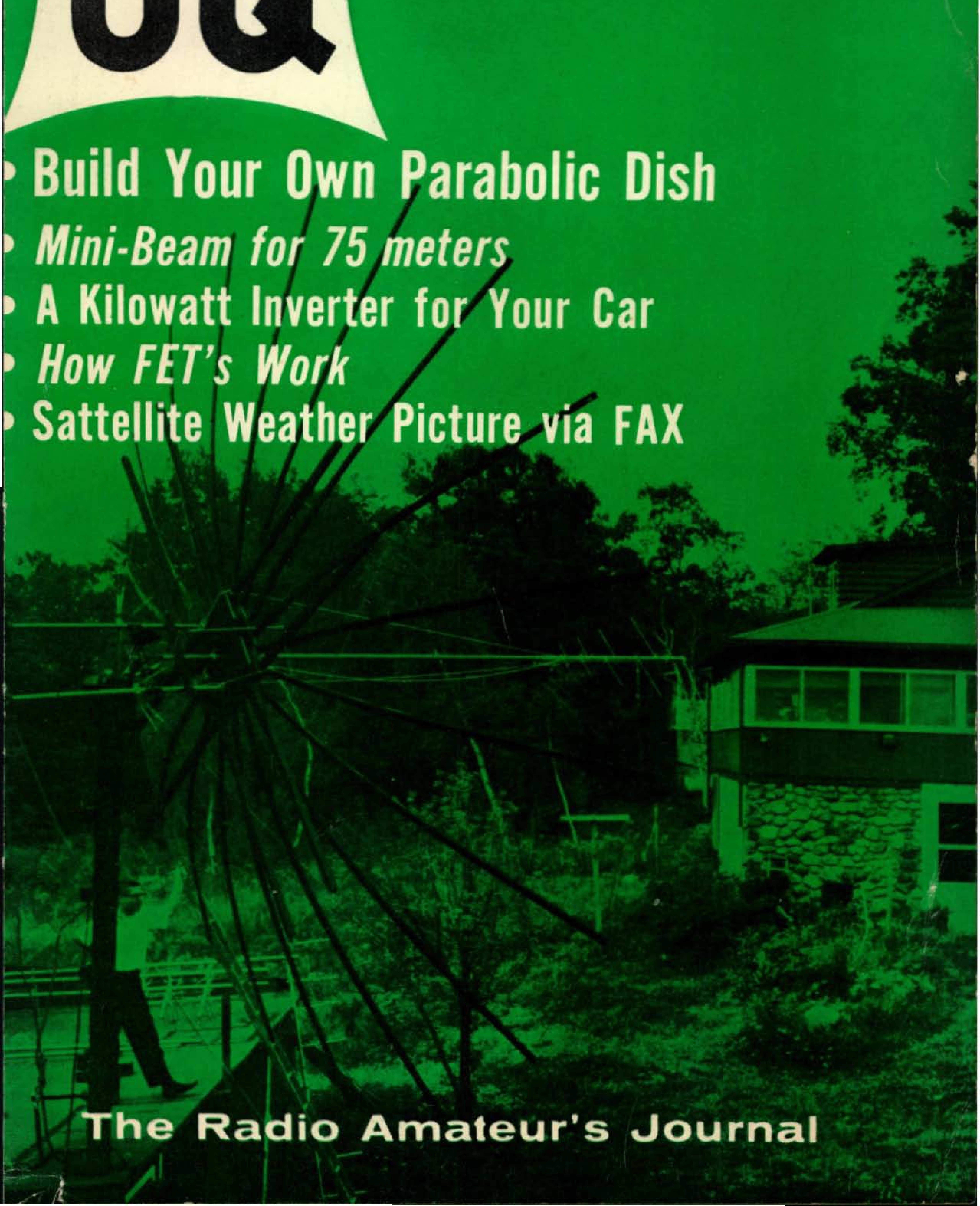
August 1966
75¢

CQ

- **Build Your Own Parabolic Dish**
- *Mini-Beam for 75 meters*
- **A Kilowatt Inverter for Your Car**
- *How FET's Work*
- **Sattellite Weather Picture via FAX**



The Radio Amateur's Journal

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COLLINS

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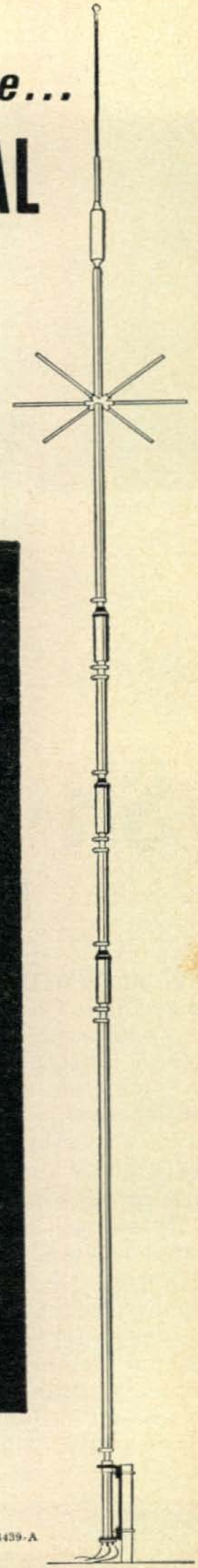

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For further information, check number 1, on page 110

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SPECIAL FEATURES: Patented Receiver Offset Control (RIT) permits ±2 ks adjustment of receiver frequency, independent of transmitter, for round-table, net or CW operation. Hallicrafters exclusive Amplified Automatic Level Control.

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GENERAL: Dial cal., 1 kc. Linear gear drive with less than 1 kc readout. Adjustable IF noise blanker. Provision for plug-in external VFO/DX adapter. Built-in VOX plus break-in CW and PTT. Built-in CW sidetone. Hi-Low power switch useable in CW or SSB.* 2.1 kc crystal lattice filter. S-meter-RFO-AALC and final screen metering.* Two-speed blower, 100 kc crystal cal. VFO covers 500 kc.

TRANSMITTER SECTION: Two 8122 output tubes. Variable Pi network. Power input, 2000 watts P.E.P. SSB; 1000 watts CW. Carrier and unwanted SB suppression, 50db; distortion products, 30db. Audio: 500-2600 cps @ 6 db.

RECEIVER SECTION: Sensitivity less than 1 μv for 20 db S/N. Audio output, 2W.; overall gain, 1 μv for ½ W. output.

*Meters for final plate current and voltage built into P-2000AC power supply. Also Hi-Lo power switch.

amateur net: $\$995^{0}$

less power supply

For further information, check number 2, on page 110

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AUGUST 1966 VOL. 22, No. 8

CQ

The Radio Amateur's Journal

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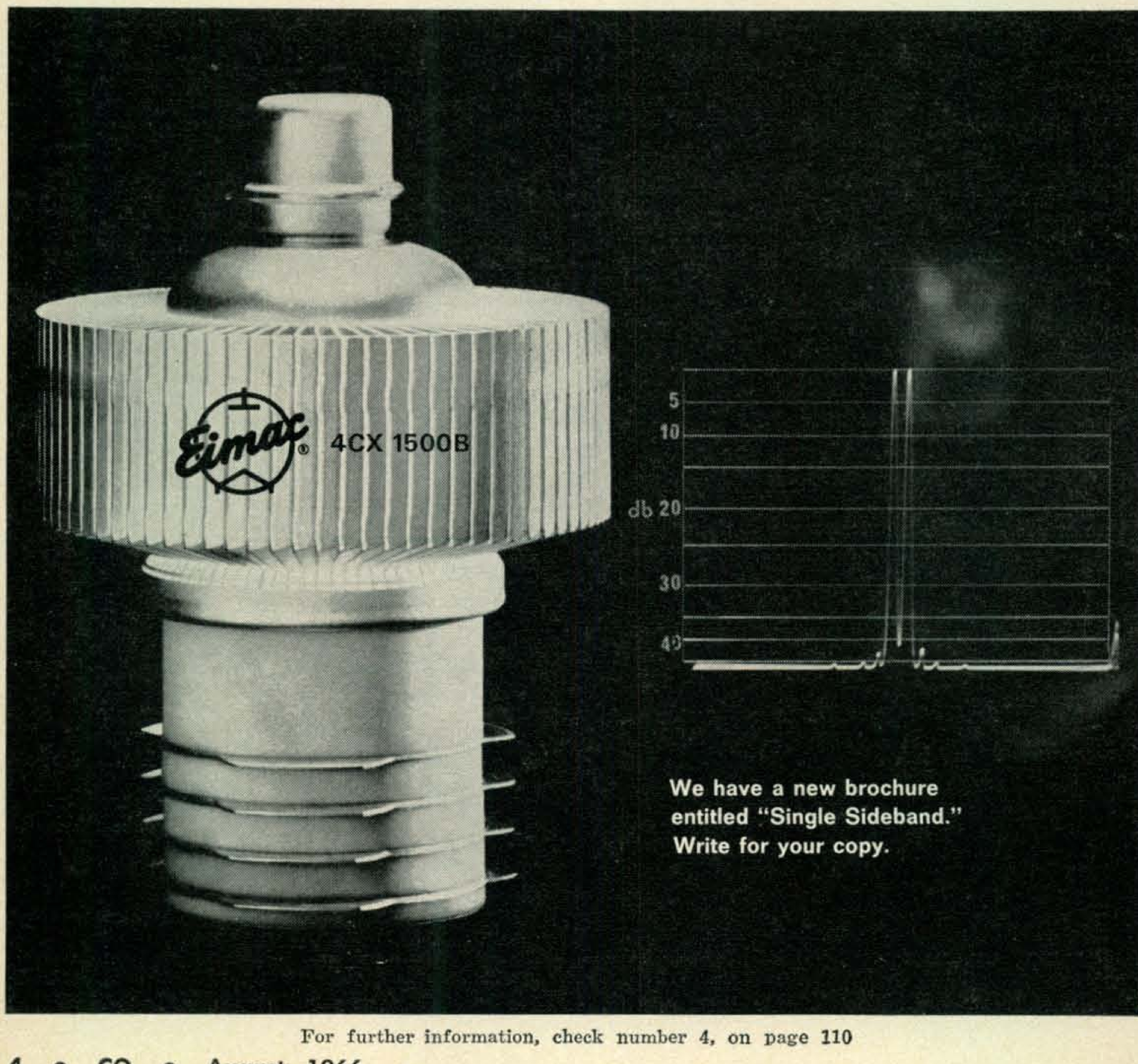
EIMAC offers new 1 kW PEP tetrode for SSB with highest linearity—at least -40 db in typical operation

EIMAC's new 4CX1500B power tetrode is the most linear tube on the market; intermodulation distortion characteristics under typical operating conditions are at least −40db at all drive power levels from zero to maximum. The new tube is ideal for advanced single sideband transmitters demanding high linearity to avoid channel-to-channel interference. The 4CX1500B is the product of a four-year development study which included optimization of internal tube geometry by computer techniques. Rated maximum plate dissipation of this radial beam tetrode is 1500 watts, and control grid dissipation rating is 1 watt maximum. Because the 4CX1500B has very low grid interception (typically less than 1.5 mA grid current), it is possible to drive the grid positive without adverse effects upon the distortion level; the tube is therefore recommended for Class AB_2 linear amplifier service. For further information, write Product Manager, Power Grid Tubes, or contact your nearest EIMAC distributor.

TYPICAL OPERATION (Frequencies Below 30 MHz)

DC Plate Voltage	2500	2750	2900 volts
DC Screen Voltage	225	225	225 volts
DC Grid Voltage	−34	−34	−34 volts
Zero-Signal DC Plate Current	300	300	300 mA
Single-Tone DC Plate Current	720	755	710 mA
Two-Tone DC Plate Current	530	555	542 mA
Driving Power	1.5	1.5	1.5 watts
Useful Output Power	900	1100	1100 watts
Intermodulation Distortion Products			
3rd Order	−38	−40	−40 db
5th Order	−47	−48	−48 db

EIMAC
Division of Varian
San Carlos, California 94070



For further information, check number 4, on page 110

ZERO BIAS

LAST month I stated my case for enticing many hobby-oriented CBers into amateur radio. Briefly, I pointed out that recent polls have shown that more than 50% of the active CB hobbiests would like to become amateurs, a number representing well over 100,000 people. I believe that amateurs should plan on making a strong bid for the interests of these fellows for several good reasons.

First, these CBers represent a large number of energetic, public spirited fellows with good experience at handling local emergencies, one area in which amateur radio has suffered in recent years. Second, they represent a group of communications-minded people who would probably have dabbled in amateur radio in the absence of CB. Just as many of them can still be valuable members of the amateur community now, as could have been without CB. Third, the growth of amateur radio in the US has slowed greatly since 1962, and while some amateurs view the trend with relief, we must be realistic: lack of growth means less justification for our occupancy of approximately 12.5% of the h.f. radio spectrum, particularly when increasing demands are being made for that same chunk of spectrum by other services.

However reluctantly, we must agree that we'd be doing amateur radio, CB radio, the public, and the FCC a very large favor if we could somehow filter out the prospective hams from the multitude of CBers now on the air, and indoctrinate them to the ways and pleasures of our hobby.

But how can it be done?

Probably the most effective way would be to work through the local amateur radio club, and organize a regular open house featuring a working rig, and plenty of coffee and donuts. Few things have the enthralling power of a full fledged high frequency ham station working into a good antenna—not the single package transceiver feeding a mobile whip, but a good "old-fashion" communications receiver and all-band transmitter combination into a well designed beam or quad. Since you're admittedly out to impress someone, don't give yourself the handicap of a hastily conceived, poorly operating station—bring out the heavy artillery!

Bringing out the CBers is the easiest part of the whole job—like hams, they're gabbers, and welcome every opportunity to get together over a cup of coffee. Post notices in as many local stores as you can, offering a standing invitation for CBers to attend your club's twice-monthly coffee-klatches. Make these get-togethers separate from regular club business meetings.

Most newspapers and many radio stations are eager to grant publicity for any legitimate social gathering such as this, just don't be afraid to ask for it. Approach the president of the local CB club, it there is one, and extend the personal invitation of the Squeedunk ARC to the Squeedunk CB club. A gallon of coffee and a few dozen donuts can go a long way towards creating a good working relationship between the two groups!

Regardless of how successful you are at bringing CBers in contact with ham radio at it's best, the entire venture can blow sky high if your own attitude is wrong.

One reason for the invisible wall that has grown between CBers and hams is the "holier than thou" attitude of so many amateurs, but then, it's not easy to erase the feelings that have grown over the years. Many amateurs, of course, still bear a foolish grudge towards anyone associated with the Citizens Band because the CB occupies what was once the 11 meter ham band. They feel that something was "stolen" from them by the CBers, when in reality, the CBers had not a thing to do with the change—CBers didn't even exist when the big step was being planned! And more, if amateurs are to bear a grudge towards anyone over the loss of 11 meters, they'd better bear it towards each other. It was largely as a result of amateur radio's own disuse of 11 that the band was lost at all! Don't try to conceal that sad fact by placing the blame on a Citizen's Band operator!

The prevailing attitude of most amateurs towards CBers is that they're a terribly inferior cut of person, to be either pitied or used as a verbal punching bag, whichever suits the amateur's need at the moment. It may come as a shock to readers of an editorial in an amateur radio magazine, but fellows, the only difference between a ham and most CBers is an examination given by the FCC, and a small matter of over fifty years of habit, tradition, history and experience with which amateur radio is graced. And the large majority of this fifty years background has simply been inherited, not created. It seems then that the main difference between a ham and a CBer is an examination administered by the FCC, which reflects his technical prowess and ability to copy code, both of which are talents which can be developed through study and experience. What the devil are we looking down our noses at? Inexperience? Lack of proper guidance? That's what it amounts to, isn't it?

The point is this: amateurs pride themselves in their great spirit of camaraderie—among amateurs, but often put themselves on a pedestal with relation to CB operators, when in fact, the CB operator has the potential to be a first rate amateur himself, *if*—and here's the problem—he's given the necessary encouragement and guidance by amateurs.

If you're open-minded enough to concede this point, I'd like to carry on next month with a discussion of how this guidance and encouragement can take shape.

73, Dick, K2MGA

OUR READERS SAY

Those Would-Be Hams

Editor, *CQ:*

As an avid *CQ* reader (and *QST*) and as an amateur very much interested in amateur radio itself, I feel compelled to toss in my two cents into what promises to become a lively argument.

First, I agree 100% with your deduction that CB Radio has absorbed a great many thousands of would-be hams by offering them the avenue of least resistance into radio. While we hams have ways of policing our on the air activities the CBers do not, therefore the 100,000 would-be hams you speak of have for a long time been living with the constant knowledge that they are breaking the rules as set forth by the FCC and getting away with it quite easily. It is not the individual CBer I am afraid of, but rather this very evident attitude that the CBer knows he can get away with anything on his frequencies.

Any effort to lure away the CB operator in the ranks of amateurs should be made with a complete brainwashing because I for one do not want 100,000 rule breakers suddenly dumped on our bands. One solution which is probably impossible, would be to enforce the rules on 11 meters.

My best wishes go with your plans but remember it is unfair to campare the wide eyed Novice of the 50's with the CBer of today. CBers now have many years experience in busting all the rules. Most of the Novices I had contact with were willing to learn and wanted to abide by the regs. Anyway, lotsa luck es 73,

Ken Mac Neilage, WA2IDH
Westwood, N.J.

Editor, *CQ:*

Just one comment regarding the CB situation in your editorial in July *CQ*. I'm sure that the hams would welcome the CB boys into their ranks if the CB boys would just only learn how to observe FCC rules and regulations. Just think what utter chaos the ham bands would be if the ham operated in violent opposition to every rule and regulation on the FCC like the CB ragchewers apparently do. We do not desire these 10-4 maniacs in our ranks.

Dick Malanowicz, W2PZI
Hamburg, New York

On page 5, I've begun to outline one aspect of what will have to be the biggest guidance and indoctrination jobs ever, in amateur radio. Our continued existence as a hobby and service could conceivably depend on the success of our efforts.

Among the more important phases of this indoctrination is instilling a strong respect for the law, both international and domestic, governing amateur radio. In view of the reckless attitude most CBers take towards the law, it might seem to be an impossible job, but it shouldn't be. Think about this: 80% of the violations recorded by hobbiest CBers *would not be violations in amateur radio.* Profanity, improper identification, etc., are as illegal on the ham bands as anywhere else, but these actually amount to a minute portion of CB violations.

Attitude and operating procedure are bound to be a problem. However, a firm but gentlemanly hand in dealing with the inevitable breaches of courtesy and tradition should swing most anyone into line. It will be a matter of setting a good example, more than anything else, don't you think—*K2MGA*

"OUR READERS SAY" welcomes letters about nearly anything of interest to amateurs, whether about *CQ* itself, the state of the hobby, or whatever else you have on your mind. The most interesting letters will be selected for publication each month; just keep them legible, keep them short, and above all, keep them clean! Something bothering you. We're not mind readers, OM, so drop us a line.

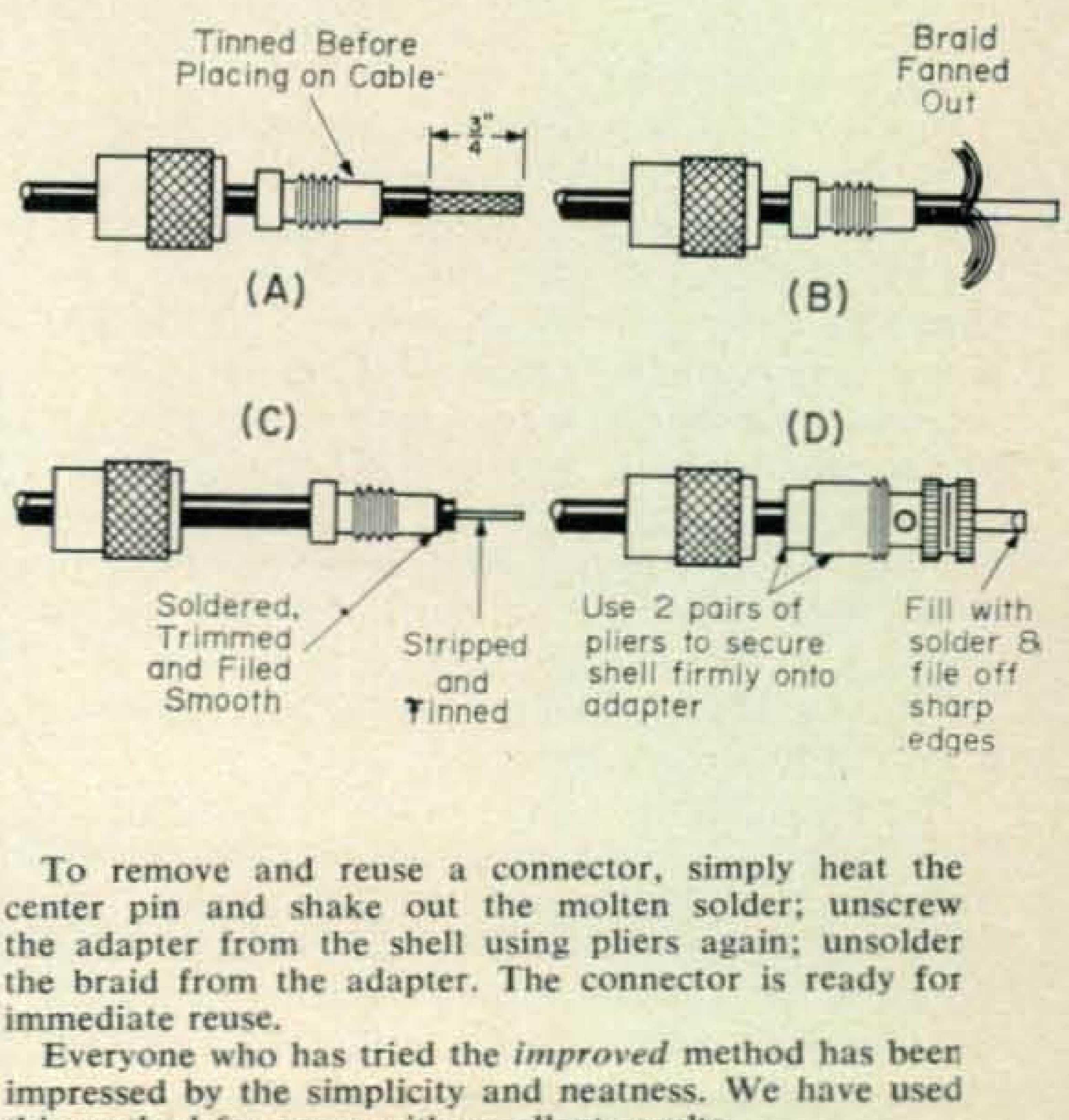
Connectors

Editor, *CQ:*

The article "A Close Look at Connectors" in June *CQ* was informative, however I contend that the method shown in fig. 9 for connecting RG-58 or RG-59 to 83-1SP coax connectors is *not* the easiest, safest, or most reliable way. . . .

The following improved method has these advantages: 1. A better ground connection, with less chance of corrosion. 2. No loose strands of cable braid to cause a possible short. 3. The connector may be easily "cleaned-up" and reused dozens of times. 4. Less heat and resultant insulator damage during soldering. 5. Much neater. 6. Greatly improved physical strength—actual tests of both methods show that it takes considerably more force to physically pull a cable loose from a connector using the improved method of connection.

In the improved method, the cable is prepared as it is in the old method, but the reducing adapter is tinned with a soldering iron before sliding it over the cable (A). The braid is fanned out over the tinned end of the adapter and is lightly soldered all the way around (B). With a pair of "dikes" the excess braid is trimmed off. A small file is used to smooth the solder bead until it will fit into the shell. The center conductor is stripped, leaving about ⅛" of insulation. The center wire is tinned (C). The plug shell is very firmly screwed onto the adapter, using a pair of pliers on the shell and a pair on the adapter. (For connectors being used outdoors, use a little Electraseal compound on the adapter threads.) Holding the center conductor up, fill the center pin with solder. While the solder is still molten, turn the center down so the solder will form a smooth bead at the end. File the two sharp edges on the center pin to avoid damage to the coax jack (D).



To remove and reuse a connector, simply heat the center pin and shake out the molten solder; unscrew the adapter from the shell using pliers again; unsolder the braid from the adapter. The connector is ready for immediate reuse.

Everyone who has tried the *improved* method has been impressed by the simplicity and neatness. We have used this method for years with excellent results.

Jerry Seligman, W7BUN/W5YFS
Tacoma, Washington

You Will Pay Over A $100 More For A Comparable 6-Meter SSB Transceiver And Still Not Receive The Quality, Value, High-Performance Features, And Protection Against Obsolescence Included In the Heath SB-110

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Kit SB-110, 23 lbs. **$320.00**

PARTIAL SB-110 SPECIFICATIONS—RECEIVER SECTION: Sensitivity: 0.1 uv for 10 db signal-plus-noise to noise ratio. **Selectivity:** 2.1 kc @ 6 db down, 5 kc max. @ 60 db down. **Image rejection:** 50 db or better. **IF rejection:** 50 db or better. **Audio output power:** 1 watt. **AGC characteristics:** Audio output level varies less than 12 db for 50 db change of input signal level (0.5 uv to 150 uv). **TRANSMITTER SECTION: DC power input:** SSB, 180 watts PEP; CW, 150 watts. **RF power output:** SSB, 100 watts PEP, CW, 90 watts (50 ohm non-reactive load). **Output impedance:** 50 ohm nominal with not more than 2:1 SWR. **Carrier suppression:** 55 db down from rated output. **Unwanted sideband suppression:** 55 db down from rated output @ 1000 cps & higher. **Distortion products:** 30 db down from rated PEP output. **Hum & noise:** 40 db or better below rated carrier. **Keying characteristics:** VOX operated from keyed tone using grid-block keying. **GENERAL: Frequency coverage:** 49.5 to 54.0 mc in 500 kc segments (50.0 to 52.0 mc with crystals supplied). **Frequency selection:** Built-in LMO or crystal control. **Frequency stability:** Less than 100 cps drift per hour after 20 minutes warmup under normal ambient conditions. Less than 100 cps drift for ±10% supply voltage variations. **Dial Accuracy:** Electrical, within 400 cps on all band segments, after calibration at nearest 100 kc point. Visual, within 200 cps. **Dial backlash:** No more than 50 cps. **Calibration:** Every 100 kc. **Power requirements:** High voltage, +700 v. DC @ 250 ma with 1% max. ripple. Low voltage, +250 v. DC @ 100 ma with .05% max. ripple. Bias voltage, —115 v. DC @ 10 ma with .5% max. ripple. Filament voltage, 12.6 v. AC/DC @ 4.355 amps. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

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For further information, check number 7, on page 110

Announcements

August 7

The South Hills Brass Pounders and Modulators, Pittsburgh, Pa., will hold its 29th annual Hamfest at St. Calir Beach Pavilion, Route 19, South of Pittsburgh. Contact W3WPR for details.

The Six Meter Club will hold their ninth annual picnic and hamfest at Picnic Grove on Route 45, one mile north of Route 30, Frankfort, Ill. Write to K9ZWU for further information.

August 14

The Iowa 75 Meter Phone Net Picnic will be held at McHose Park, Boone, Iowa. Check with Dr. J. H. Robinson, O.D., Creston, Iowa, for more info.

The Burlington Amateur Radio Club and the Central Vermont Amateur Radio Club are co-sponsoring International Field Day this year on Aug. 13-14. For information on the activities contact W1HRG, Chairman.

The 32nd annual Hamfester Radio Club Midwestern Hamfest and picnic will be held near Chicago at Santa Fe Park, 91st and Wolf Road, in Willow Springs, Illinois. For complete details including a special map of the location write to WA9MRE.

The Greater Pittsburgh VHF Society is holding its Annual Corn Roast and Transmitter Hunt at South Park, Mercer Grove.

August 21

The North Alabama Hamfest this year will be held in Decatur, Alabama. W4HFZ has complete details.

The Mini-Hamfest, sponsored by the Big Thunder Radio Club will be at the Boone County Fairgrounds in Belvidere, Ill. For more information write to W9HRF or WN9RPW.

August 27-28

The Delta Radio Clubs weekend "Hamfest 66" will be at Whitehaven, Tennessee. Check with WA4GOM for more details.

The International Amateur Radio (station 4U1ITU) announces that their 1966 Convention will be held in Geneva, Switzerland, from August 26 through the 28. A complete program and registration form will appear in IARC Newsletter No. 5. For all registration information and pertinent details write to I.A.R.C. Box 6, 1211 Geneva 20, Switzerland.

The Lanierland Amateur Radio Club will sponsor a Hamnic at the Sportsmans Club, Highway 53, one mile south of Gainesville, Georgia. Write to W4RZL for details.

The Southwest Missouri Amateur Radio Club is planning to hold their annual picnic on Aug. 28. For time and place write to P.O. Box 291, Springfield, Missouri, 65801.

The Southern Counties Amateur Radio Association (SCARA) will hold its annual outing at Egg Harbor Lake, Egg Harbor City, New Jersey on the 28th of Aug. Details and advanced reservations can be had from W2TUR.

Correction

In the article, "Recommended Reading," *Single Sideband Principles and Circuits,* *CQ* June 1966, p. 33, the price quoted for the book is in error. The price for the book is $15.00, not $7.00 as stated.

For further information check number 8 on page 110 ➤

NEW!

FOR THE CW MAN

NEW EICO 717 ELECTRONIC KEYER

Now, a fully automatic electronic keyer for CW hams! Capable of providing self-completing clean-cut dots, dashes, and spaces accurately timed and proportioned from 3 to 65 WPM in four switch-selected ranges, with vernier control of all speeds within each range. Output is a 25 volt-ampere dry reed SPST relay whose contacts are simply substituted for the key terminals of your rig. A built-in adjustable tone and volume oscillator with a 3" by 5" speaker enables monitoring transmissions, or permitting the 717 to act as a code-practice oscillator. **Matches EICO 753 in appearance to make it a perfect table-top companion unit.**

- Speed – 3 to 65 WPM in four over lapping ranges
- Output Contacts – 25 volt-ampere dry-reed SPST relay
- Self-completing dots, dashes and spaces
- Dot/Space Ratio – 1:1 electronically timed to within 2 milliseconds at all speeds
- Dash/Dot Ratio – 3:1 electronically timed to within 2 milliseconds at all speeds
- Built-in adjustable tone and volume oscillator with a 3 x 5 inch speaker
- Can be used as a code practice oscillator
- 5 tubes, 2 silicon rectifiers
- 100-130 VAC, 50-60 CPS, 40 watts
- Size (HWD): 5½" x 8" x 8¼" WEIGHT: 9 lbs.

Model 717 Kit $49.95, Wired $69.95

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NEW EICO 753 SSB/AM/CW 3-BAND TRANSCEIVER
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Build the finest of SSB/AM/CW 3-band transceivers with 200 watts of SSB punch and every wanted operating facility, plus the extra reliability and maintenance ease inherent in kit design. Assembly is made faster and easier by VFO and IF circuit boards, plus preassembled crystal lattice filter. Rigid construction, compact size, and superb styling make this rig equally suited for mobile and fixed station use. The new EICO 753 is at your dealer now, in kit form and factory-wired. Compare, and you will find that **only the 753 has all these important features:**

■ Full band coverage on 80, 40 and 20 meters. ■ Receiver offset tuning (up to ±10kc) without altering transmitter frequency. ■ SILICON SOLID-STATE VFO for drift-free and voltage stable operation in both fixed and mobile installations. ■ Built-in VOX. ■ Panel selected VOX, PTT & STANDBY. ■ High level dynamic ALC to prevent flat-topping or splatter and permit the use of a linear amplifier. ■ Automatic carrier level adjustment on CW and AM. ■ Dual ratio ball drive permits single knob 6:1 rapid tuning and 30:1 vernier bandspread (over 10 degrees of scale). ■ Position of hairline adjustable on panel. ■ Illuminated S-meter/PA Cathode Current Meter and tuning dial. ■ Fast attack, slow decay AGC. ■ Grid-block break-in CW keying. ■ Product detector for SSB and CW, triode detector for AM. ■ TR relay with auxiliary contacts for use with high power linear amplifier. ■ Includes mobile mounting bracket.

ADDITIONAL SPECIFICATIONS

FREQUENCY COVERAGE: 3490-4010kc, 6990-7310kc, 13890-14410kc. SSB EMISSIONS: LSB 80 and 40 meters, USB 20 meters. RF POWER INPUT: 200 watts SSB PEP and CW, 100 watts AM. RF POWER OUTPUT: 120 watts SSB PEP and CW, 30 watts AM. OUTPUT PI NETWORK MATCHING RANGE: 40-80 ohms. SSB GENERATION: 5.2 Mc crystal lattice filter; bandwidth 2.7kc at 6db. STABILITY: 400 cps after warm-up. SUPPRESSION: Carrier-50db; unwanted sideband-40db. RECEIVER: Sensitivity 1uv for 10db S/N ratio: selectivity 2.7kc at 6db; audio output over 2 watts (3.2 ohms). PANEL CONTROLS & CONNECTORS: Tuning, Band Selector, AF Gain, RF Gain, MIC Gain with calibrator switch at extreme CCW rotation, Hairline Set (capped), Mode (SSB, AM, CW, Tune), Function (Off, Standby, PTT, VOX), Carrier Balance, Exciter Tune, PA Tune, PA Load, Receiver Offset Tune, MIC input, phone jack. REAR CONTROLS & CONNECTORS: VOX Threshold, VOX delay, VOX sensitivity, Anti-VOX sensitivity, PA Bias adjust, S-Meter zero adjust, power socket, external relay, antenna connector, key jack, accessory calibrator socket. METERING: PA cathode on transmit, S-Meter on receive. SIZE (HWD): $5\frac{13}{16}$" x $14\frac{1}{4}$" x $11\frac{1}{4}$". POWER REQUIREMENTS: 750 VDC at 300 ma, 250 VDC at 170 ma, -100 VDC at 5 ma, 12.6 VAC at 3.8 amps.

The Model 753 is an outstanding value factory-wired at $299.95.

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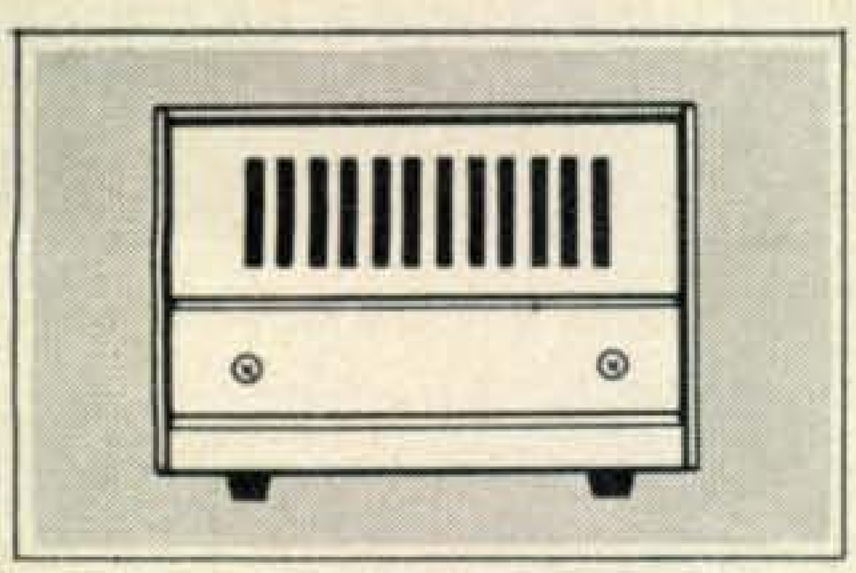

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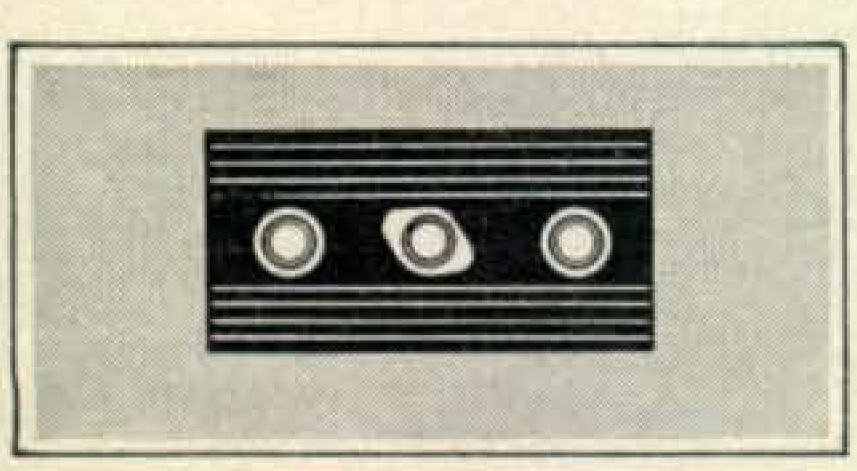

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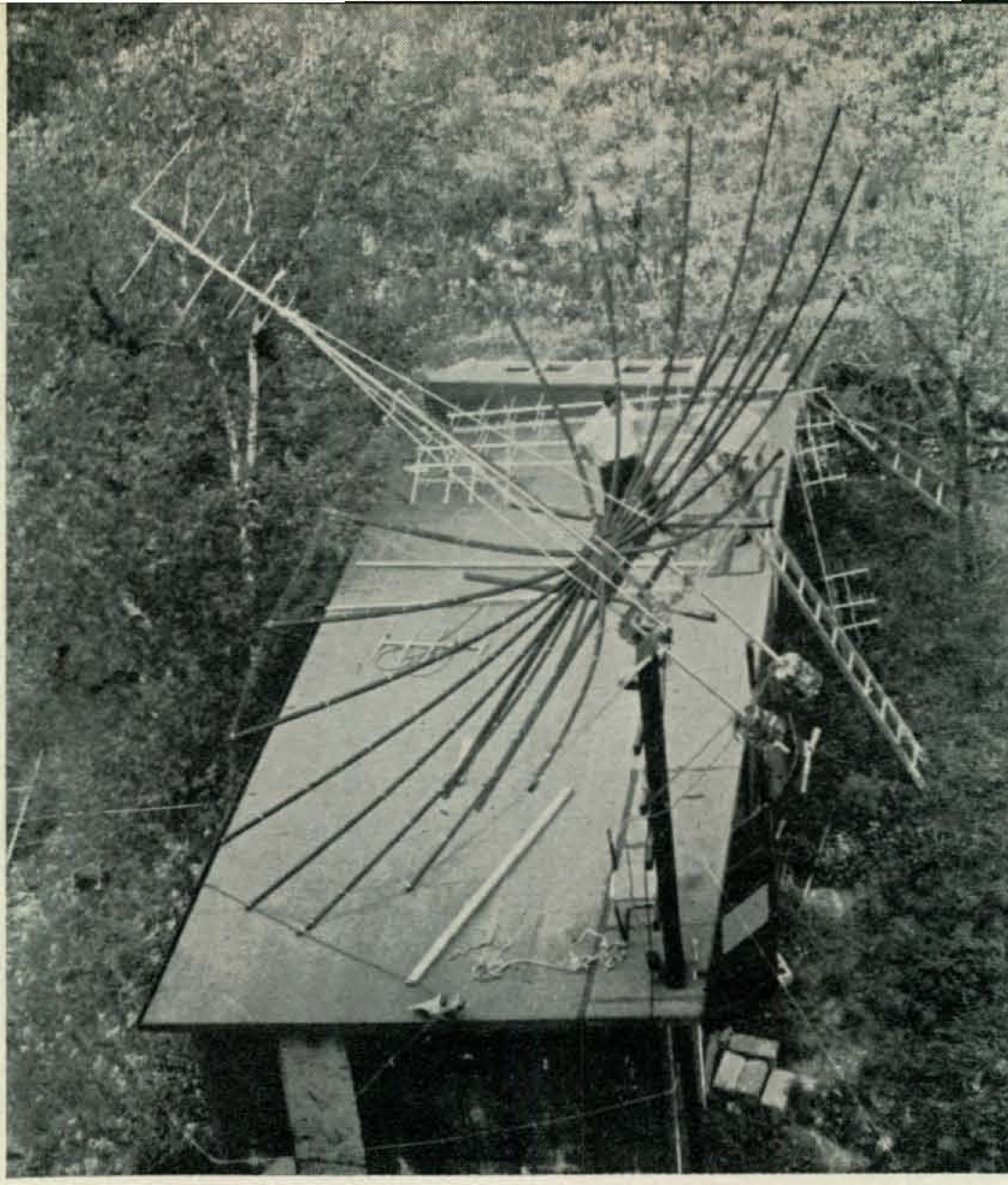


Al Katz and his electric moonbounce machine, better known to the layman as a home-brew 20′ parabolic dish reflector with a u.h.f. log periodic antenna at its apex. Counter-balancing weights are visible at the rear, mounted on pile extensions.

