenant Jennings B. Dow, USN, ex-W3TL.

Postscript

Experimenting with oscillators is a most rewarding experience. Comparisons are easy to make between one test and the next.

The principle is basically understood, yet there is much in the subject of oscillators for the ham to improve and invent—for instance a good *and exact* mathematics of how those blinking things work in Class C.

THE CQ HAM MART

MOBILE HANDBOOK

Anyone who tries to go mobile without getting this book, should think twice before going ahead. *Bill Orr, W6SAI* has put everything you need to know in this book, Build-its by the dozen . . . solutions to ignition problems, keeping the battery charged, noise . . . only *$2.95* postpaid.

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212 pages of everything the Amateur must have to get his license and progress toward the general class ticket. Plus many additional pages of vital information for the ham operator. All this for only *$2.50*.

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A treasury of vital and "hard to get" information. Loaded with equipment schematics, adjustment procedures, operating procedures, etc. A valuable asset to both the beginning and the experienced RTTY'er. Special section on getting started, all written by *Byron Kretzman, W2JTP*, a well known authority in the field. This book is a must for your library! Only *$3.95*.

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This is a collection of reprints, containing all of the available information on the conversion of the popular "Command" transmitters and receivers into good ham transmitters and receivers. Invaluable for Novice, Technician, General, Advanced and Extra class operators. 136 fabulous pages, only *$1.50* postpaid.

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Written by *Don Stoner, W6TNS*, was almost one full year in the preparation of this terrific volume. This is not a technical book. It explains sideband showing you how to get along with it . . . how to keep your rig working right . . . how to know when it isn't . . . and lots of how to build-it stuff, gadgets, receiving adaptors, exciters, amplifiers. Price, only *$3.00*.

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For those who would like to know what happened to the young Lieutenant—he retired as a Commodore, having spent twenty-eight years in the Navy. Not content to have just one career, he made a second within Hazeltine Corporation. Perhaps, "JB", you might have fun making hamming your "Third" career so you can straighten out some of us young squirts. In any case, Tnx es 73. ■

700 Watt Linear *[from page 25]*

when you consider that it only takes a few watts of harmonic output to reach the input of a TV set across the street.

Connect all chassis together with heavy braid and then to a good water pipe ground. One last thing, the 4-400A tube has to be cooled from the bottom. This can be done by bolting a small fan under the chassis or by using a flexible tube into the chassis from a remote squirrel cage fan. I use a fan, blowing air into a scoop box under the chassis.

Good luck, and remember to keep your hands out of the cabinet when the power is on. ■

DX *[from page 61]*

9N1 Nepal: Father Moran, 9N1MM, has been active on 14,295 kc s.s.b. around 1230 GMT. *(Tnx WGDXC)*

Certificates

The Budapest Radio Club is issuing the Budapest Award Certificates I and II on the occasion of the fifth anniversary of the club's founding.

1. All licensed amateurs and short wave listeners are eligible to win Certificate I, the Budapest Award, upon fulfilling the requirements of the certificate.

2. All QSOs established with HA5 and HG5 stations after January 1, 1959 are valid.

3. Stations applying for the certificate have to verify the following number of points.

DX stations	8
European stations	15
Hungarian stations	40 (HF), 20 (VHF)

4. QSOs established with Budapest Radio Club stations, HA5KDQ and HG5KDQ, count for three points; those with members of the Budapest Radio Club, 2 points and those with other Budapest stations (HA5-HG5) 1 point.

5. Any authorized amateur band may be used, including v.h.f. bands above 30 mc. European stations, in the event they use the v.h.f. band, must verify the 8 points prescribed for DX stations.

6. The certificate may be obtained with the use of c.w., fone, mixed or s.s.b. method of operation.

7. A list must be attached to the application, which contains the most important data of the QSOs, QSL cards and also 5 IRCs.

The application should be sent to the following address: Budapest Award, C.R.C., Viktor Mayerhoffer, HA5AW, Award Mgr., Budapest 5, P. O. Box 214, Hungary.

Members of the club are: HA5KAG, KBC, KBF, KDF, KFZ, AA, AE, AN, AW, DQ, FE, and FK.

QTHs and QSL Managers

The following eight QSL managers were listed erroneously in the December list of QSL managers. Please correct your list: **CR7IZ** via K3HQJ, Ken Phillips, 1213 Drey St., Arnold, Penna.; **EI8P** via W4OPM, W/VE only; **PJ5MC** via W3ZQ; **TT8AJ** via WØLYQ; **VKØVK** via W1AGS; **VP2GAC** via W8EWS; **VP8GQ** via G3PAG J.J., Davies 139, the Fairway, Leigh-on-Sea, Essex, England; **3A2DA** via G3CWL.

BV1USC—Box 194, USARSCAT, APO 90, San Francisco, Calif.
CEØAC—via CE3HL
CN8FE—via W2CTN
CN8FW—via W2CTN
CN8FX—via K8GVK
CN8GB—via W2CTN
CP1DJ—via K9PNV
CR6JA—Box 71, Vila Mariano Machado, Angola
ex-CR8AB—now CR6JJ
DU1MR—Marcial Recio, 2660 T. Ayala Singalong, Manila, Philippines
EP2DM—via WB2FMK, Robert J. Rasche, 950 State St., Albany, N.Y. 12203
ET3PT—via W8IEB
F2CC/FC—Roger Grabot, via Chez Mme. Vve. Fieschi, Cargese, Corsica
FG7XT—via K5AWR
FP8CG—via W1DDF
FY7YE—via W5JLU
FY7YF—via W2FXA
HB9YG/4W1—via USKA
HBØTL—via WA2QNW
HC1LE—via W2MUM
ex-HI8AKU—now YV5-AKU, Box 5163, Caracas, Venezuela
HI8NPI—Box 145, San Cristobal, Dominican Republic
HP1AC—via W2CTN
KA7DR—Richard Randall, FEARL APO 925, San Francisco, Calif.
KB6CP—Box 5, Canton Is. Phoenix Group
KC4USK—via W2CTN
KL7EFN—Box 184, APO 736, Seattle, Washington
M1VU—via DL1VU
MP4QBF—Box 73, Dola, Qatar, Persian Gulf
MP4TAS—via G3KDE
PZ1CN—Box 71, Nickerie, Surinam
SL8AY/MM—via SM6-CUK
SU1IM—Ibrahim I. Mohamed, 7 El Roda St., El Roda, Cairo, Egypt
TF2WHT—via K9RNQ
VP2SX—via G8KS
VP6LN—Dr. Louis Nicholls, Worthing, Christ Church, Barbados, W.I.
VP7BG,CC—c/o RCA, San Salvador AAFB, Patrick AFB, Fla.
VP7CT—now W3LBJ
VP7CX—via W9VFO
VP9WB—via WØORH
VQ1IZ—Via K6PUC
VR1B—via VK2EG
VR1G—via W6BSU
VS1LS—Dave Llewallyn, Box 25, Paya Lebar, Singapore 19, Malaysia
VS1MB—via K7GCM
WA6LED/KG6 — Wm. Broder, Box 116 NAVCOMMSTN, Navy 926, FPO San Francisco, Calif.
XW8AU — Chas. Swain, Box 46, Vientiane, Laos, **or** via W4QCW
XZ2VK—Union of Burma Applied Research Inst., Kanbe Rd. Yankin P.O. Rangoon, Burma
ZD8HB—via W2CTN
ZS1AB—via WA2FQG
ZS1ACD—via W2EVV
ZS5LU—C. J. Peterson, c/o Overseas Visitors Club, 180 Earls Court Rd. London SW5, England
ZS9A—via W8EFS
3A2AE—via G3LKZ
5B4WS—via K1LBH
5Z4IV—via W2CTN
6W8AC — Jean-Claude Wagner, Box 971, Dakar, Senegal
9A1VU—via DL1VU
9Q5UC—Box 1459, Leopoldville, Congo
9X5MH—via DL1LC, Box 344, Cologne, Germany

My Thanks to the following for this month's QTHs and managers: YV5AKU, W7LZF, K3HQJ, W4UWC, W4OPM, VP7CX, W4SKW, W2EVV, W5KNE, CN8FE, W5QK, WA2QNW, WA6LED, NEDXA, LIDXA, NCDXC, WWDXC, WGDXC, FDXC, PRDX'er, and VERON.

73, Urb, W2DEC

Contest Calendar [*from page 63*]

last month's CALENDAR.

There are several topics I could cover but at this moment the one that is foremost in my mind is the unnecessary date duplication that continues to prevail.

Some of these cannot be avoided and others are of little consequence because the involved events are dissimilar in nature, (c.w. and phone) but when two major activities are booked on the same week-end, one begins to wonder if the prevailing world attitude, "the heck with the other guy," has also taken over in the amateur radio field.