SIMPLE PARABOLIC ANTENNA DESIGN

BY ALLEN KATZ,* K2UYH

THE parabolic antenna is not a new idea. The use of a parabolic curve to direct radio waves dates back to the early experiments of Hertz with electromagnetic radiation.[1] Today there is more interest in this old type of antenna then ever before. However, despite this interest and the passing of nearly a century since its first use, the parabolic antenna is still misunderstood by many radio amateurs.

Theory

The parabolic antenna works in a similar fashion to an automobile headlight. It makes use of a special propert of the geometric curve known as the parabula. This curve transforms rays generated at a point source into parallel lines. See figure 1. It is this property of the parabolic reflector which has led many amateurs to picture it as the perfect antenna. They reason that an antenna placed at the focal point of a parabolic curve should produce a parallel beam of radio energy. Those who believe this way forget that an antenna has a finite size (usually a half wavelength) and thus can never be a point source.

In practice, however, the larger a parabolic reflector is made the more closely the feed antenna will appear a point source, and the more closely a parabolic antenna will perform to that of the ideal.

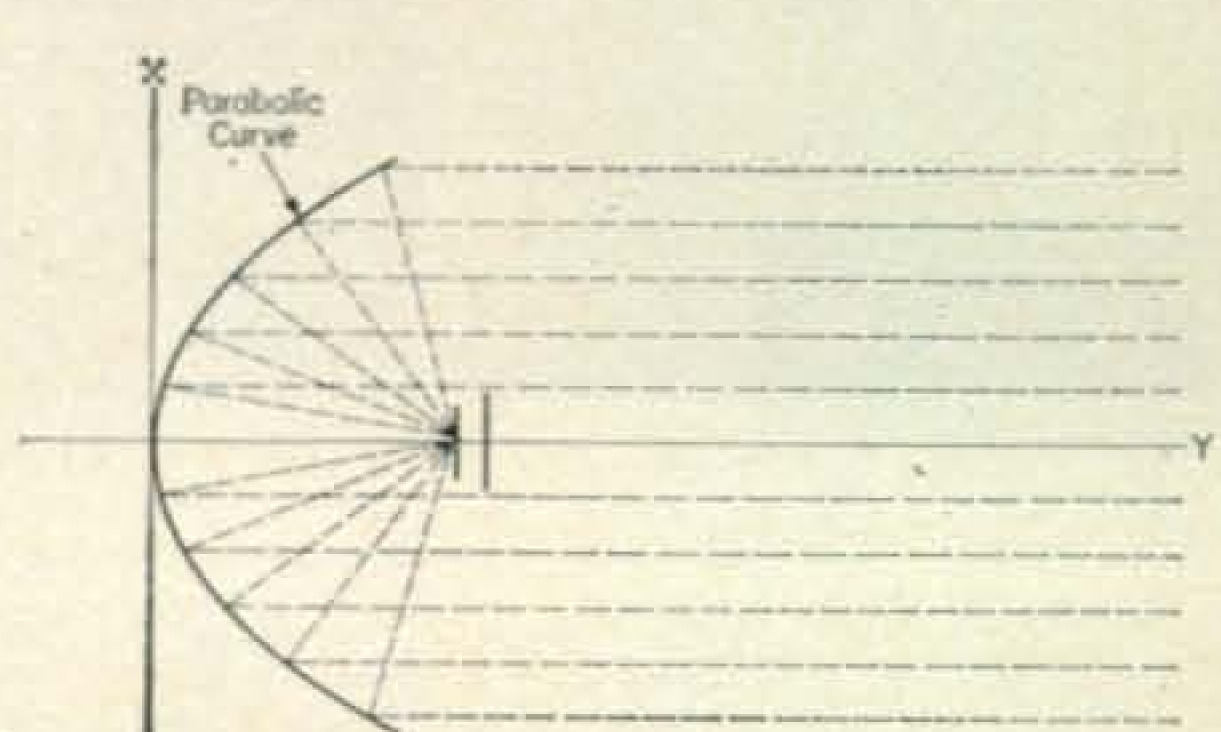


Fig. 1—The parabolic reflector converts energy from a point source to a parallel beam. The parabolic curve is defined by $Y^2 = 4PX$.

*48 Cumberland Avenue, Verona, New Jersey.

[1]Orr, W. I., and Johnson, H. G., "V.H.F. Hand Book," *Radio Publication, Inc.*, Wilton, Conn.

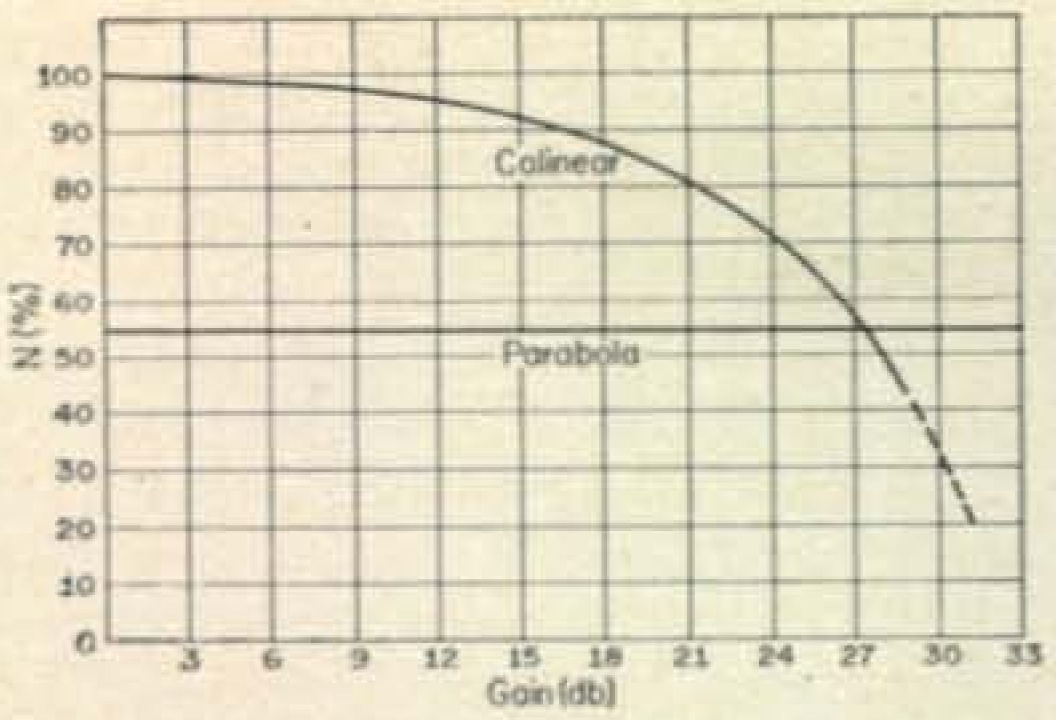


Fig. 2—Plot of antenna efficiency versus gain.

In general an antenna's gain is related to its area in the direction of radiation; the more area the more gain.[2] The efficiency of an antenna is defined as the ratio of its actual gain to that which it should theoretically have for its given area. The parabolic antenna is not the most efficient antenna. Its efficiency usually turns out to be about 65 percent. A colinear array for example can have an efficiency which approaches 100 percent. The advantage of the parabolic antenna is that as its size is increased, its efficiency stays approximately the same. The efficiency of the colinear (and most other phased arrays) on the other hand drops off sharply as size is increased. Figure 2 shows a comparison of the efficiencies of a colinear and a parabolic reflector as a function of gain. The curve for the colinear is only approximate since the rate of gain increase is very much dependent of the craftsmanship of the constructor.

Another advantage of the parabolic antenna is that once the reflector is constructed, it can be used on a variety of frequencies. You change bands simply by changing the feed antenna.

Figure 3 shows how a parabolic antenna's gain varies with size for several of the v.h.f. bands. As expected the gain increases as you go higher in frequency. On 144 mc because of the large physical size of the feed antenna, you need a rather large dish to obtain any appreciable gain. You need at least a true 23 db of gain to consider doing any serious moonbounce work on 2 meters.[3] According to the chart you would need at least a 40 foot dish to achieve this gain. 220 mc is pretty much in the same boat as two meters. However as one gets up to 432 and especially 1296 mc things become more interesting. On 432 mc a 20 foot dish (an antenna size which can be squeezed into most amateurs back yards) will produce a gain of 27 db, and on 1296 a gain of 37 db. These values of gain start to look reasonable from the point of view of moonbounce and are quite substantial for most other forms propagation.

[2]The yagi may appear to be a contradiction to this rule. However, as soon as several are stacked, the rule applies.
[3]Katz, A., "Moon Bounce Activities," *V.H.F. Amateur Magazine*, April, 1961.

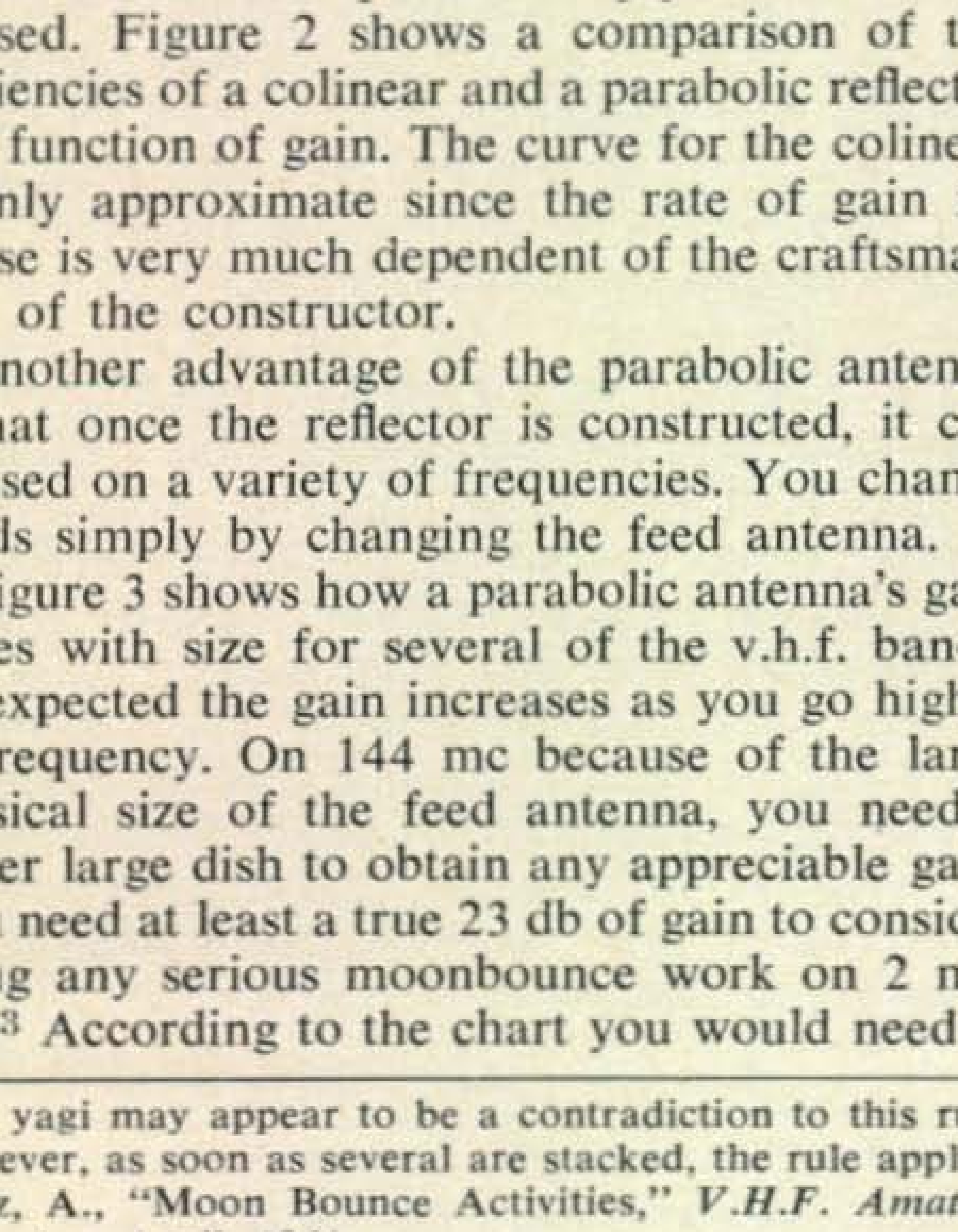


Fig. 3—Plot of parabolic antenna gain versus diameter for the various bands.

Construction

Another common belief is that the parabolic antenna is a particularly difficult antenna to construct. Again, this is not the case. There are basically two methods in use by amateurs for the construction of parabolic antennas. The curve is rigidly constructed in the first method. For instance the parabolic curve could be layed out on a large piece of plywood and the plywood cut to the desired shape.

The second technique with which this article will be concerned is known as the "stress method." This technique makes use of the fact that when a beam is stressed at its ends, it takes the form of a parabolic curve. The curve of an archer's bow is an example of an approximate parabola created in this manner. If many beams or struts are arranged in the form of the spokes of a wheel, and a wire is threaded through their ends, when the wire is pulled taut they will bow up to form a dish shaped structure. In this way one can construct a parabola of revolution or "dish" type antenna.

To illustrate this point let us consider the construction details of a 20 foot parabolic antenna. As mentioned earlier this size antenna is not unreasonably large and yet has enough gain to be useful for 432 and 1296 mc moonbounce experiments.

The first thing to be considered is the shape parabolic curve wanted. A 20 foot dish can be made shallow or deep. The measure of a dish's shape is the f/d (focal length to diameter) ratio. The larger this value the shallower the dish. In general the efficiency of a parabolic antenna depends on how the feed antenna distributes its radiation over the surface of the reflector (illumination taper). Ideally, we would like the feed antenna to distribute energy equally over the reflector's surface without spilling any over the sides. This condition, however, is impossible to achieve in practice.

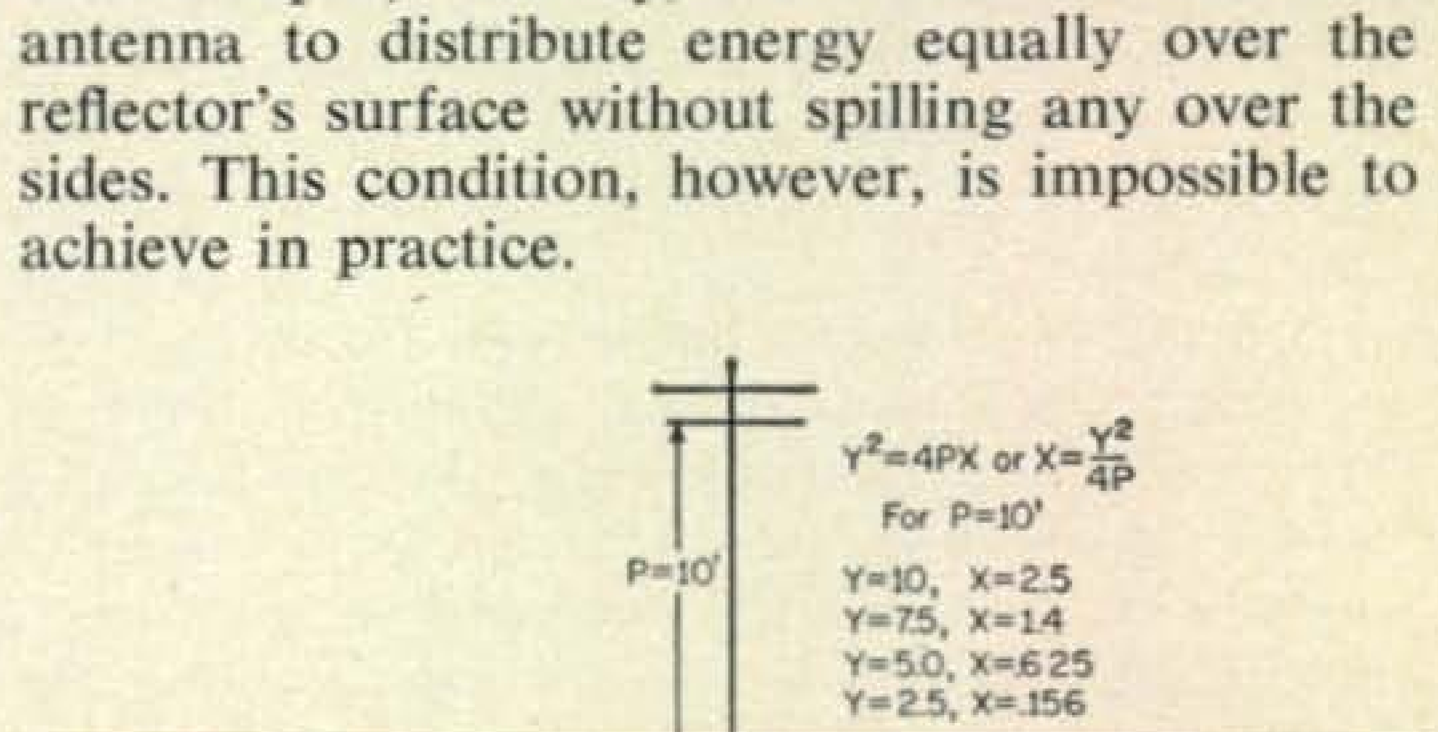


Fig. 4—Graph of a parabolic curve for a 20 foot dish with an f/d ratio of 0.5.

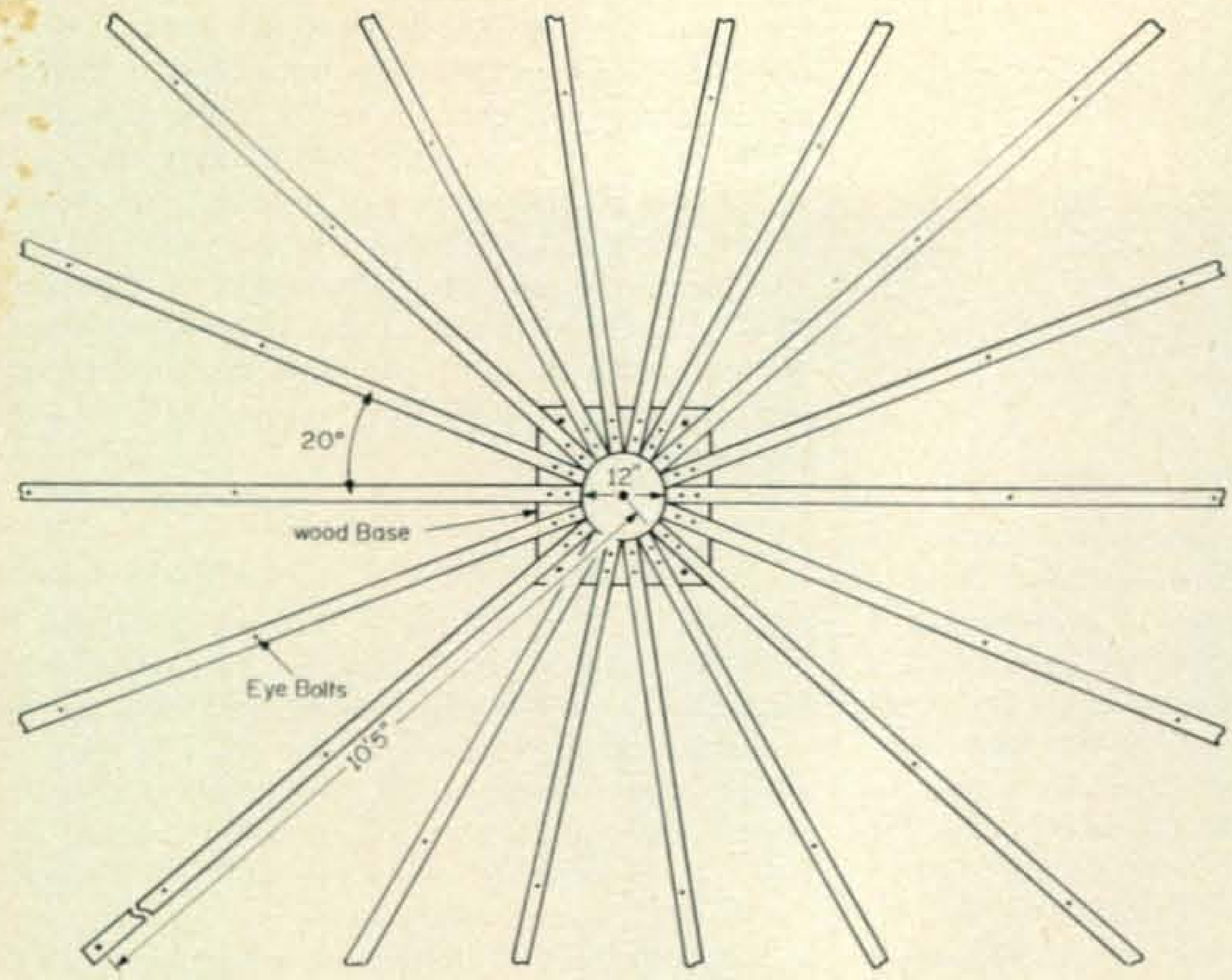


Fig. 5—Frame construction details for a 20 foot diameter dish with an f/d ratio of 0.5. The 18 members are 1" × 2" redwood struts 10½' long and the base is made of 2' × 2' × 1" plywood.

Commercial antenna designs tend to stress antenna pattern. Energy spill over produces side lobes. To avoid these side lobes, commercial designs create a hot spot at the center of the dish with the feed antenna's radiation pattern 10 db down or so by the time it reaches the reflector's edge. This design usually requires a deep dish.

As amateurs, we are interested in gain. More gain is obtained when some energy spills over the edge of the dish. A feed antenna pattern with half power points corresponding to the edge of the reflector is a good compromise. To achieve this result requires a relatively shallow reflector. The antenna to be described here has an f/d ratio of 0.5. This ratio produces a reasonable efficiency with a dipole and reflector used as a feed antenna. Possibly a f/d ratio of 0.8 might have produced slightly better results, but we have not tried that design.

The parabolic curve decided upon should be carefully plotted on a sheet of graph paper. The analytic geometry relation $Y^2=4fX$ (where f equals the focal distance), is the equation of a parabolic curve. For our chosen f/d of 0.5 and 20 foot diameter, f turns out to be 10 feet. Plugging this value into the equation, one can solve for the X coordinate (height of the curve) in terms of the Y coordinate (radius of curve). (See figure 4.)

A parabola of revolution can be thought of as being composed of an infinite number of circles. The graph of the parabolic curve can be used to determine the distance along a strut to any one of these infinite circles. This distance is obtained by laying a wire or string along the parabolic curve until the desired point is reached. The wire is then pulled straight and its length measured. In this manner the length strut needed to produce the 20 foot dish (distance to outermost circle), as well as the location of correction circles can be determined.

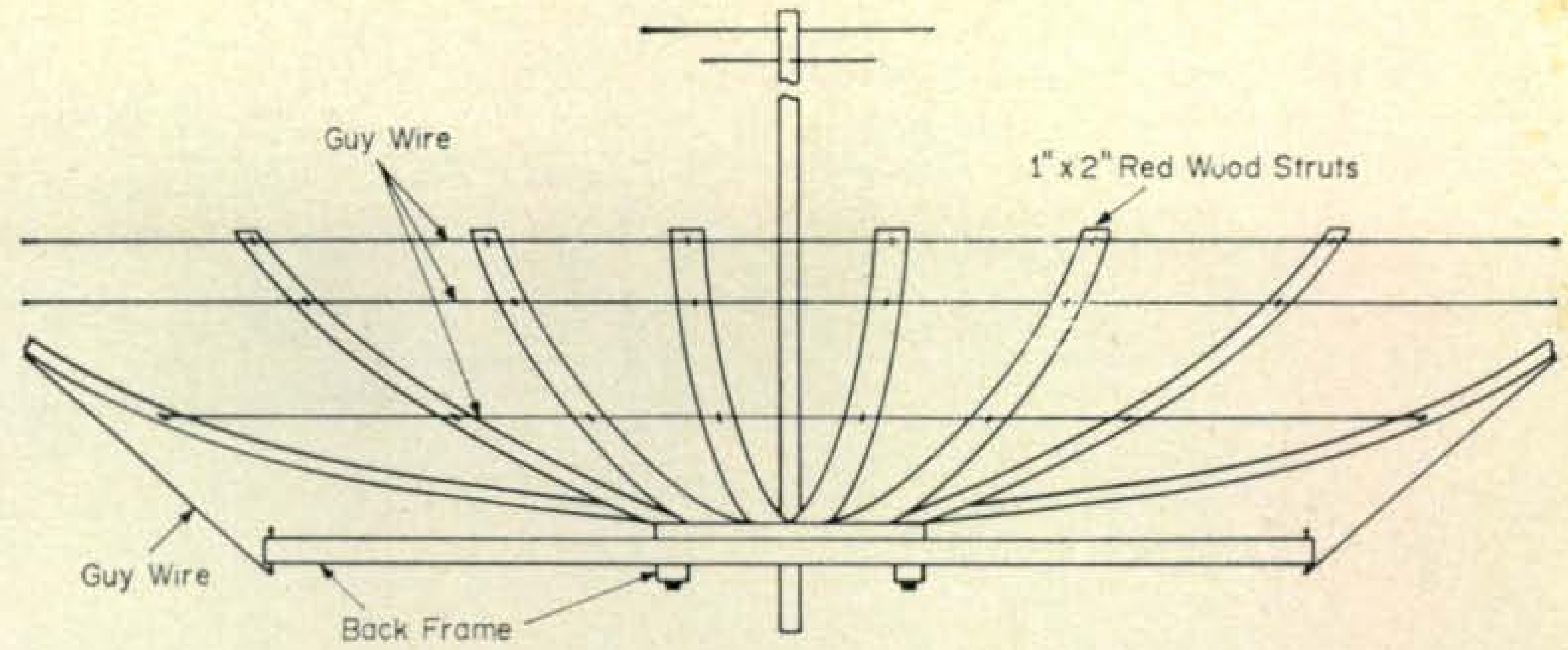
The layout of the dish's frame is shown in figs. 5 and 6. The base of the dish is made from a 2' × 2' × 1" piece of plywood. Holes should be drilled every 20 degrees for the mounting of 18 radial struts. The struts were constructed from 10 foot lengths of 1" × 2" redwood. Both the redwood struts and plywood base were found to standup well in all weather conditions. In all cases, however, the wood members should be treated with a wood preservative and then painted with a good exterior paint. It was found that the struts should be 10½ feet long. Thus, the mounting holes in the base should be positioned so that the struts attach ½ foot out from the center. A 1¼ inch hole should also be drilled into the center of the base to pass the mounting pole for the feed antenna. Besides the mounting holes, holes must be drilled in the struts at 5, 7½ and 10 feet from their ends. Eye bolts are placed in these holes for the guy wires of the outer and inner support circles.

The parabola of revolution is a very strong structure. However, the majority of the forces are in the forward direction. Back bracing should be used to protect the antenna from winds approaching from the rear. Such braces were constructed from four 10 foot sections of 2" × 2" redwood which were criss-crossed and bolted to the back of the base as shown in fig. 6. Guy wire was run from the end of each strut to the nearest back member. This procedure produces a strong light weight reflector which will hold its shape in the wind.

After the frame is bolted together, guy wire should be strung through the outermost ring of eye bolts. The two ends of the guy wire are then pulled together, and with the aid of a turnbuckle the ring's diameter adjusted to 20 feet. Usually it helps in getting the bowing started to have each strut initially elevated above ground about a foot. This condition can be accomplished by putting a box or other support under each strut before pulling the guy wire taut. Next guy wire should be run through the other two eye bolt rings and to the back braces and the guy wire adjusted for the most accurate shape.

At this point let us say something about accuracy. Again many amateurs have the wrong impression about the amount of error a parabolic antenna can tolerate. The necessary accuracy of

Fig. 6—Side view of the frame showing how the wires are used to draw the struts into a parabola. Note, also, the rear support frame made from 2" × 2' × 10' redwood.



a parabolic reflector depends on the frequency of operation; the higher the frequency the more accurate the curve must be. According to the theory of optics, an accuracy greater than ⅛ λ will buy nothing.

Several studies have been made of the loss in gain due to the "average" error of a parabolic reflector. Results from one of these studies is shown in fig. 7.[4] From this graph we see that an r.m.s. error of 0.1 λ will degenerate the performance of a dish less than 1 db. On 1296 mc, 0.1 λ is a little less than one inch. This is an accuracy well within the capability of the construction method being described.

After the frame is completed, it must be covered wtih a conducting material, preferable a mesh to keep down wind resistance. A common question is, "How fine a mesh is needed?" A conservative rule of thumb is to have the mesh opening less than 1/16 λ. The dish shown in the pictures is covered with one inch chicken wire. The chicken wire was rolled across the frame, tucked under the sides and tied down to the struts at a multitude of places. We have used many other methods for attaching the chicken wire (or screening), including stapling and bolting, but prefer simply tying the mesh in place. A good quality lacing cable or even tie wraps work well.

We have found that the dish works well through 1296 mc and know of people who have used similar antennas with two inch mesh on 1296 mc without a great deal of deterioration. Recently we have heard some question as to the usefulness of chicken wire as a reflector material.[5] To this we can only answer that we have had no problem with this material. It does rust quite badly in only two years, but we usually seem to have another antenna built by then.

Feed Antenna

The feed antenna seen in the photographs is a log periodic antenna.[6] Initial tests were made with a dipole and reflector. Later this simple feed antenna was replaced with the LPV to facilitate the use of the reflector on several bands. The feed antenna is mounted on the end of a 12 foot aluminum pole. This pole was moved in and out until the point of maximum gain was found (a distance slightly longer than 10 feet) and then clamped in place. Three insulated guy lines were also attached to keep the antenna in position.

Antenna Mount

In dreaming of exotic forms of communications, one can get carried away into thinking that all that is needed is large antenna. This is not the case. A big antenna is only one piece in a total communications system which includes transmitter, receiver, antenna, and mount. In particular we would stress the mount. This vital piece of the communications system is often forgotten. The antenna described here has less than a 2 degree beamwidth, on 1296. The mount shown in the picture along with the antenna is not adequate for serious work on 1296 mc. It is passable on 432 mc where the beamwidth is 8 degrees. ■

[4]Yarnall, W. M., "Antenna Design Supplement," *Microwaves*, May, 1965.

[5]Michael, V. A., "Moonbounce Newsletter," *VHFER Magazine*, Jan., 1966.

[6]Tilton, E. P., "*The Radio Amateurs V.H.F. Manual*," A.R.R.L. Newington, Conn.

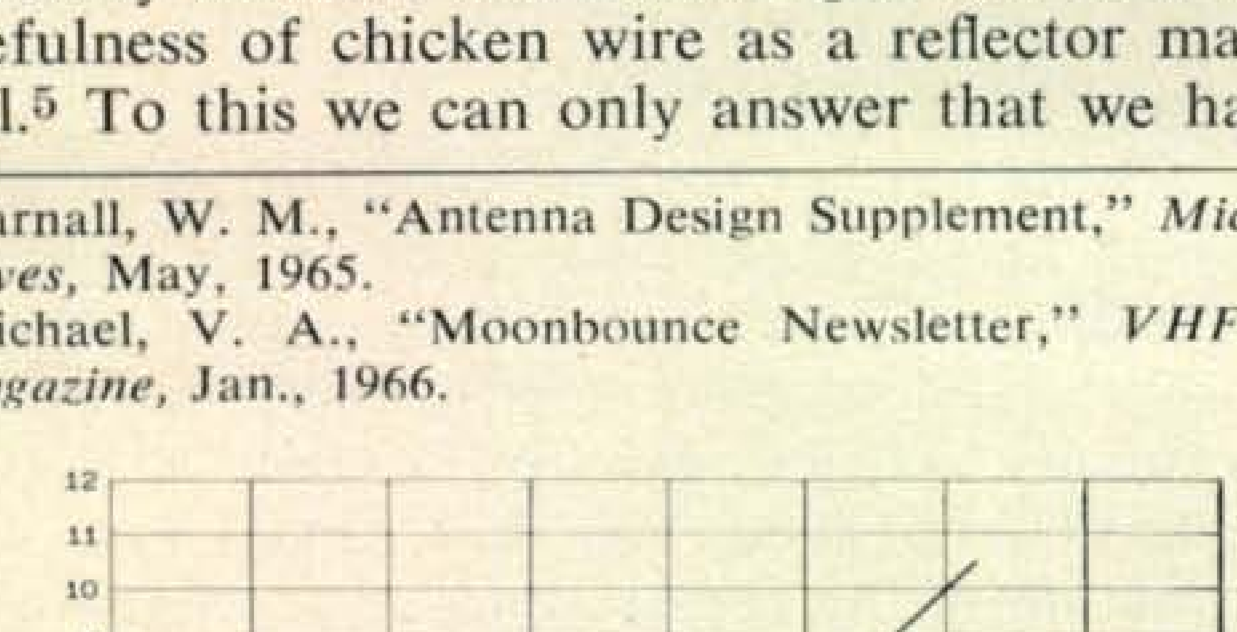
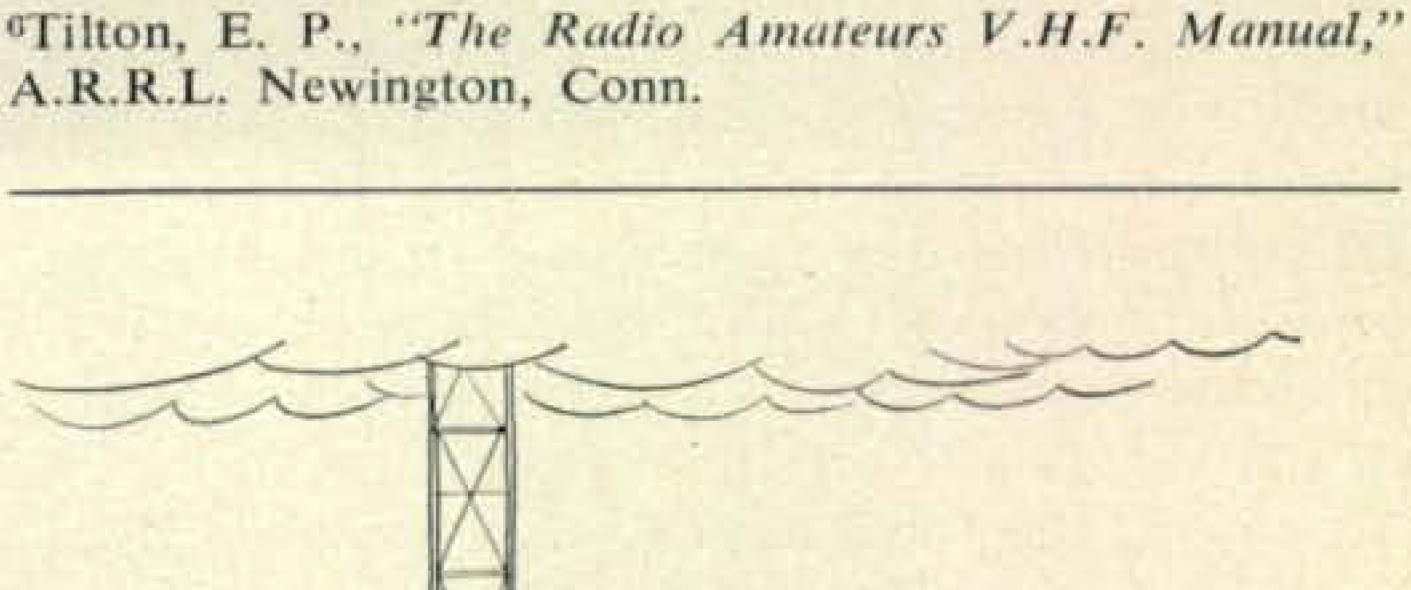


Fig. 7—Plot of gain loss versus average error in wavelengths.



"How high *is* this antenna of yours, anyway, Steve?"

The Lafayette HA-250 Linear Amplifier. It is a compact package. The power-switching transistors are installed in a heat sink with heat-radiating fins on the right side of the case.

CQ Reviews:

The Lafayette HA-250 Linear Amplifier

BY WILFRED M. SCHERER,* W2AEF

THE Lafayette HA-250 Linear Amplifier is a compact job with a built-in power supply and is designed for 100-watt p.e.p. input with very low-power exciters for mobile operation on the 6, 10 and 15 meter amateur bands. Requiring only 1-2.5 watts of carrier drive for a.m., it is an ideal unit for use in conjunction wth the Lafayette HA-650 6-meter transceiver, recently reviewed here,[1] or for operation with other low-power gear. For s.s.b. use, a maximum of 10 watts p.e.p. drive is needed for full power capabilities, which should be of interest to those who might contemplate the construction of transistorized mobile s.s.b. transceivers. The amplifier may also be operated with f.m., d.s.b. and c.w.

Circuitry

Two 12JB6 vacuum tubes (heater type), connected in parallel, operate with zero bias in grounded-grid circuitry. R.f. drive is applied through a .01 mf coupling capacitor to the tube cathodes which are connected to ground through a 22 μh choke. The input impedance is approximately 50 ohms. All the tube grids are connected directly to ground. The output circuit consists of a pi-network which is adjustable for 50-600 ohm loads using variable plate-tuning and output-loading capacitors. Bandchanging is accomplished by manually removing and resoldering a tap on the tank inductor. This should be an acceptable method, since operation on only one of the three bands is likely, eliminating the need for a bandswitch. No alterations are required at the input when bands are changed.

R.f. switching between exciter-feedthrough or linear-amplifier operation is handled with a relay that has one set of s.p.d.t. contacts at the r.f. input side of the amplifier and another set of similar contacts at the antenna. When the power switch on the HA-250 is off, r.f. from the exciter goes through the normally-closed contacts at the amplifier input and then to the normally-closed contacts at the antenna for operation with the exciter only.

When the power switch is turned on, a sample of the r.f. input is rectified by a pair of diodes to provide a d.c. voltage that actuates a "sensing" relay. The relay in turn energizes the r.f. switching relay to transfer drive to the amplifier cathodes and also transfer the antenna to the amplifier output. At the same time, the high-voltage power supply is turned on by a second relay energized by the sensing relay. The r.f. drive from the exciter therefore automatically fires up the linear by means of the r.f. sensing affair. No specially actuating connections are required between the exciter and the amplifier.

Power-switching transistors are used in conjunction with a neat little toroid-type transformer in the high-voltage supply that furnishes 350 volts under load. Operation is designed for 11.5-14.5 v.d.c. negative-ground systems.

A panel meter indicates relative-power output when either the linear or the exciter (alone), is used, providing a convenient tune-up indicator for either situation.

Operation

Although the HA-250 is simple to tune up, requiring only adjustments of the plate tuning and loading as indicated by the panel meter, certain precautions must be observed if optimum performance is to be realized. In order to better understand the need for these measures, an examination of the performance of the amplifier will be helpful.

Figure 1 shows the output power in relation to the input power and thus is indicative of the linearity characteristics for the amplifier.

Curve "a" was derived from the performance specifications for 10-meter operation as given in the equipment manual. Curve "b" is the result of measurements made in the *CQ* Lab, showing slightly better linearity than the ratings indicate. This measurement was made after the amplifier was initially adjusted for maximum output with

*Technical Director, *CQ*.

[1] *CQ* Reviews the Lafayette HA-650 6-Meter Transceiver, *CQ*, July '66, page 18.

10 watts r.f. drive. Curve "c" is the result obtained after an initial loading adjustment for maximum output wtih only 1-2 watts drive. Note how severely the linearity deteriorates.[2] For a.m. operation under these conditions, not only will there be excessive distortion, but full peak power will not be realized and "downward" modulation will take place; however, when only low drive is available for tuneup, proper adjustment and modulation may be obtained by reducing the loading (counter-clockwise) to a point where the output is about 10% less than maximum or to where "upward" modulation results during voice operation. Curve "b" also shows that in order to obtain good modulation (p.e.p. = 4 × carrier power), the maximum allowable carrier drive is in the neighborhood of 2 watts.

In the case of s.s.b., the maximum p.e.p. drive tolerance would be 10 watts and since tuneup power with s.s.b. exciters usually is about the same as the p.e.p., initial adjustments with 10 watts drive can be made to provide proper loading and operation. With c.w. and f.m., tuneup for maximum output may be made at the available drive levels up to 10 watts. The performance on 15 meters was found essentially the same as above.

6-Meter Performance

Curve "d" shows the characteristics with 6-meter operation as obtained after tuneup with 10 watts drive. Note the improved linearity, indicating a more favorable impedance match between the tubes and the tank circuit due to a higher *C*-to-*L* ratio which is used for this band; however, this is obtained at a price of lower power and less efficiency. The d.c. plate input on this band with 10 watts drive was 66 watts, 89 watts on the other bands. Due to power-supply regulation, actual p.e.p. with voice modulation will run slightly higher. Current drain from the d.c. power source was about 8 amperes at maximum peak power.

On 10 and 15 meters the s.w.r. at the imput measured 1.1 to 1 (for 50 ohms) and on 6 meters, 1.5 to 1. About 1 watt of drive power is needed to operate the r.f. sensing relay. The time constant of the circuit is such that the relay will remain closed with the normal rise and fall of the r.f. envelope during s.s.b. modulation.

[2]A normal situation experienced with linear amplifiers.

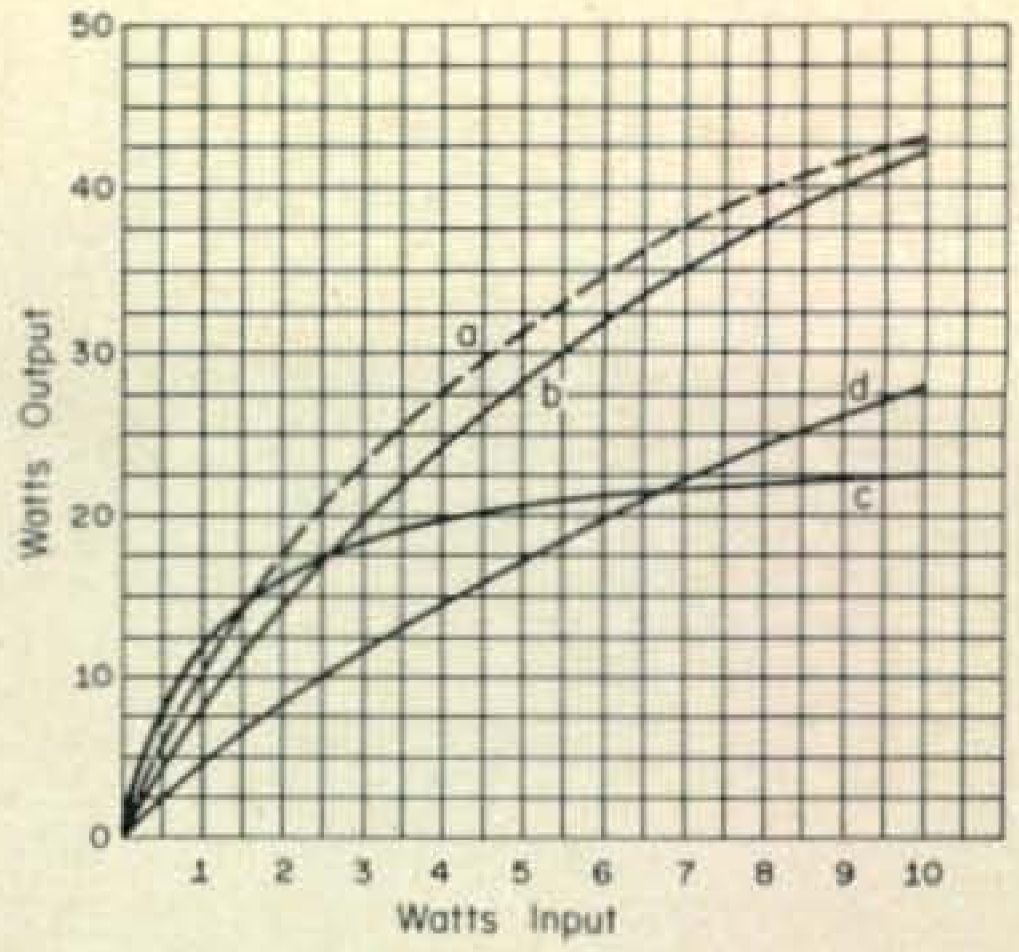
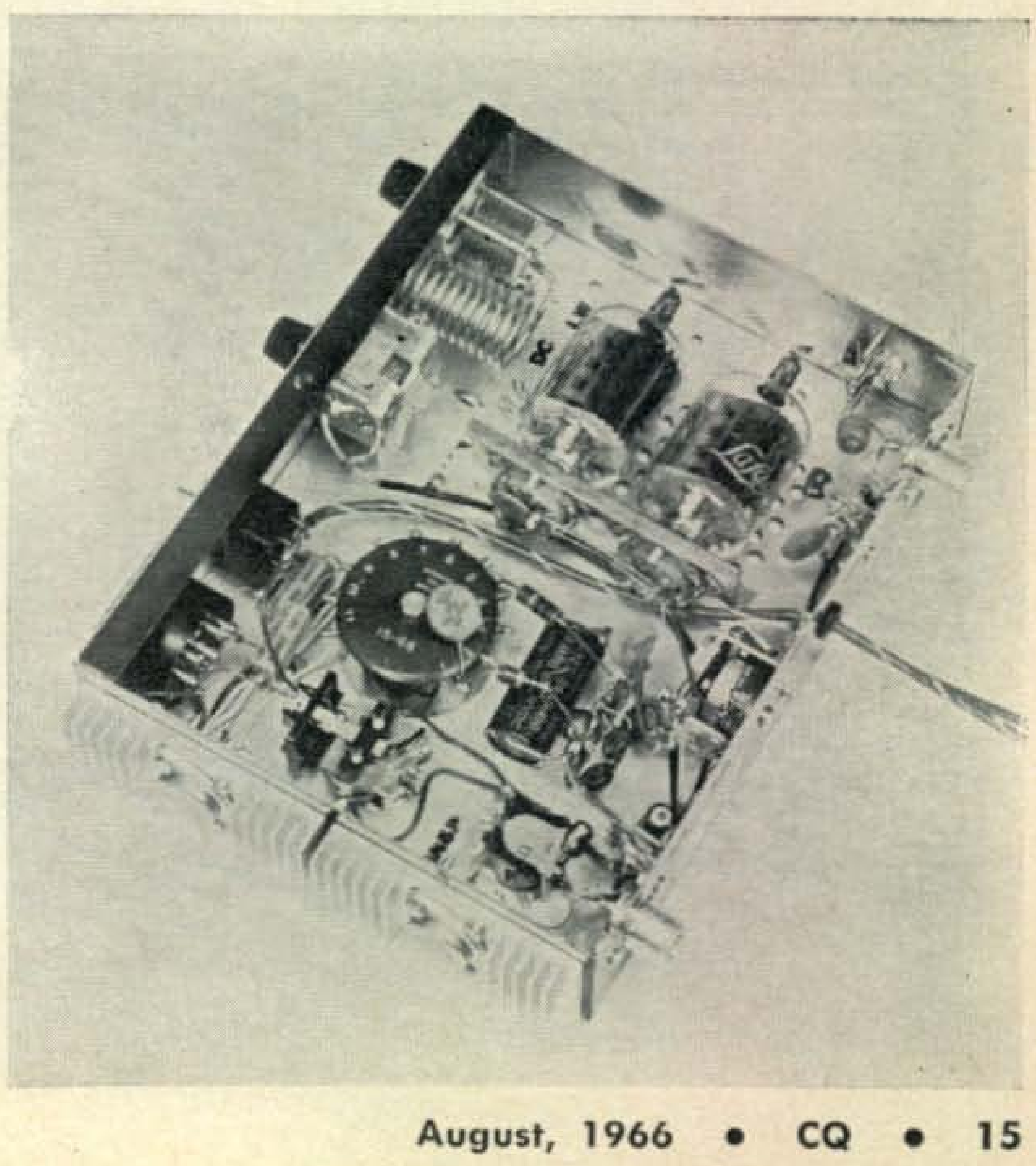


Fig. 1—Graph showing input v.s. output power characteristics of the HA-250 linear amplifier.

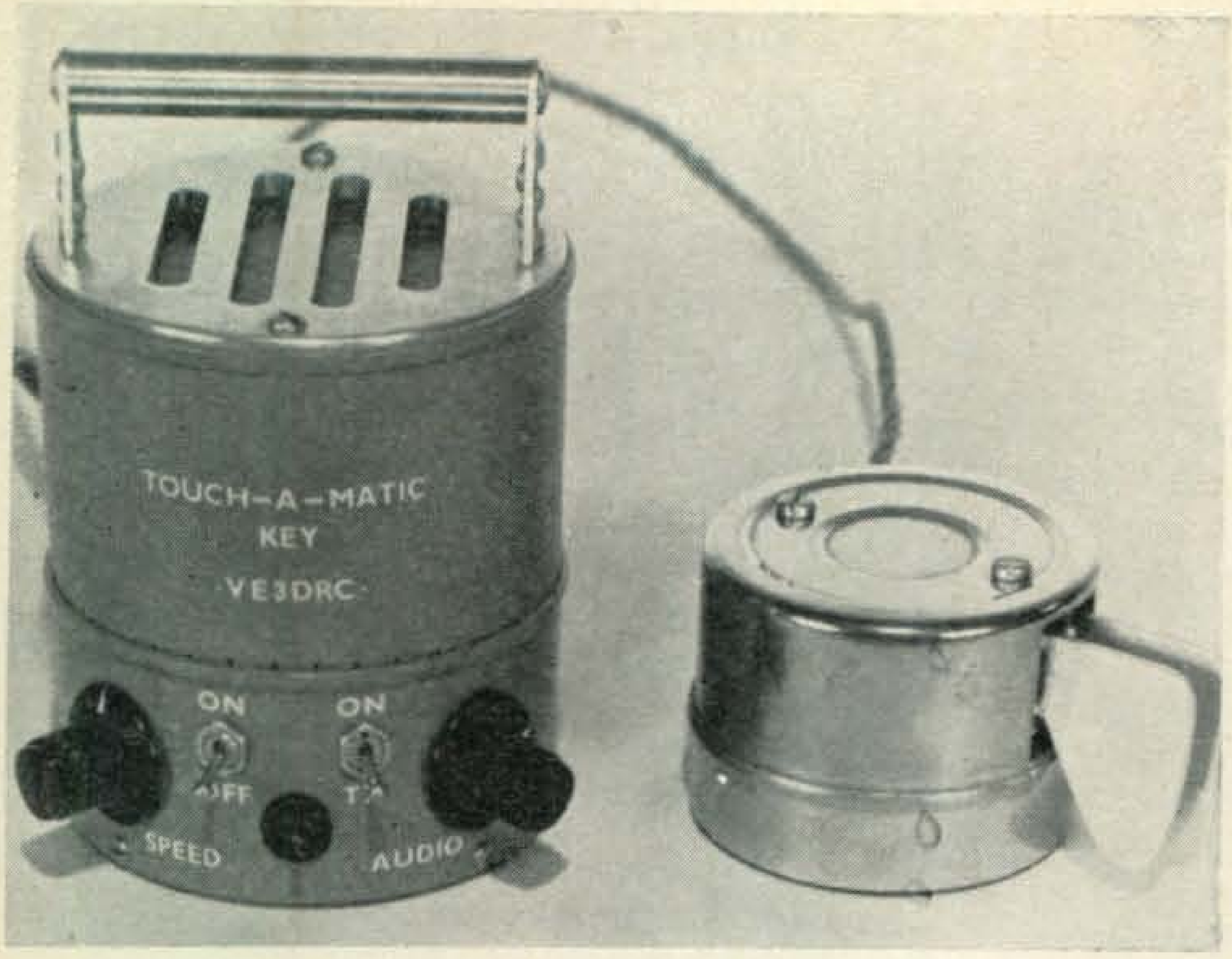
The safety factor for the r.f. sensing diodes appears to be somewhat marginal, as it was found that they will burn out quite readily with r.f. input levels slightly above 10 watts. Care must therefore be taken not to exceed input-power levels in this vicinity. Should this be of concern, you can bypass the sensing relay and actuate the r.f. transfer and power relays directly by means of the RCV-XMT control circuits of the transceiver/exciter.[3]

The HA-250 linear amplifier which, by the way, is manufactured in the U.S.A. with American-made parts, is well built and neatly laid out for ready access to all components as may be seen in the photographs. It measures only 7″ D. × 9″ W. × 2″ H., making it ideal for "out-of-the-way" installation in a vehicle. The unit is priced at $79.95 and is available from Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791. —*W2AEF*

[3]To do this, connect the normally-open stationary contact of the sensing relay to one side of a pair of normally-open grounding contacts on the exciter control relay or on its transmit switch.



Interior view of the HA-250. It is a simple and easily accessible layout. The output-tank components are at the upper left. The round object near the center is the toroid-wound transformer for the power supply.



Front view of the Touch-A-Matic key with the Can-Key alongside. The speaker is mounted face up under the handle; left control is for SPEED and the right control is AUDIO volume. The two switches are S_1 and S_2 with the On Off indicator between them.

The Touch-A-Matic Key

BY ALBERT H. JACKSON,* VE3QQ

Part II

Construction and testing details are given in Part II for this solid state keyer. The keyer features circular construction, long dash output and can be used with a straight key, dual paddle key, the Touch-Key[3] or Can-Key.[4]

THE parts board assembly layout and wiring for the Touch-A-Matic Key is shown in fig. 3. The advantages gained from the circular layout were described in Part I and so will not be covered here again. Do not forget to use clip on heat sinks as suggested in Part I, to protect the components.

Nearly all items are mounted from the inside, with their leads bent and inserted through holes in a piece of 1/16" thick phenolic tubing, 2⅝" in outer diameter by 1½" high. All connections, with two exceptions, are made on the outside, using component leads wherever possible and spaghetti tubing as required.

Template

The easiest way to lay out a round form such as this, is to do it in flat, by making a template of light sheet iron and then bending it into a circle later. Use fig. 3 as a guide, and mark all positions, altering dimensions where necessary to fit available parts. Remember that longitudinal spacing on the template will close up to some extent between the various items when they are mounted inside the tubing, since its inner circumference is shorter than the template length on the outside.

Drill through all center marks with a small drill. De-burr, then bend the finished template to make a close fit around the phenolic tubing. Clamp in place with a pair of tightly twisted wire loops, and center mark all locations with the same drill. Remove the template and finish drilling to the required hole sizes.

Construction

Note that the layout and wiring views presented in fig. 3 are both of the outside of the circular parts board, and parts locations are shown "looking through" the phenolic tubing, as if it were transparent. A straight-edge placed vertically across both sections of the drawing will help to sort out components and their respective connections. Component R_{26} is the only item mounted on the outer surface; its lead to the audio control passes through hole *E*, and is attached to the resistor on the inside. The 1N536's are inserted through the tubing wall from the outside, and cemented in place on the inside with Duco or Household cement. Diodes such as the 1N2071, and other silicon types having the same forward voltage drop (0.6 v.), can be substituted for the 1N536's if the mounting holes are altered accordingly. Remember to

*12 Third Ave., Box 453, Arnprior, Ontario, Canada.
[3]Jackson, A. H., "The Touch-Key," *CQ* Nov. 1964, page 28.
[4]Jackson, A. H., "The Can-Key," *CQ* Feb. 1964, page 36.

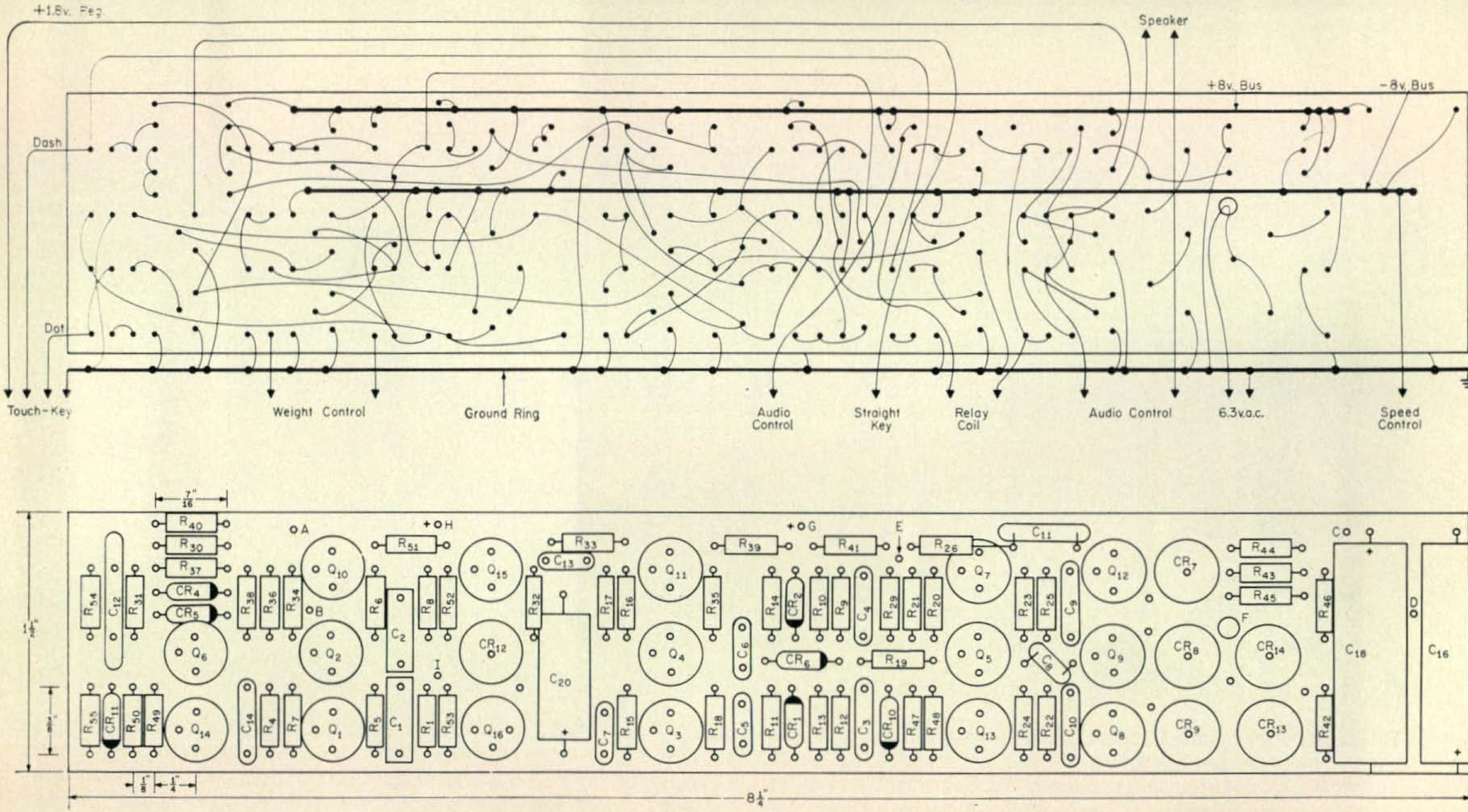
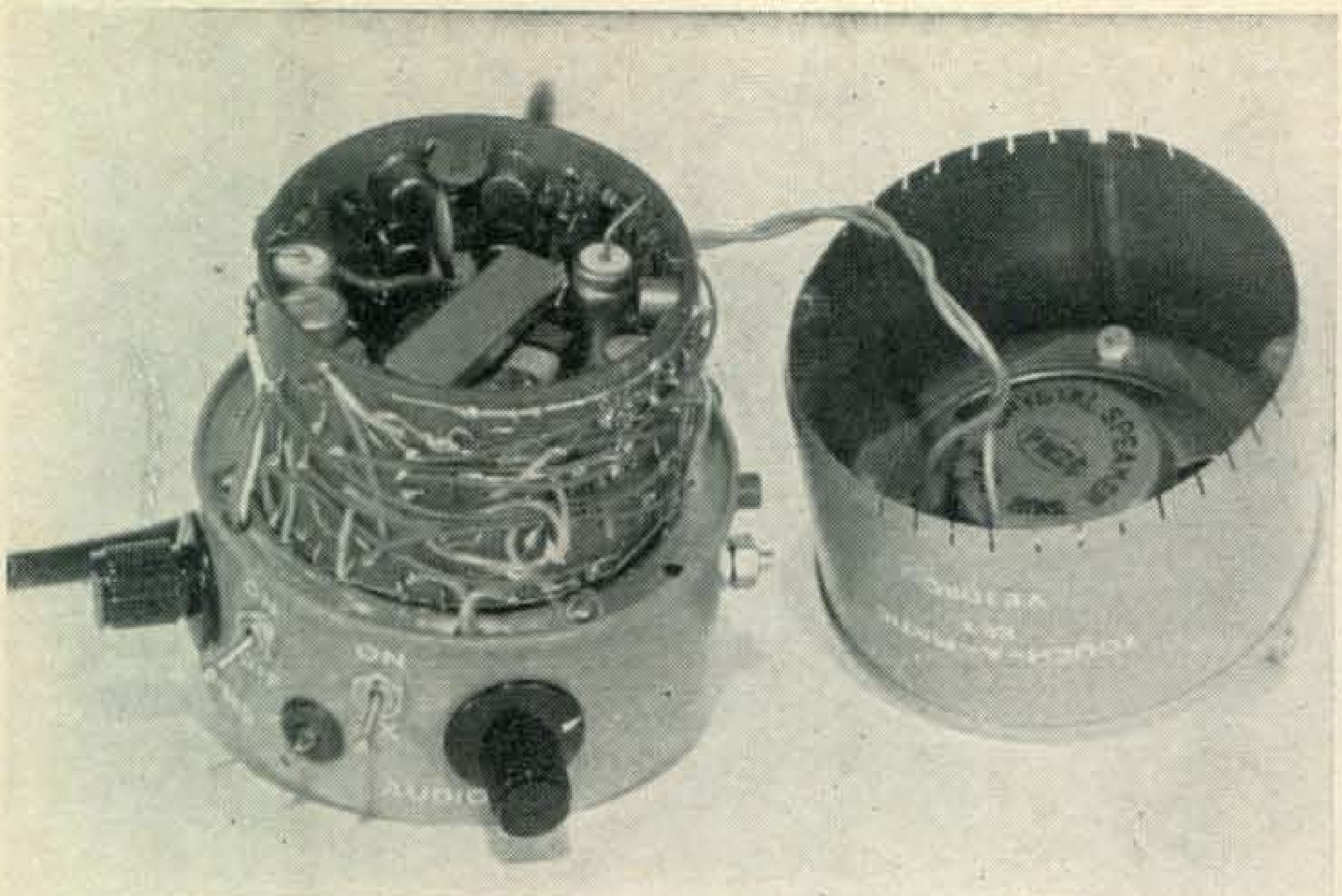


Fig. 3—Template for the circular parts board of the Touch-A-Matic key and layout and wiring data. These represent the flat outside view as explained in the text. Holes *A, B, C, D* and *E* are made with a #53 drill. Hole *F* requires a ⅛" drill while holes for CR_7, CR_8, CR_9, CR_{12}, CR_{13} and CR_{14} require a 9/32" drill. All other holes are made with a #58 drill. The shaded ends of the small diodes represent the cathodes. Capacitor C_{17} is mounted over CR_1, CR_2, R_{10}, R_{13} from hole *G* to ground. Capacitor C_{19} is mounted over R_8 and R_{52} from holes *H* to *I*. Check this article for important corrections to part I.



Top front view of the Touch-A-Matic key shows front control grouping and circular parts board. Note the 6.3 volt filament transformer mounted on the bottom can in the center of the parts board. The crystal speaker is mounted in the top section.

A close-fitting grommet holds the NE-2 pilot lamp in place at the front, and the cable entrances, fuse-holder *etc.,* are located at the rear. Use jacks of different types for the straight key input and transmitter key connections, to forestall any possibility of accidental introduction of higher voltages into the transistor circuits.

polarize all diodes correctly, as they are installed.

Use bare, tinned #18 wire for the plus and minus 8 volt busses, and pull tightly around the tubing between holes *A, C* and *B, D,* respectively. Bend the ends over on the inside to hold the wire in place.

Mount and connect all components as shown, leaving the ground and off-the-board leads until last. Make the ground ring from flashing copper as indicated in fig. 4(A); turn the assembled parts board upside down, and lay the ring in position on top of it. Bend all ground leads flat against the ring, leaving a small loop in each to facilitate attachment of a heat-sink clip, and solder into place. Solder three #4 soldering lugs, mounting holes protruding over the outer edge, to the ground ring in the remaining spaces about 120 degrees apart. These will serve to attach the entire assembly to the top of the lower case, after the small filament transformer is in position.

All connectors, controls, fuse, relay or transistor output circuits, C_{15}, R_{56} and R_{60}, *etc.,* are installed in the bottom section. The controls are miniature ½ watt potentiometers, but larger styles can be fitted with a slight re-arrangement of parts. Resistor R_3 should be a screw driver adjust locking type for semi-permanent setting.

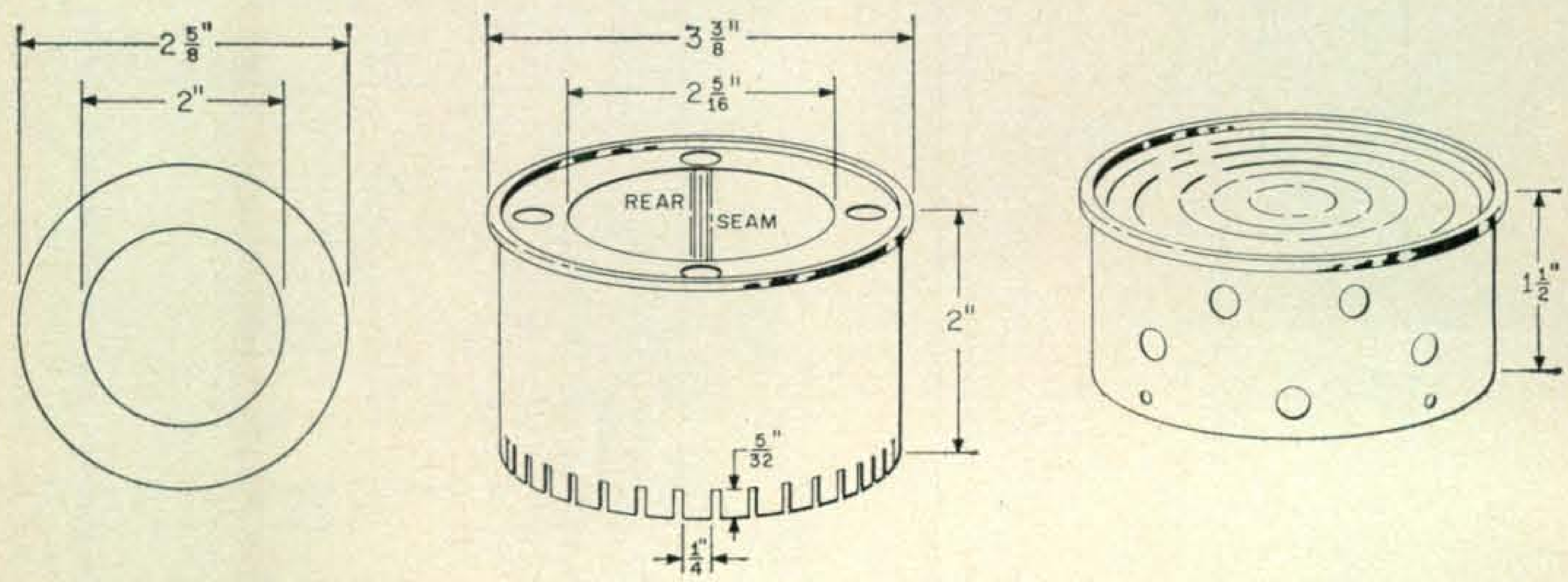
Corrections to Part I

Due to an error some mistakes crept into the parts list in Part I. The values shown on the schematic are correct and should be followed wherever figures differ. Q_{18} *referred to in the Long Dash Circuit section should be* Q_{10}. *ed.*

Case

The case is made of sections cut from two 20-ounce food tins, prepared as shown in figs. 4(B) and 4(C). Notch the lower end of the top part as indicated, and bend the tabs so formed to fit inside the top flange of the bottom portion. Work on the thin metal will be made much easier and safer if you first cut enough wooden discs to fill the portions used, and then clamp the cans endwise between blocks in a vise. Bore 1" holes through the centers of the discs, to facilitate removal as various operations are completed. The outer seams and minor dents in the tins should be filled with solder and filed flush with the surface.

Upper and lower parts of the case are held together by two 4-40 screws inserted through the top of the bottom section, near the edges, on opposite sides. These are threaded into tapped



(A) (B) (C)

Fig. 4—(A) Dimensions of the ground ring made from flashing copper. (B)—Dimensions of the case top section cut from a 20 ounce food tin. (C)—Dimensions of the case bottom section also cut from a 20 ounce food tin.

studs, 1/4" in diameter by 1/2" long, soldered in the correct positions at the sides of the upper case.

The bottom plate consists of a disc of 1/8" aluminum, drilled and tapped at the edges to take four equally spaced 2-56 mounting screws. A center hole, tapped to allow insertion of a 6-32 screw as a handle, enables removal of the plate when necessary. Mount the bottom plate inside the lower case wall, leaving a 1/32" lip to accommodate the 1/16" non-skid rubber ring. Cut the rubber from two common "jar-rings," expand and cement in position; a little paraffin, rubbed on the inside of the case, will prevent the cement from sticking to it.

The speaker grille, also made from 1/8" aluminum, fits inside the end flange of the upper case; the slots are 1/4" wide, bounded by a circle 2 1/4" in diameter. Make the handle from 5/16" aluminum rod, supported to clear the surface by about 5/8". The grille "cloth" is a piece of thin, opaque plastic sheet, stretched and cemented to the underside of a light gauge aluminum ring, 3 1/4" outside diameter by 2 3/8" inside, placed behind the grille itself.

Painting

When all mechanical work has been completed, and before assembling the various pieces, go over both case sections with fine emery paper, then clean with washing ammonia and water; rinse well and dry thoroughly. Mask the top and inside of the lower case, and paint both portions using Aerosol-spray base and finish coats according to directions. Pressure type transfers were used for the lettering, and clear lacquer over-spraying may be done without lifting the paint *if* you apply several very light "dusting" coats, allowing a few minutes drying time between applications. If in doubt, experiment on a piece of scrap material to get the feel of things before attempting the final job.

Final Assembly

Mount the speaker, grille and handle, *etc.*, to the top section of the case. Set up the filament transformer and completed parts board on top of the lower case, and position to give sufficient inner and outer clearances for all components and wiring. Mark and drill the mounting holes and clearance holes as needed for through-the-case connections. Solder one end of the 6.3 volt transformer secondary to the lower case, and pass the other end through hole F in the parts board to the junction of $CR_{13, 14}$. Finish the assembly and wiring.

Some Tips

Any difficulty which may be experienced with the leading dash of a series, or missed dots, can usually be traced to one of two causes:

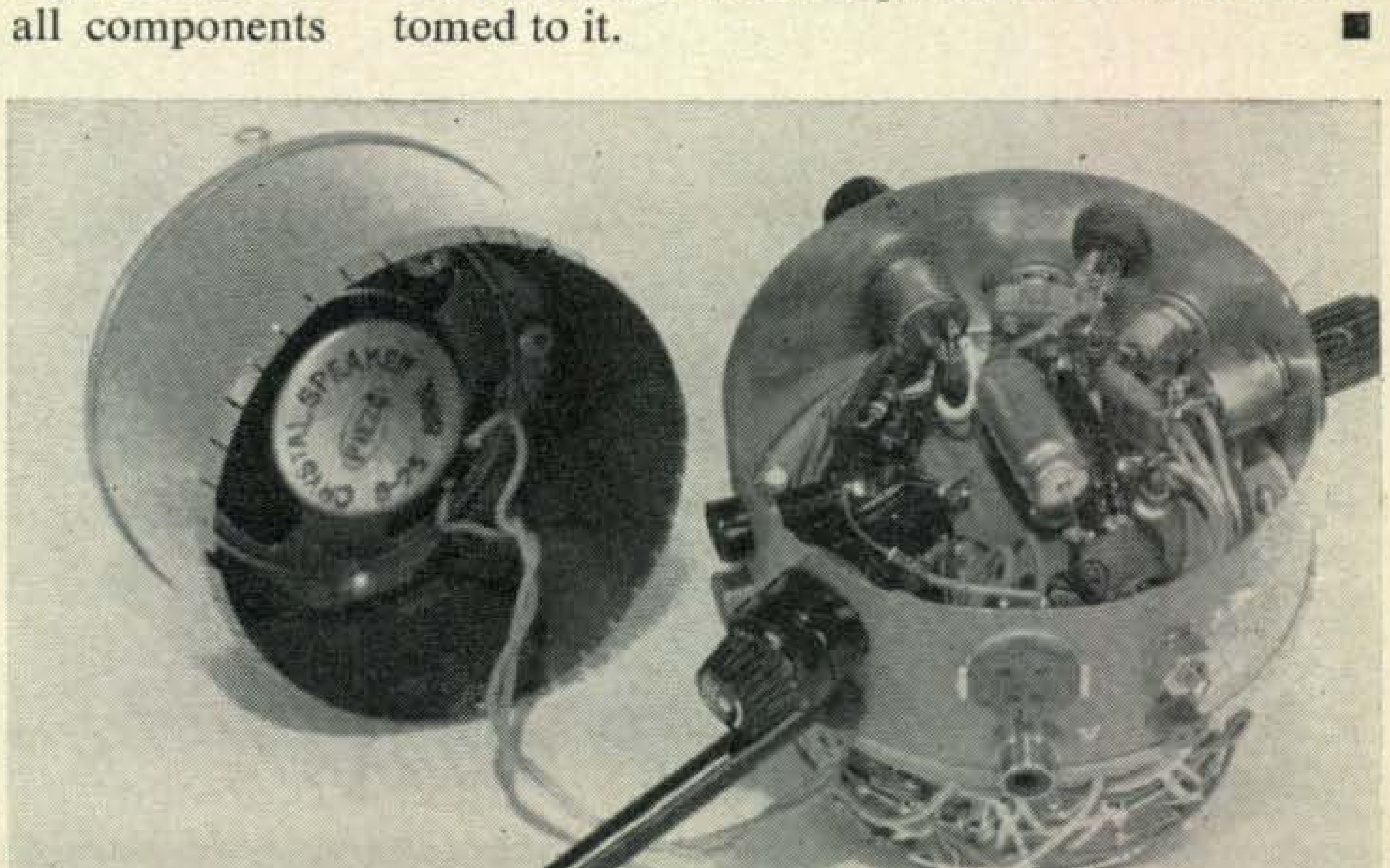
(a) Incorrect operator timing; remember that the keyer makes self-completing mark plus space characters. The remedy here, of course, is more practice!

(b) Poor contact in the paddle unit, either mechanical or electronic; in the first case, clean the contacts, and in the second, use a little glycerine on the fingers. Make sure the Touch-key is well grounded.

Handle the crystal speaker carefully and do not expose it to excessive heat or humidity.

Note that nominal values only are given for the timing components C_1, C_2, R_2 and R_3 in the dot multivibrator. Owing to rather wide manufacturer's tolerances for both capacitors and potentiometers, the actual values needed for the specified speed range may vary somewhat from these figures. For a given pair of capacitors C_1, C_2, there will be found a maximum permissible resistance for R_2 which will give the lowest practicable operating speed. This should occur at the maximum resistance position of R_2, and should correspond to a speed of about 15 w.p.m. Increasing the value of R_2 beyond this point will produce a slight rise in speed and erratic operation. Where this happens within the range of a particular potentiometer, it may be necessary to substitute a lower resistance value for R_2, or to shunt its connected terminals with another resistor of about 50K to 100K, in order to make the minimum speed point coincide with the maximum resistance end of the control.

As far as the writer is concerned, the *entirely* solid-state key is here to stay, and is well worth the minimum effort required to become accustomed to it. ■



Rear bottom view of the Touch-A-Matic key shows the wiring in the control and connector section. Connectors on the rear are for the straight key (lower right) and the Can-Key or Touch Key (center). The bananna jacks on the left are for connection to the transmitter keying circuit. The weight control is on the upper right. Phono jack A is for audio output to v.o.x. break-in circuit if used.