My "Suggested Calendar of Events" published at the start of the season, was also distributed to all the leading world amateur radio organizations, as an informative guide as to what to expect in the field of contests.

Although the list was not a cure all it certainly presented a good outline of what to expect and suggested changes that would improve the overall picture.

Many state parties would stand a better chance of success if they stayed clear of dates already established by major events.

And finally, as we have said time and time again, we cannot publicize your activity if you don't get the information to us in time. Allow at least three months before the date of your activity.

73 for now, Frank, W1WY

YL *[from page 78]*

ing Mabel got the serum on its way and it did arrive in time.

The EL2E emergency traffic was on Nov. 22. The American Embassy had requested information as to any special programming on VOA following the death of President Kennedy, and ham radio is the only two-way communications the Voice of America in Liberia has with the U.S. on weekends. With the help of K3OJU in Washington, the info was obtained from the head of the African Div. of VOA and Ellie relayed it to EL2E.

As mentioned above, both of these incidents occurred during the YL International SSB Net. This organiaztion recently rewrote its By-laws to dedicate the YL International SSB'ers, Inc. to a world-wide public service program through creation of amateur radio communications system facilities to be in operation seven days a week for the purpose of handling international emergency traffic, effecting delivery of urgently needed life-saving medication to individuals world-wide, plus good will and public relations activities. Primary frequency for the SSB'ers "System" is 14.331 mc; time 1800 GMT, except Mon. (1900) and Fri. (2000). Wed. and Sun. nets are CHC/FHC, which operate an Emergency Flying Medical Corps to provide transport of medicines to stricken areas or individuals and utilize the SSB'ers "System" during emergencies.

YL Chap. 4 CHC

Officers for 1964 for YL Chap. 4 CHC: Pres., K5BTM, Dot; V.P., W7GGV, Helen; secy, W1YPH, Leona; treas., W5LGY, Helen; Royal Huntress, W6YZV, Mable; Royal Wolf, K8CIR,

For further information, check number 39, on page 110

Ott. YL CHC now numbers over 100 members.

YLRL International Convention

Do you have *your* ticket for YLRL's 4th International Convention? (We do—No. 106) Get your reservations in early to K8UKM, "Zip" Isham, 474 Darbyhurst Rd., Columbus 14, Ohio.

Sponsored by the Buckeye Belles, convention committee includes: General chairman, K8MZT; co-chairman, W8LGY; favors & decorations, K8ITF; donations & prizes, K8GWF, K8PXX, W8NAL; program, K8WZF; gift shop, W8WTB; stamp books, K8YFB; P/C, W8MBI; business mgr., W8OTK.

Congratulations . . .

To Alicia Rodriguez, KP4CL, for earning WAZ. Only the 20th YL to achieve WAZ, she holds certificate #195 on two-way s.s.b.

Contests

Two contests for YLs coming up March 9-13—the Buckeye Belles-YL QSO Week and WRONE Week.

The Belles-YL QSO Week is to promote the Belles certificate, as well as YLRL's Silver Anniversary and the International Convention in June '64. Logs should show station worked and handle, Belle number, QSO number, date and time (GMT). Scoring: 1 point per contact. An award will be made to non-Belle YL with greatest number of Belle contacts. Send signed copy of log to K8VMV, Jean Posey, 2864 Sherwood Dr., Aurora, Ohio, postmarked no later than Mar. 31, '64.

WRONE Week, sponsored by the Women Radio Operators of New England, is especially for YLs in those states to become better acquainted, but YLs everywhere are invited to participate. Contest begins at 1300 GMT Mar. 9; ends at 2300 GMT Mar. 13. Score 1 point if YL worked is YLRL member; 2 points if WRONE member; 3 points if both YLRL & WRONE member; ½ point if neither. High scoring WRONE member to receive 100 Miss WRONE QSLs. Send copy of log, with YLRL & WRONE membership indication, to Ruth Barber, K1IIF, 19 Bidwell Pkwy., Bloomfield, Conn., 06002, to be received no later than Mar. 25.

Remember the dates of YLRL's 15th Annual YL-OM Contest: Phone—Feb. 29-Mar. 1; C.W.—Mar. 14-15. Rules in Feb. *CQ*.

33, W5RZJ

RTTY [*from page 77*]

operation also for the Ranger. WØHFX of Colorado Springs, Col., is on 80. WØGUS of Newport, KØODS of Minneapolis, and WØDKN of Roseville, all in Minnesota, all on 80 meters.

VO1DZ is looking for dope on the O-39C, CV-182A, and the TT-4/TG machine. *(For technical manuals on these pieces of military gear, check Propagation Products Co., Box 242 Jacksonville, Florida; and, Technical Manuals Co., Box 406 Utica, New York.)*

BARRY ELECTRONICS

Mini. Variable Cap.: 3 to 10 Mmf. W/¼" shaft. **29¢.**
115 VAC Blower Assembly: 4 blade fan, 6" diam. Ideal for 4-400A's, etc. New. **$2.25.**
Plate Xfmr 1500-0-1500 VAC @ 350 Ma. Pri: 115 VAC @ 60 CPS. **$19.50. Eldico R-100 rcvr. $295.00.**
French Type Cradle Phone: Brand new, 19th Century reproduction. Ideal for Home or Office. Wonderful extension phone, just plug it and it's ready to operate. Black with Gold trim: **$49.00;** All Gold: **$54.00.**
"UG" Coax Connector Specials: All brand new. UG-88B/U @ **55¢;** UG-290/U @ **50¢;** UG-306/U @ **75¢.**
Tuning-Fork Generator: 400 or 500 CPS. Specify. **$7.50.**
Step-Down/Isolation Xfmr: Pri: 220 VAC @ 50/60 CPS. Sec: 118 VAC @ 4.5 Amps. **$24.00.** (24 lbs.)
Aircraft Range Filter: Advanced version of the old familiar FL-8. Ideal for CW use. W/PL-55 plug & 3 ft. cable. Plug right into rcvr without any rewiring. **$2.50.**
25 Amp. Silicon Rectifier: Rated at 50 to 75 PIV. **$1.75.**
Jennings Type "U" Vacuum Variable: 50 to 250 Mmf. @ 15 KV. **$45.00.** R/E. Tested OK.
Hindle Rectifier Xfmr. Pri: 115 or 230 VAC @ 60 CPS. Sec: 27 VAC (tapped at 25 VAC) @ 4 Amps. **$3.95.**
Binaural Headphones: Receive two channels simultaneously. W/3 conductor standard plug & 7½ ft. cord. Chamois earpads for comfort. **$9.88.**
2 Amp. Silicon Rectifier: 2 Amps @ 700 PIV. Mounts with 10-32" screw. **60¢. Collins** 51J4. **$850.**
Mallory Inductuner: 3 Section. Tunes channel 2 to 13. W/data sheet. **$3.95.**
RF Choke: 1 Mh. @ 600 Ma. Three for **$1.00.**
RG-19A/U Amphenol Coax Cable: Unused. **75¢** per ft.
Dow Key Coax Relay, Type DK60: 52 Ohms/1 KW/115 VAC. **$12.45. Dow Key Coax Relay, DK60-G: $13.70.** DK60-2C **$14.35. Dow Key Coax Switch DKC-71:** 52 Ohms/1 KW/SP-Six Throw/110 VAC. **$49.50. Dow Key In Line Coax Broadband Preamp. DKC-RFB** (.5 thru 30 Mc.). **$10.75.**
Ameco 1.8 to 54 Mcs Nuvistor Preamp (Wired) **$24.95.**
Zeus 1 KW Gas Generator: 115 VAC/60 CPS. **$148.13.**
1¼ KW Zeus. $190.88; 3 KW Zeus (115 or 230/60 CPS), $431.25. Eimac 4-400A Air Sockets. **$7.50.**
600 PIV 750 Ma. Silicon Epoxy Rectifier. 36¢; Surge Limit Capacitor for Silicon Circuits .001 Mfd. **10¢.**
Hammarlund 320/320 Mfd Dual Xmtg KW cap. **$4.25.**
Ceramic Antenna Insulator Sale: 4¼" x ½" **10¢;** 7½" x ½" **15¢;** 6⅛" x ¾" **20¢.**
Johnson Miniature Butterfly Capacitor: 4.3 to 26 Mmfd. per section. (With ¼" shaft). **95¢.**
Johnson Single Section Miniature Variable Capacitor: 3.5 to 27 Mmfd. with ¼" shaft. **75¢.**
Capacitor Sale: .01 Mfd/5 KV **$1.00;** 10 Mfd/1500 VDC G.E. Oil. **$2.50;** 2 Mfd/7500 WVDC Oil. **$13.50;** Pair of brackets for 2 Mfd 7500 VDC **$1.00;** C.D. .5 Mfd @ 600 VDC **10¢;** 8 Mfd/1500 VDC G.E. Oil. **$1.95;** 4 Mfd/2KV Oil **$2.95;** 3000 Mfd/150 VDC **$2.95;** 1500 Mfd/270 VDC surge **$2.95;** 3800 Mfd/108 VDC **$2.50;** 1700 Mfd/180 VDC **$2.25;** 2000 Mfd/75 VDC **$1.75;** 1250 Mfd/175 VDC **$1.00;** 8000 Mfd/55 VDC **$2.95.** 10 Mfd @ 1500 VDC G.E. Oil. Cap. **$2.50;** 3000 Mfd @ 30 VDC @ **$1.00.** 2" brackets for above Capacitors. **25¢.**

LARGEST DIVERSIFIED TUBE STOCK IN USA! (Unused, first-quality NAME BRANDS G.E., RCA, Westinghouse, Eimac, etc.). Write or call for immediate quotes. Get all your tube needs at Barry's. Write for latest price list. Full line of brand new, TV-Radio, European and Hi-Fi types. First quality only. Write or call for latest price list.