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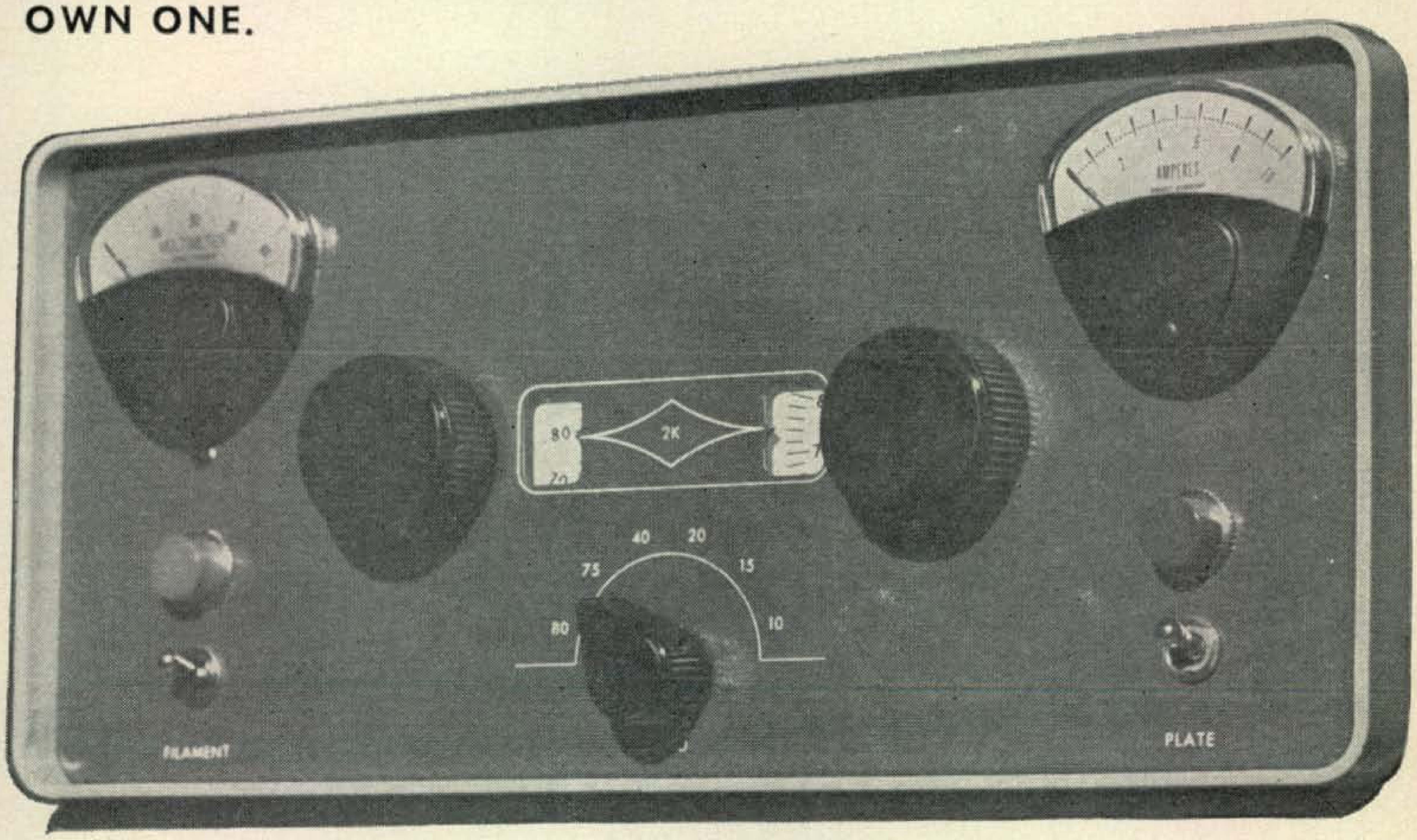

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DXPEDITION TO:

French Somaliland

BY ALBERT L. KEMMESIES,* K1QHP/FL8AK

ETHIOPIAN Air Lines advertises in such a manner as to suggest that one travel to, and visit off-beat places, and thence become a name-dropper. "Visit such enchanting spots as the city of Djibouti, in French Somaliland," say the advertisements. The study of this advertising alone did not generate the spark that set me planning for a DX-pedition to the little East African colony.

Being stationed in Ethiopia with the U.S. Army, it did not take long after my arrival to start queries rolling to the surrounding countries reference to possible amateur radio operation. From the very start it was discouraging, to say the least. ST2AR advised of no possibility in the Sudan. Aden advised they would license Nationals only. Queries to Lebanon, Yemen and to FL8ZA in Beirut remained unanswered. But finally good news arrived from the Director of Posts and Telecommunications in Djibouti, advising that the Governor had given permission for operation in French Somaliland, and that I had only, on arrival there, to present my credentials and take care of the taxes. This was heart-warming, and from that time, in May of 64, I started planning my little trip.

Having shipped my Johnson 500 into storage on departing from DL4-land, and realizing the lack of portability of equipment at hand, a Collins KWM-2 was ordered and air-freighted to Asmara from Iowa. Receipt of a B&W Vacationer antenna completed the package. Now remained only the planning for the 1,055 mile trip from Asmara to Djibouti. This presented an interesting problem in itself.

It might be appropriate, here, to mention

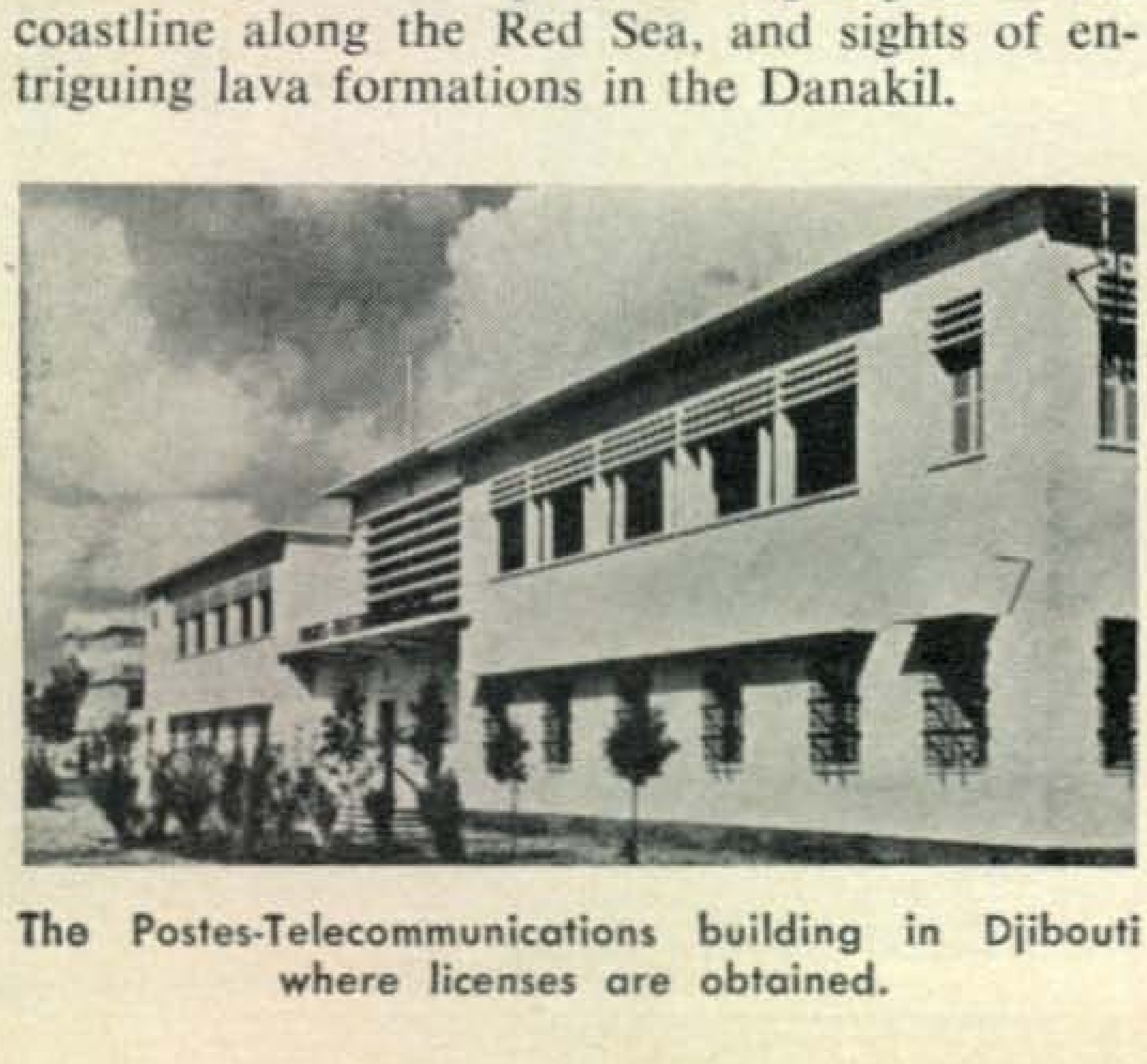
*RA 11072340, HQ Co., USASATR, Box 643, Fort Devens, Mass., 01433.

just a little about Djibouti and the general vicinity. It lies on a coral peninsula on the Red Sea, facing the Gulf of Aden. It, like the port of Massaua in Ethiopia, is considered having the hottest average climate in the world—an average yearly temperature of 86°. A road, running parallel with the railroad from Addis Ababa to Djibouti is unpredictable and considered a dry weather road. At many times during the year, and especially after rains, it is impassable. This, in addition to the fact that it follows the edge of the Danakil Desert where the Danakil tribesmen, too, are unpredictable, caused change of plans to attempt the 480 mile trek by vehicle. A check with Ethiopian Air Lines showed a flight departing on 6 November which would bring me into Djibouti in less than 3 hours flying time, with only one stop enroute at Assab, Eritrea's second port city on the Red Sea—situated less than one hour's flying time from Djibouti. This required delaying my departure for 5 days but still was far more advantageous than a 5 to 6 day trip by combination vehicle and railroad.

An offer from Ken, WA2HLH, to act as QSL manager was received but George, ET3GC/K2PWS had already graciously accepted to handle the cards via ET3USA.

To coincide with the usual frustrations that seem to go along with any DX-pedition planning, the KWM-2 went QRT approximately a week before the departure date. Even though the rig had been little more than tested once or twice here in Asmara, the altitude of almost 7,000 feet above sea level apparently was not compatible with the capacitors in the rig. One gave up its existence completely. The absence of one resistor in the wiring probably gave an assist to its deterioration. A thorough hunt produced nothing of the necessary value right up to the date before departure. ET3GC again helped roll the dark clouds away by his generous offer to loan his Drake TR-3, which was most hurriedly accepted.

The air trip, itself, proved uneventful, but provided most interesting movie material. The route basically covers mountains and desert the entire way, broken up by short glimpses of the coastline along the Red Sea, and sights of entriguing lava formations in the Danakil.



The Postes-Telecommunications building in Djibouti where licenses are obtained.

This is the card that 501 operators received for working FL8AK.

On arrival in Djibouti, arrangements were first made with the Director of Posts and Telecommunications who, within 4 hours, provided me with a license to operate c.w. and voice on 15 and 20 meters and issued me the callsign of FL8AK. The latter rather surprised me, as Gus had previously been issued an FL5 prefix there, but due to a deficiency in my linguistic ability, I never did discover the reason. The procedure was strictly routine and consisted of a check of my U.S. license, a visual check of my transmitting equipment and payment of 5,000 Djibouti Francs, which is roughly US $25.00. My license was issued as being valid for the months of Nov. and Dec., 1964.

My original plan had been to remain in Djibouti for approximately 30 days so as to include the CQ WW DX Contest on c.w. on the 28th and 29th of the month. I learned almost at once that to do this would cause a financial dilemma, as hotel prices proved much higher than had originally been estimated. I found the average price for an air-conditioned room (which was actually almost a necessity due to the extremely hot weather) ran US $13 to $14 per day, to which was added a 10% service charge, with meals costing extra. Some lower prices were noted in a few hotels, but in all cases there were no vacancies. A room was finally selected in the Hotel d'Europe, on the 3rd floor, with a porch providing sufficient antenna space.

Another problem then arose almost immediately. I discovered that there was no transformer available to reduce the 220 v to 110 v a.c.—the hotel had none and did not know where to locate one. A search of about 3 hours by cab then commenced with a check of just about every radio and electrical outlet in the city. What was believed to be the only one available in the whole city was finally located—a Freed, 1,000 watt job, for approximately US $37.00. From then on I was in business.

A Hy-Gain Tape Doublet was strung up on the porch after being unable to find an appropriate location for the window-sill antenna, and the TR-3 loaded up on 20 meters c.w. The response was most gratifying. ET3GC in Asmara proved to be the first contact, with ZC4TX following. I had hoped to make early contact with

Here is Al, K1QHP, at the operating position of FL8AK in Djibouti. Notice the healthy tan from the East African sun.

Jim, K4YFE, who was standing by at ET3USA, club station of the Kagnew Station Amateur Radio Club in Asmara, but I was unable to hear that station during my entire stay in Djibouti. Almost in every contact I was informed that I was their first FL8 station, and in many cases, that they were on the air, specifically, looking for me, after reading the advance notices in *CQ* and *QST*, or the information from them having been QSP'd.

Of the 8 US call areas worked, first contacts were with: K1UTC, W2GKZ, W3AFM, WA4-HUR, W5RU, W6AWT, W8LOF and K9WTS.

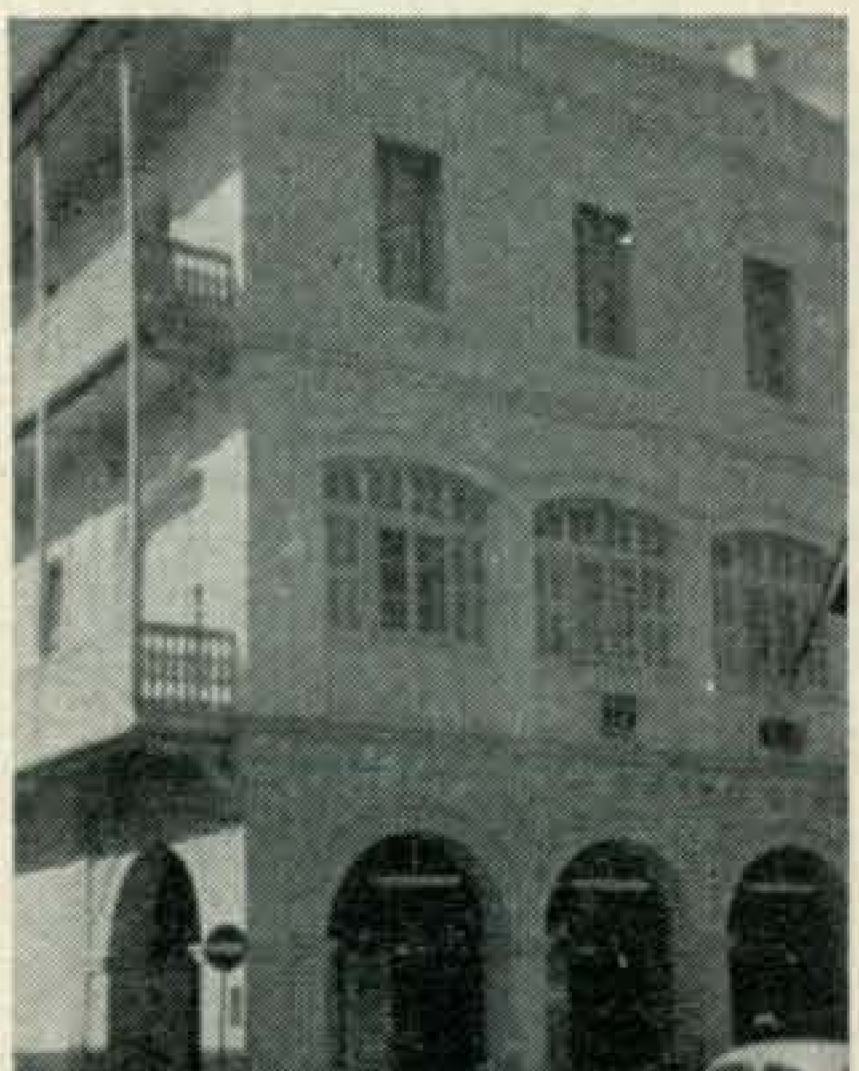
Most operation was carried out on 14005 kc but it was frequently necessary to QSY higher due to commercials and European stations calling CQ on the DX frequency. Only 3 s.s.b. contacts were attempted. With the rig only loading to approximately 50 watts, it was felt a higher number of contacts could be made by continuous c.w. operation. A few general calls were made on s.s.b. with no response, and occasionally a check of the band only showed one or two stations active, and these engaged in long outdrawn conversations. 15 meters was also checked occasionally, but conditions at such times never seemed to merit QSY to that band.

Conditions were spotty, but generally good, on 20 meters. Short opening occurred daily to the states, South America and to the Pacific area. A number of VK's were worked each day of the 8 day operation, as well as a number of 9M2's, 9M4's and 4S7's. No JA or ZL stations were either heard or contacted, with exception of one QSO with a JA/MM station. BY1PK was heard very raggedly on 11 Nov. covered up by a large pile-up of Europeans. WAC was worked in approximately a day and a half of operation. Final totals for the 8 days of operation from 8 to 16 November were 501 station worked in 64 countries.

A few notes of operating habits, courtesy, etc, should perhaps be added here. W/K operators continue to be as courteous, or more so, than most ops—in general. Some frustrating experiences were occasionally suffered for various reasons. Some stations would come up to my frequency to work me, then go QRZ without QSY'ing and commence another QSO on the frequency. While I was in contact with ZD3A, a YV5 station insistently called ZD3A on a.m. on 14005 Kc. Many stations worked insisted on signing with long calls of stations calling. It was noted that apparently numerous stations hop on a frequency and call after they hear some other station call a DX station. I would get calls such as FL? or FL8? or sometimes even the full call, go back to them, and there would be no response, with the possibility existing that they never had heard me in the first place. With due respect to a number of excellent operators in those countries—U stations and the satellite countries proved to be what I would term as most discourteous of all. Their procedure, basically, was to call in the middle of a QSO already in progress, blocking readability, and necessitating requesting repeats and generally increasing the length of QSOs—resulting in fewer stations worked.

All in all, however, considering the low power and necessary hand-keying due to lack of side tone with the TR-3, I consider the operation successful and am well satisfied with the result. QSL's have been printed and already received from the printer, and will be forwarded to every station worked. Direct QSL's to FL8AK should be addressed to S/Sgt Albert L. Kemmesies, K1QHP, RA 11 072 340, HQ Co., USASATR, Box 643, Fort Devens, Mass. 01433.

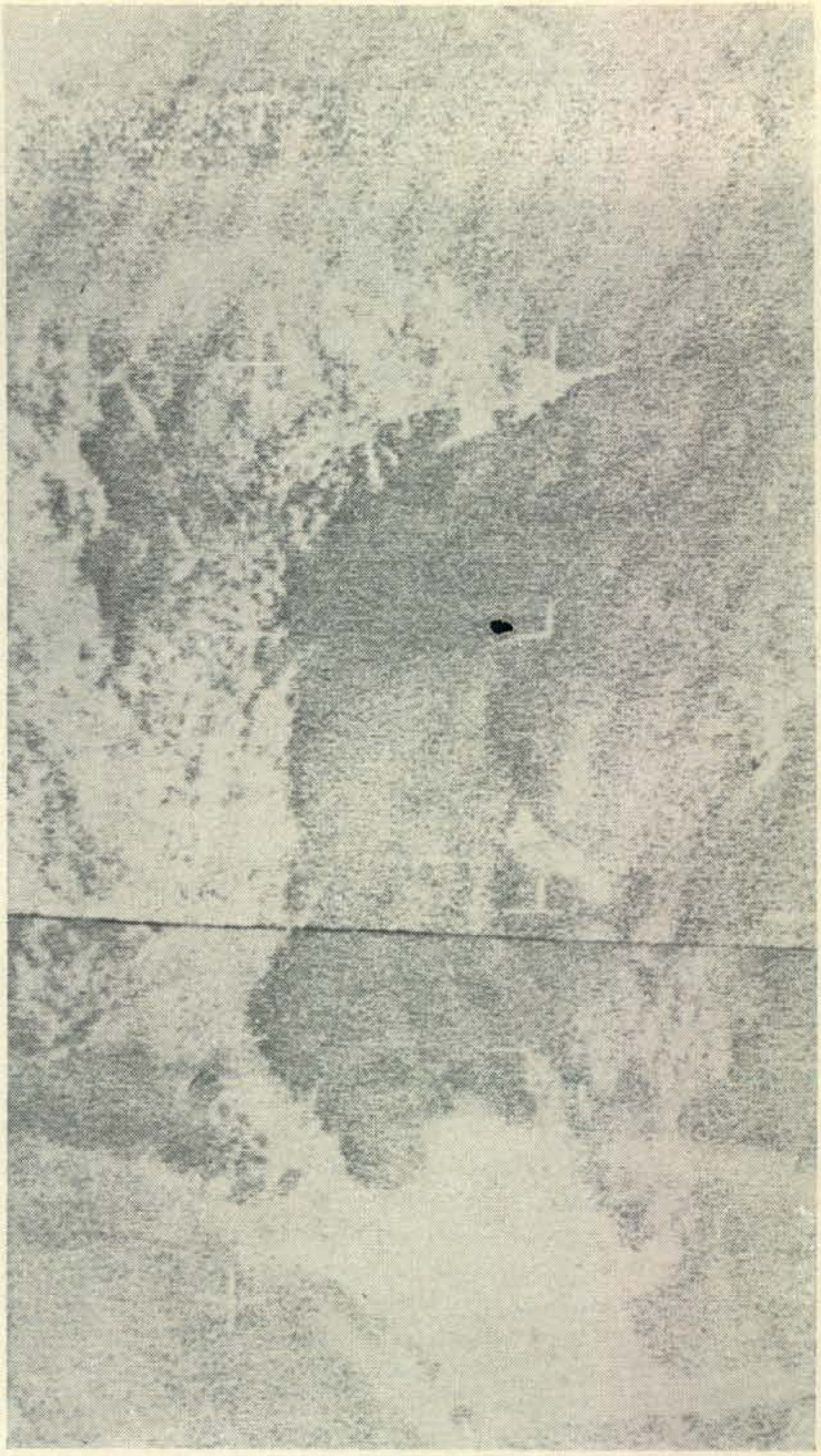
In preparing to return to Ethiopia, and to cut down on excess baggage, the Freed transformer was left at the Hotel d'Europe, located on Place Menelik in Djibouti. The hotel manager has promised its availability to any amateurs that might desire its use there in the future. ■



The Hotel d'Europe which housed the FL8AK operation.

Editor's note: **All of Al's QSO's were QSL'd almost immediately upon his return from Asmara. QSL's for his second trip to FL8 in June 1965 were and still are being handled by W7TDK.**

This relatively good picture showing Norway was received by the author from the satellite ESSA II on his facsimile equipment.



COPYING WEATHER PICTURES VIA AMATEUR FACSIMILE

BY J. B. TUKE,* GM3BST

As the author points out, most of us have a second hobby which is more or less conventional. He thinks his is not. It is the gathering of meteorological data through the use of facsimile equipment. He explains why and how he does it. The equipment was first described in the April, May, June and Oct. 1959 and January 1964 issues of Short Wave Magazine.

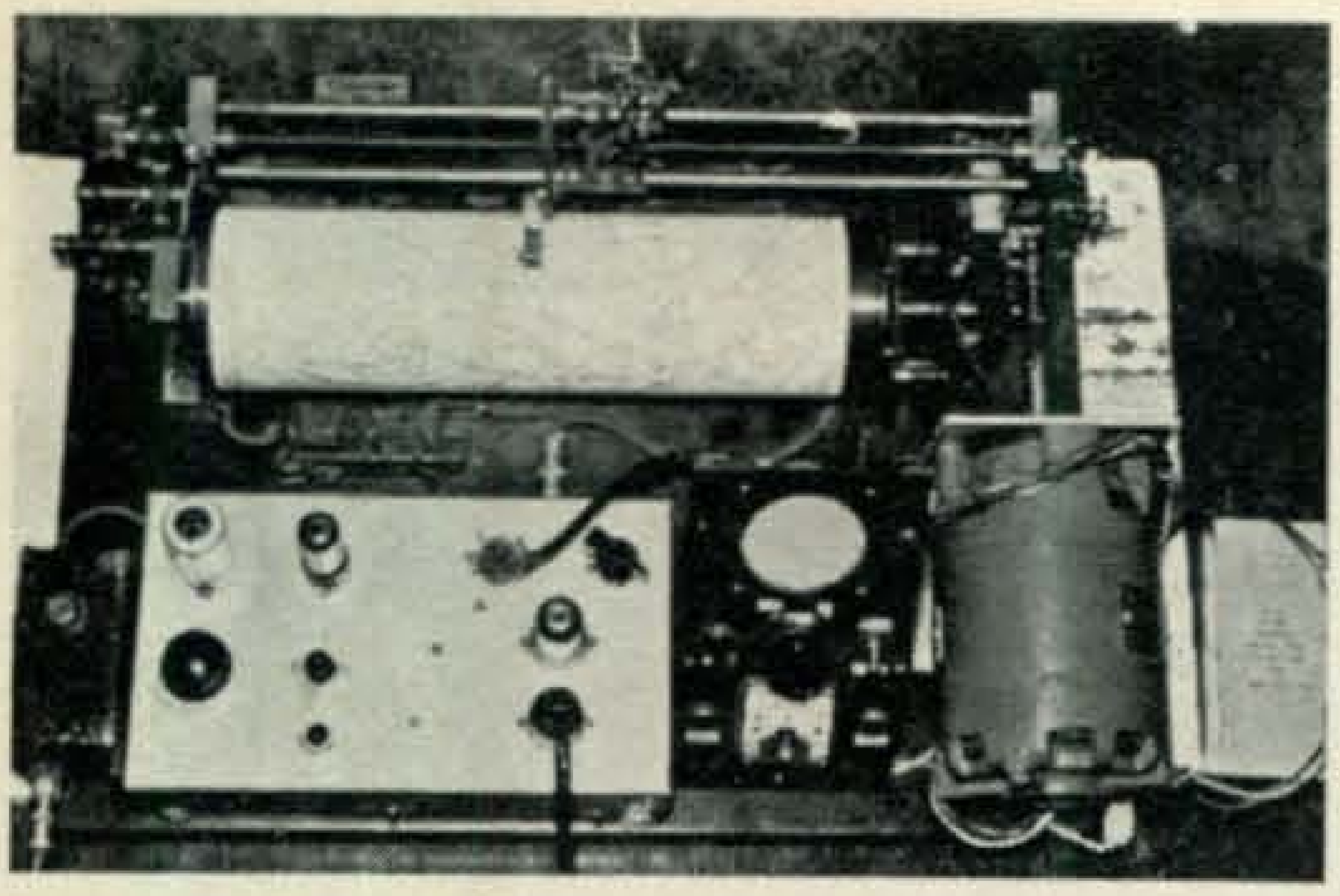
MOST radio amateurs are reasonably human—this means to say they have some other interest in life apart from amateur radio. They have conventional second hobbies like gardening or fishing and their neighbors think them not entirely anti-social. But there are other amateurs who although they do not devote all their hobby time to radio, take up second hobbies which are just about as way-out as their first. Perhaps they study zoology, Egyptology or even, as the writer does, meteorology.

Weather

Most folk just accept the weather for what it is, and admittedly there isn't much you can *do* about it. If you happen to live in Britain, it is best simply to accept the weather, for if you worry about it, you will soon end up a nervous wreck. There is another way of tackling one's relationship with the weather though, and that is to say "If you can't beat 'em,—join 'em."

To learn to understand something about the weather is not only interesting and instructive but it gives you a definite superiority over your lesser mortal friends who don't know an occlusion from a wave in the Westerlies. Just when you are taking the wife and kids out for the day, and after a promising morning the rain suddenly tips down, there is some satisfaction in being able to say, "Looks as though that cold front is more active than we thought." Maybe the wife

*MOA Radio Station, Galdenock, Stranraer, Scotland.



Close up of the fax printer. Along the front edge, from l to r., there is the Wein bridge, the signal amplifier, the control panel and the syncronous motor. The motor drives the drum through a set of reduction gears. On the left end of the drum another set of gears transfers power to the lead screw which moves the writing carriage and stylus.

will bat you over the head, but the inner satisfaction is still there!

Weather Communications

Once you are interested in meteorology you soon find you need to make some observations. This you can do by setting up suitable apparatus in your back garden, but no sooner have you done this that you find you not only want to know what is going on in your own back garden, but what is going on for several hundred miles around you as well. And you want to know it quickly, not tomorrow or the next day, so the mails won't help much. What you want is an up to date weather chart. These weather charts are familiar to almost everyone — they contain masses of information on a single sheet, showing fronts and pressure patterns and all the other data you need to know if you are going to come to terms with the weather.

In case you think this article has got into the wrong magazine by mistake, it is at this point that radio comes into the picture. Fortunately for amateur meteorologists, not only do *we* want to see what weather is going on around us, but official weather stations also want to know what is happening, so there is a requirement for a continuous exchange of information between weather centers. This material is exchanged from center to center as radio broadcasts, and we may intercept these to give us the information we require.

Synoptic information (which is the type that either is, or results in, a weather chart) is generally transmitted by two methods. The older of these two is radio-teletype and the more modern is radio-facsimile. The older system requires that the weather chart picture first of all be "coded" into series of five-figure groups, as you cannot send pictures direct by teletype. If you have an RTTY receiver, you can receive these coded groups, and then plot a chart of your own by decoding them. This is alright if you happen to have unlimited spare time.

In the more modern system of facsimile, the weather chart is drawn at the weather center and it is then transmitted as a *picture*, producing a complete chart "untouched by hand" at the receiving end. Most charts only take 9 minutes to complete, though some take 18 minutes, but this is a pretty big improvement on the RTTY and five figure coded method. The first time the writer saw this method in use was during a visit to the British Weather Center about 9 years ago. It was decided there and then that for meteorological purposes the RTTY could be replaced by "fax". Since that time, fax receivers have come and gone, each being a small improvement on the earlier model. The present one is about Mark 4.

"Fax" Equipment

Before giving a description of the actual equipment used, a brief explanation of the system used may be of interest to those who have not met it before. The object is to reproduce a picture at the receiving end which is an exact copy of that transmitted. To achieve this, at the transmitting end, the picture is wrapped around a drum which rotates at a fixed predetermined speed. A photo electric device is then moved slowly parallel to the axis of the drum, so that in effect the picture is scanned in a series of lines. See fig. 1.

At the receiving end, the mechanical set up is the same, only the photo electric device is now replaced by something which will write on a piece of blank paper around the drum, when actuated by an electrical impulse. If we imagine that we wish to transmit a picture of a single black line on a white background, then while the picture at the transmitting end is rotating on the drum, the output from the photo-cell will vary according to whether it is seeing black or white at any instant. This electrical output is made to modulate a transmitter in some way.

At the receiving end, signals from the transmitter are picked up and these will vary according to whether black or white is under the photo cell. We have a similar mechanical set up, with blank paper on the rotating drum, and some form of electrical writing stylus. When the photo cell is seeing black, a signal is applied to the writing stylus and a black line is drawn. When the photo-cell is seeing white, the signal is now different, no information is fed to the writing stylus, so the paper remains white. Since the picture to be transmitted is being scanned slowly line by line, an identical "facsimile" of this will slowly be built up at the receiving end.

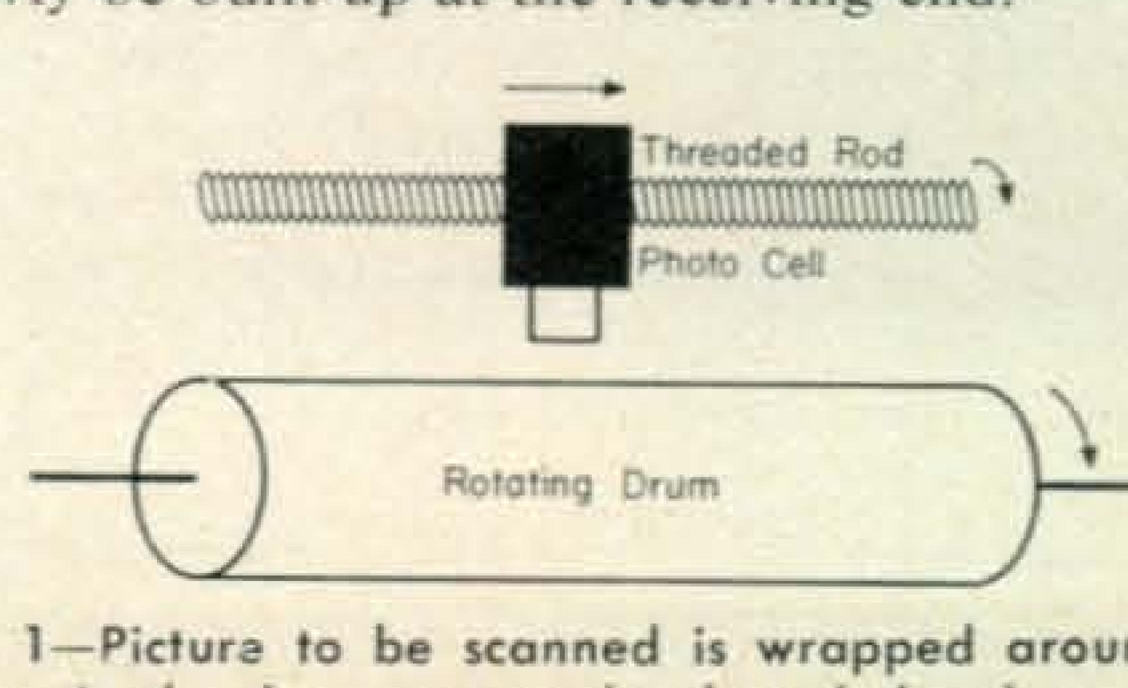


Fig. 1—Picture to be scanned is wrapped around the drum. As the drum rotates the threaded rod moves the photo cell along the drum axis.

So far we have only considered pure black and white. If it is desired to transmit intermediate shades of grey, then the output of the photocell must be capable of providing a proportional signal for the transmitter, and similarly the writing device at the receiver end must be capable of producing intermediate tones between black and white according to the information fed to it from the radio receiver. For meteorological charts, only black and white are required, and intermediate shades are not used. While this does not affect design of the equipment to any great extent, it means that a very simple type of electrical writing can be employed—namely an electro-sensitive paper which is white to start with, and turns black under the application of a voltage much in excess of 100 volts. The writing device is simply a sharp point which rests on the rotating paper, and to which a voltage is applied everytime it is required for it to make a black mark.

Standards

Before designing a facsimile receiver, we have to know what standards are employed for transmission, as obviously drum speed at transmitting and receiving ends, together with rate of lateral scanning, must be identical. To consider the radio signal first—the transmission is in the form of a frequency shift signal, where one frequency means "black" and the other "white". Stations using low frequency bands usually use 300 cycle shift, while those on the h.f. bands use 800 cycles. Facsimile transmission can be found all over the h.f. spectrum; lists of transmissions are available from the Meteorological Center in Switzerland.

The picture standards are as follows: Drum speed 60 or 120 r.p.m. (there are some stations using 90 r.p.m. but these can be neglected). The rate of scanning is determined by a figure called the "Index of Cooperation". This is equivalent to drum diameter multiplied by scanning rate in the same units. Two I.O.C.'s are in common use —576 and 288. This means if the receiving drum is 3" in diameter, the scanning rate will be either 192 or 96 lines per inch.

It is necessary to be able to use either drum speed with either scanning rate, as all combinations of the four are used. In the writers equipment, the two drum speeds are obtained by a two-speed motor (the field windings are switched to provide more or less poles) and the scanning rate is altered by a simple sliding gear.

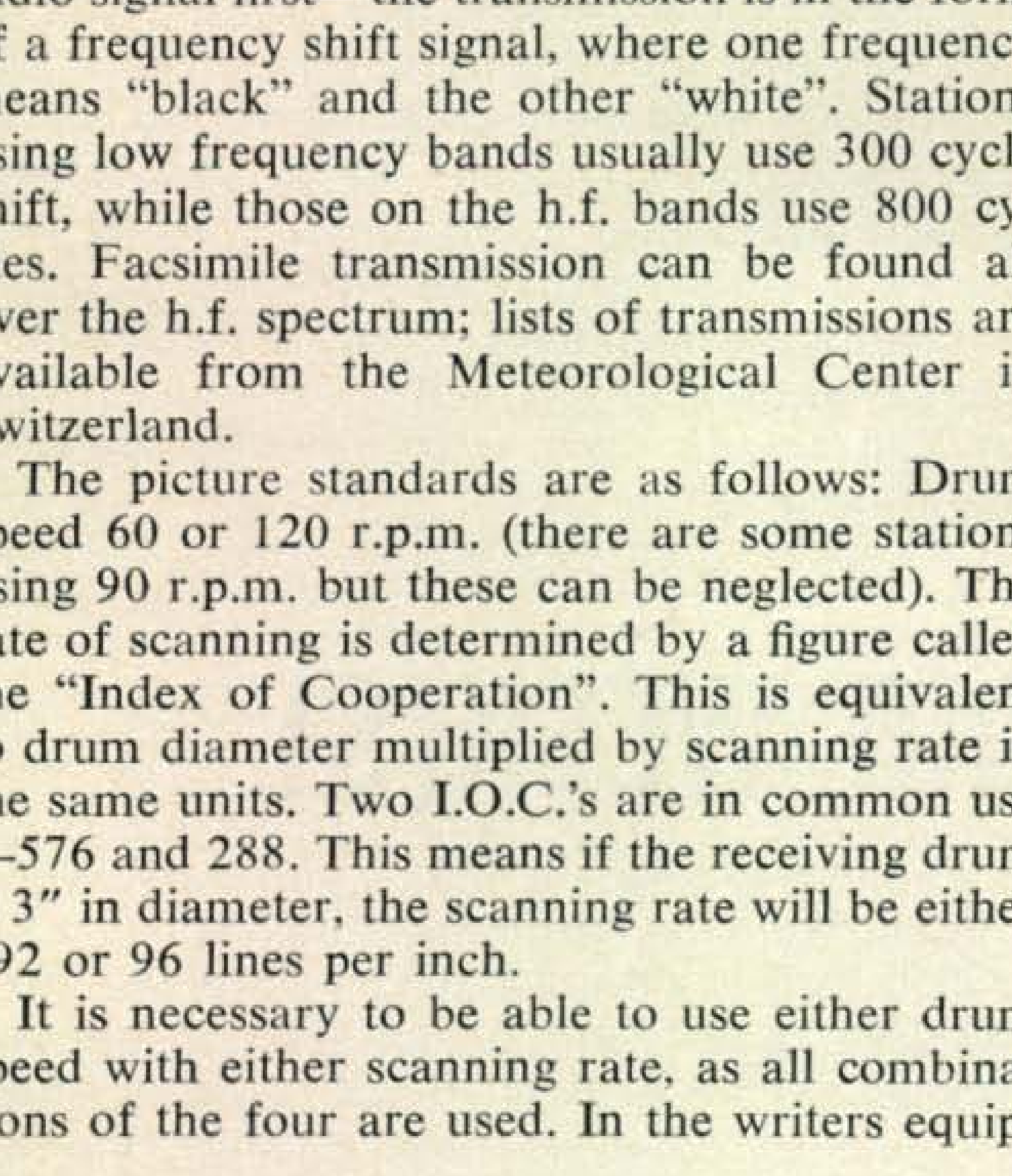
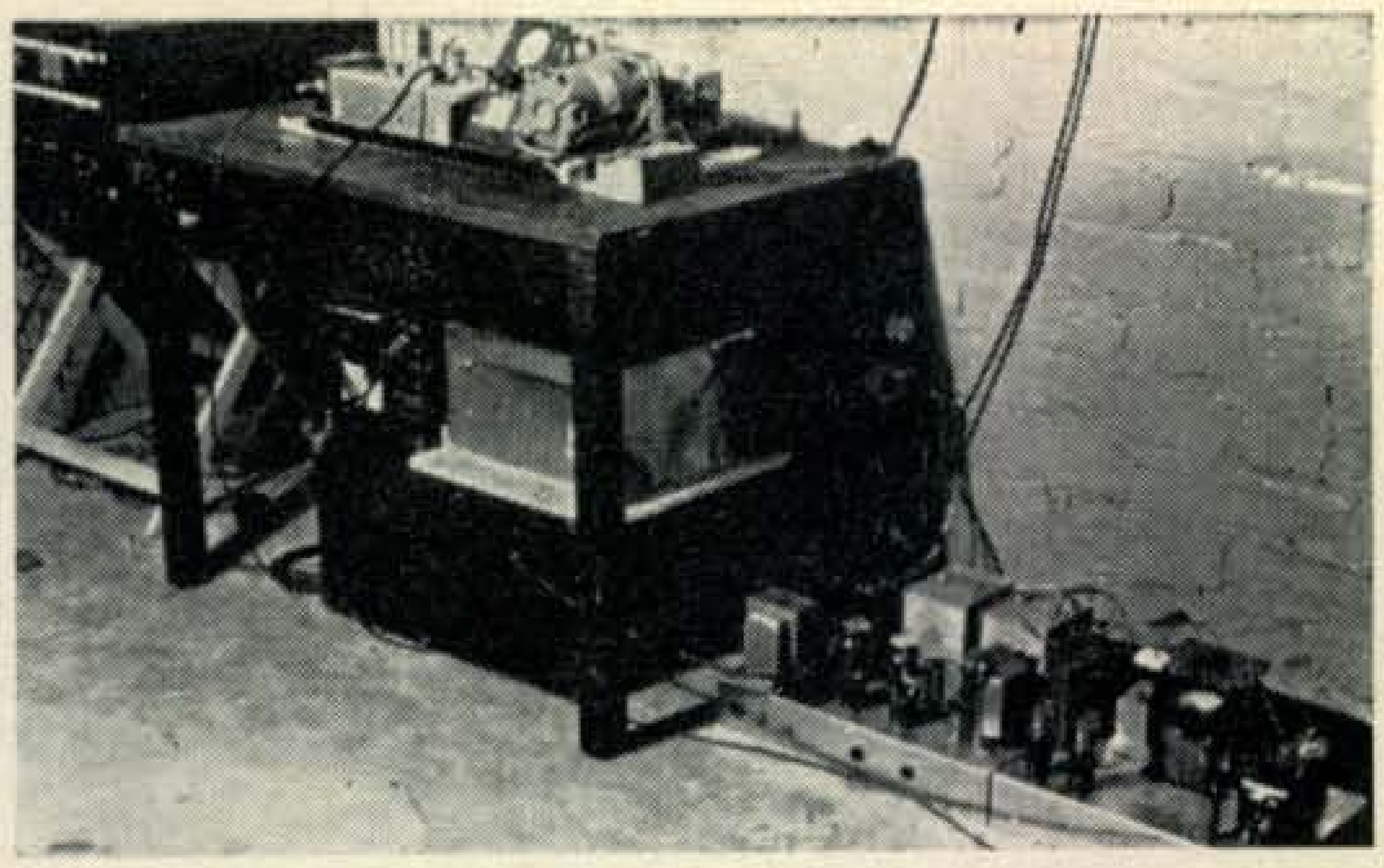


Fig. 2—Block diagram of the equipment used to receive facsimile transmissions.