Drake 2B rcvr.—$279.95; Drake 2B-Q Speaker/Mult. **$39.95. Drake RV-3. $79.95. Drake** TR-3—DC for supply **$129.95.**
RME6900 Recvr and Matching Speaker—Write for special deal on this excellent SSB/CW/AM Rcvr.
Sale! Mallory 12 Volts Vibrapacks: Puts out approx. 30 VDC @ 100 Ma. **$5.95.**
Mallory 6 V. Vibrapacks: Puts out approx. 300 VDC @ 100 Ma. **$4.95.**
Price Heavy Duty Relay: 115 VAC 3 P.S.T. (N.O.) 35 Amp. contacts. **$4.50.**
10 Hy. @ 75 Ma. Choke: 2 lbs. 250 Ohms. Herm. sealed. **90¢.** 30 Mc IF Strip w/6 tubes. **$7.95.**
Cardwell Type TC-300-US Variable Capacitor: 300 Mmfd. 7000 VAC Peak Mycalex. **$8.75.**
DK2-60B Dow-Key Coaxial Transfer Switch: Switches Power Amp. between exciter and antenna. 1 KW/standard UHF connectors/115 VAC. **$19.00.**
Kenyon Universal Modulation Transformer: Pri: 500 to 18,000 Ohms; Sec: 20 to 19,200 Ohms. 250 Watts of audio will modulate 500 Watts R.F. Fully shielded. New. With specs. Kenyon type T-495. 21 lbs. **$10.95.**
Kenyon T-359 Filament Transformer: Pri: 115 VAC @ 50/60 CPS; Sec: 7.5 V.C.T. @ 9 Amps. **$5.75.**
Kenyon T-369 Dual Filament Transformer: Pri: 115 VAC @ 50/60 CPS; Sec: #1—2.5 V.C.T. @ 8 Amps; Sec: #2—6.3 V.C.T. @ 4 Amps. **$3.95.**
Kenyon T-383: Pri: 115 VAC @ 60 CPS; Sec: 5.25 V.C.T. @ 21 Amps. (Secondary tapped at 5.1 and 5.0 volts). **$7.95. Dage** SO-239 (83-1R). **35¢.**
Kenyon Filter Choke T-530: 10 Hy. @ 500 Ma. Orig. cartons. 31 lbs. **$14.95.**
Kenyon T-663 Plate Transformer: Pri: 115 or 230 VAC. Sec: 2360-0-2360 VAC @ 500 Ma. ICAS (350 Ma. CCS) Orig. Kenyon carton. 98 lbs. **$49.95.**
10 KW Mycalex Antenna Relay. DPDT. 600 Ohms Impedance. Operates from 230 VAC. Gvt. cost approx. **$330.00.** Sale: **$25.00** (Brand new in original carton with book.)

COME IN AND BROWSE. MONDAY TO FRIDAY—Thousands of items that we cannot list in an ad. MON. TO FRI. 9 to 6. SATURDAYS 10 to 2 PM (Free parking on Street Sat.) Mon. to Fri. parking lot 501 Broadway, WRITE FOR BARRY'S Green Sheet #12.

BARRY ELECTRONICS **DEPT. CQ-3**
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WALKER 5-7000 (AREA CODE 212)

☐ Enclosed is money order or check and my order. Prices FOB NYC. Shipment over 20 lbs. will be shipped collect for shipping charges. Less than 20 lbs. include sufficient postage. Any overcharge will be refunded. Fragile tubes shipped via Railway Express.
☐ Send copy of new 64-page 1964 "Green Sheet" Catalog #12.
☐ Send information ....
☐ I have available for trade-in the following ....

Name .... Title
Company ....
Address ....
City .... State ....

For further information, check number 41, on page 110

EASY TO LEARN CODE

It is easy and pleasant to learn or increase speed the modern way—with an **Instructograph Code Teacher.** Excellent for the beginner or advanced student. A quick, practical and dependable method. Available tapes from beginner's alphabet to typical messages on all subjects. Speed range 5 to 40 WPM. Always ready, no QRM, beats having someone send to you.

ENDORSED BY THOUSANDS!

The Instructograph Code Teacher literally takes the place of an operator-instructor and enables anyone to learn and master code without further assistance. Thousands of successful operators have "acquired the code" with the **Instructograph System.** Write today for full particulars and convenient rental plans.

INSTRUCTOGRAPH COMPANY

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4700 Crenshaw Blvd., Los Angeles 43, Calif.

For further information, check number 42, on page 110

DOW-KEY

New DK72

SINGLE POLE THREE THROW COAXIAL SWITCH

Weatherproof coaxial relay for remote switching of r.f. sources. Designed for mounting on mast and remote switching up to 3 antennas. Not a rotating or stepping switch. Simplify installation, save money by running one cable instead of several to your antenna array.

See your dealer for catalog sheet and complete specifications, or write:

MODEL DK72 with UHF Connector **$22.95**
With type N, BNC, TNC OR C connectors $26.95

DOW KEY CO., Thief River Falls, Minn.

For further information, check number 43, on page 110

Comments

If you have been reading this column consistently you will remember the heartaches associated with Project Despair, the project of obtaining printed circuit boards at a reasonable cost for the W2JAV transistorized wide band TU and a.f.s.k. oscillator. (They are all gone, now.) Well, maybe we are a sucker for punishment, but we are going to *try* to get boards for the narrow shift TU described in the September '63 RTTY Column. Don't write, don't call; just watch here for reports on our progress, if any.

73, Byron, W2JTP

SX-115 Receiver [*from page 50*]

ranges. In-band tweets (spurious receiver responses) are given as equivalent to less than 1 μv. One such response was found on each range. They were well within tolerance, (the strongest one being experienced at 21.2 mc).

Cross Modulation

Strong-signal handling capabilities, in respect to overload and cross modulation, were found to be excellent after following simple modification instructions, requiring less than 10 minutes time, as given in the Engineering Bulletin for the SX-115. (This bulletin may be obtained by writing to the Hallicrafters Co.). Input signals of between 10,000 and 20,000 μv could be tolerated without deteriorating effects. 14 mc reception was possible using the receiver in the same room with several 50 kw transmitters one of which was operating on 15 mc; something which was not possible with many other receivers.

A. F. Output

Inverse feedback is used in the audio system. The a.f. output power is specified as 1.5 watts at less than 10% distortion with a power gain of less than 1 μv (30% modulation) for 0.5 watts output. Full output was obtainable with 1 μv of signal input.

B. F. O. Control

The b.f.o. is tunable from the front panel and is usually set so that zero beat is maintained with a signal when the selection of either sideband is made; however, the b.f.o. may be tuned for the operator's taste to alter the pitch or the unwanted sideband suppression of a signal and thereby obtain passband tuning, but when this is done, the receiver must also be retuned accordingly.

Mode and Sideband Selection

A function switch provides the following: receiver on and off, lower or upper sideband for s.s.b./c.w. (b.f.o. and product detector in use) and lower or upper sideband for a.m. (envelope detector in use). A.m. is not restricted to one sideband however. When the 5 kc i.f. selectivity is used, normal double-sideband a.m. may be had by tuning the receiver to the center of the i.f. passband. Lower or upper sideband a.m. reception is best used as needed to get out of adjacent-channel QRM. Also, the s.s.b./c.w. function for either sideband will be found useful for a.m. exalted-carrier reception.

A.V.C.-A.N.L. Switch

This is a four-position switch which provides A.V.C. OFF, A.V.C. ON, S.S.B. NOISE LIMITER ON with A.V.C. on and A.M. NOISE LIMITER ON with A.V.C. on.