View of fax receiving station. The equipment on the floor, to the right of the table, is the power supply and motor amplifier. The fork oscillator oven is the metal case under the table. The fax printer and amplifier is atop the table and the AR 88 receiver is to the left.

Synchronizing

Since the picture is scanned in a series of lines, it could be said that the system is quite like a single frame of a television transmission, only of course very very much slower. This is quite true—but there is one big difference and that is that there are no "line-sync" signals. This means that the drum at the receiving end must go round at *exactly* the correct speed, without any correction information being received along with the picture,—like running a television receiver with line-sync disconnected. This is achieved by using an a.c. synchronous motor to rotate the drum. This motor must keep a constant speed with an error not exceeding much more than 30 p.p.m. so it is not sufficient simply to drive this motor from the household electricity supply as the line frequency is not held to anything like this degree of accuracy. It is necessary to generate one's own high stability a.c., and this is done with a tuning fork oscillator. The frequency of the fork depends on the type of motor used, and may be several hundred cycles, or more conventionally 50 or 60 cycles. The writer found it best not to use a fork the same as the line frequency (50 cycles in Britain), so a 25 cycle fork was used, the frequency then being doubled. The motor used to drive the drum consumes about 90 watts, so a suitable amplifier increases the small signal from the fork oscillator-doubler to the required value. It has been found necessary to enclose the fork in a thermostatic oven, as day to day temperature changes had the effect of altering its frequency slightly. A large tin box was thermally insulated inside, and two 15 watt lamps provide the heat, and a simple thermostat keeps the internal temperature about 28°*C*.

Picture Signal

Let's leave the mechanical side and think now of the signal side. It was said earlier that the signal is in the form of a frequency shift carrier where one frequency corresponds to black and the other to white. If the b.f.o. in the receiver is switched on, the result is two tones from the receiver, one black, the other white. If the writing stylus is to make black marks on white paper, then the white tone is not required. Accordingly, the two tone signal from the receiver is first fed to an a.c. tuned bridge (Wein bridge) and the white tone is filtered out.

We are now left with an on-off black tone. This is amplified by a 6AQ5 and impedance coupled direct to the writing stylus which is a sharpened steel point. There is no need for the audio signal to be rectified before writing; the individual half cycles are too close together to produce individual marks on the paper, and a continuous tone simply produces a black line.

Frame Sync

Although there are no line-sync signals, there is a "frame-sync" signal at the commencement of transmission. This is to ensure that the piece of paper on the receiving drum is in the same position as that on the transmitting drum, as otherwise the overlapping join at the receiving end might well appear in the middle of the completed picture.

To get this synchronism correct, a "phasing signal" is transmitted just before picture transmission commences. This is (usually) a short "blip" of signal which indicates that at that moment, the photocell is passing over the join in the picture to be transmitted. At the receiving end, the drum is held captive by a metal catch, and at this point the writing stylus is over the join in the paper. Receipt of a phasing blip releases the catch, and the drum commences to rotate, and it is now not only going at the same speed as that at the transmitter, but is in the same relative position or phase as well. During this phasing action, the synchronous motor continues to rotate, and to enable the drum to be held stationary it is driven through a friction clutch.

Equipment

The general arrangement of the writers equipment is shown in the photograph and block diagram of fig. 2. Although moderately complex in the initial design and building, the system is really quite simple. The gear is reliable, and the meteorological side of the hobby has gone from strength to strength. Although mostly interested in charts applicable to ones own part of the world, it is quite possible to copy "DX" charts from all continents. When automatic Picture Transmission is available from satellites a system similar to standard facsimile is to be used.

There is a further side to this "fax" business —and that is the purely amateur radio aspects. The writer constructed the equipment primarily for weather charts, but it is not possible to avoid getting interested in the technical angle as well. The Post Office (our licensing authority) has permitted me to transmit fax on 420 mc or above, and though no radiating experiments have been carried out yet, a simple fax transmitter has been built and tested, and worked very successfully over closed circuit. Like amateur television, one could never expect this form of communication to be popular with everyone (I doubt if there will ever be a world wide "fax" contest), but even if it is restricted to the v.h.f. bands, the possibility of satellite or moonbounce communication means that DX will be possible. Perhaps one day I may even work into "W" on fax—here's hoping. ■

AMATEUR RADIO WEEK(S)

THIS past June and this month are singled out for honors to amateur radio. The week of June 19 through June 25th was proclaimed Amateur Radio Week by Austin N. Volk, Mayor of the City of Englewood, State of New Jersey. A fine public relations job was done by Dave, WA2CCF, President of the Englewood Amateur Radio Association to bring this about. This month from August 8th through the 14th has been designated Amateur Radio Week by the Governor of Illinois, Otto Kerner. The week will be climaxed by the 32nd Annual Hamfesters Radio Club "Hamfest," to be held on Sunday, August 14.

Pictured on the left are members of the Hamfesters Club looking at Illinois Governor Kerner's Proclamation. L. to r. Joe Poradyla, WA9IWU, John Curtis, WA9DDY, Greg Purtock, WA9MRE, and Tony Seekus, WA9EOC. At the right is Mayor Volk's Proclamation for the City of Englewood, N.J.

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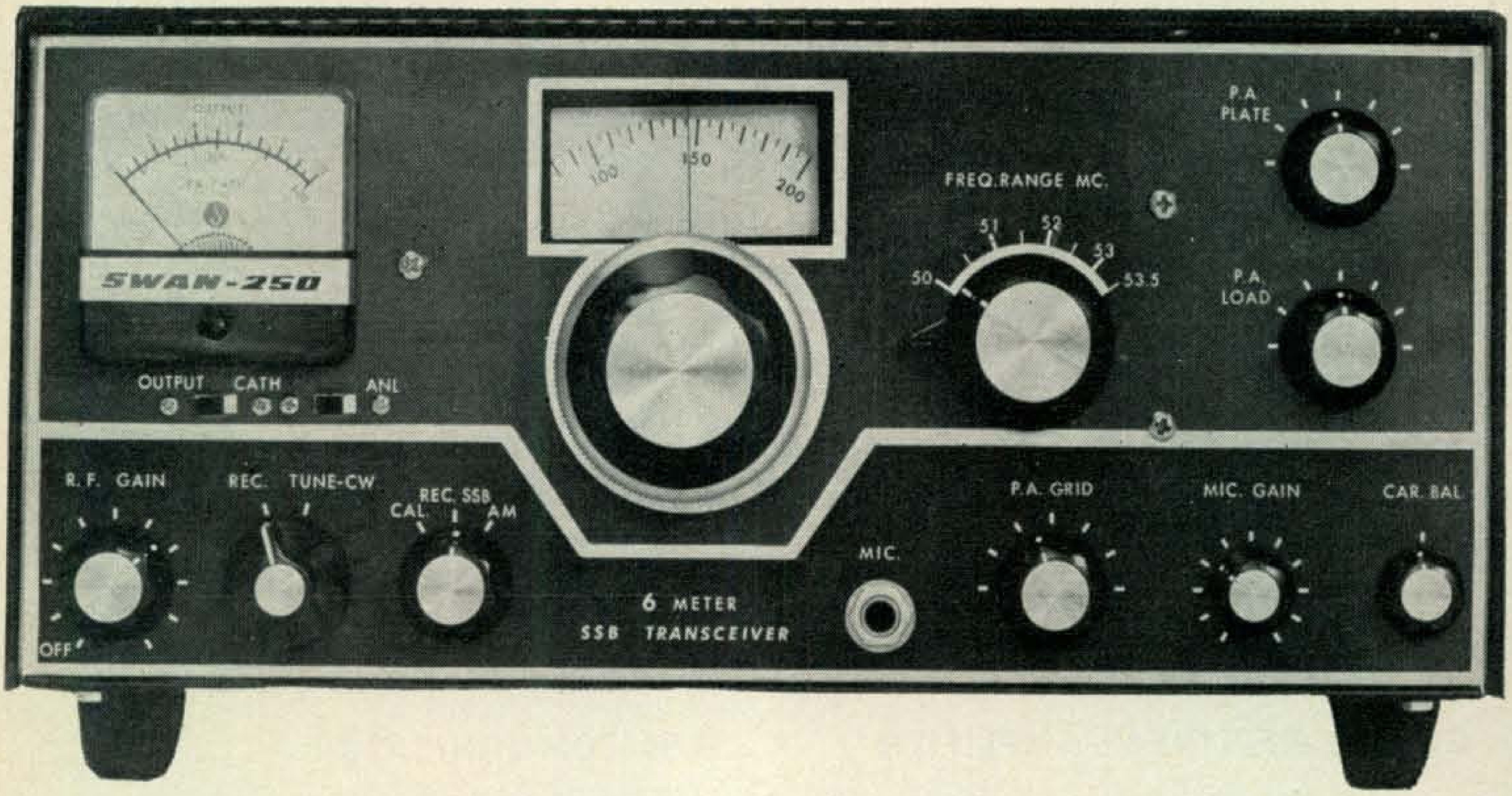
For further information, check number 29, on page 110

Swans Model 250 a smashing success on 6 meters



An unusual opportunity has now been made available by Swan Electronics. I am referring to the newly announced Model 250 6 meter transceiver, construction of which has now been started in California. Very likely this set will do more for 6 meters and for the subsequent sideband occupancy of this band than any other similar design. The reason we feel so strongly in making this statement is that the 250 possesses that combination of design features which most hams want, with a quality of construction and reliability so inherently sound as to constitute an overwhelmingly good value.

When a product is exceedingly popular, and retains its utility for a long period of time, it becomes known as a "classic." Ham radio has seen few such classics. Amongst the great pieces that have been commercially available in the past fifteen years are the Johnson Ranger, the Hallicrafter HT-37, the Collins 74A-4 and, of course, the Swan 350. These were great pieces because they made so many people happy—because they were moderately priced—and because over a period of time the demand for them has not diminished. The Swan 250 is such a product.

Any piece of commercial amateur gear must offer a combination of desirable features to merit unusual customer acceptance. A transceiver must be moderately powerful, selective, and sensitive, and capable of operating on AM as well as SB, as well as CW. It must be truly serviceable, attractive in appearance and priced so that large numbers of hams can afford to buy it. This general description exactly fits the Swan 350 which is already justifiably famous as being the most popular transceiver of *all* time. You have only to listen across the low frequency bands to prove this point and now, after a year of research and development, of continuing field development amongst the most professional of the VHF hams, the Swan people have introduced and are making available their Model 250. This is the set you will want to buy. This is the set which offers balanced design and a very high order of performance. This is the set which will be talked about in VHF circles for years to come.

The Model 250 makes it possible for the average ham having a technician grade license to break into 6 meters with the assurance of having the best and latest piece of gear available—barring none. In most of the 6 meter areas of our country, AM operation still predominates and to buy a set which does not provide AM operation for both receiver and transmitter is to restrict your QSO's to approximately 5% of those you hear. The Swan 250 will enable you to operate with 80 watts of AM power, one hundred per cent modulated. When you find a station that is equipped to operate sideband, as for example another Swan 250, you can immediately switch to upper sideband suppressed carrier. If you want to work CW, you merely

have to grasp a key and flick another knob. So, for any mode of operation, the 250 is the answer.

The 250 will cover the entire band—not just .5 megacycles—not just 1 megacycle—not just 2 megacycles—but the whole 4 megacycle band plus a generous allowance below and above to accommodate MARS and CAP. The velvet smoothness which has characterized the 350 will enable accurate tuning of high resolution. An accessory calibrator will enable you to know precisely where you are. You may use VOX if you want to—again by means of an accessory costing only $35. The high frequency oscillator is a carefully designed transistor circuit with an isolating transistor buffer. This circuit is temperature compensated for a high order of stability.

The Swan 250 uses 2 6146B's in its final and when used with its companion power supply is capable of running 250 watts PEP. When you consider the inherent high gain possible with physically small antennas and think of this 250 watts, you will realize that it is most unlikely that you will ever want a linear. This is all the power that will be needed for overseas 6-meter contacts and with the sun spot activity returning to maximum, those of us owning a 250 are going to have a ball. Even the Sam Harris's of 6 meters will find this set an advantage to them.

The Swan 250 is priced at $325. Its AC supply is only $95 and that with matching cabinet and speaker, making a total of 415 bucks. Compare prices with other brands—compare specifications—compare the advantages. This set can be gimbel-mounted under the dash of most vehicles. You can use it on field day or for any of your summer mountain top expeditions. The receiver is darned good. It has an exceptional noise limiter. It has a specially designed RF front end. The transmitting portion is again single conversion as in the 350 with a 10.7 MHZ crystal filter.

It has often been said that we hams are slow to react to good things—that by the time the product has been proven and, therefore, acceptable to us, the factory has discontinued its production or has removed it from the line. Here, now, is an example of a product which will be a smashing success from its very beginning. The factory is planning to make the Model 250 on a continuous basis. We will ship against orders received on a first come-first served basis. Those ordering now can expect delivery commencing August 15. If your remittance in full accompanies your order, we will prepay the shipping charges to any point in the original 48 states. We are open to trades and will treat you fairly. Remember, we service what we sell and we unhesitatingly recommend the Model 250 as the best thing that ever happened to American VHF. In the final analysis, though, it is your support and patronage that will enable Swan to keep on making this model.

SWAN 250 SPECIFICATIONS

- ★ 240 watts P.E.P. input on single sideband, 180 watts cw input, 75 watts AM input with carrier insertion.
- ★ Two 6146B tubes in Power Amplifier.
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- ★ Automatic noise limiter.
- ★ Audio response essentially flat from 300 to 3100 cycles.
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- ★ Meter indicates either cathode current or relative output for optimum tuning and loading.
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- ★ Dimensions: 5½ in. high, 13 in. wide, 11 in. deep. Weight: 17 lbs.

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The V.H.F. Conical Monopole Antenna

BY WALTER L. HARNISH,* WA8IHF

Simple construction for an efficient broadband antenna with low s.w.r. over a 4:1 frequency range.

THE original article that appeared in *CQ* describing the conical monopole stirred up considerable interest and an attempt was made to scale it down for v.h.f. operation.[1] The results were good and the entire range, from 50 to 220 mc, was covered with the s.w.r. less than 2:1 at all times.

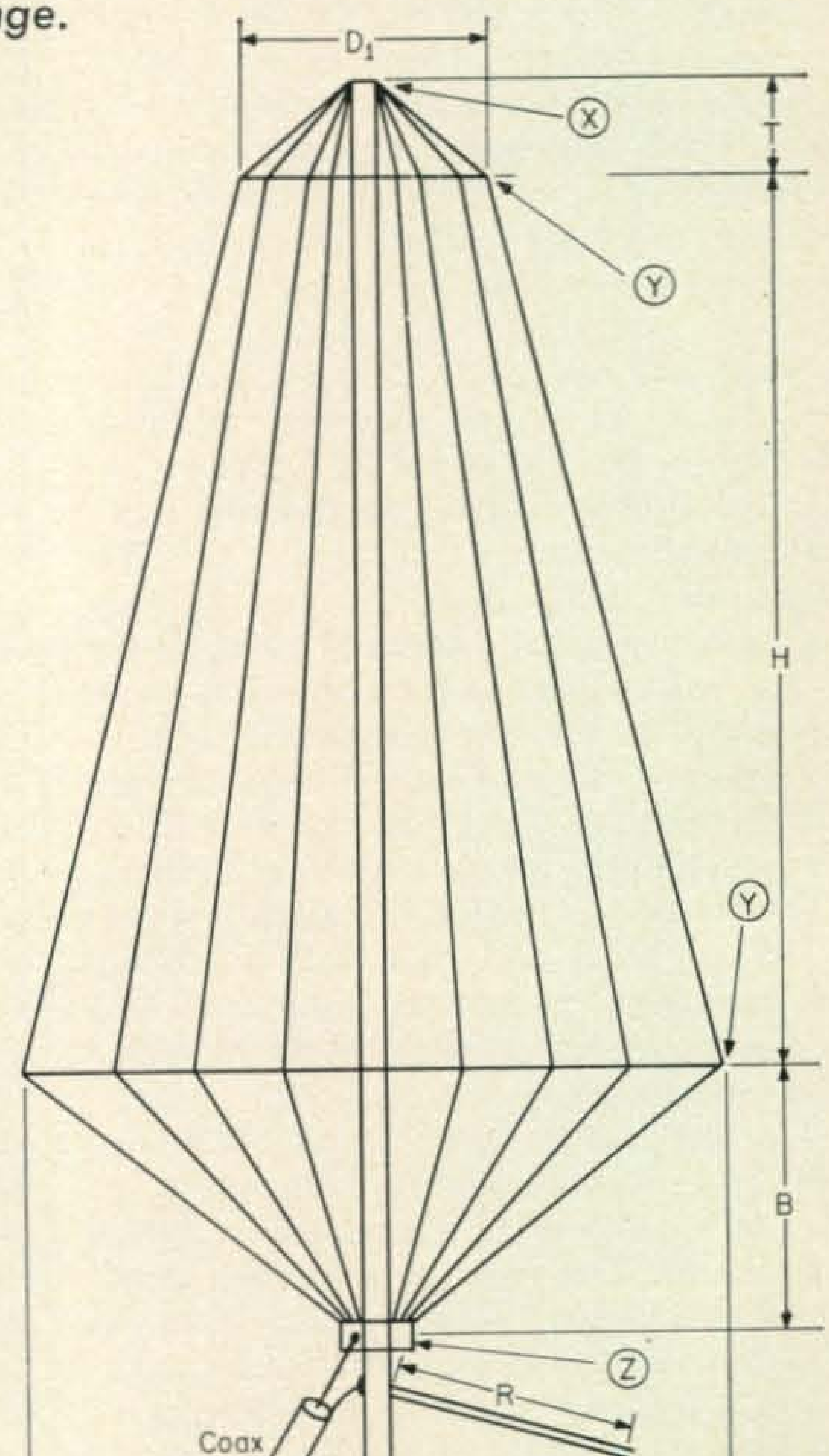
The construction of the v.h.f. model differs from the original. The two rings, shown in fig. 1, are hoops (*D1* and *D2*). The wires are fastened from the top of the mast to the top hoop, down to the bottom hoop and then to the collector ring. Only the collector ring is insulated from the mast. At least twelve wires should be strung in this manner, (I used sixteen), and they should be equally spaced.

The alternate method, crossarms, used in the original article, is suitable for lower frequencies as the hoop sizes become unwieldy. Three or more crossarms may be used with the wire stretched around the ends. Two wires are run from the top over the ends of each crossarm and spaced a minimum distance "*S*" as given in the dimension chart in fig. 1.

The antenna should be fed with 52 ohm coax, the center conductor connected to the collector ring and the shield to the mast. The match may be adjusted very carefully by setting the droop of the radials. This can only be done for the two small antennas because the larger radials are rather unmanageable.

The performance of the larger antennas may be improved by the use of counterpoises, or radial wires. The suggested lengths for these are shown in the chart in fig. 1, as R.

While the antenna is called the conical monopole, the name "periodic halo" would more properly describe it. The main cone, when wired as illustrated in fig. 1, is in effect a solid cone at the frequencies used. The circumference, at some point, is resonant to the frequency to which the transmitter is tuned. All other circumferences have high reactances. As you shift frequency, the active part of the antenna shifts to a new location which is resonant to the new frequency. Therefore, if the transmission line is properly matched to the antenna, a low s.w.r. will result (less than 2:1). ■



Range	D_1	D_2	T	H	B	R	S
6–1¼M	8"	24"	3"	30"	9"	56"	
10–2M	12"	40"	4.5"	45"	15"	8'	
20–6M	20"	60"	8"	79"	23"	57"	1"
40–10M	38"	9'6"	12"	13'	33"	9'	2"
80–20M	5'10"	17'8"	26"	24'	6'8"	16'10"	3"
160–40M	13'	39'	4'9"	53'4"	14'8"	37'	9"

Fig. 1—Construction technique and dimensions for the v.h.f. Conical Monopole. Wires are connected to the mast at "X", and to the metallic "hoop" spreader at points "Y." The hoops must be securely grounded to the mast. Point "Z" is a collector ring connecting the bottom ends of the wires, and is insulated from ground. Dimension "S" in the table is the spacing between pairs of wires (used only on the low frequency model.) As many radials ("R") should be used as space permits.

*1055 College Ave. N.E. Grand Rapids, Michigan.

[1]Stroup, L. A., "The Conical Monopole," *CQ*, Jan. 1966, p. 59.

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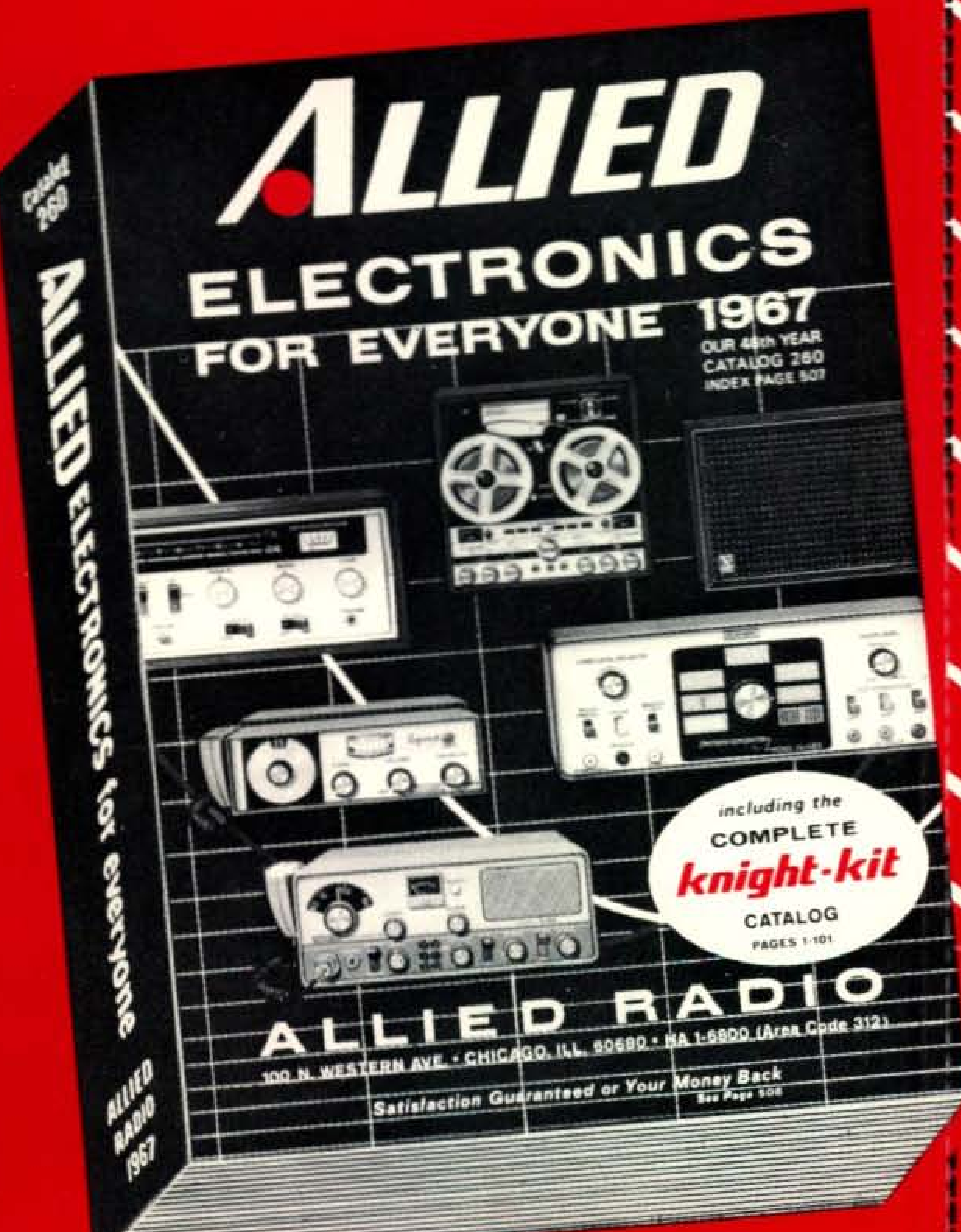

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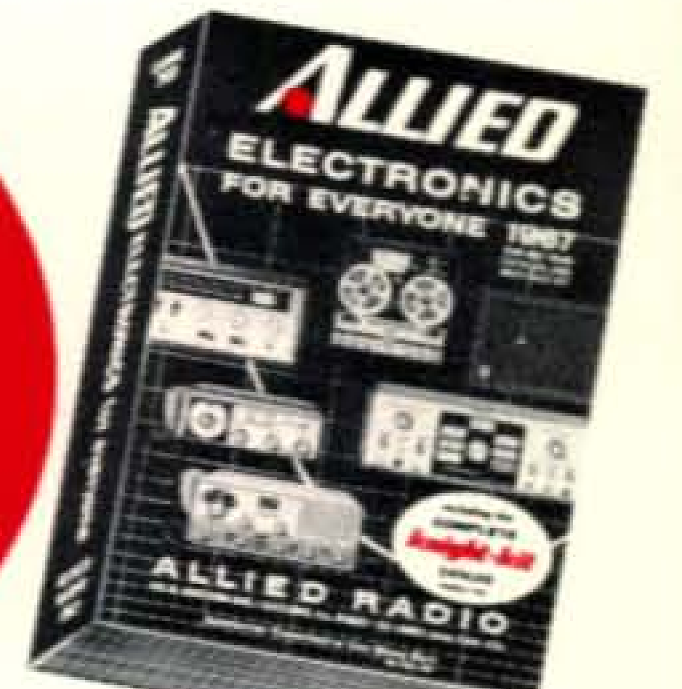

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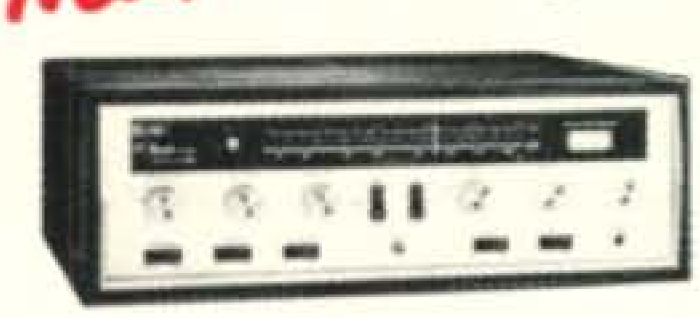

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Amateur Radio Hall of Fame Announced

An International Amateur Hall of Fame is being organized to provide permanent recognition of individual contributions made by hams around the world to the advancement of Amateur Radio.

Each year five amateurs will be honored by having their names and calls inscribed on a plaque to be displayed at the International Amateur Radio Club in Geneva, Switzerland. Each of the five will receive a replica of the plaque.

The five amateurs will be selected from nominees submitted by fellow amateurs from all parts of the world to a board of distinguished judges, themselves internationally known to the ham fraternity. Nominations are invited in the following fields: (a) Advancements in electronic techniques and equipments; (b) Traffic and DX activity; (c) Achievements in exotic phases of amateur radio; *i.e.*, moonbounce; OSCAR; space probes; (d) Emergency and disaster communications; (e) Development of amateur radio. Nominees may be any man or woman holding a radio amateur's license issued by a recognized authority in a member country of the I.T.U.

The Hallicrafters Company will provide the plaques and will donate advertising space for the announcements during the program.

Amateurs everywhere are invited to join in honoring those amateurs who have made significant contributions to the art in their respective fields by submitting their names, calls and a brief outline of accomplishment by December 31, 1966, to Dorothy Strauber, K2MGE, Secretary, International Amateur Radio Hall of Fame, 12 Elm Street, Lynbrook, N.Y. 11563.

Search On For "Miss Amateur Radio"

Amateurs in the ARRL Hudson Division are being asked to aid in the search for "Miss Amateur Radio" who will reign over the Hudson Amateur Radio Council convention October 15 and 16 at the Hilton Inn in Tarrytown, New York.

The qualifications are that she be a licensed amateur residing in the Hudson division, and be entered by a HARC member club. Miss Amateur Radio will receive free accommodations at the convention as well as free transportation to Tarrytown, N.Y. Flowers, an engraved plaque, and $100 towards a wardrobe will help make her time a bit more pleasant. Judges will be HARC officers.

Nominations, including a photo, name, address, age, and class of license should be sent to Stan Zak, K2SJO, Convention Chairman, 13 Jennifer Lane, Port Chester, N.Y., before Sept. 15, 1966.

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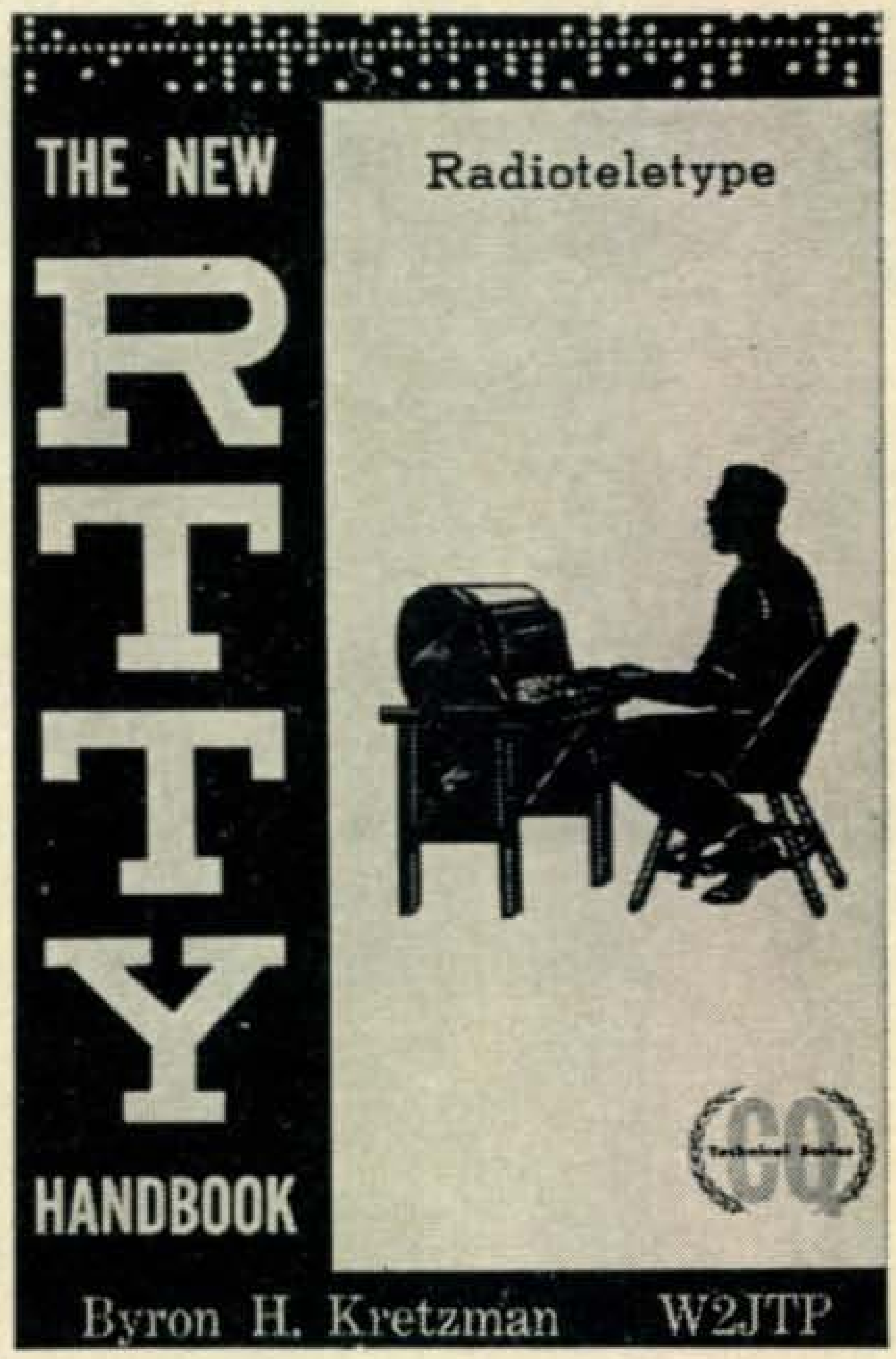

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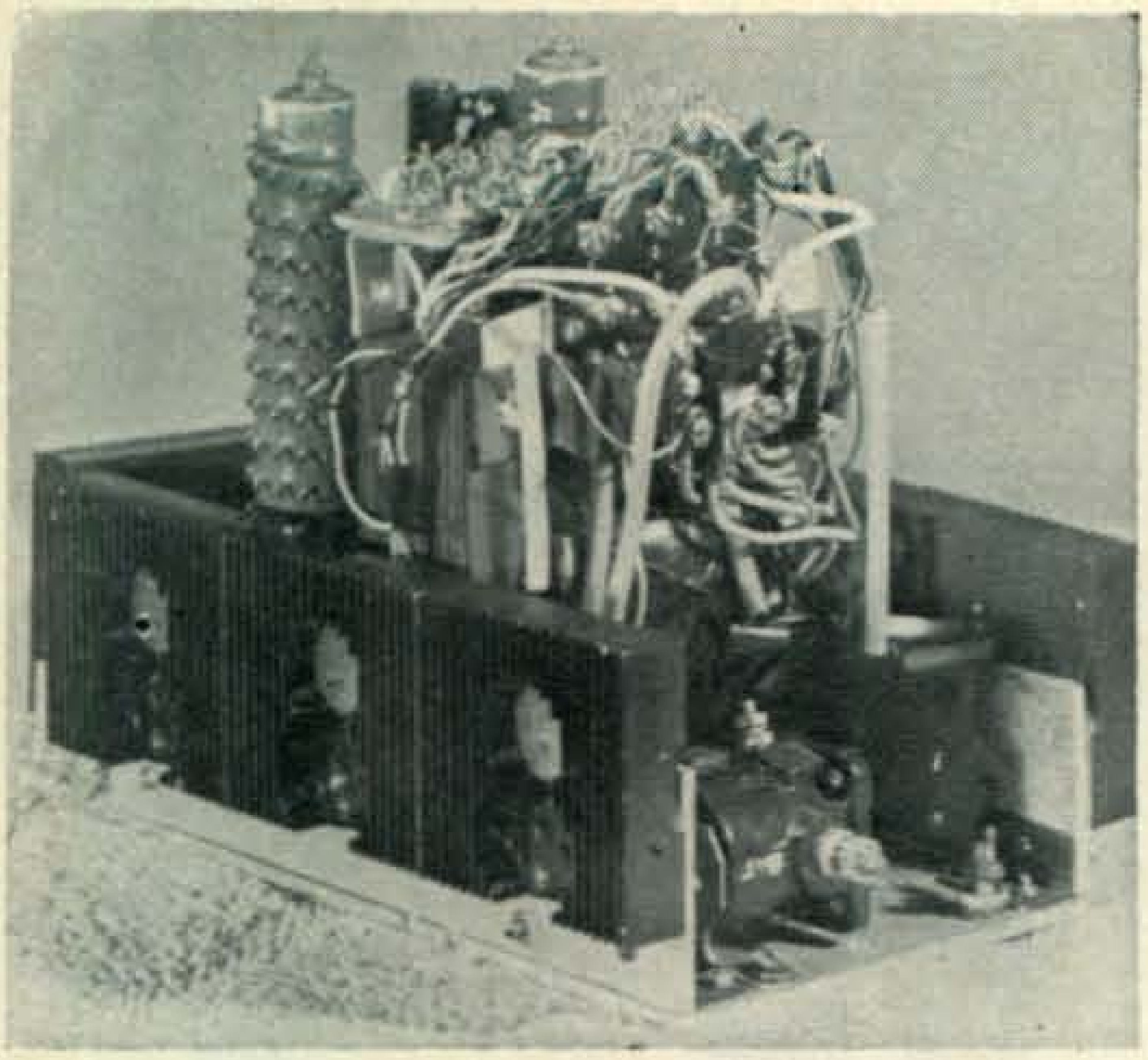

Three quarter view of the kilowatt inverter. The transistors are mounted on the heat sinks around the chassis perimeter. The 0.1 ohm resistors are mounted atop the transformer and the starter relay can be seen bolted to the bottom plate.

A ONE KW INVERTER

BY COL. FREDERICK L. MOORE,* W6RTD

This inverter provides slightly more than one kilowatt of power at 117 v.a.c. for a d.c. input 12 volts. Using the inverter to operate a linear, mobile has enabled the author to cut through the QRM with ease.

If life is getting dull, you haven't built anything for a long while, trasistors are somewhat mysterious to you, and you have never gone *high power mobile*—read on.

Completing this project will change all of the above. In the process you will learn about transsistors and transformers and find several new wrinkles in adapting to 100 ampere currents, hysteresis losses, and above all, low cost. Similar commercial power supplies go for $250 plus. The one described here cost all of $12.50, plus tax, plus junk box. The principles followed in designing this unit may be modified to meet other requirements you may have. The idea is to power the plate transformer of a 1.2 kw 117 v.a.c. s.s.b. linear from the 12 volts d.c. available in the average passenger car.

There are many articles and circuits on transistorized inverters, but no amount of digging produced a simple solution to 1.2 kw power levels desired. Also there were the inevitable discussions on toroids, fast switching rates and high efficiency of transistors. It was decided to build an inverter as simply as possible and see what would result in spite of dire forebodings of dead batteries and heat problems. Several different circuits were tried with the one shown taking the honors for simplicity, size, and ease of construction. It starts reliably while working into an idling plate supply d.c. load of 300 watts.

The entire unit is mounted on a flat base of aluminum panel, ¼" × 7" × 10". Although the heat sinks came from some demolished surplus, the four paralleled transistors on each side of the primary winding could be mounted on a sheet of aluminum 7" × 10" and bolted vertically on each side to the base.

*730 Osceola Circle, Elgin AFB, Florida 32542.

The relay for handling the 100 amp d.c. current is an automobile starter relay. Its solenoid requires 3 amps at 12 volts. Although a relay with less current drain could be obtained, this was cheap and did the job.

Transformer Core

Since the transformer is the principle item, let's start the calculations, apply some common sense and see what we come up with. The design was to power the plate-bias-screen transformer of an SB-1LA linear amplifier rated at 1.2 kw peak at 117 v.a.c. sine wave.

The first step is to compute the transformer cross section core area which is determined by the frequency of switching and wattage required.

$$\text{Area in in.}^2 = \frac{\sqrt{\text{Watts}}}{5.58} \times \sqrt{\frac{60}{f \text{ in cycles}}}$$

At this point the whole plan seemed to get difficult. Toroids aren't easy to obtain, and besides one hears much about switching rates of 1000 cycles plus, which are useless in driving a normal 60 cycle rated plate transformer. So throwing caution to the winds, it was decided to use an ordinary transformer and not worry about core losses. One important decision was made though, to use around 200 instead of 60 cycles as the switching rate thereby reducing the required core area and weight just about one-half. Most 60 cycle transformers will handle 200 cycles with reasonable efficiency. This also helps prevent square wave saturation of the plate transformer. The core on hand was two inches across and totaled 4.16 square inches of core area. On the slide rule this calculates as a 1600 watt transformer, more than is needed.

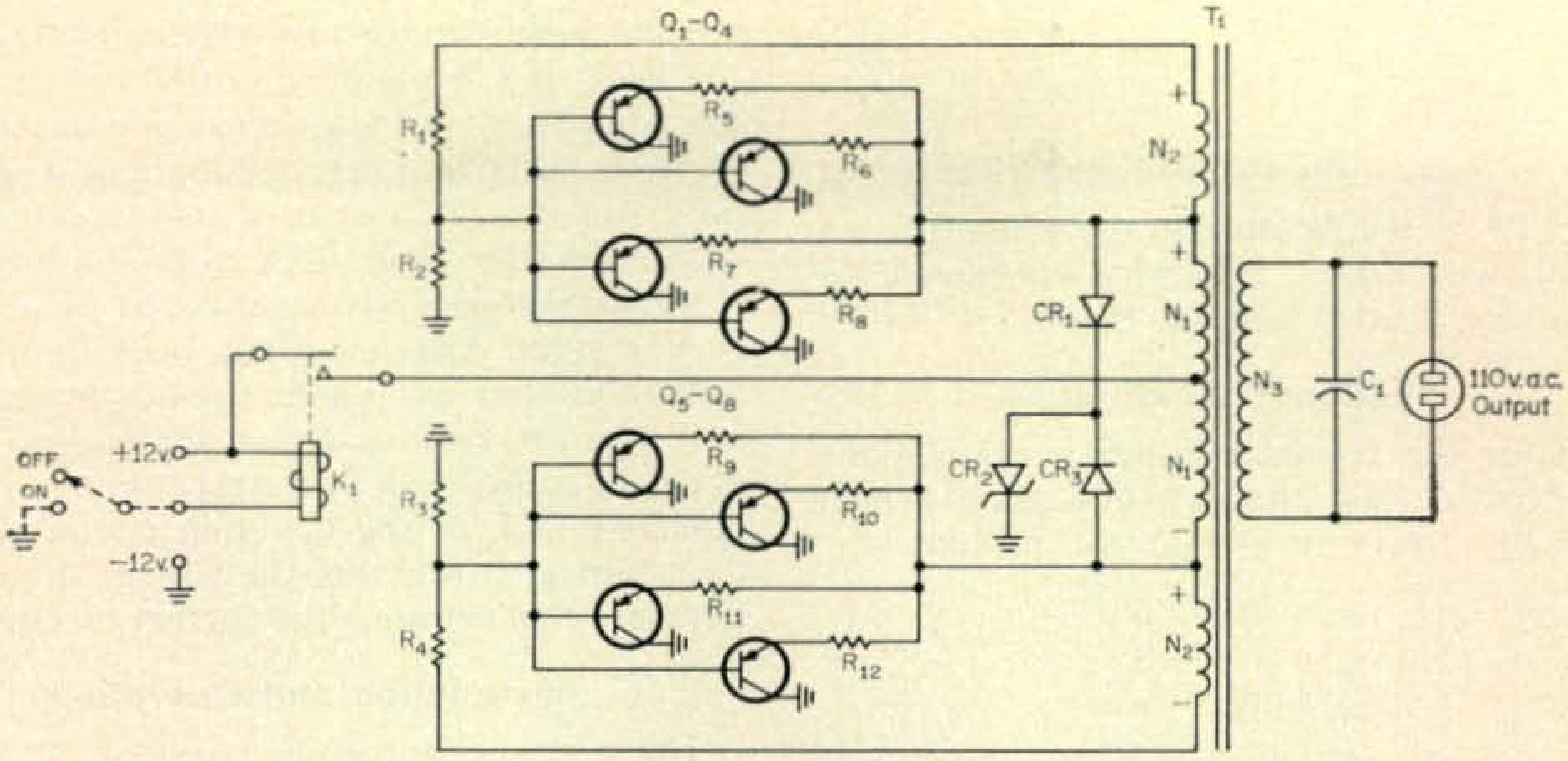

Fig. 1—Circuit of a 12 v.d.c. to 117 v.a.c. kilowatt inverter.

C_1—0.1 mf 600 v.
CR_1, CR_3—750 ma, 400 p.i.v. diodes.
CR_2—37 volt 10 watt Zener diode.
K_1—12 volt automobile starter relay.
Q_1 to Q_8—2N173 or similar p.n.p. type transistor.
R_1, R_4—2.2 to 3 ohm, 50 watts.
R_2-R_3—125 ohms, 10 watts.
R_5 to R_{12}—0.1 ohms, See text.
T_1—4.16" square core.
N_1—8t dual #8 s.c.
N_2—11t #18 enam.
N_3—107t #14 enam.

Primary Winding

The next step is to compute the number of turns for one side of the primary which can be figured from this formula:

$$N = \frac{e \cdot 10^5}{25\,BAF}$$

where e = voltage input (d.c.).
A = flux density at saturation in kilogauss.
B = area of core in square inches.
F = frequency of switching.

The A factor was a sticker; Silectron, Orthonal, Hipernik V and other exotic core materials have a saturation flux density of 14-16 kilogauss. Available was the heavy duty core form, characteristic unknown, but obviously of 1943 vintage. So a figure of 8 kilogauss for "B" was chosen as an educated guess.

Now, N calculates to be 7.3 turns each side of center on the primary. If we use 8 turns as an even figure, the only effect will be to reduce the rate of switching slightly.

Wire Size

Now let's look at the current drain and compute size of wire needed. If an efficiency of 90% for our transformer is assumed, then:

1200 watts peak × 1.10 = 12 (volts) × amperes
Amperes required = 110 peak amperes

Looking at the wire tables in any handbook, we see that #8 copper will handle 23.6 amps at 750 circular mils per amp. Transformers for intermittent service use as low as 250 circular mils/amp. Also, since each leg of the primary only carries ½ the average power input, we can satisfy the wire size requirements with parallel #8 wire giving a very conservative and husky winding. A visit to the local electric motor rewinding shop produced 40 feet of #8 silk-covered wire.

Rather than go into the mechanics of explaining how to wind a transformer, you are referred to an excellent article in the March *CQ*[1]. However, the bifilar winding technique is important, so follow the description closely. Cut the 40 feet of #8 into four equal lengths. Mark both ends of two of them alike, the ends of the other two with a different mark. Wind the four wires simultaneously and parallel on the core form for 8 turns. To obtain the center tap of the winding, connect the *start* of two alike wires to the *end* of the other two wires. This is the center tap. You now have 16 turns center tapped with good electrical balance.

Secondary Winding

The secondary winding comes next and here is an unexpected wrinkle. The square wave generated in a transistor inverter has for all practical purposes an r.m.s. equal to the peak voltage. If we provide turns ratio to produce a 110 v.a.c. square wave output from our 12 volts of ½ primary input, to drive a plate transformer power supply designed for 110 v.a.c. sine wave, we will be somewhat disappointed in the d.c. voltage we obtain. The turns ratio of a sine wave transformer is calculated on *peak* relationship. The 110 v.a.c. rms from the house power system socket has a peak voltage of 154 volts. Therefore, to derive the same output peak voltage (square wave) from this transformer as we obtain from sine wave, we must have 154 volts out of the inverter. So, the number of turns in the secondary are computed:

$$N_{sec} = N\text{pri}\frac{E\text{ out}}{E\text{ in}} \times 1.05$$

[1] Sherred, Lyall. "Rewinding Old Transformers", *CQ*, March 1966, p. 63.

$$N_{sec} = 8 \cdot \frac{154}{12} \times 1.05$$

$$N_{sec} = 107 \text{ turns}$$

where 1.05 = the *IR* drop in the windings
From the wire tables, #14 wire will handle the approximate 8 amps output. Better get 100′.

Feedback Windings

Now for the feedback winding calculations. As a general rule this winding should have around 30% more turns than the primary—

$$N_{fb} = 1.30 \cdot N_p$$
$$N_{fb} = 1.30 \cdot 8$$
$$N_{fb} = 10.4 \text{ turns}$$

Eleven turns will do for each winding and again we use the bifilar winding method. Use most any size wire you choose but #18 will do nicely as the current load is not heavy. In this case, however, a center tap is not used. Mark the polarity at the start of one wire "plus," the start of the other "Minus." On the finish end mark the reverse. This will help sort out the polarity of feedback if the inverter does not oscillate. Wind 11 turns and assemble the transformer.

The Inverter Construction

The inverter circuit shown in fig. 1 uses eight inexpensive transistors. The transistors, as well as zener diodes, are on sale at most big name parts house bargain counters. Get the 40 watt, p.n.p. germanium types which are equal to 2N173, 2N441, 2N442, 2N1099, 2N1100, 2N278 and use the TO-36 base. Get a few extras; at 88¢ they are cheap. The four-paralleled transistors provide a 60 amp steady state rating. Although they must switch the 110 amp calculated current, four will do the job if you are somewhat judicious about tuning periods and use speech only on s.s.b. As a general rule, a pair of transistors will switch 20 times the Class A power dissipation ratings of one transistor.

Heat sinking for the transistors is a *must*. The rated amperage can even be exceeded on peaks provided a good heat sink is used to dissipate generated heat. Although elaborate heat sinks are shown, the transistors should operate perfectly well if bolted to the aluminum sheet. No insulation is needed as the circuit is the grounded collector variety. Thickness of the sheet is not too important but area is. After operation over a 3 hour period in the trunk of the car, the transistor mounts were only perceptibly warm.

The 37 volt zener diode and the two 750 ma diodes are necessary for spike suppression on the 40 volt transistors. Also, the 0.1 capacitor across the 154 volt square wave output will help reduce spiking. Observe polarity and bolt the zener in a location suitable for a heat sink.

The eight 0.1 ohm resistors are made from heavy duty nichrome wire and serve to equalize the current distribution through the paralleled transistors. The 2.2 to 3 ohm resistors in the feedback circuit carry about four amperes so use the high wattage resistors indicated.

Check the hookup carefully before putting the power to it. A loose connection at the wrong place means a ruined transistor. For a start, use only 1 or 2 transistors on a side to determine if oscillation starts and check without a load. Then if something goes wrong, the cost of a mistake isn't so great. After checkout, hook up the other transistors and test under various loads.

If you are curious about amperages, do not insert an ammeter in the transistor circuitry. The inductive kick of the metering circuit can ruin the transistors. Measure the voltage drop across a resistor and compute the current by Ohms law.

Installation and Operation

The peak d.c. amperage required can be over 100 amps. There should be a hard source of d.c. Therefore, location of the inverter in relation to the car battery is important. A battery cable length of over three feet will begin to spoil the voltage regulation. In this installation, a second battery in the trunk, paralleled to the car battery, did the job well.

The car generator is rated at 40 amps maximum output. Under receive conditions the SB-33 transceiver takes 4 amps, the SB-1LA filaments draw 3 amps for a total of 7 amps. In transmit, key down, no speech, the SB-33 draws 8 amps, the SB-1LA filaments draw 3 amps; the idling current of the inverter is 19 amps for a total of 30 amperes. Under dynamic speech conditions, the car generator goes to 40 ampere charge and is held there by the voltage regulator. On completion of a 2-3 minute transmission, there is about a 2 minute charge period at 40 amps when the regulator starts pulling back the charge rate. So far, after 50 hours of operation, the same generator is still operating and no trouble is anticipated.

Do not power a filament transformer with this inverter as the voltage output will be excessive in this use. Run the filaments direct from the d.c. source.

Tune up at low power, then switch to high power for speech only. A steady load at 1 kw may overload the transistors or the oscillation rate may go out of control. With the stabilizing influence of the d.c. high voltage capacitors in the linear, the inverter will do a good job and maintain voltage stability very comparable to 110 v.a.c. sine wave operation.

In the final analysis and in spite of all the unknown factors that were hard to guess in the design, the inverter switches at 200 cycles, hums quietly but with a substantial effect on the mobile signal output. Weekend QSO's on the 20 meter band are a cinch. ■

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UNDERSTANDING

Field Effect Transistors

BY HARRY R. HYDER,* K7HQN

Part I

Presented below is Part I of a three part article on the theory and operation of field effect transistors, the fet. This first installment covers basic semiconductor theory, fet principles and construction.

ALTHOUGH the transistor has been generally available for about fifteen years, and in that time has developed from an expensive, fragile, low frequency device into an inexpensive, reliable, high frequency device, most equipment built at home by amateurs continues to use tubes.

There are many reasons for this. A vacuum tube circuit can be made to work, after a fashion, with little expenditure of design effort. If the heater continues to glow warmly, and the other elements do not run red, the experimenter is fairly safe, although performance may be far from optimum. But transistors look the same whether they are alive or dead, and many an amateur has wound up with a handful of burned out transistors without ever finding out what he did wrong. A vacuum tube's data sheet is a marvel of simplicity compared to that of a transistor. A tube's maximum ratings have a great deal of forgiveness; a transistor's almost none. The transconductance of a vacuum tube is held to fairly close limits by the manufacturer; the current amplification factor of a transistor may have production limits of five to one. The characteristics of a transistor are highly dependent on temperature, and it has feedback mechanisms unknown to tubes. The low input and output impedances of transistors complicate the design of narrow-band amplifiers, and so on.

But transistors are here to stay, and with good reason. All of the seeming disadvantages enumerated above can be overcome by good design, and the transistor's overwhelming advantages of efficiency and unlimited life *should* make them much more popular with amateurs than they appear to be.

The unipolar field effect transistor (fet) may be the stimulus necessary to popularize semiconductors with hams. For here we have a transistor that in many respects acts like an old-fashioned vacuum tube. But in other respects it does not act like a tube at all. The purpose of this article is to describe the fet and its characteristics, its virtues and limitations, and its application to practical circuits.

History and General Characteristics

The modern field effect transistor was first described by Shockley in 1948, but the basic idea is much older. It remained in the laboratory until about 1960, when semiconductor manufacturing techniques had reached a state of development that permitted practical devices to be put on the market. These first commercial fet's were low frequency amplifiers, and quite expensive. Since that time, development has been rapid, and fet's are now available that provide good gain at frequencies as high as 500 mc, and by the time this appears in print, the figure may be higher. The trend in prices has been downward, and before long they should be in the same class as conventional transistors.

The chief virtues of the fet are:

1. Very high input impedance.
2. High output impedance.
3. Low noise.

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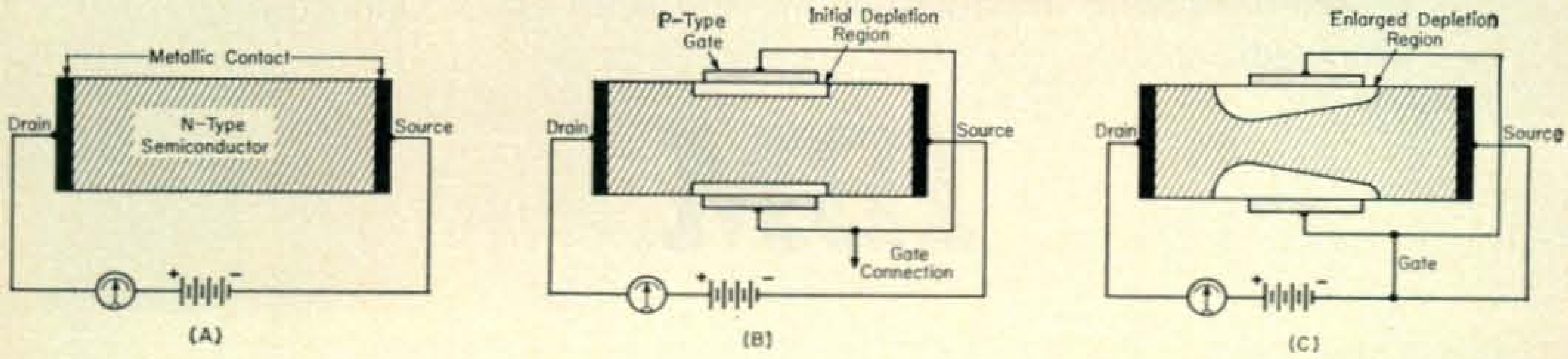


Fig. 1 (A)—A bar of N type semiconductor material forms the channel for the fet and acts as a poor conductor. (B) The addition of two facing P type sections creates a "gate" around which a depletion region is formed. (C) Biasing the gate enlarges the depletion region reducing the cross-sectional area.

4. Low distortion and cross-modulation.
5. Few inherent limitations of frequency or power.

The only apparent disadvantages of the fet are the dependence of its characteristics on temperature, similar to, but not as severe as with transistors, and a relatively high capacitance between its input and output terminals. The effects of the former can be easily minimized by proper circuit design. The latter will necessitate neutralization of tuned amplifiers, or the use of a special circuit such as the "cascode."

There are several kinds of fet. The most common type today is the junction fet, and the bulk of this article will deal with it, as it is the least expensive and the type most likely to be useful to amateurs. Other types, generally called surface fet's, will be described briefly in a later section.

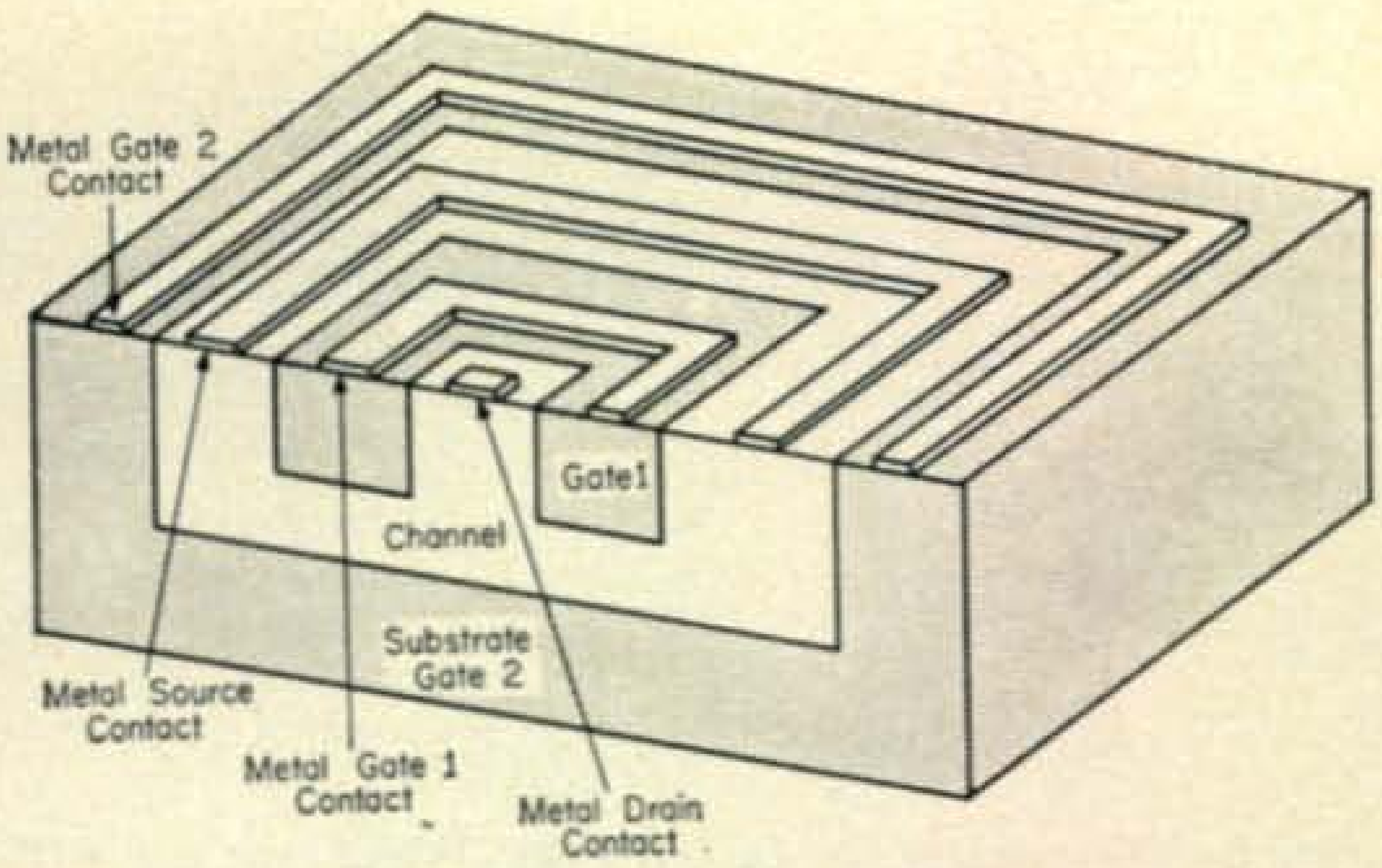


Fig. 2—Cross section view of a typical junction fet structure. The substrate, the first layer upon which the rest of the transistor is built, forms gate two.

Basic Semiconductor Theory

A semiconductor is a material of low conductivity. The two most commonly used semiconductor materials are germanium and silicon. These are called "Group 4" semiconductors, because each of their atoms has four "valence," or loosely-bound outer orbit electrons.

In a crystal of pure germanium or silicon, the valence electrons of all the atoms will be locked in a symmetrical arrangement. Occasionally, due to heat, electrons will shift from one atom to another, and their places taken by other electrons. But essentially there will be no free current carriers; the resistivity of the material will be high.

To make silicon or germanium useful for transistors or diodes, the materials must be "doped"; the crystal lattice arrangement must be modified by the addition of small amounts of certain impurities. In effect, the symmetry of the structure must be destroyed. If the doping agent is a Group 5 material (arsenic, antimony, boron, *etc.*), each atom of which has five valence electrons, there will be present in the crystal free electrons that can be easily moved by an externally applied electric field. Since electrons are negative charges, a material so doped is an "N" semiconductor.

If the doping agent is a Group 3 material (aluminum, gallium, indium, *etc.*), each atom of which possesses three valence electrons, there will figuratively be more possible places for an electron to be than there are electrons to go around. The temporarily vacant position is called a "hole," and it can be viewed as a positive charge. The hole is free to move as is an electron, since when an electron fills the hole, the hole has, in effect, moved to the atom that the electron came from. Such a material is a "P" semiconductor; the holes are the current carriers.

The crystal as a whole, though, is electrically neutral. It has no charge. Viewing it as a whole, there are exactly as many electrons as there should be for each atom in the crystal. Some of them have just been loosened up a little.

If a battery is placed across a piece of N semiconductor, the free electrons will move toward the positive end, and electrons will flow into the N material from the negative end of the battery to replace them, one for one.

But what happens when a battery is connected across a piece of P semiconductor, where the carriers are holes? Holes can not flow in the external circuit like the electrons did; there is no such thing as hole conduction in ordinary metals. Here is what happens: the holes, which are positive charges, flow toward the negative terminal. When they get there, they are filled by electrons entering from the external circuit; they disappear. This leaves a deficiency of electrons in the external circuit that can be corrected only by electrons flowing from the positive end of the bar into the battery. This obviously creates new holes at that end, which flow toward the negative end as before.

There is no favored direction of current flow in a semiconductor. The battery can be reversed, the electrons will always flow toward the positive end and the holes toward the negative end.

The electrons in N semiconductors and the holes in P semiconductors are called the majority carriers. However, there are always present a relatively few carriers of the opposite type; these are called minority carriers. "Bipolar" transistors make use of both types of carriers; hence the name. Fet's are called "unipolar" transistors because they depend only on majority carrier conduction. The effect of minority carriers in fet's is to cause undesired leakage currents, and every attempt is made to minimize them.

The action of diodes and bipolar transistors is based critically on conduction across junctions of P and N types of semiconductor material. This is not a factor in normal operation of fet's and will not be discussed here.

FET Construction and Operation

The best way to understand fet operation is to construct one in our imagination. Let's take a bar of N semiconductor and call it a "channel." It could just as well be P type, but it will be less confusing if we stick to one type for the present.

If we connect a battery across the ends of the bar, as in fig. 1(A), free electrons will flow from negative to positive. So far, we have nothing but a resistor. Now suppose that midway down

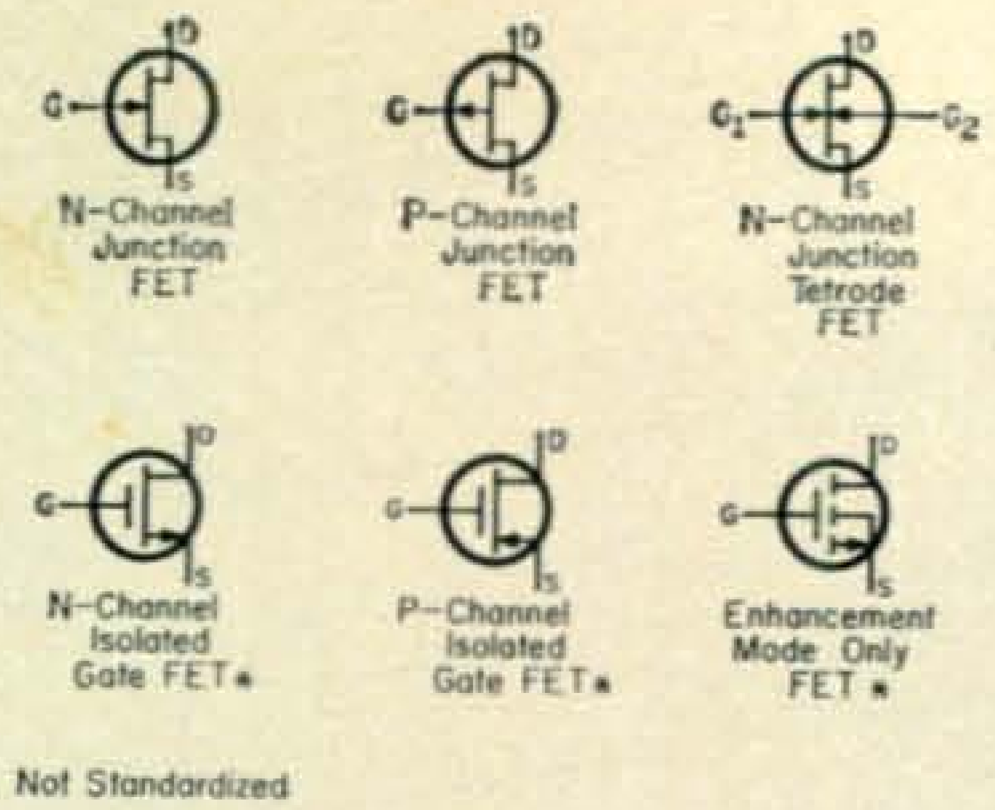


Fig. 3—Fet symbols in current use. Those marked with an asterisk are not standardized.

the channel we join two small pieces of P semiconductor material, as in fig. 1(B). What have we done? As far as the channel current goes, we have done nothing; current continues to flow as well or as poorly as before. But right at the junction, a subtle change has taken place. Some of the free electrons in the N channel have filled some of the holes in the P regions. Therefore, right at the junction, there is a symmetrical crystal structure, which forms a barrier and prevents any further combinations of holes and electrons. On either side of the junction, there is a small area devoid of free carriers; this is called a "depletion" region.

Let's call the negative end of the channel the "source" and the positive end the "drain" (these would be reversed if we had a P channel). And we will connect together the small P regions midway down the channel and call them the "gate."

If we connect the gate to the source, while observing the channel current on a meter, we will see that the channel current drops sharply. In some way, the gate is controlling the channel current, even though the gate itself is not drawing current. In fact, the gate is now reverse biased. Why the PN junction we have named the gate is reverse biased may not be immediately apparent, but let us look at it this way: there is a voltage gradient along the channel. If there are ten volts across the channel, and the gate is midway down the channel, the gate is at +5 volts with respect to the source. Therefore, the gate terminal, which we connected to the source, is at −5 volts with respect to the channel side of the gate. And, of course, a reverse biased PN junction does not conduct current, except for a small leakage current, which plays no desirable part in fet operation.

When the gate was first connected to the source, current tried to flow. Holes in the P gate flowed toward the gate terminal, but could go no farther because there were no holes in the N channel to cross the junction and take their place, and current flows only when there is a continuous flow of carriers through the entire circuit. Similarly, in the channel, electrons rushed away from the junction, but were stopped because there were no free electrons in the P gate to cross the junction and replace them. But one very significant thing has happened: the rush of electrons away from the junction has left the region of the channel near the gate completely *free* of carriers. The depletion region, originally formed by the PN junction and quite small, has become greatly enlarged. This is shown in fig. 1C. A depletion region, free of carriers, has very low conductivity, so the actual effect of the enlarged depletion region has been to reduce the effective cross-section of the channel, increasing its resistance, and reducing the channel current. The extent to which the depletion region extends into the channel is proportional to the junction reverse bias. Therefore, by controlling the gate voltage, we can control the channel current.

It will be noticed in fig. 1C that the depletion region is skewed toward the drain end of the channel. The reason for this is obvious: because of the voltage gradient along the channel, the part of the gate nearest the drain has a higher reverse bias than the end near the source. The depletion region at the drain end will therefore extend farther into the channel.

The reverse bias on the gate can be made high enough to cut off the channel current completely, except for leakage current. The channel current can not be cut off, however, merely by connecting the gate to the source and increasing the drain-to-source voltage, for the same reason that you can't cut off a tube's plate current with cathode bias. But the resistance of the channel between gate and source is a sort of built-in cathode bias, and tends to make the fet a constant-current device, something like a pentode. The "dynamic resistance" of the fet is quite high.

One more thing. The movement of carriers away from or toward the junction as the gate voltage is varied is called a "displacement current," and is exactly the same as the current that flows in a capacitor. In fact, the gate-channel junction *is* a capacitor.

To the best of my knowledge, there is no commercial fet that actually looks like our simple model. But it is a good model for explaining principles of operation. An actual fet physical configuration is shown in fig. 2. At first glance it may not look much like the model, but if you study it for a minute you will see the resemblance. Sometimes the second half of the gate is brought out to a separate terminal; we then have a tetrode fet. The two gates can be used as individual control elements, or connected together for greater control of channel current. At high frequencies, the second gate might be grounded, to reduce the input capacitance.

Our simple model fet was symmetrical; source and drain terminals could be interchanged without affecting operation. Many commercial fet's are completely symmetrical, and all are to some degree. But many have a favored usage based on internal geometry. When in doubt, follow the terminal markings.

Some of the symbols currently used for fet's are shown in fig. 3.

[*To be continued*]

Superior Antenna Wax and Ethereal Glue!

BY RAY SWINDERMAN,* KP4AMI

Those of you who remember the author's fabled sojourn on an idyllic south sea island immediately after World War II are aware of some of the incredible developments in the state of the art as a result of fantastic concentration upon pure research at that time. This account details two completely new developments never before disclosed. One of these was almost a corrollary of the other.

After developing the RPHTSSR and incorporating the IPS[1] as a last minute safety factor we surveyed our flexible cone variable selectivity loud speaker perched proudly on top of the receiver and realized we had just about milked dry the possibility of improvements in the receiving part of the circuit.

The next field to survey was antennas and the improvements possible here seemed infinite. Obviously, all we needed was a consistent increase in the efficiency of our antenna system to give us unlimited radiated power while still staying comfortably within the input limits established by Uncle.

Back to the drawing board. Geometric design and spacing has always been the field of eager seekers after the great gain god. It seemed to us that this overlooked completely the character of the individual radiator. This most important part of the antenna system could be the key. Thumbing through our mental notebook for a likely angle of attack, we hit upon the idea of increasing the actual emitted signal from a given radiator by interposing an intermediate media which would have the effect of encouraging the signal to depart from the radiator. Something to minimize that intermediary friction might well be the answer. Out came the Chemical handbook—our most recent copy of Encyclopedia Britannica—a copy of the Radio Amateur Handbook (pre-war model) and an ancient voodoo witch doctors tome we had unearthed in the island's jungle fastnesses.

Poring over this formidable array of knowledge yielded a likely formula. When the ingredients were properly mixed and the compound stood ready for use, it was a rather unprepossessing mess. Pasty white and jelled it looked for all the world like a cross between a bowl of solidified gelatin and parawax.

Now to determine the best method of using this product. A few hours work with a bit of advanced mathematics quickly showed that this should be applied in a rather thin but not particularly uniform coating directly to the elements of the antenna.

It so happened that we had two identical rhombics up beamed toward the old home town. One of these we lowered and coated with the new product. The other stayed in place in its original form.

Trial Run

Then to the shack! Firing up the rig we carefully racked across the band listening for a likely signal. Not much luck—the band seemed dead. Oh well, a short CQ never hurt anybody. Came a stand by and the band exploded into a fury of activity. Three thousand, give or take several hundred, stations were on frequency calling like mad.

We waited for the storm to subside; picked out one of the signals and began a contact. Fantastic! We were running to the limit of the S meter on a dead band. Might as well try a little reduced power. Off went the linear and our two 6V6's still bent the pin on his meter. Back went the Variac until we were apparently showing no emitted power and we still pinned the needle on his meter. Must be skip, I reasoned and asked him to note the difference in signal strength with the other rhombic. We flipped the switch—gave him a transmission and then went back to him on the original antenna. Absolutely no copy with the other rhombic. Well this proved something, so we decided to try it full bore with the untreated rhombic. No dice. Switching back and

*Box 717, Guayama, Puerto Rico.

[1]Swinderman, R. W., "The RPHTSSR," *CQ*, May 1966, p. 29.

forth between the two rhombics showed that the treated rhombic put a stronger signal into the states every time. Running QRP it still outperformed the untreated one hooked to a full gallon input.

Fine business!! The Superior Antenna Wax was functioning perfectly. The signal was slipping off the radiator into the ether so smoothly that we were approaching infinite gain from the antenna system. What a happy development! Needless to say, we now enjoyed ideal operating conditions. The output from our QRP transmitter, was being boosted infinitely and legally. The RPHTSSR on the receiving end really kept things coming our way.

Retardation

However, life is short and man is discontented. Our restless mind again began searching for some way of improving our set-up or utilizing the developments we had already made to an even greater degree. Back to the board! Additional thinking and coldly calculated planning made us realize that if it was possible to enhance the ability of a radiator to transfer a signal to the ether it should also be possible to retard this same function.

A sally into optics showed us an allied principle in the transmission of light. *Index of refraction*. Ha—That was it! What we needed was a media with an index of emmission that could be controlled. Back into the pure research phase of development.

Out came the musty tomes and other rudimentary source data. This was beginning to be duck soup. In no time we had a formula and a method of use calculated. Now for the acid test. We whipped up a batch of the goo and this came out looking surprisingly like common flour and water paste.

Rechecking our calculations for the method of application we were not too surprised to find that this material should also be applied in a thin but not necessarily uniform coating. Devising a test for the new product was easy. We simply applied the new material to 180 degrees of a vertical six inch tube we had been using as a radiator; the other 180 degrees of the vertical tube we coated with Superior Antenna Wax. Since the vertical radiator was mounted on an old prop pitch motor, rotating the radiator was no problem.

Listening on the band quickly told us that when the Superor Antenna Wax coated side was toward the signal we had a super gain highly directional antenna. 180 degree rotation to put the new product toward the signal resulted in an absolute blackout. Making some front to back measurements, we found that the gain went from infinity on the front or wax coated side to 0 on the reverse side coated with the new product. Now we needed a name and realizing the function of the new material was simply to slow down or trap and turn back electrons we decided to call it some sort of glue after its appearance. Because of its nature the name Ethereal Glue seemed appropriate.

We tried coating various size radiators with the two materials and found that we could get a true beam effect with a single number 18 wire quite easily. Since antenna gain was no longer a problem and we were mostly interested in directivity, we utilized an interplay of the two products to workup some miniature Yagis which we mounted directly on top of the receiver and transmitter. These out performed the eight wave length rhombics we had been using up to this time.

The next development came from re-surveying the characteristics of the two products. Superior Antenna Wax had a super emissive effect and Ethereal Glue a super reflective and absorptive effect. Combinations of the two should be usable for many purposes in hamdom.

The abacus showed that these two materials would respond to a variation in an electromagnetic field by effectively varying their resistance and conductivity. It followed then that the resonance of a feed line and an antenna could be made infinitely variable.

I combined the two ingredients according to the formula indicated and coated the little Yagis sitting on top of the equipment with this material. Sure enough! As soon as we pumped in a signal of a given wave length the antenna's electrical length adjusted so that it was automatically in resonance at that frequency. By the same token, when the RPHTSSR was dragging in a signal the same phenomenon occurred. Here we had at hand the ultimate! An auto tuned antenna with infinite gain, flatly resonant across the entire spectrum, and small enough to look well sitting on top of the rig.

Disaster

We stepped back and proudly surveyed the peak of perfection in ham equipment. Just then typhoon Gerty came roaring over the island. She flattened the shack, dispersed the equipment, lost the formulas and took me back in fifteen seconds to the stone age method of signaling with fire and panels for assistance from a passing plane.

Moral of this story: *Man in his most advanced civilization is still only one step away from the jungle.* ■

← Controls at the top of the panel are Band Switch and Plate Tuning. At the bottom are the filament and plate ON-OFF switches, with the meter switch and Plate Loading control at the right.

A DESK TOP KW LINEAR

BY JOHN M. PORTER M.D.,*
WA4EII

Here's a particularly neat packaging job on a full kw linear amplifier, complete with power supply. The amplifier is styled to match the popular Hallicrafters HT-37 s.s.b. exciter/transmitter. Covering 10 through 80 meters, it is easily driven to full the legal limit with under 100 watts.

In the past several years, especially with the surge of interest in single sideband operation, many amateur operators have expressed the desire to build a kilowatt linear amplifier. A number of high power final tubes have been readily available on both the surplus and the second hand market for very reasonable prices, but the complexity and the cost of components in the available linear circuit diagrams have discouraged many interested would-be builders.

With a pair of final tubes, 4-400A's, jealously in hand, numerous articles on amplifier construction and circuit diagrams were carefully examined. It became apparent that for the various reasons of size, complexity, and expense none of these would suffice unmodified. Long before the final circuit or even the class of final amplifier was decided upon, the following requirements were established:

1. The unit had to be capable of 1 kw key down input and had to be desk-top in size with a self-contained power supply.

2. The circuit had to be straightforward and simple enough to be constructed by anyone with a limited fund of electrical knowledge and a very limited amount of test equipment.