Other Controls

Other controls are: R.F. GAIN, A.F. GAIN, ANTENNA TRIM, BAND SELECTOR, SELECTIVITY, T-NOTCH FILTER, CRYSTAL CALIBRATE switch, CALIBRATE SET and DIAL LOCK, RECEIVE-STANDBY switch and TUNING. All controls are individual; no dual concentric types are used. A phone jack is also located on the front panel. 50-2000 ohm impedance headphones may be used.

Rear Apron

Speaker output terminals for 3.2 or 500 ohm impedances are located on the rear apron with an SO-239 coax antenna connector, a line fuse and an auxiliary octal socket with plug which may be used for remote control connections to operate receive-standby or transmitter relays. The 50.75 kc i.f. output is also available from this socket.

Construction

Besides being solidly constructed, the SX-115 is exceptionally well ventilated. The use of silicon rectifiers in the power supply also minimizes heat build-up. Continuous operation over long periods of time did not show up any overheating or deterioration of components.

The front panel is symmetrically laid out and is gray colored with a cast-metal escutcheon plate finished in black crackle. Knobs are black with polished-aluminum inserts and skirts. The S-meter, main-dial, band-selector-dial and vernier-dial windows are illuminated, while the background for the meter scale and the dials is black. Glare is eliminated, making observations easy on the eyes. The tuning knob has a solid feel to it which makes operation comfortable.

The cabinet is black with a hinged silver-colored perforated cover for ready access to the inside of the unit. The overall dimensions are 16" side, 10½" high and 16" deep. Weight is 44 pounds.

The instruction manual provides the most needed information regarding specifications, operation and servicing of the receiver, including detailed alignment procedures.

Use of the SX-115 over a period of many months, in all modes of operation, has provided much pleasure, especially in respect to its stability, frequency readout, handling capabilities and its convenient features with smooth performance. It also really digs out the very weak signals. It is a Class "A" receiver priced at $599.50. The Manufacturer is The Hallicrafters Company, 5th and Kostner Avenues, Chicago 24, Illinois.—*W2AEF*

For further information, check number 46, on page 110

For further information, check number 47, on page 110

PREMAX ANTENNA EQUIPMENT

Proven For Performance and Value

	Amateur Net each
MOBILE	
Type CA Bumper Mounting, Chain Style	$6.60
Type R-200 Universal Ball Mounting — Coax type	6.90
Type R-300 Universal Ball Mounting — Standard	6.90
Type SA-2 Heavy Duty Stainless Spring Adaptor	7.50
Type RS-300 Comb. Ball and Spring Mounting — Standard Type	13.50
Style BXS — Center loaded Antenna for standard frequencies — 72" S. S. Whip	9.00
Style BSS — Same as BXS with SA-2 Spring	15.00
TS-896 — 96" one piece Stainless Whip — taper ground	4.50
TS-884 — 84" Same description as above	4.50
TS-872 — 72" Same description as above	4.20
BASE STATION	
GP-430 — Light weight Aluminum Ground Plane Antenna fully adjustable from 20-40 MCS	30.00
GP-450 — Same as above — adjustable from 60-40 MCS	24.00
GP-312 — Civil Defense VHF Ground Plane Antenna — Efficient and inexpensive — 108-120 MCS	4.80
GP-314 — Same as above — 144 MCS	4.80
GP-315 — Same as above — 152-162 MCS	4.80

Types M, AL and SS Telescoping Vertical Antennas are available in Steel, Aluminum and Stainless ranging from 12' to 35' in height.

Safeguard your Base Station Equipment with a Premax Ground Rod, 3/8" to 5/8" diameters, up to 8' in length.

See your dealer or write for catalog

PREMAX PRODUCTS

DIV. CHISHOLM-RYDER CO., INC.

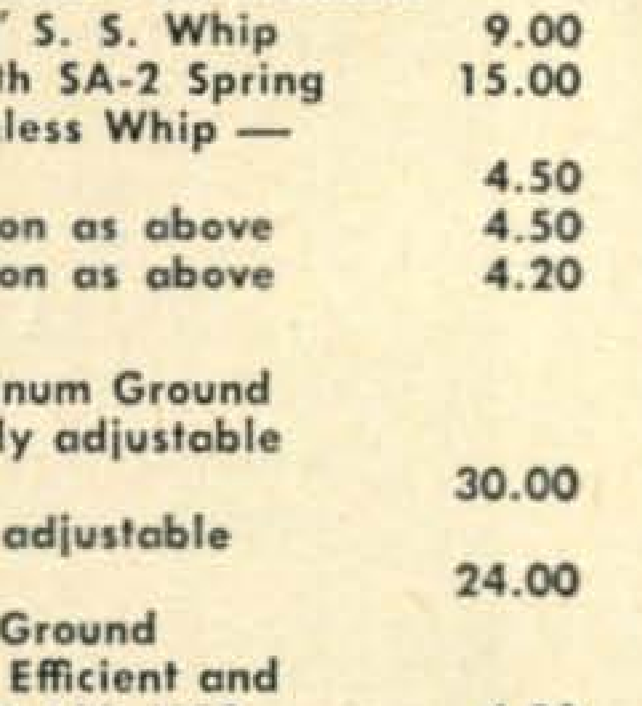
6403 HIGHLAND AVE. • NIAGARA FALLS, N. Y.

For further information, check number 48, on page 110

B&W

TR SWITCH

(TRANSMIT/RECEIVE SWITCH)



MODEL 381B $60.00

An electronic antenna changeover switch. Transmitter is continuously connected to antenna; antenna circuit to receiver is blocked during transmit. No switch contacts to arc or burn. Switching is instantaneous. Selectable band-switching insures no loss in receiver sensitivity. Substantial gain in receiver sensitivity results in most installations. Ideal for break-in operation on CW, SSB and AM. Bandswitch conveniently located on front. Three coax connectors are mounted on rear. Conservatively designed for full legal power. Operates from 115 volts, 60 cycles. For 52-75 ohm lines.

Size 4¾" x 4" x 5½"

BARKER & WILLIAMSON, Inc.

Radio Communication Equipment Since 1932

BRISTOL, PENNSYLVANIA • STillwell 8-5581

For further information, check number 49, on page 110

Ham Shop

Rates for the Ham Shop of 5¢ per word for advertising which in our opinion, is non-commercial in nature. A charge of 25¢ per word is made to all commercial advertisers or organizations. Since we do not bill for Ham Shop advertising, full remittance **must** accompany all orders.

Closing date is the 15th of the 2nd month preceding date of publication. Your copy should be typewritten, double spaced on one side of the page only.

Because the advertisers and equipment contained in Ham Shop have not been investigated, the publishers of CQ cannot vouch for the merchandise listed therein. We reserve the right to reject advertising which we feel is not of an amateur radio nature.

QSL's? WPE's? CB's? Finest samples 20¢. DeLuxe 35¢ (refunded). W8DED, Sackers, Holland, Michigan. (Religious QSL samples 20¢) Christian Ham Callbook $1 postpaid.

QSL's . . . Sparkling new. Dime. Filmcrafters . . . Martins Ferry, Ohio.

QSLs large selection including photos, rainbows, cuts, etc. Fast service. Samples 25¢, includes beautiful 4-inch call letters for your shack. Ray, K7HLR, Box 1176, Twin Falls, Idaho.

QSL's Free samples. Little Print Shop, Box 9363, Austin, Texas.

CREATE a QSL with a Sampler Instruction Kit, 25¢. Cards $1.50 up per 100. Samco, Box 203 Wynantskill, N.Y. 12198.

Q-STAMPS Now $1.50! Postage stamp size photographs for QSL's! 50 large or 100 small, $1.50 per gummed-backed, perforated sheet. Free Samples. Q-Stamps, Box 149, Dept. 4A, Gary, Indiana. 46401.

QSL's Samples 25¢. Rubber Stamps; Name, Call, Address, $1.55. Harry Sims, 3227 Missouri Avenue, St. Louis, Mo. 63118.

QSL's—Brownie, W3CJI—3111 Lehigh, Allentown, Pa. Catalog with samples, 25¢.

QSL's 100/$4.00 High gloss, three color. Free samples, quick service. B&R Printing, Box 8711, Orlando, Fla.

QSL's, CB, WPE samples 10¢. Nicholas & Son Printery, P.O. Box 11184, Phoenix, Arizona. 85017.

QSL CARDS Largest selection-Lowest prices. Samples & catalog, 25¢. Refund or 25 extra cards with your first order. Debbeler Printing, 1309-C North 38th Street, Milwaukee, Wis. 53208.

QSL's-SWL's or what have you. You name it and we will do it for you as you wish. Expert art work at nominal cost, enough said? R. McGee, 6258-103rd St., Jacksonville, Fla. 32210.

1964 QSL-size calendars, 100—$7.00. Samples 25¢ Morgan, W8NLW, 443 Euclid, Akron, Ohio.

PICTURE of yourself, home, equipment, etc., on QSL cards, made from your photograph. 250—$7.50 or 500—$10.00 postpaid. Samples free. Write to Picture Cards, 129 Copeland, LaCrosse, Wis.

QSLs SWLs XYL-OMs (Sample assortment approximately 9¾¢) covering designing, planning, printing, arranging, mailing, eye-catching comic, sedate, fantabulous. DX-attracting. Protopay, snazzy, unparagoned cards. (Wow!) Rogers, KØAAB, 961 Arcade St., St. Paul 6, Minn.

QSLs free samples. Fast service. Bolles, 7701 Tisdale, Austin, Texas.

RUSPRINT QSLs—SWLs 100 2-color glossy $3 postpaid. QSO file cards $1 per 100. Rusprint Box 7507, Kansas City, Mo. 64416.

QSL's 3-color glossy. 100 $4.50. Rutgers Vari-typing Service. Free Samples, Thomas Street, Riegel Ridge, Milford, N. J.

CALL CARDS Badges, decals, goodies, illustrated literature with samples 25¢. Errol Engraving Att: K1VRO, Westfield, Mass.

QSLs Samples, dime. Print Shop, Corwith, Iowa.

NEW QSL PRINTER with new designs. "2-color" $2.25 per 100. 10¢ for samples. Corneilson, 321 Warren, N. Babylon, N. Y.

1964 QSL catalogue. New Designs. 10¢. Longbrook, Box 393-Q, Quakertown, N.J.

QSL CARDS $2.50 per 100 in three colors. Samples and catalog free. Garth, Box 51C, Jutland, New Jersey.

QSL CARDS. As low as $2.50 per 100. Samples free. Radio Press, Box 24C, Pittstown, New Jersey.

TOROIDS 88 mh 60¢ each or 5 for $2.50. Fasold, WA6VVR, Box 34, Dixon, Calif.

CRYSTAL clear bargains in xtals. Free list. Nat Stinnette W4AYV, Umatilla, Fla. 32784.

FOR SALE Complete instructions including 28 page booklet and 22" × 36" schematic for converting the ART-13 transmitter to a.m. and s.s.b. Satisfaction guaranteed. $2.50. Sam Appleton, 501 No. Maxwell St., Tulia, Texas.

FOR SALE New and used CB and 2-way F.M. radio equipment. Send for list. Dealer inquiry invited. Becom Co., Seminary Heights, Weatherford, Texas. 76086. 817 LY 4-5172.

TECHNICAL MANUALS for surplus electronics. Free list. W3IHD, 4905 Roanne Drive, Washington, D.C. 20021.

BC-611 Pair of BC-611 handy-talkies, 3885 kc. In perfect cond. With manual. Will take $50. Karl Schneider, 5023 Florida Ave., Temple City, California. 91780.

75A3, crystal calibrator, speaker, product detector, two filters, $300. TG10 keyer with 5 Army tape code lessons, $20. Apt #1, 424 W. Prairie, Decatur, Ill.

WANTED Panadapter for 455 kc I.F. in working condx. Mil surplus unit okay if p.s. included. State lowest price first letter. Box TK2, CQ, 300 W. 43 St., New York, N.Y. 10036.

NO TIME TO OPERATE Complete 1 KW s.s.b., a.m., c.w. station. Less than 40 hrs. use. Cost, $1900. Sell for $1100. Will ship. Singly HT32A, $400; includes D-104 w/PTT stand; HT-33A—$500; NC-303 with xtal calibrator & WWV adapter, $300. W7PMC, Philipsburg, Montana.

SELL Hallicrafters HT-30 S.S.B. transmitter, $120; Johnson Ranger, $160; Early Heathkit SB-10 excellent condx, $50; Revere C-153 16 mm 100' Rollfilm Turret Movie Camera, $100. Want KWM-2 with portable a.c. supply and carrying case; also want Collins mechanical filters, advise model and price. Contact W4ADU or K1YYM.

SELLING ENTIRE SSB STATION. All equipment immaculate and with manuals. Consists of 75A-4 Receiver, Eldico SSB-100F transmitter, matching speaker console with light, drake phone patch, timer, audio test oscillator, control switches, etc., all built in, Harvey Wells Z Match, Homebrew KW Linear using pair 4-400A's, B and W TR switch, and coaxial relays. Must see to appreciate. Prefer you pick up the works for $850.00 KØBXJ, 114 Louise, Topeka, Kansas.

SELL: 32S-1 with a.c. supply, less than 2 hrs. use, will throw in old Dumont scope . . $530; Eldico SSB 1000F linear . . $300; Eldico SSB 100F exciter . . $400; Transtenna T-R switch, new . . $45; Eldico low pass filter . . $5; Sony CS-300 stereo tape recorder . . $225; Concertone professional recorder, 7½ and 15," five heads, 10" reels . . $500; all f.o.b. . . Lamb, 1219, Yardley Road, Morrisville, Penna.

TWO METER NOVICE STATION: Heathkit Twoer cleanly modified for push-to-talk operation and rotary switch crystal selection. Price, $55 postpaid. Includes three Novice band crystals, Turner 350C PTT mike and 110 v.a.c. cord. See photographs of this unit on pages 34 and 35, October 1963 CQ. Will ship immediately on first come basis: Bob Brown, K2ZSQ, 481 W. Grand Ave., Rahway, N.J.

JOHNSON DESK KILOWATT—new side band modification kit—Ranger PTT sequence keying—factory wired—Kilowatt Match Box swr bridge—new tubes—extra spares 4—400A's—810's—872 A's—not surplus—complete cables ready to operate—condition like new—$900.00 cash. Ted Brix—5573 No. Van Ness Blvd, Fresno 5, California.

TOROID RTTY KIT Mark-Space discriminator and bandpass filters. Includes 4-88 mh and 1-44 mh uncased, like new toroids; information sheet, mounting hardware and six mylar capacitors. $5.00 Postpaid. Toroids: Specify 88 or 44, less capacitors, $1.00 ea. 5/$4.00 Postpaid. KCM Products, Box 88, Milwaukee 13, Wis.

!!SWAP, SELL, TRADE with other hams!! Special subscription to "Ham Trader" 12 issues $1.00—Box 153C, Franklin Square, N.Y.

WANTED: Commercial, military, all types ARC, ARN, ARM, GRC, PRC, URR, URM, TS, 618S, 17L, 51R, 51X, APN, others . . . Ritco, P.O. Box 156, Annandale, Va.

QSL's Large selection, including photos, rainbows, cuts, etc. Fast service. Samples, 25¢. Includes beautiful four inch call letters for your shack. Ray, K7HLR, Box 1176, Twin Falls, Idaho.

NOW! 1000 gummed name & address labels with call, $1.00; self-inking pocket name & address rubber stamp with call, $1.00. Boss's, Box 7-A, Grandville, Michigan.

SELL Heathkits, GR-91 rcvr, $23; GP-11, 12 v. pwr., $13. Ameco CB-2 conv., $14. WA8HKN, 375 So. Market, E. Palestine, Ohio.

ART-13, complete with power supply, $80., or will trade for DX-60 or equivalent. Write: Michael Windolph, 3644 Rocky River Drive, Cleveland, Ohio.

WANTED: Early CQs. Jan., Feb., May, 1945. Last issues needed to complete collection. Write: A. M. Dorhoffer, 75-15 177 St., Flushing, N.Y.

BUY used equipment with confidence. See Amatronics ad page 95.

NOW 1000 gummed name-address labels with call $1.00. Pocket name-address rubber stamp with call $1.00. Ross's, Box 7-D, Grandville, Michigan.

BUY, SELL or trade ham gear. Free listing in Ham Directory. Card for free details. Lupi, 1225 Hillside Pl., North Bergen, N.J.

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10 to 17 mc Fund	4.50	4.00	3.35
2 to 2.9 mc.	4.50	4.00	3.35
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SWAP sell and buy ads. Write for free copy. All kinds of equipment and deals. Hams Hobbymart, K1WPZ, Box 38, Rowayton, Conn.

FOR SALE Clegg Interceptor, perfect condition. Price $335.00 or best offer. Moving to St. Pete Fla. March 1st, cutting down on gear. K9HOW, Paul, 10511 Emerald Ave., Chicago 28, Ill.

NEW YORK area hams—Sell your used gear for cash through Amatronics PPA Service. We have the customers. See page 95.

FOR SALE R-388 receiver $350.00. RCA 16 mm sound projector $150.00. Bell & Howell SOF projector with amplifier & lens missing $50.00. Motorola FMT80DB & FMT140D 2-way radio less acc. $75.00. Acc. $25.00. Motorola T-41G with acc. $125.00. Used 6198 or 7038 Vidicon tubes $25.00. Communication Service P.O. Box 303 Georgetown S.C. Phone: day, 546-4666, nite, 564-4666.