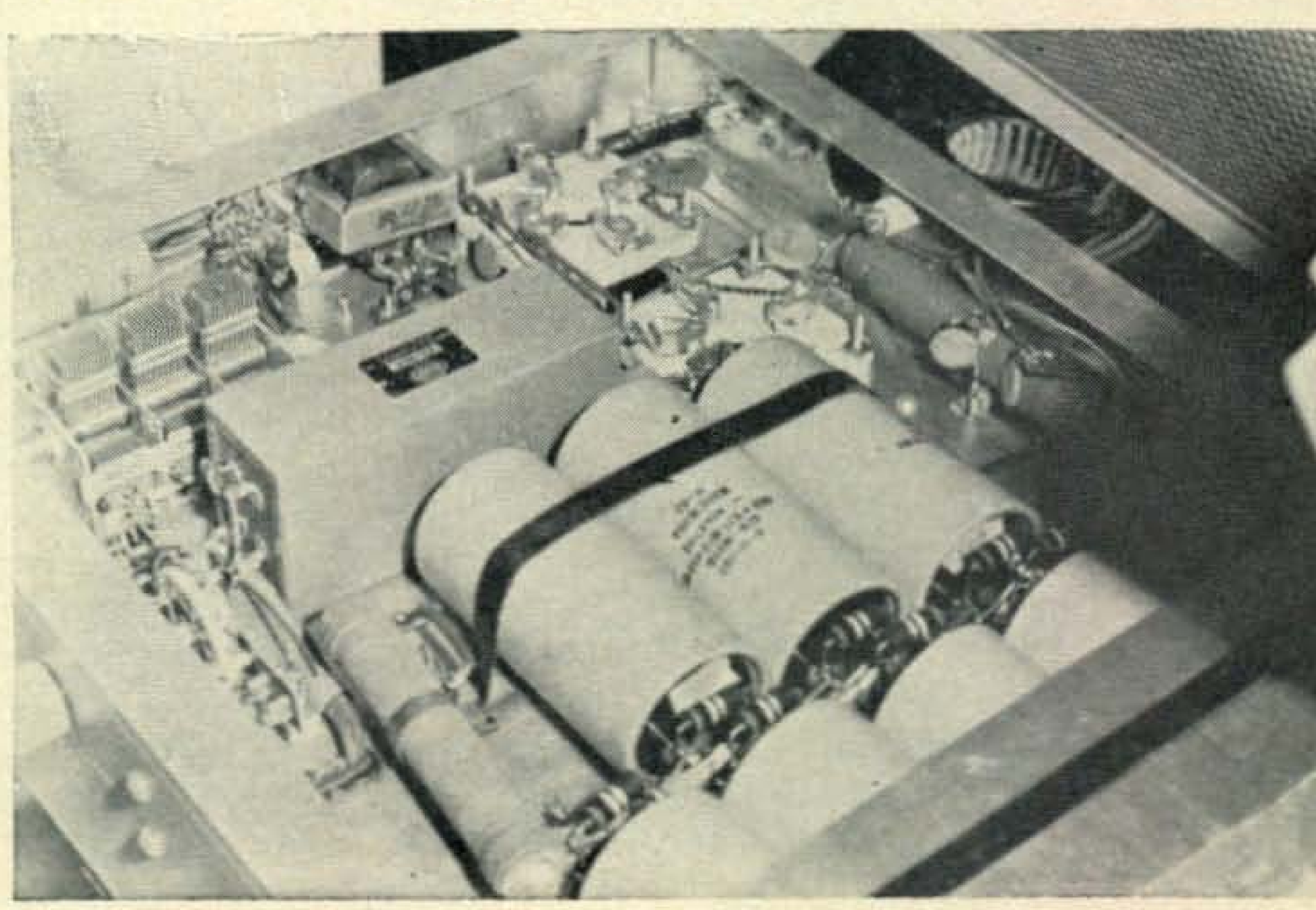
3. The components all had to be readily available and inexpensive.

The available amateur radio literature does not contain any description of a linear amplifier built around one or two final amplifier tubes fulfilling the above criteria. Several excellent articles are available on high power final amplifiers. M. D. Smith[1] has an article in October, 1963, *CQ* on a desktop final using a pair of 4-400A's, but this unit uses elaborate circuitry and the power supply is not contained. Joseph Semkow[2] has his well known article in the July, 1962, *CQ* on the Ultimate Linear which presents

*3115 Mossdale Street, Durham, North Carolina.

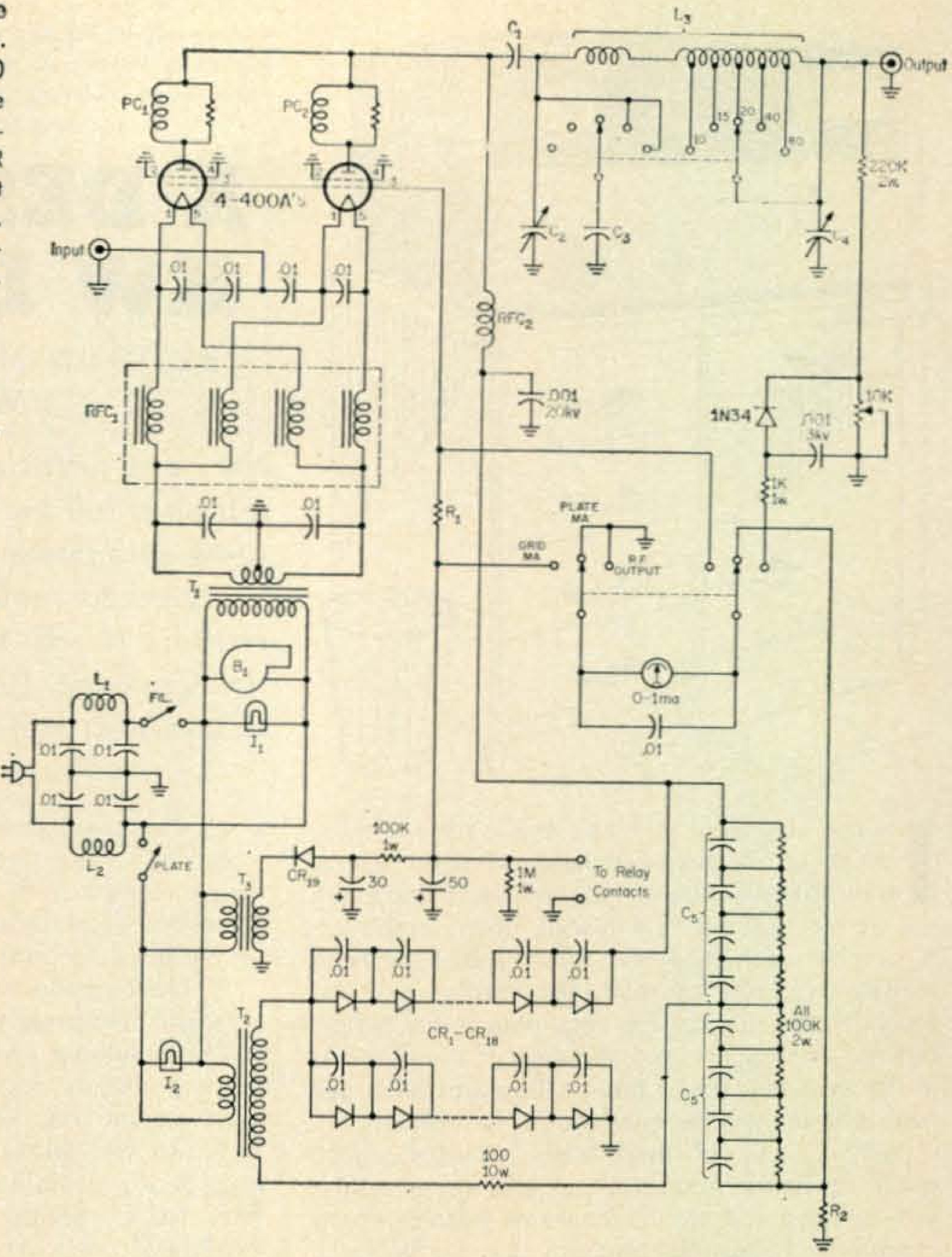
[1]Smith, M. D., "A 2 KW PEP Linear Amplifier," *CQ*, October, 1963, p. 30.

[2]Semkow, Joseph W., "The Ultimate Linear," *CQ*, July, 1962, p. 32.



Bottom view of the linear shows the filter capacitors on the right side of the chassis with the filament choke alongside. Near the far wall of the chassis is the antenna loading capacitor and the bias power transformer. The blower, a 60 c.f.p.m. centrifugal type, may be seen on the rear of the chassis.

Fig. 1—Complete circuit for the one kilowatt table top linear. All the 0.01 capacitors are 600 volt disc ceramics. The nine diodes in each leg of the rectifier circuit are Sylvania SR 3011, or equivalents rated at 600 p.i.v., 750 ma (CR_1-CR_{18}). Each of the 18 diodes is bypassed by a 0.01 mf at 600 v.



C_1—500 mmf 20 kv door knob type capacitor.
C_2—8-80 mmf wide spaced tuning capacitor.
C_3—100 mmf silver mica 20 kv.
C_4—1100 mmf, 3 gang broadcast variable, all sections paralleled.
C_5—55 mf at 450 v. ea.
CR_1-CR_{18}—Sylvania SR 3011, or equiv.
CR_{19}—1N34.
L_1, L_2—10 ampere line choke, Ohmite or equiv.
L_3—Pi-net work, Air Dux 195-S1 or equiv.
PC_1, PC_2—3 turns #16 enameled wire wound around 3 220 ohm 2 watt paralleled resistors.
R_1, R_2—See text.
RFC_1—B&W FC-30A or equiv.
RFC_2—National R-175A or equiv.
T_1—Chicago Transformer P-6492 or equiv.
T_3—1:1 ratio power transformer 117 v.a.c. See text.
T_2—1300 v. at 1.5 kva. See text.

some excellent ideas on the building of high power finals, but the size and especially the price of this unit does not fulfill the established criteria of compactness and relative low cost.

Most of the circuit diagrams available on high power finals describe a circuit in Class AB_1. While this circuit has definite advantages for the individual with a low power driver and perhaps some theoretical efficiency advantages, it does present the necessity for a well regulated screen supply and neutralization. This grounded grid circuit on the other hand requires no screen or grid supply, no neutralization, and has the definite advantages of simplicity and compactness.

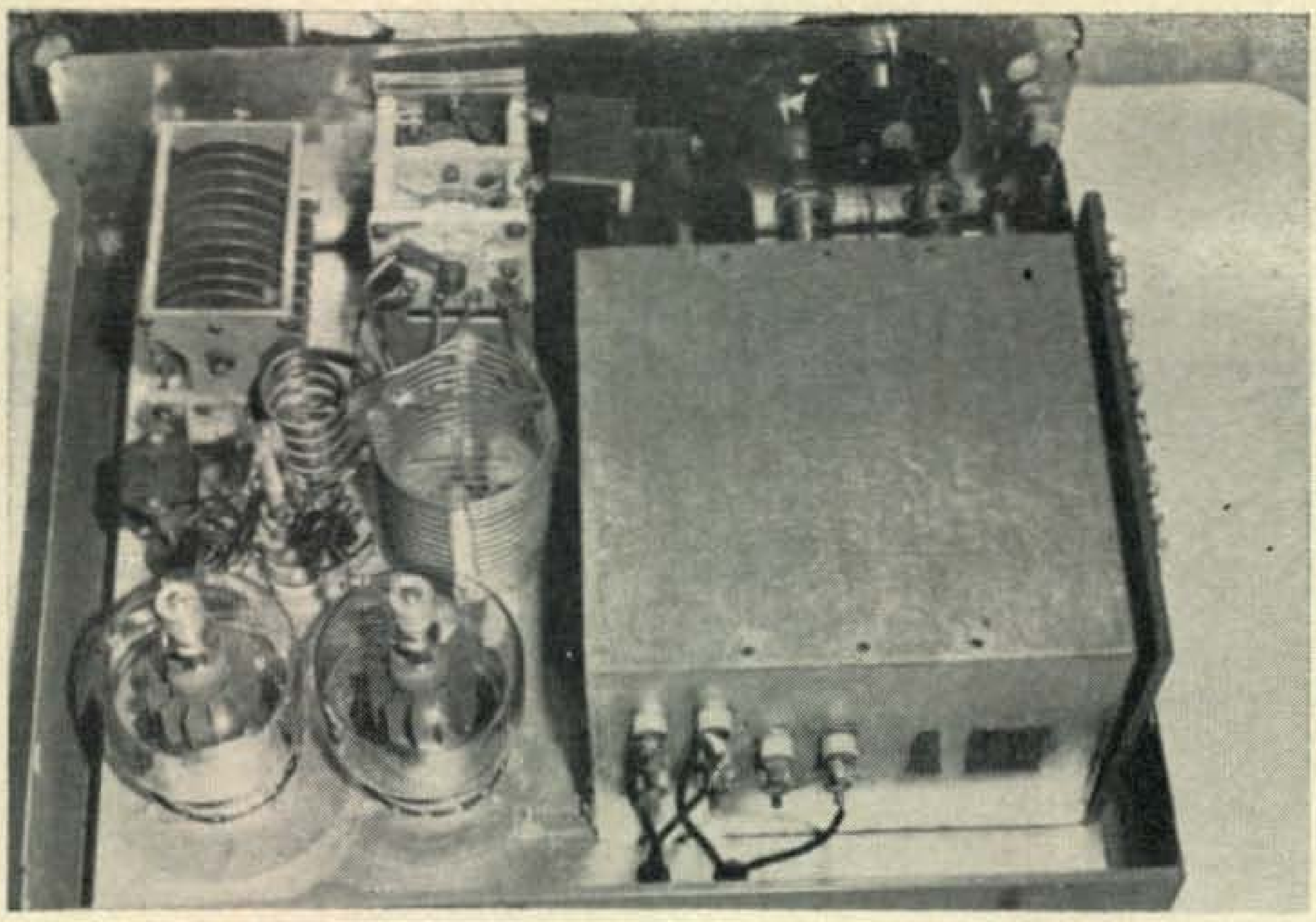
The unit finally decided upon consists of a pair of 4-400A's in grounded grid with a self-contained silicon diode doubler high voltage supply capable of operation on 10-80 meters and easily driven to a full kw by any exciter with an output of 75-100 watts.

The Amplifier Circuit

Experimentation has shown that the space-consuming and cumbersome pi-net input on each band offers little or no advantages when the linear is used with an exciter having approximately 100 watts driving power. With a lower powered exciter, a tuned cathode circuit may be necessary to drive a pair of 4-400's or comparable high power final tubes to a full kilowatt input. Also the expensive chimney tube socket is not essential with an input of 1 kw. if adequate socket blowing is used in association with the heat dissipating plate cap. The present circuit directs the output of a 60 c.f.p.m. (centrifugal) blower directly on the submounted tube sockets, and no problem with the tube over-heating has been encountered.

The filament choke proved to be somewhat of a problem. Several attempts were made to use a homemade choke wrapped on a ferrite core. These chokes did perform fairly satisfactorily but drive on all bands proved to be difficult and erratic. The B&W FC-30A filament choke has been used in the amplifier, and no problem has been experienced in driving the linear to full input on all bands.

The output circuit employs an Air-Dux 195S1 tank coil tapped according to the manufacturer's specifications. The tuning capacitor is a 4-80 mmf wide spaced variable with fixed silver mica capacitance being switched in by the second



Interior view of the linear shows the 4-400's on the left along wtih the plate r.f. choke and pi-network components. Note that in front of the power transformer (which seems to occupy most of the space) there is the filament transformer and the silver mica (on the bandswitch) for 40 and 80 meters. The phenolic board with the diodes is located just to the right of the power transformer.

section of a surplus ceramic band switch on 40 and 80 meters. The loading capacitor is a standard 3 gang broadcast variable.

Metering of the amplifier has proved to be quite satisfactory. Since the relative output is metered along with the plate and grid currents, a 0-1 mil meter must be used. The meter is shunted in the plate circuit so that 0.1 mil corresponds to 100 mils plate current for a full scale deflection of one ampere, and 0.1 mils on the meter corresponds to 50 mils grid current for a full scale deflection of 500 ma. The relative output of course is read directly without shunting. This circuit has the advantage of providing constant monitoring of the plate, grid, and output on the same meter without the danger of having the B+ directly on the meter.

Note that no values are given for the meter shunts R_1 and R_2. The exact value required depends upon the resistance of the meter movement used. To determine the value of the shunt and the type of wire to be used for winding, it would be best to refer to a previous *CQ* article[3].

Biasing

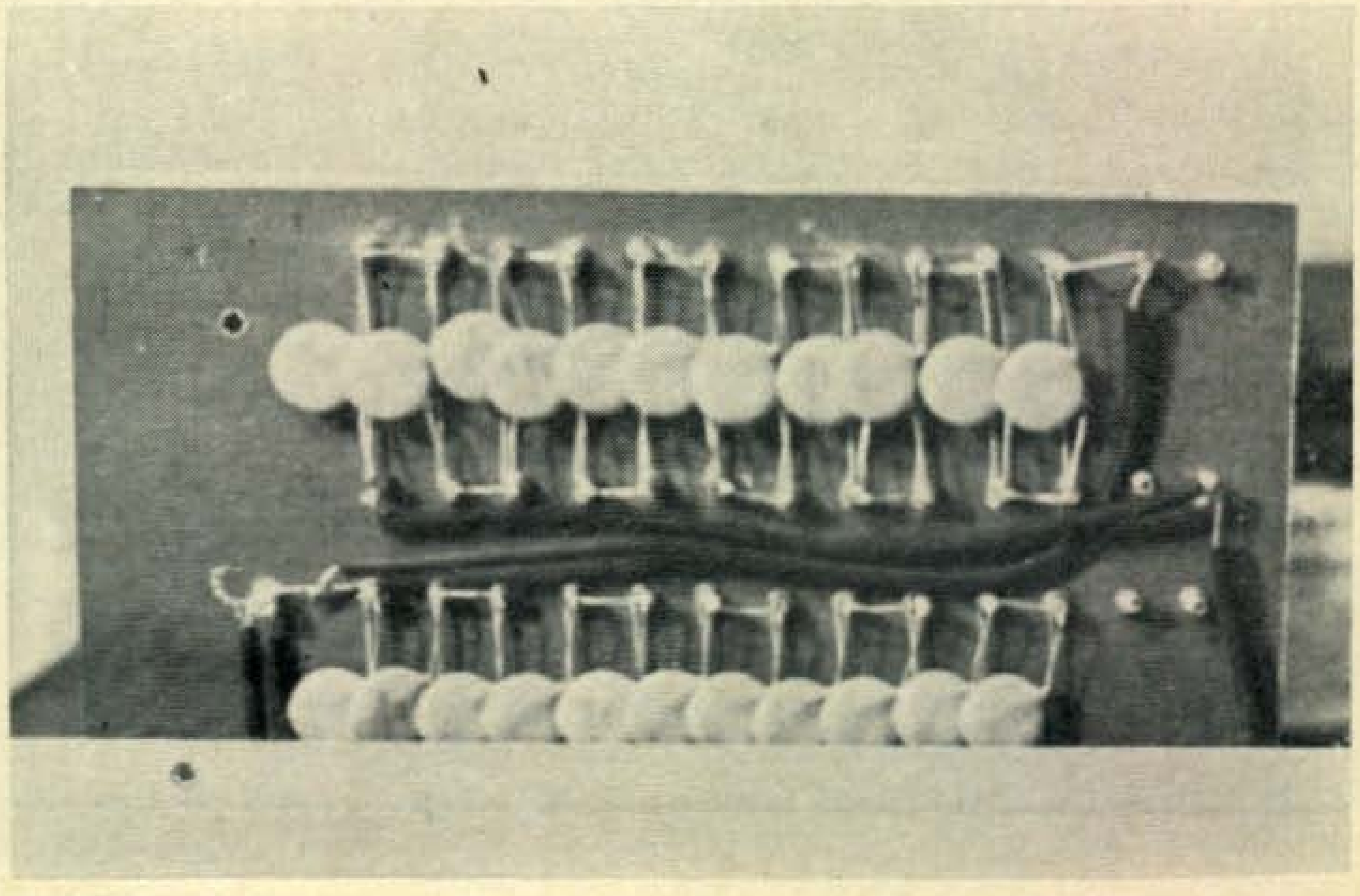
A cut-off bias supply is included in the circuit in the standby position as an additional tube protection especially since the chimney tube socket has not been used. With 3600 volts on the pair of 4-400A's, the resting plate current is about 100 mils. While this results in a total plate dissipation of only 360 watts, which is well within the capability of the tubes, the amount of heat generated is considerable. The transformer for the bias supply has a 1:1 ratio with a current rating of only several mils. A filament transformer can be connected backwards to a 5 or 6 volts winding of the power transformer. T_2, it has one. The voltage is rectified with a single silicon diode and filtered with a dual section 30-50 mf capacitor and relayed with the side contacts of the Dow Key Relay. With minus 100 volts applied to the grids in the standby position, the tubes are cut off completely.

[3]Young, Eric J., "Shunting The Milliammeter," *CQ*, March 1960, p. 40.

The Plate Supply

The plate power supply is the standard silicon diode full wave voltage doubler. A brief survey of the surplus market revealed numerous inexpensive transformers available with a full secondary winding of between 800 and 1400 volts. The one used is a 1.5 kva transformer with a secondary voltage of 1300. In the doubler supply the resting plate voltage is 3600 with a drop under load of less than 300 volts.

Numerous doubler circuits were constructed, using components of various values. Low kva transformers give the same resting voltage as the larger ones in the doubler supplies, but the drop under load is excessive. In order to absolutely minimize voltage drop, a very hefty transformer has been used along with a considerable amount of filtering. The capacitive filter consists of 8 General Instruments capacitors rated at 525



Close up view of the phenolic board shows the silicon diodes well hidden behind each of the 0.01 mf disc ceramic capacitors.

mf at 450 w.v. d.c. This gives an effective filtering of 60 mf when connected in series. It is undoubtedly more than absolutely required and quite satisfactory performance has been obtained using 240 mf capacitors at 450 volts, and capacitors as low as 100 mf may be used, if desired. The power supply as finally constructed is easily capable of providing a full kw for continuous a.m. output, if desired.

Component Layout

This linear has been constructed to be a companion desk-top unit to the author's HT-37 transmitter, and it was decided that the entire unit was to be contained in an HT-37 cabinet. No commercially available chassis is of the proper dimensions, and it is necessary to construct one 18½" × 15" ×2½". This provides adequate space for subchassis mounting of the filter capacitors as well as the loading capacitor and the meter switching circuit. The ceramic sockets for the 4-400A's are submounted ¾ of an inch and the output of the centrifugal blower is pointed directly on the sockets below the chassis. The tank coil is mounted vertically using very short leads between the tank coil and the band switch and the tuning capacitor. Shielded wire is used throughout the metering circuit and standard 20,000 volt insulated wire is used for the high voltage leads. The front panel is constructed from a heavy piece of aluminum and painted to match the exciter panel.

Operation And Conclusion

This amplifier can easily be driven by a 70 watt output exciter to a full kw input on all bands 10-80 meters. It has been used by the author for over one year and has proved quite satisfactory. There have been no component failures. The linearity as measured on the oscilloscope and then on the air signal reports have been quite satisfactory. A previous linear employing exactly the same circuit but using a pair of 813's provided equally satisfactory performance.

This amplifier is certainly not the ultimate linear. Indeed it was never constructed to be. The unit does not represent any radical circuit departures. It does, however, combine the existing linear circuitry into a simply constructed, inexpensive, table-top linear capable of full legal input with any of the commonly used final power tubes, when driven by a 70-100 watt exciter. The total cost of the linear was under $100, and with an adequate junk box and supply of surplus parts can be duplicated by anyone for this price. ■

YL Chronicle

MARLENE Kaniuk, WA9FRW, age 17, has held her General ticket since she was 13 years old. Her Dad is W9CDQ, and their QTH is Morton Grove, Ill. Marlene is a member of the Eye-Bank Net on 75 meters and helped man the Eye-Bank Booth at the Lions Club State Convention. She loves to ragchew, run phone patches and work her Dad mobile. Marlene will be attending summer school at St. Andrews College, Dundee, Scotland, and will tour England and France before returning home to complete her senior year of high school where she is an honor student. *(Louisia, W5RZJ)*

The Bedford Incident

WHEN *CQ* joined forces with Columbia Pictures, Inc. in a program to set up amateur stations in connection with the screening of "The Bedford Incident" (see Zero Bias, *CQ*, Nov. '65, and "The Bedford Incident," *CQ*, Jan. '66), the local theater manager called Phyllis Shanks, K7KSF, and asked if the Richland (Wash.) Amateur Radio Club would be interested in cooperating. Assured that the club would be happy to cooperate, the manager named a date two months away. However, as plans sometimes do, the screening date changed, and they were notified just five days before the first showing. Time? Just before Christmas!

K7KSF was named Project Chairman, and with the help of Pat, K7OFX, and her OM, Dwight, K8OFW; Frieda, K7PVG, and her OM, Hugh, K7PVF, and daughter Vicki, K7VSG; Shirley, K7PVJ, and her OM, Jerry, K7DCJ; Ev, W7OEB; Don, K7QOM, and Russ, K7VNV, an antenna was strung on the theater roof, the club station, W7VPA, was moved to the lobby and the system was tested. A portable TV was set beside the transmitter, a monitor-scope was hooked up, and a closed circuit RTTY (courtesy of K7DED) was included for demonstration purposes. The theater personnel were briefed and were all very courteous and helpful.

The lobby display included QSLs from all over the world, achievement certificates and a large layout explaining the operation. Standard message forms were provided and the station was manned throughout every show by at least two, and sometimes three, club members.

Last, but not least, *all* messages were handled during the movie, either directly through service nets, or through relay to an NTS station locally, with no interference to the theater program.

Since many of the club members work rotating shifts, it would have been difficult, if not impossible, to keep W7VPA operating without the help of the active YL members of the Richland Amateur Radio Club. *(Louisa, W5RZJ)*

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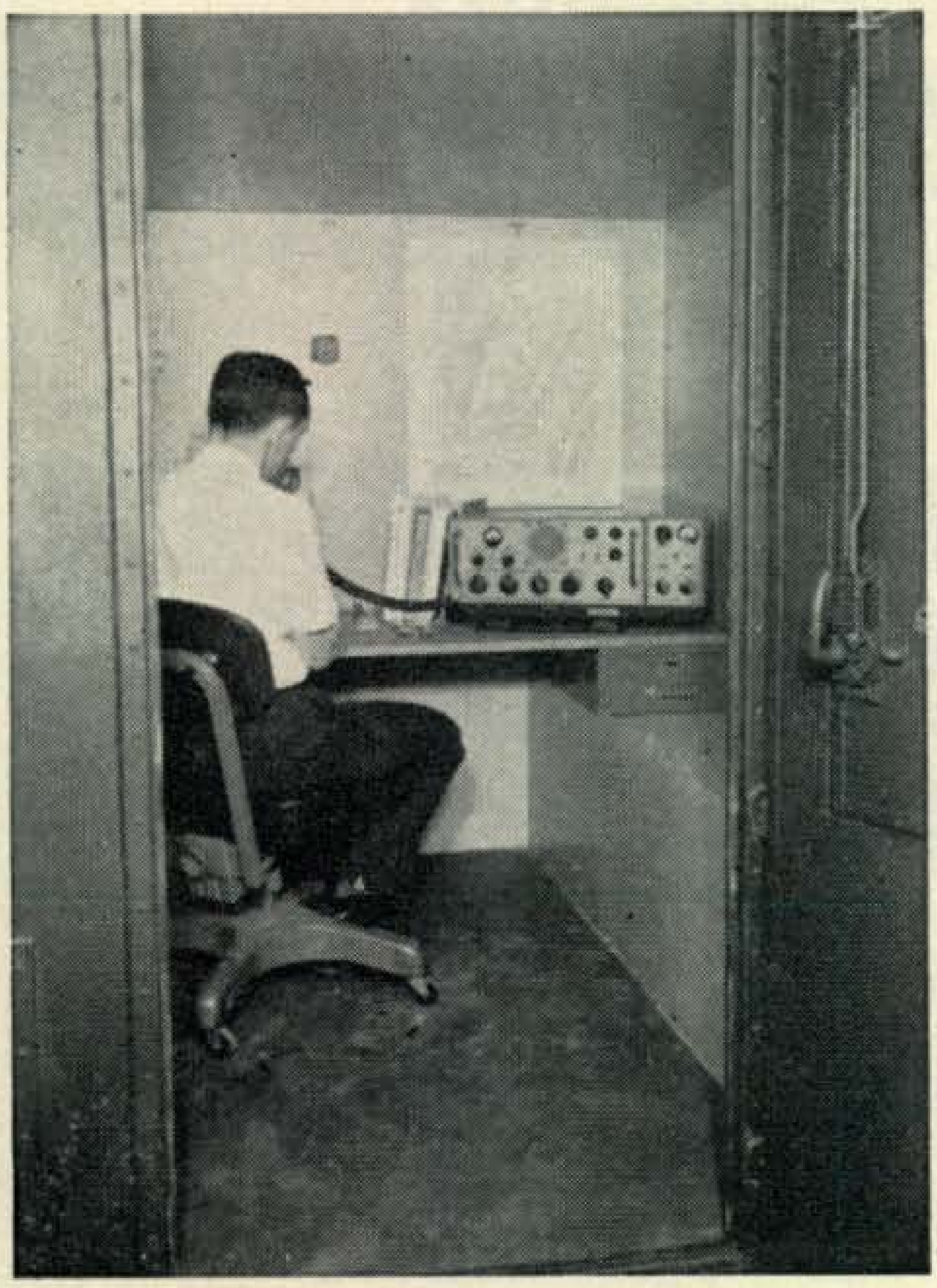

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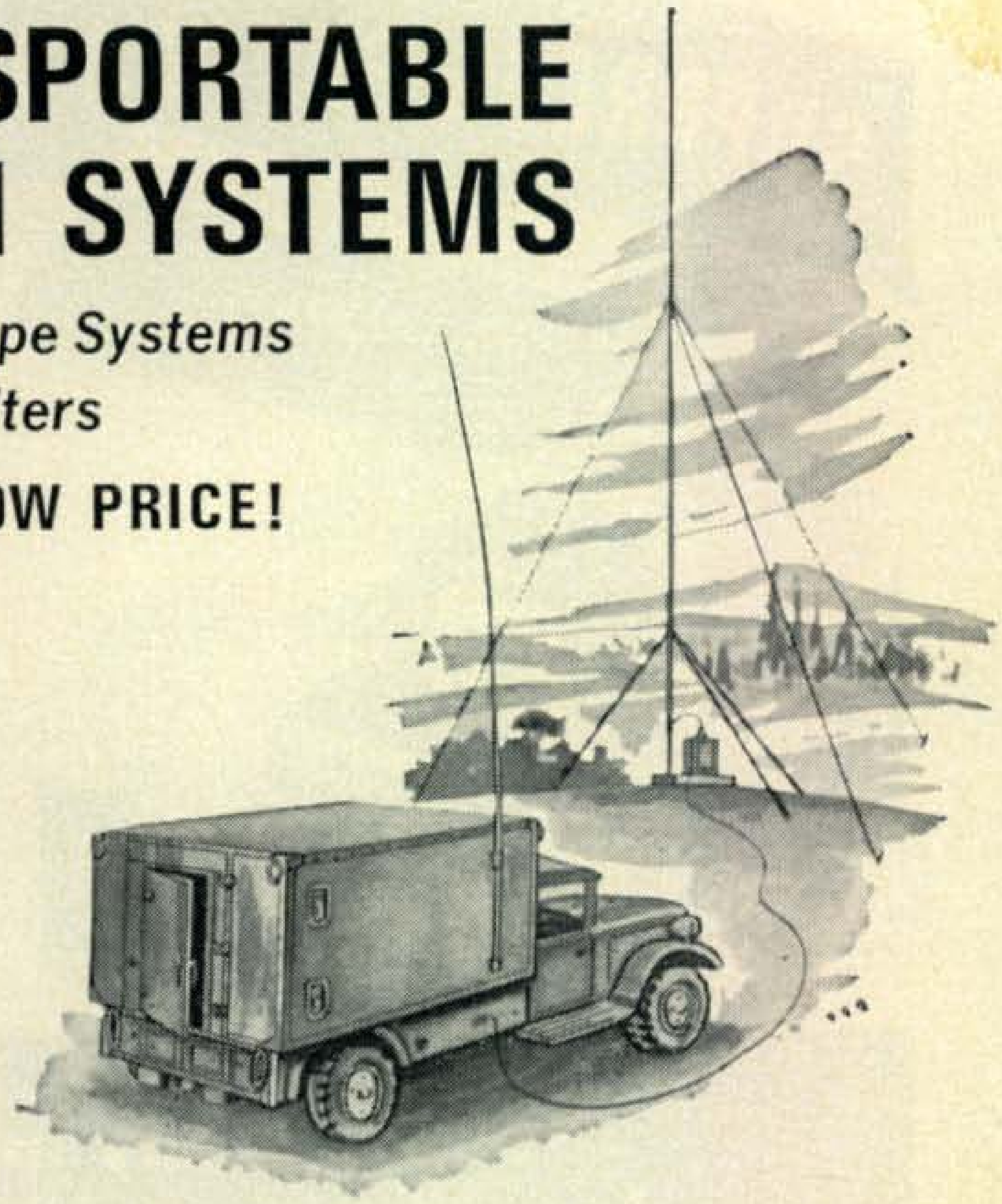

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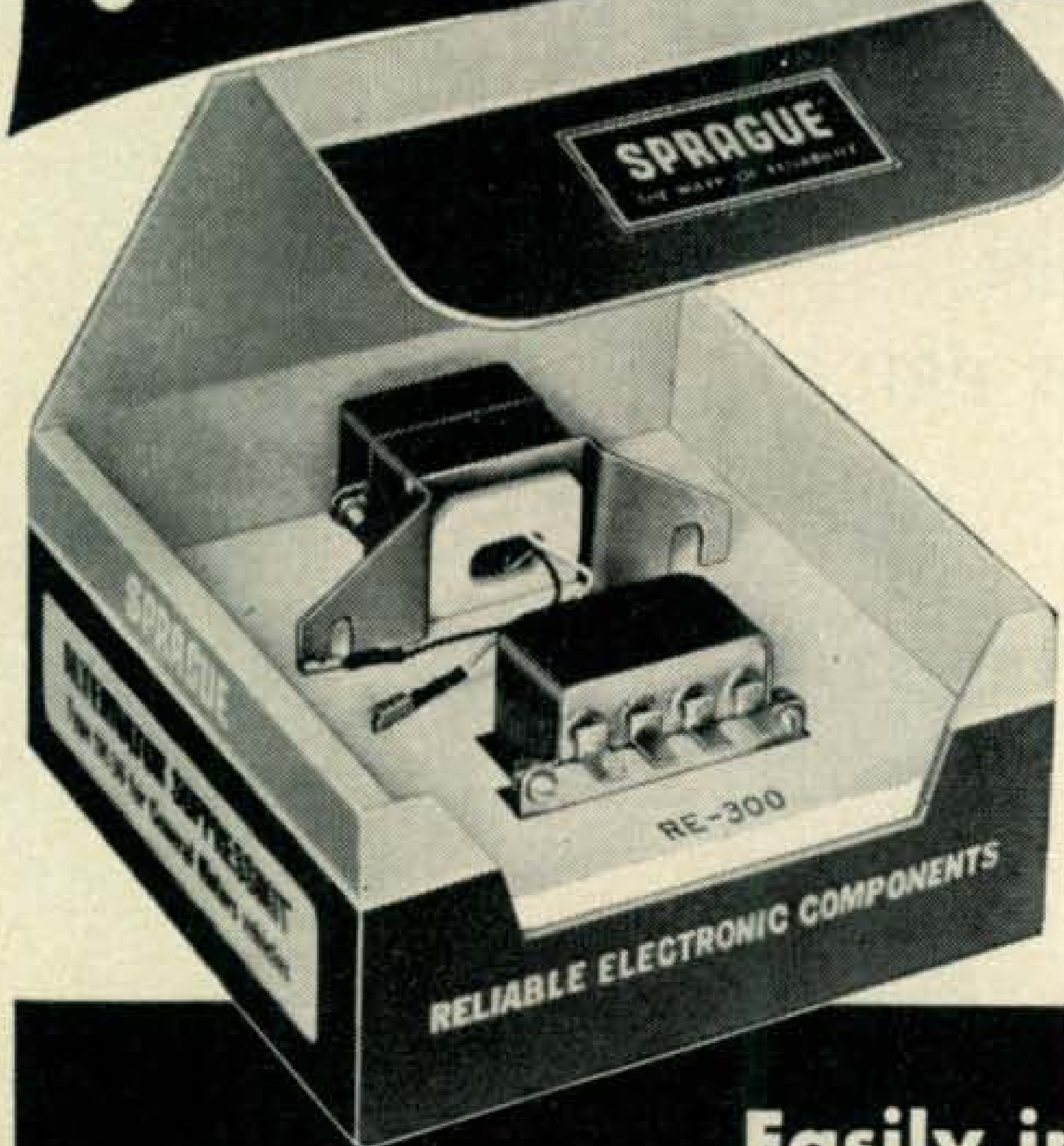

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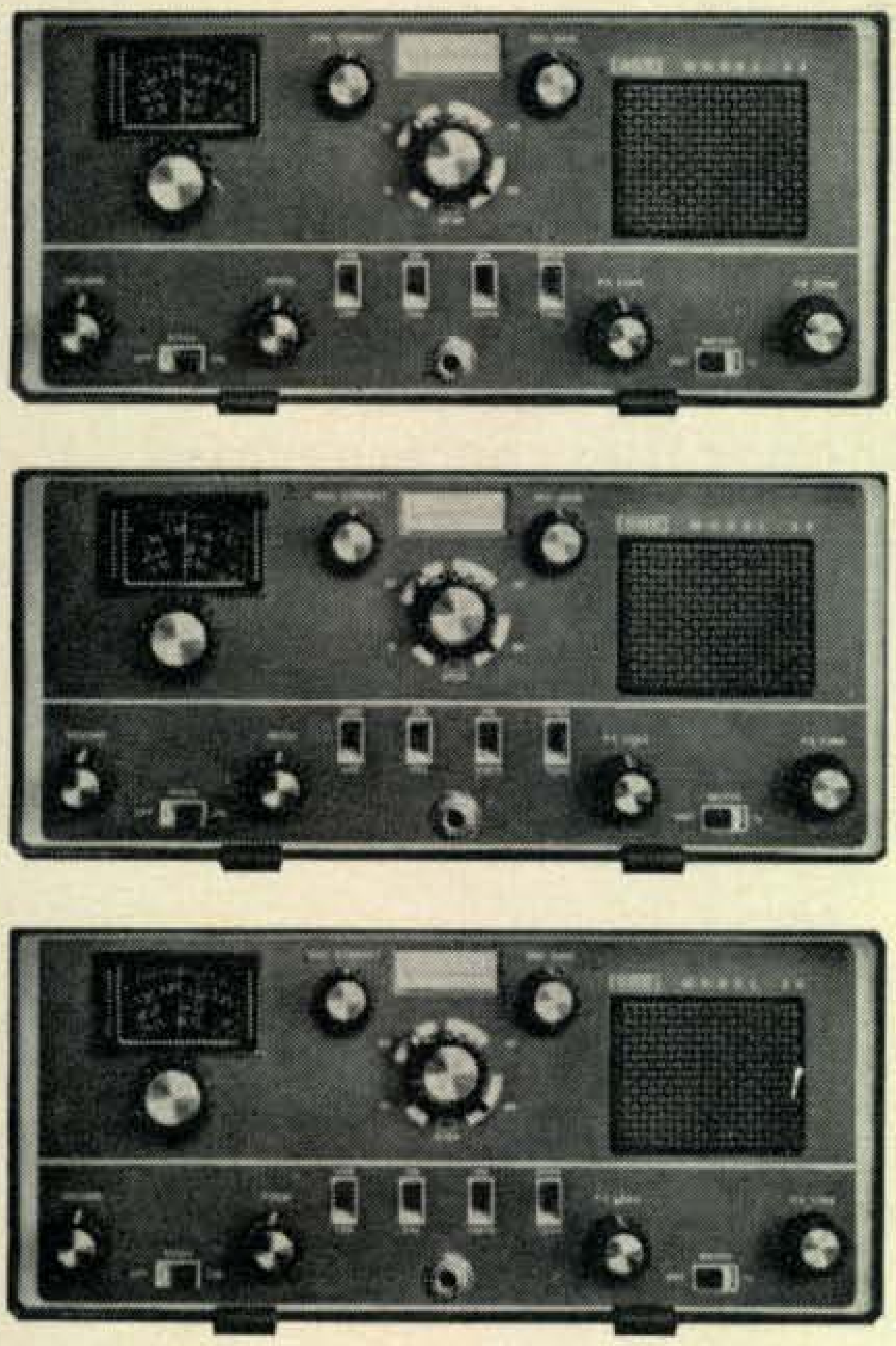

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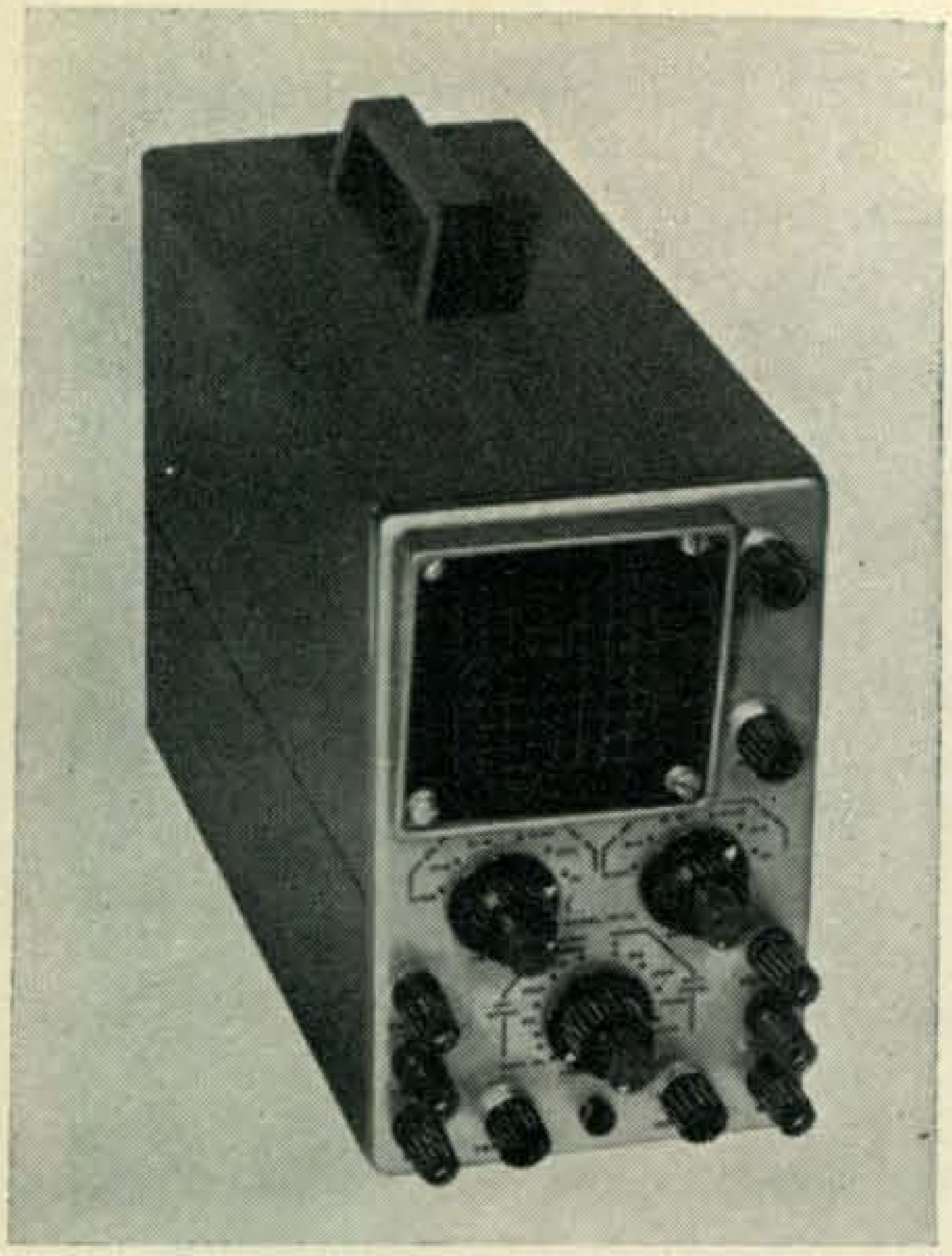


The Oscilloscope

Part II

BY WILFRED M. SCHERER,* W2AEF

Last month we discussed some of the fundamentals relating to the operation of the oscilloscope. Other basic uses concern phase and distortion observations. These will be taken up in this installment.