COMMUNICATIONS teletype, unusual surplus bargains. Free flyer, MDC, 923 W. Schiller, Phila. 40, Pa.

ANTENNA tuning unit, brand new $3.00 postpaid (cost Navy $85.00). MDC, 923 W. Schiller, Phila., 40, Pa.

REMOTE CONTROL unit, 9 tubes, AN/ARW-26, brand new, complete, $5.00 postpaid (cost Navy $125.00) MDC, 923 W. Schiller, Phila., 40, Pa.

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FOR SALE Collins 75A-4 Model No. 5195 with all latest modifications with 4 mechanical filter, 800 cycles 2.1, 3.1, and 6.1, plus matching speaker—Best offer. Also, Viking Ranger II like new—make offer. Call JU 2-4460 (NY) between 10:00 a.m. and 4:00 p.m. ask for Miss Mark.

FOR SALE like new SR-150 Transceiver; PS-150-120AC power supply. Need cash—Best offer over $600 takes. Charles Mahnke, Iola, Wis.

WANTED URA—8A/CV89A cabinet less plug-in units. State price and condition. K1AJE, 50 Crabapple Lane, Groton, Conn.

OVER 400 QST's, CQ's, Radio, Call Books, Handbooks, etc., 1925 through 1962, $100 or best offer lot only, f.o.b. Minneapolis. Send stamp for list. WØCTW, 8715 Logan Avenue South, Minneapolis, Minnesota.

KWS-1 75A-4, Hy-Gain beam, spare tubes, like new condition $1250 f.o.b. Minneapolis. WØCTW, 8715 Logan Avenue South, Minneapolis, Minnesota. Phone 881-8126.

WILL TRADE Halli. SX-42 a.m./f.m. receiver & R-42 Speaker for 35mm camera equip. H. Carlson, Box 190, Tinley Park, Ill.

WANT used C.I.E. Electronics Course. Sell CQ—1960, 1961, 1962; 73—1961, 1962. $5.50 per year. K1OMJ/2 2526 Watt, Schnectady, N.Y.

FOR SALE HQ—170A s.s.b. specialist. Used less than 20 hours, perfect, $270.00. Write J. Bravo, K3KWM, 441 R. Hickory St., Peckville, Pa.

SELL Drake 2-B, 2-BQ, 4 months use, perfect condition, $230. Steve Kraman, 750 East 82nd St., Brooklyn 36, N.Y.

SWAN 120 single sideband transceiver w/book. Xlnt. Cond. 180 watts pep output 20 meters. One owner and little used. First draft or money order for $165.00 FOB here. C. L. Wilson, P.O. Box 1094 Sierra Vista, Arizona.

80 METER Final $50, 40 meter final $50. Both use single 4-400A and are fully shielded and metered. 3.5 kv 2 amp power supply $110. 50' tower $20. Deluxe 6 meter vfo a.m. xmtr $75. Ssb package $75. Dave Allen, W1WAI, 9 Upland Rd., Burlington, Mass.

FOR SALE: Collins 32V-2 in like-new condition, $175. Local sale preferred. K2QMM, 79-35 209 St., Flushing 64, N. Y.

RECEIVE Worked Trumbull County Award for Trumbull County and Warren Amateur Radio Association members contacts since January 1, 1959; Trumbull County 20 contacts including 10 members; other W, K and VE, 10 contacts including 5 members; DX 5 contacts including 3 members. Send log data, 50 cents, certificates by two amateurs that you have QSL's to K8BXT, Box 809, Warren, Ohio.

FOR SALE 6 meter Gonset G-50 transceiver, 50 watts, 6146 final, $225. Express prepaid. M. E. Atkins, W9CFB, Calhoun, Illinois.

RADIO, ELECTRONIC, experimental items, variety of publications. Reducing home stockpile to gain space. Write for list. William C. Reichard, Netcong, New Jersey.

SELLING clean National HRO-50T-1. Make offer. Dick Sowler, Box 35 College Station, Berrien Springs, Michigan.

WANTED A dependable s.w. receiver that receives on the 6 meter band, in trade for a Hallicrafters S-120, good condition. Ray Busick, 1319 Washington, Covington, Indiana.

QCWA If licensed 25 or more years you are eligible for membership in Quarter Century Wireless Association. Over 3,300 current members. Write Executive Secretary W2ZM for information and application.

WANTED Simpson 260 with damaged meter. Stan, W8QKU, 2748 Meade, Detroit 12, Mich.

SELL-TRADE 15 watt 6 meter phone transmitter, complete $35. 125 watt plate modulator $20. Electronic keyer $25. Antique Atwater Kent radios model 30 and 40, $50 each. Plate transformers: 2000-0-2000 volts, 375 ma, 1800-0-1800 volts, 475 ma. Power supply, 750 volts, 200 ma, 6.3 volts $15. Combination 220/110 volts 10 amp. Variac, $15. Need: BC-221, BC-779, S-38C, tube checker, or? ? ? ?. Stan, W8QKU, 2748 Meade, Detroit 12, Mich.

KWM-2 serial 10916, never used, $825.00; 75S-1, serial 11484 $355.00; 30L-1 linear, serial 11080, $365.00; dc power supply for KWM-2, new, $150.00; Drake 2-B, serial 7991, $219.00; Drake 1-A, $135.00; new Hallicrafters HA-6 transverter in carton, never opened, $185.00; HT-32, mint condition, $340.00; Eico 720, factory wired, $59.00. G. M. Barnes, W8WGA, 3451 Ridge Ave., Dayton 14, Ohio. Phone: 513 277-0409.

WANTED Kleinschmidt TT-76A tape machine and TT-4A page printer. W9UE.

FOR SALE f/w Viking Ranger and Courier $125 each or $250 for both. LM-5 frequency meter, p/s, and calibration book $30. Johnson low-pass filter $5. W6BVW P.O. Box 142 Loleta, California.

HT-37 $295, Drake 2A with Q multiplier and speaker and xtal calibrator $185. WA2FSD, 516 HU 2-2737.

SELL f/w Valiant, immaculate condition $300. Wanted: teletype equipment, back issues of ham magazines. WA2WMP 86-91 188 St., Jamaica, N.Y.

WANTED correspondence course on communications, electronic technology or transistors with experimental equipment if possible. Thomas Condon, 321 Moreland St., Staten Island 6, N.Y.

BARGAINS reconditioned guaranteed shipped on 15 day trial. Subject to prior sale. 32V-2, $149; G-76, $249; SX-101A, $225; HT-32, $299; HT-37, $299; HQ-170, $199; Viking II, $99; HRO-50T, $99; NC-190, $129; NC-270, $129; new B&W 6100, $595. Hundreds of other items. Write for free list and time payment plan. Henry Radio, Butler, Mo.

SELL DX-100 modified for s.s.b. $150, SB-10 $85.00. All equipment is in excellent condition. Gary Sundstrom, P.O. Box 232, Camden, Maine. K2LXL & K1YQE.

LINK 1890 2-way remote control unit $50. Phil Peterson, 3001 St. Charles Rd., Bellwood, Illinois.

DX-100B and Mosley TA-33 jr. Both excellent condition with manuals $175. Power supply, 600 v., 100 ma; 250 v., 100 ma; 150 v. reg.; 225 v. reg. and 6 and 12 volt filaments. $20. Glenn Yates, Mackinaw, Illinois 61755.

ESTATE of W5YEN: Collins 75S-1, 32S-1 w/ps & spkr, 30L-1, like new. All for best offer over $1200. Will break up set. Contact Dave Singleton, 115 Dearman Ave., Long Beach, Miss.

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JOHNSON desk kilowatt, new sideband modification kit; Ranger, ptt, sequence keying, factory wired; kilowatt Matchbox s.w.r. bridge; new tubes, extra spares: 4-400A's 810's 872A's not surplus. Complete, cables, ready to operate, condition like new —$900 cash. Ted Brix, 5573 No. Van Ness Blvd., Fresno 5, Cal.

For further information, check number 56, on page 110

For further information, check number 57, on page 110

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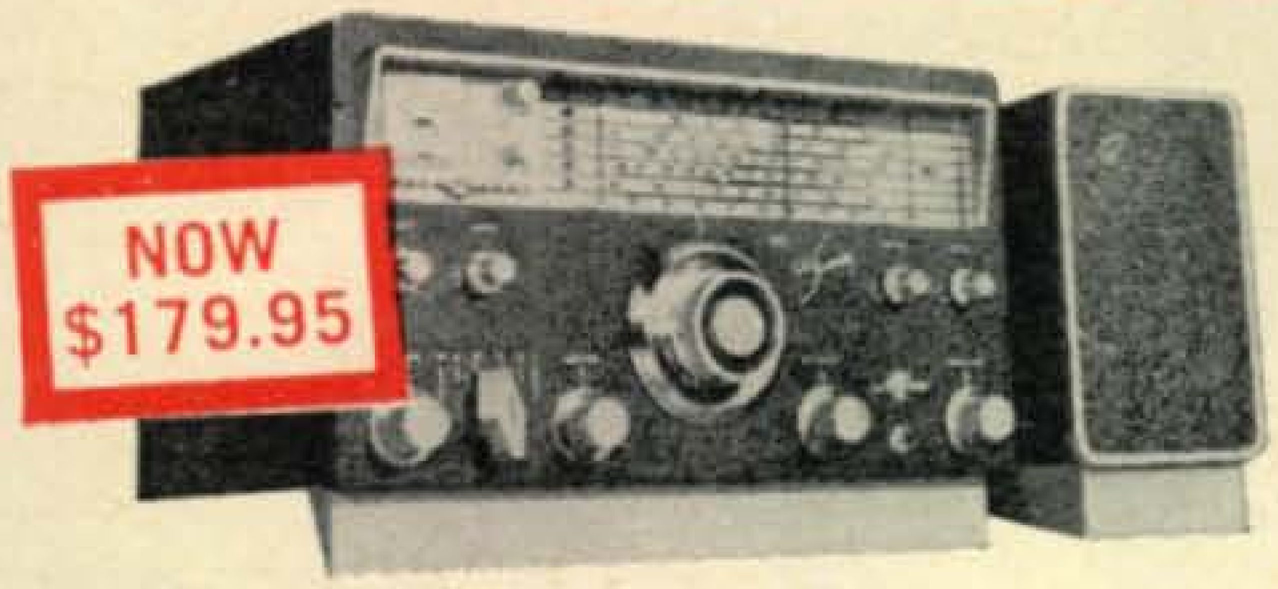

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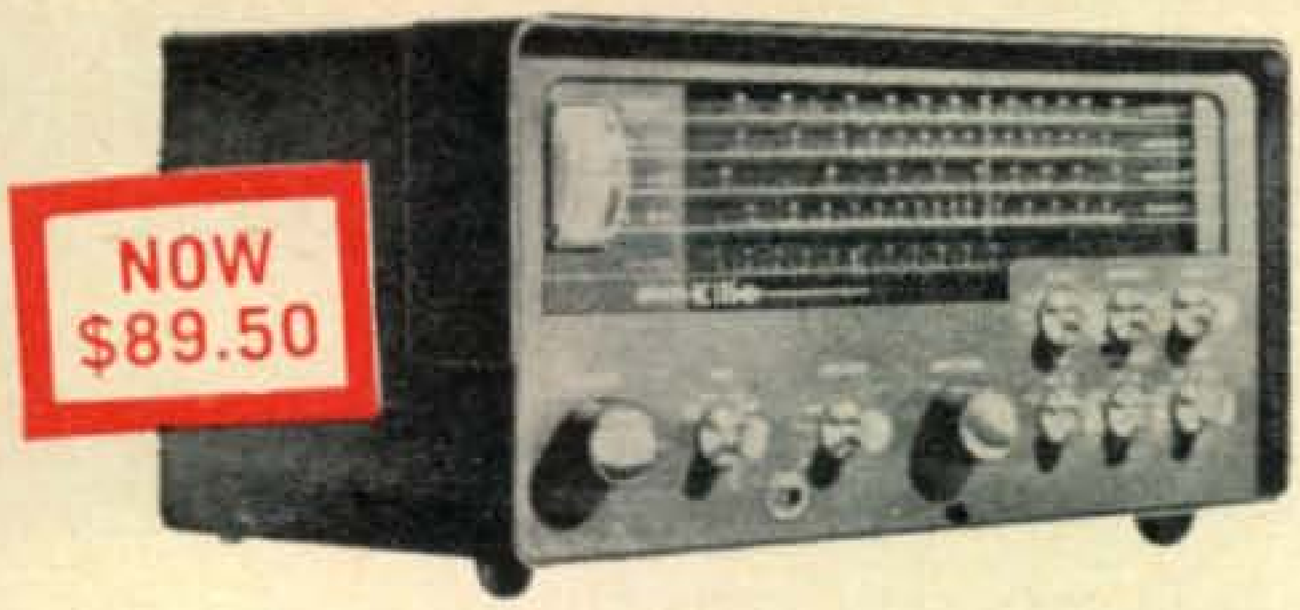

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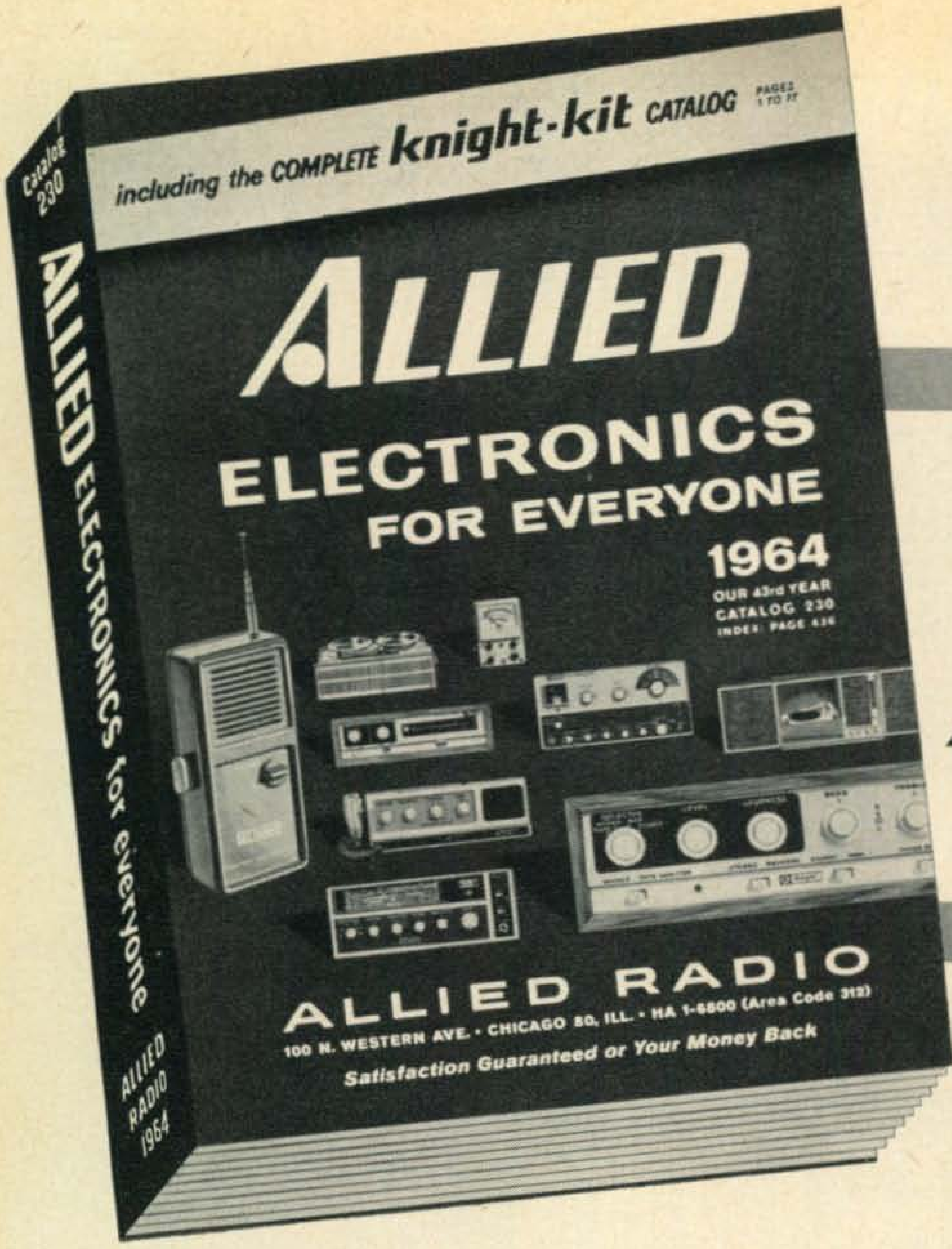

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ave been in amateur (and commercial) radio since the '20's, and the NCX-3 is the most enjoyable and interesting rig I ever owned. W7M--, Seattle, Washington

In comparison with a higher priced unit ur NCX-3 walked away with the honors. I am more than pleased with my NCX-3.
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ng a ball with it! Excellent rts audio wise and signal strength.
W1H--, Merrimac, Massachusetts

I've had the NCX-3 just over a month now, and I must say that it does everything your advertisements say and then some.
W1--, Portland, Maine

et amazing signal reports on mobile Most fun I've had since I got on the ! Very excellent piece of electronic pment.
W6L--, Mission San Jose, California

3 is untouchable in its class.
WN5F--, Vicksburg, Mississippi

How you did it I don't know. The rig is absolutely unbelievable, fabulous.
WA2J--, Freeport, New York

This is one of the nicest pieces of equipment I have ever had the privilege to own.
KØI--, Cedar Falls, Iowa

I have been in ham radio for about 9 years and I am sure that this is the best piece of radio equipment ever to enter my room. Keep up the good work.
W9R--, Belleville, Illinois

Best VOX I've ever used!
K5R--, Dallas, Texas

Words cannot express my ultimate satisfaction with the NCX-3. Thanks to National for putting such a rig on the market.
K9M--, Peoria, Illinois

Am quite surprised and pleased with my investment in the NCX-3. SSB reception quality is best I've heard. Good job National! K9A--, Cicero, Illinois

This rig is the best rig I have run for general performance. The SSB audio is terrific.
WAOA--, Delta, Colorado

Best investment in amateur equipment I ever made! WA4A--, Colonial Heights, Virginia

Couldn't be happier. Wouldn't trade this NCX-3 for the world!
K7V--, Williams AFB, Arizona

Best piece of amateur radio gear on the market for performance and price.
W9R--, Indianapolis, Indiana

I wish to state the performance is beyond my expectations — the performance of the unit is excellent.
Merriam, Kansas

Outperforms any other transceiver I have heard. National has done it again.
K9L--, LaPorte, Indiana

You have a wonderful rig in the NCX-3! I wouldn't sell it for double the purchase price! Sure works fb on SSB and CW. Couldn't be more happy with the finest rig I've ever owned!
WØP--, Independence, Kansas

The nicest piece of equipment I've had in many a year. W8L--, Lansing, Michigan

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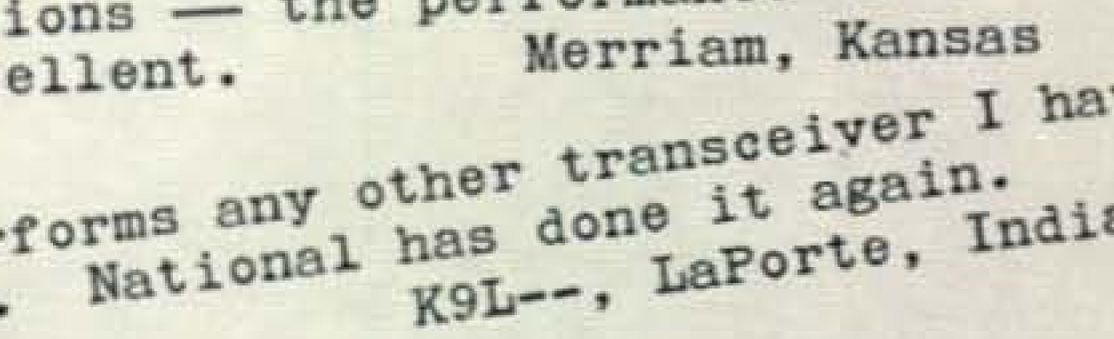

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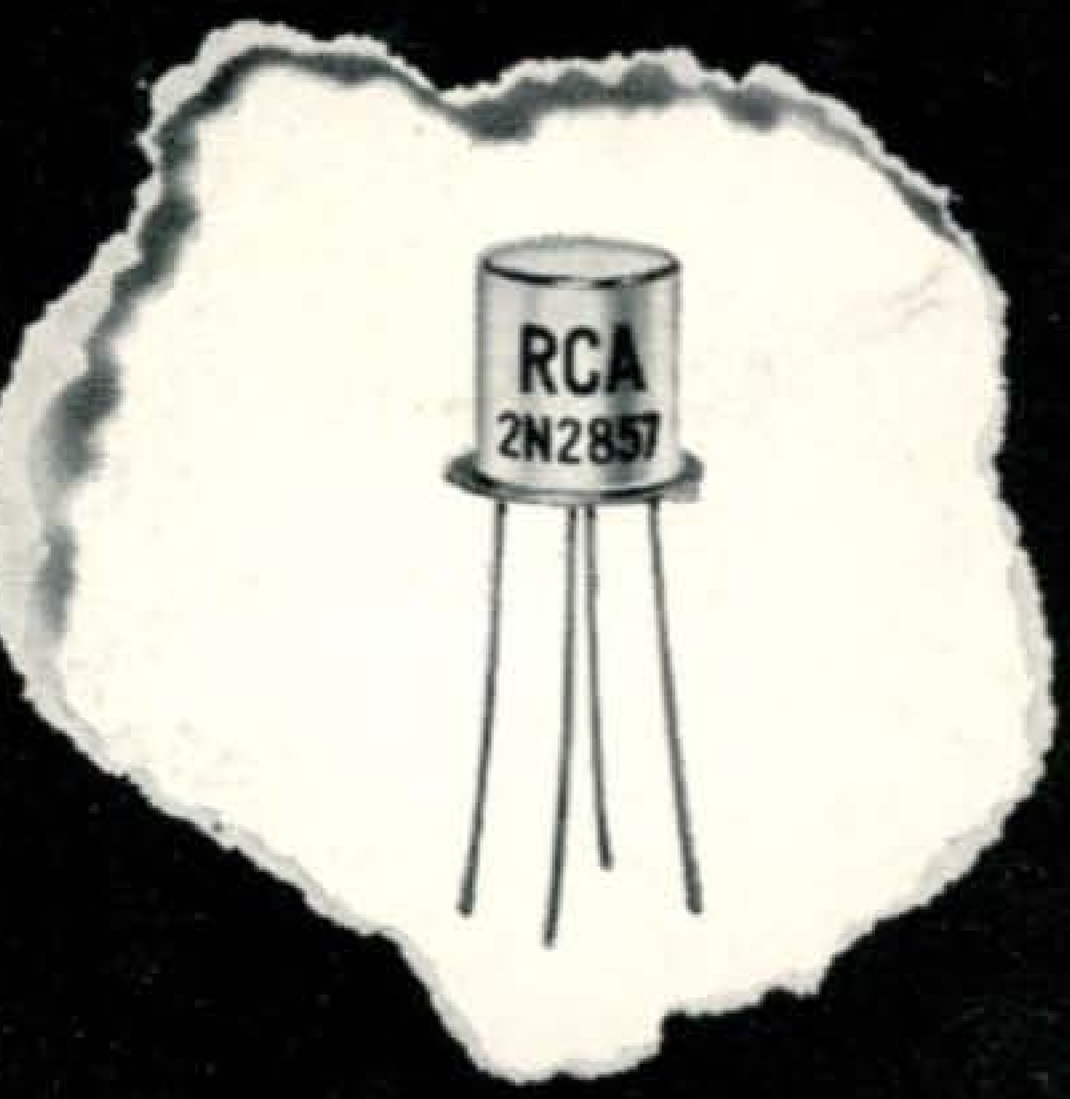
For further information, check number 7, on page 110



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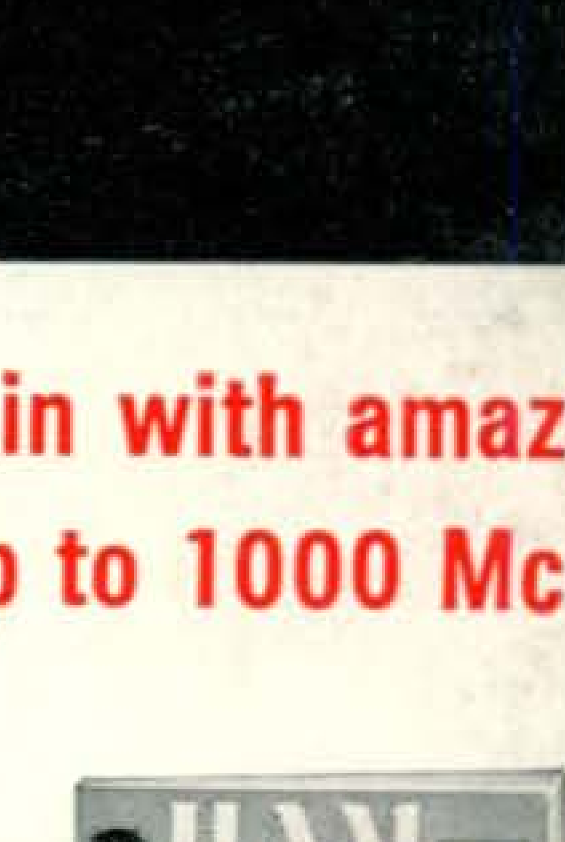

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