ONE of the principle uses of the oscilloscope is that of detecting or measuring the phase difference between two a.c. voltages of the same frequency. This is done by applying one signal to the vertical scope input, the other to the horizontal input. The resulting display is either an ellipse, a circle or a solid line, depending on the phase relationship between the two signals. Some typical traces are shown at fig. 1.

Obtaining and interpreting phase patterns is quite easy, and the procedure is as follows:

1. Connect one signal to the vertical input, the other one to the horizontal input.
2. Reduce the vertical and horizontal gain controls to zero.
3. Use the positioning controls to center the spot on the c.r.t. screen.
4. Adjust the VERTICAL gain to provide a vertical deflection of one or two inches.
5. Leaving the VERTICAL gain set at the adjusted position, remove the signal from the VERTICAL-input terminals.
6. Adjust the HORIZONTAL gain for a deflection of exactly the same amount as in step 4.
7. Reconnect the signal to the VERTICAL input.

A display, similar to one of those shown at fig. 1, should now be seen. The phase difference, if any, may then be determined according to the dimensions and the tilt direction of the pattern, as follows:

1. Referring to fig. 2, note the dimensions a and b. (In order to determine these dimensions easily, a graticule with ⅛″ square grids is advisable).[1]
2. Divide b by a. The result will be the *sine* of the phase angle.
3. Referring to a table of sines, find the angle which corresponds to the sine found in step 2.
4. Step 3 will indicate the degree of phase shift for a right-hand tilt. If the trace leans toward the left, the phase angle is 180° *minus* the angle found in step 3.

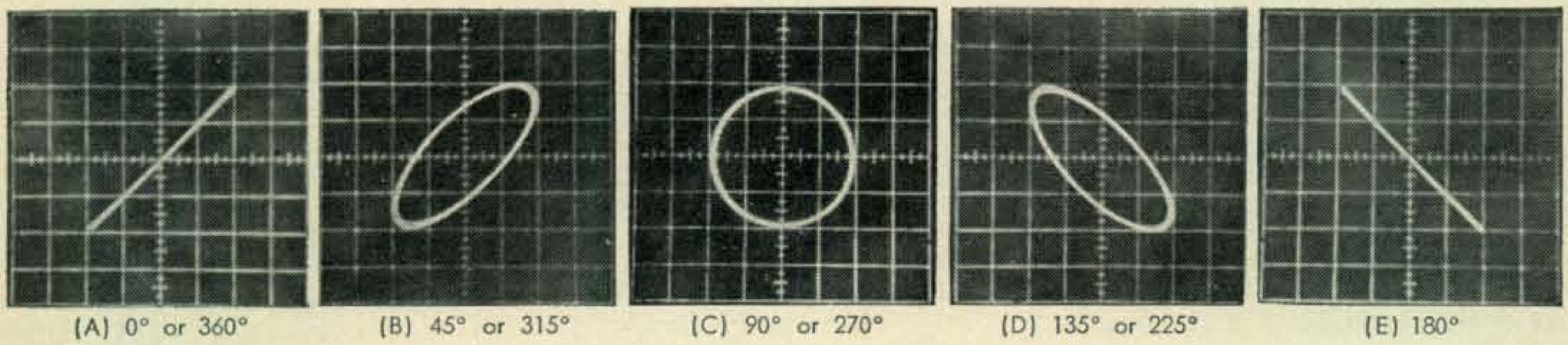
EXAMPLE: If, with a right-hand tilt, $b = 5$ and $a = 10$, the sine of the angle is $5 \div 10 = 0.5$, corresponding to 30°. For a left-hand tilt the phase angle is $180° - 30° = 150°$.

As illustrated at fig. 1, the same phase patterns can indicate a shift smaller or greater than 180°. To differentiate between the two, the following procedure may be employed:

1. Determine the basic phase angle (between 0° and 180°) shown on the scope face.
2. Open the *vertical*-input lead and insert a negative phase-shift network in series with it as shown at fig. 3.

*Technical Director, *CQ*.

[1]Also, the best accuracy is obtained when the vertical and horizontal amplitudes have initially been made equal, in which case the trace will tilt at 45°; however, the calculations still may be made using the same formula with a and b when the amplitudes are unequal. In any case, the trace should be accurately centered with the reference grid.



(A) 0° or 360° (B) 45° or 315° (C) 90° or 270° (D) 135° or 225° (E) 180°

Fig. 1—Typical phase-shift patterns produced on the oscilloscope by two sine wave voltages of the same frequency and amplitude. The phase angles are indicated below each display. Determination of the correct quadrant is explained in the text.

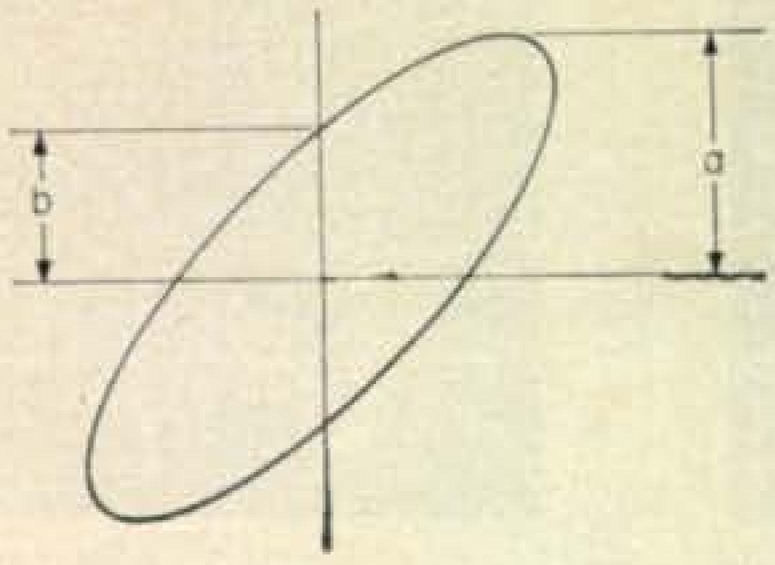


Fig. 2—Measurement of phase angle using elliptical display on oscilloscope is obtained by $b \div a =$ sine of the angle. See text. As shown here, equal vertical and horizontal amplitudes cause the ellipse to tilt at 45°. Unequal amplitudes result in greater or lesser tilt, but the relative values of *a* and *b* will still be valid to find the sine of the angle.

3. Note the resulting phase angle (between 0 and 180°).

4. If the new reading (step 3) indicates an *increase* in the angle, the original angle (step 1) was a negative (lagging) one the actual value of which is 360 *minus* the angle indicated in step 1.

5. If the new angle (step 3) *decreased*, the original one was positive (leading) and less than 180° as found by zero *plus* the reading in step 1.

The tilt of the patterns for the various phase shifts will be in the directions shown when the polarity of the vertical and horizontal sections of the scope is normal; that is, the same polarity going vertically upward and horizontally to the right. If the polarity of one amplifier is reversed, the traces will lean in the opposite direction. For instance: the 45° ellipse will then tilt to the left. You can check this by applying the *same* signal to both inputs to provide two in-phase signals. Reversed polarity will be indicated if the resulting solid line tips to the left instead of to the right.

If, during this check, the trace is other than a solid line (or if it is slightly elliptical), inherent phase shift between the oscilloscope amplifiers is thereby indicated and it may vary with frequency and with different gain control settings. This must be taken into account when the actual phase relationship between two individual signals is to be measured. On the other hand, it often can be corrected by connecting a variable phase-shifting network (as just described) ahead of one of the inputs, using the above test while adjusting the device for an in-phase pattern. It should then be left in the circuit during a phase measurement; however, the correction will be good only for the frequency at which it was initially set up.

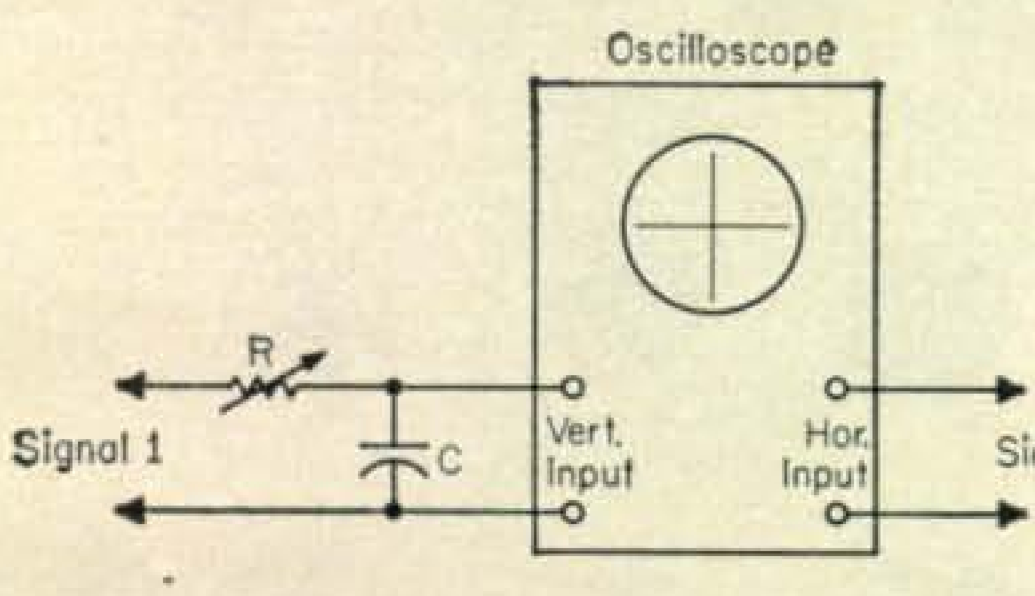


Fig. 3—Negative phase-shift network arrangement for checking the quadrant of the phase angle as explained in the text. Where *R* is 500,000 ohms, C for 30-500 c.p.s. may be 0.1 mf; for 300-5000 c.p.s., C may be .01 mf. Various settings of *R* will introduce a loss in signal level, in which case the vertical gain on the scope may have to be readjusted accordingly.

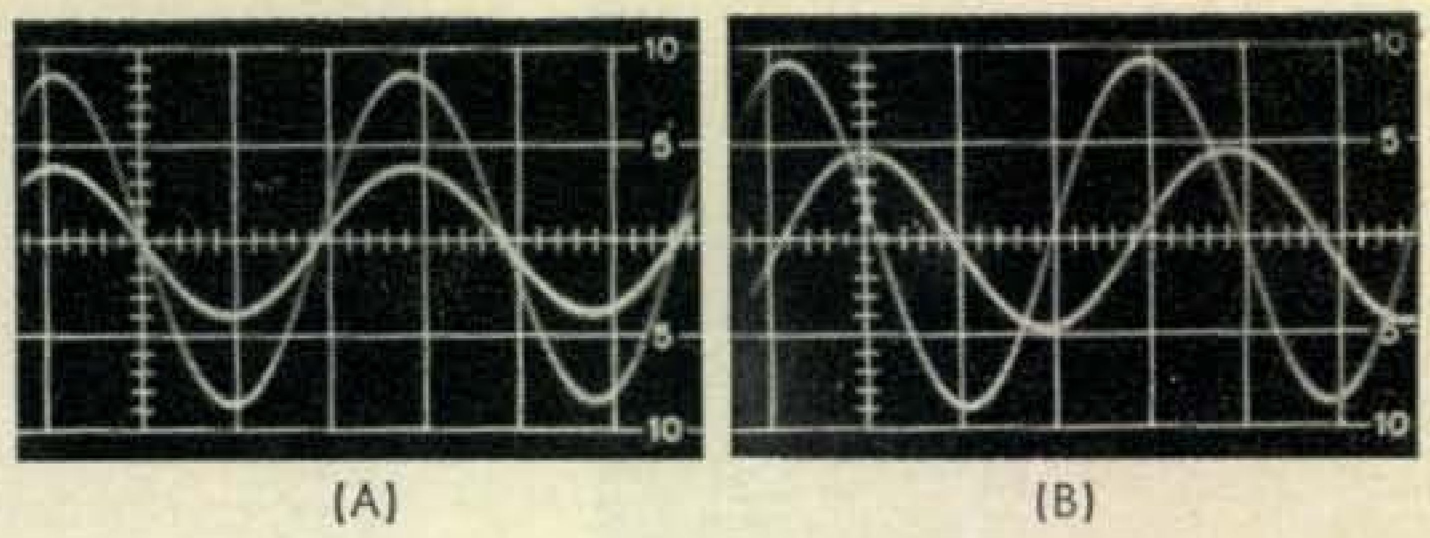


Fig. 4—Phase relationship between two sine-wave voltages of the same frequency and different amplitudes as displayed on the oscilloscope using the linear horizontal sweep and an electronic switch. The latter has been adjusted to superimpose the signals upon one another. At (A) both signals simultaneously cross the horizontal reference axis at the same point, showing the voltages to be in phase. At (B) the smaller signal crosses the axis slightly less than one-quarter cycle later than does the larger signal, indicating a phase difference just under 90°.

Electronic Switch

Phase observation also may be made in conjunction with an electronic switch. This is a device that enables the scope input to be electronically switched back and forth between two different input signals. It incorporates circuitry that may cause one signal to appear at the upper part of the c.r.t. screen, the other at the lower section. The result is a dual display that allows both signals to be observed simultaneously for comparison purposes. A means is also provided for superimposing one signal on the other. Phase difference, as observed using the electronic switch, is shown at fig. 4. Since one complete cycle of a sinewave represents 360°, the difference in phase can be found directly according to the number of degrees by which one signal is displaced from the other as read along the horizontal axis.

The need for phase-shift observations in connection with amateur gear is somewhat limited, except where alignment of phase-shift networks for s.s.b. and RTTY may be required; nevertheless, the subject has been discussed here to acquaint you with the fundamentals of such

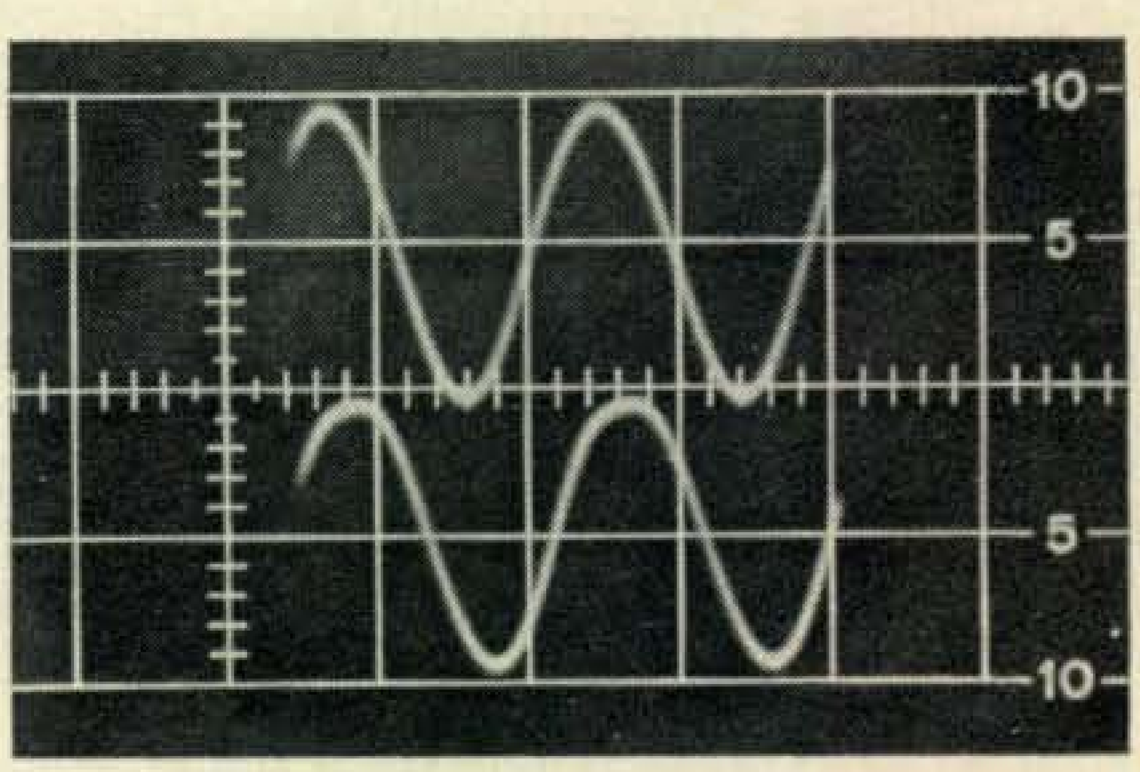


Fig. 5—Comparison between the waveform of two different a.c. voltages as observed with a dual display on the oscilloscope obtained using an electronic switch. The difference between the waveform of the true sinewave voltage (at the top) and that of the second voltage (at the bottom) is indicated by a rounding-off on the positive peaks of the latter.

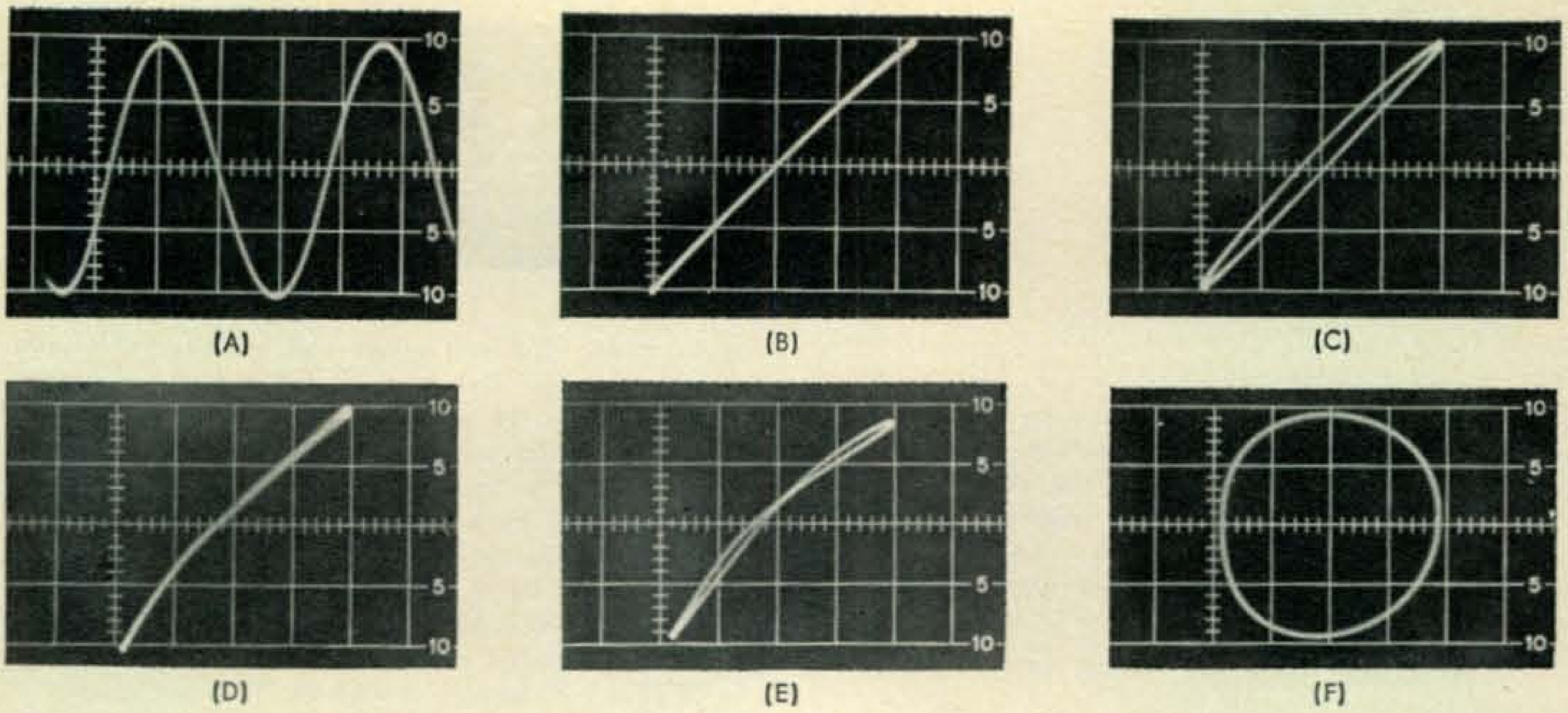


Fig. 6—The presence of distortion in equipment is more readily seen on the oscilloscope when the input and output signals from the equipment are compared with one another by their respective application to the vertical and horizontal sections of the scope. At (A) is the waveform pattern of the output voltage from the equipment which, as far as the eye can tell, is an undistorted sine-wave. At (B) the input-output comparison trace, for the same signals, curves slightly and thus indicates a small degree of distortion or non-linearity. At (C) non-linearity of the same signal, when phase shift exists between the input and output voltages, is indicated by the dissymmetry of each side of the ellipse.

Higher distortion in the equipment, due to an increase in input-signal level, is indicated by a more pronounced curvature as shown at (D). A similar situation may be seen at (E) where a slight degree of phase shift is also exhibited, while at (F) the distortion produces an imperfect circle when there is a 90° phase difference between the input and output signals.

observations for which the oscilloscope no doubt is the most widely used instrument. The information also should facilitate recognition of the presence of phase shift which may confuse other observations as we'll eventually see.

Distortion Observations

Since the waveform of an a.c. voltage may be observed on the oscilloscope, the instrument may be used to detect the presence of distortion. In the case of a sine-wave signal this is done by noting whether or not there is a difference in its waveshape compared to that of a true sine wave.

It might be difficult to recognize that there is distortion, because a true sine wave cannot be accurately interpreted by casual eye observation. Unless the waveshape of the signal is an obvious departure from an undistorted wave, it will be best to make a direct comparison with a true sine wave drawn on a transparency that can be overlayed on the display at the c.r.t. screen. A dual display obtained with the electronic switch also may be used as shown at fig. 5.

If *any* type waveform is involved with testing a piece of equipment, distortion will be indicated if there is a difference between the waveform of the output signal and that of the input signal. This may be found using one of the following methods:

1. With the test signal applied to the equipment, directly compare the waveform of the input and output signals by alternately connecting the vertical input of the scope to the input and output terminals of the equipment. This can be conducted manually, but a more convenient way would be the use of the electronic switch for automatically changing the scope input back and forth. The horizontal-sweep frequency

[*Continued on page 99*]

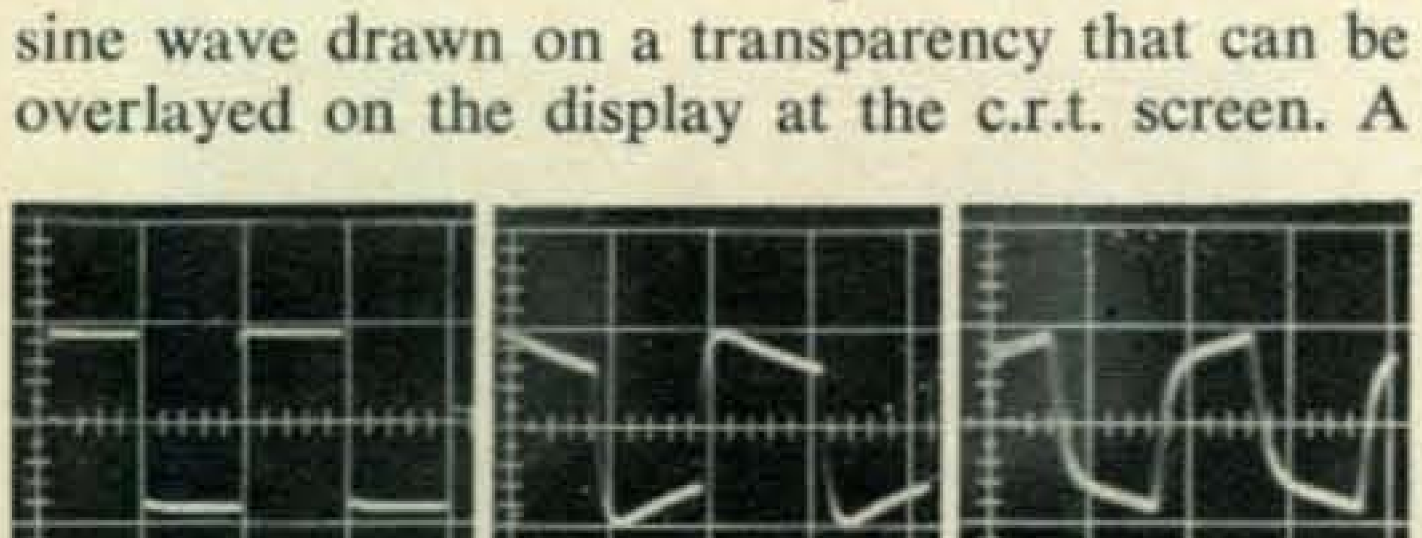
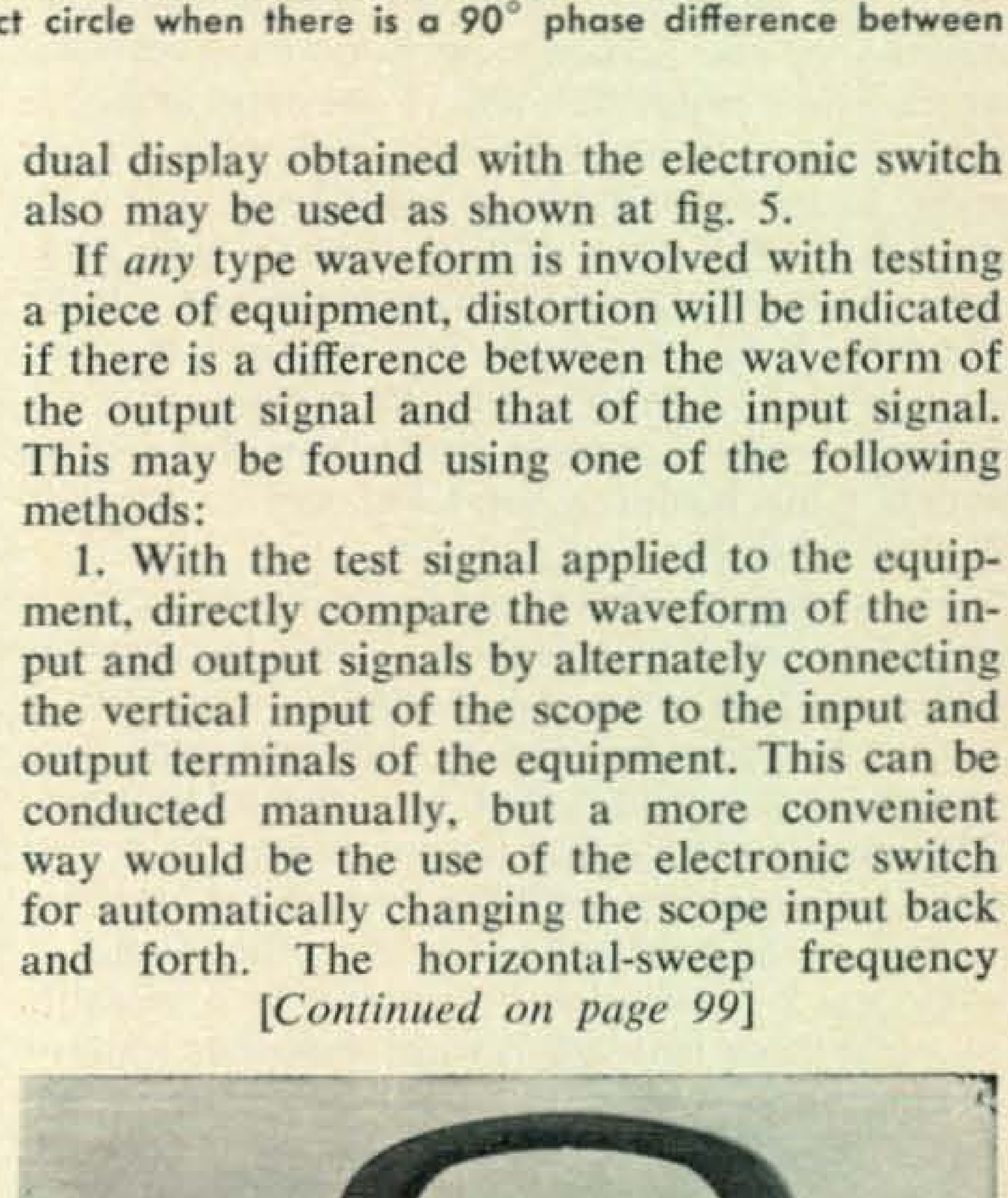
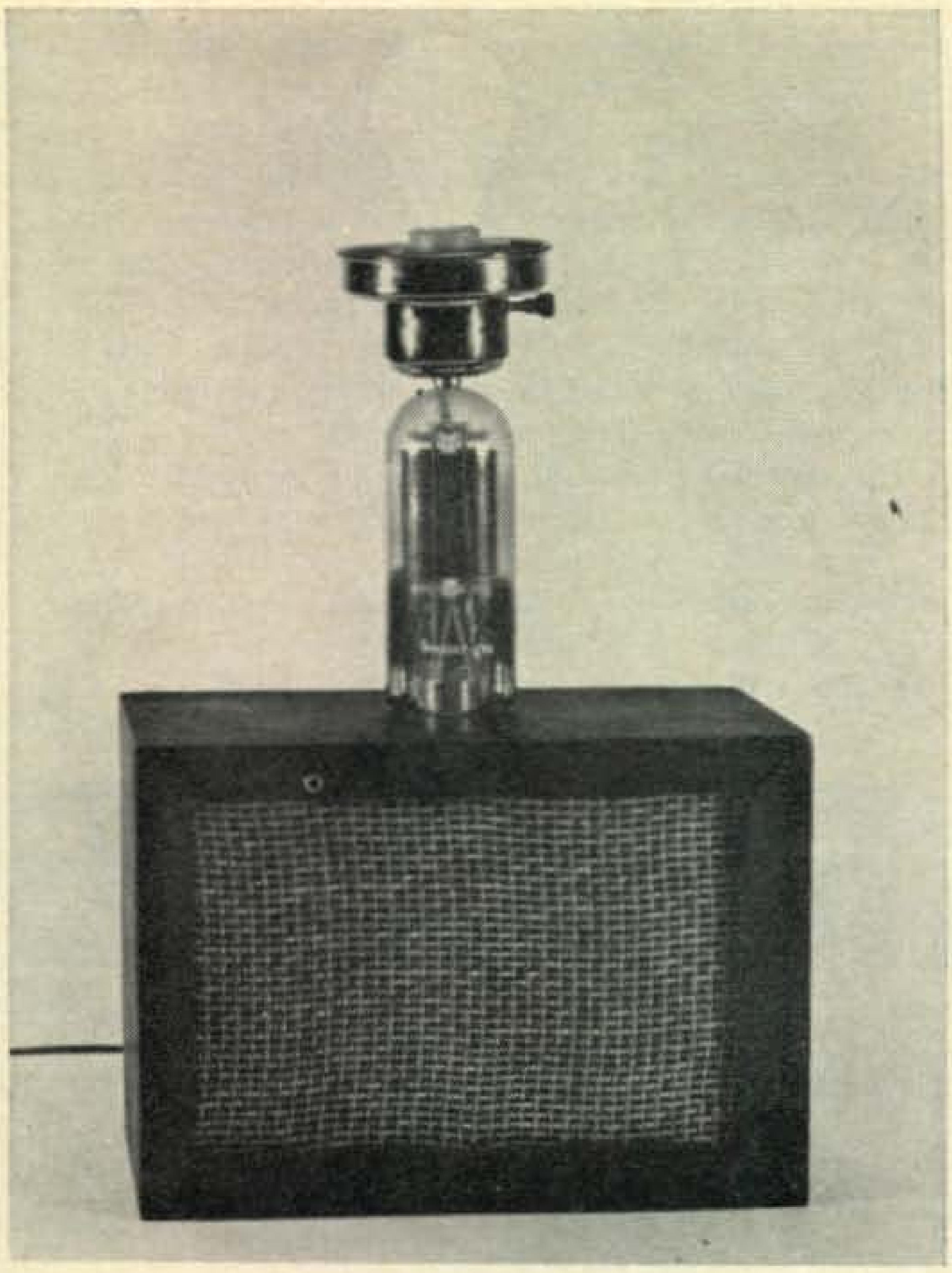


Fig. 7—Distortion of a square wave input signal as observed at the equipment output indicates many characteristics of the gear. Some of these relate to frequency response where a reproduction of the input signal at (A) indicates a flat response. At (B) low-quency attenuation is indicated, while high-frequency loss is indicated at (C). Such tests are seldom required with amateur gear.



An electronic switch that enables superimposed or dual displays to be obtained on the oscilloscope.



The Ham Lamp

BY JOAN VOGT,* WA2YTK AND

JERRY VOGT,* WA2GCF

WANT an interesting lamp for the shack, the recreation room, or the living room? I accidently stumbled on this idea, and unlike most of my brainstorms, it turned out to be better than I had expected.

It began when I won a big, otherwise useless, transmitting tube at a ham club meeting one night. I think it was the booby-prize because it was the last prize on the table and no one seemed to even know what type tube it was, much less what to use it for. Just before tossing it in the junk box, I came up with the idea of building a ham-lamp, using the tube as the body of the lamp.

There just happened to be an unfinished, sorta hi-fi speaker and cabinet in the shack, which served as a base for the lamp. How novel —speaker lamp. It serves two purposes and saves needed space in the shack.

Almost everyone has a few old lamps kicking around the attic. One of these can be salvaged for the parts needed. Most lamps use a ⅜″ threaded tube to support the socket. A ⅜″ switch shaft bushing, stolen from a broken rotary switch, can serve the same purpose if the flange end is epoxy-cemented to the top of the tube's glass envelope.

A fly-cutter or pipe reamer, in a drill press, is used to make a mounting hole in the top of the wooden speaker cabinet to epoxy the tube base in. A pipe reamer was used, in this case, so that the hole would be tapered the same as the lower glass portion of the tube. A nice, snug fit resulted, and the metal base of the tube and the pins were concealed. If desired, the tube could be mounted by drilling small holes spaced to accept the pins of the tube, and the epoxy cement could be used under the metal or glass base to secure the tube.

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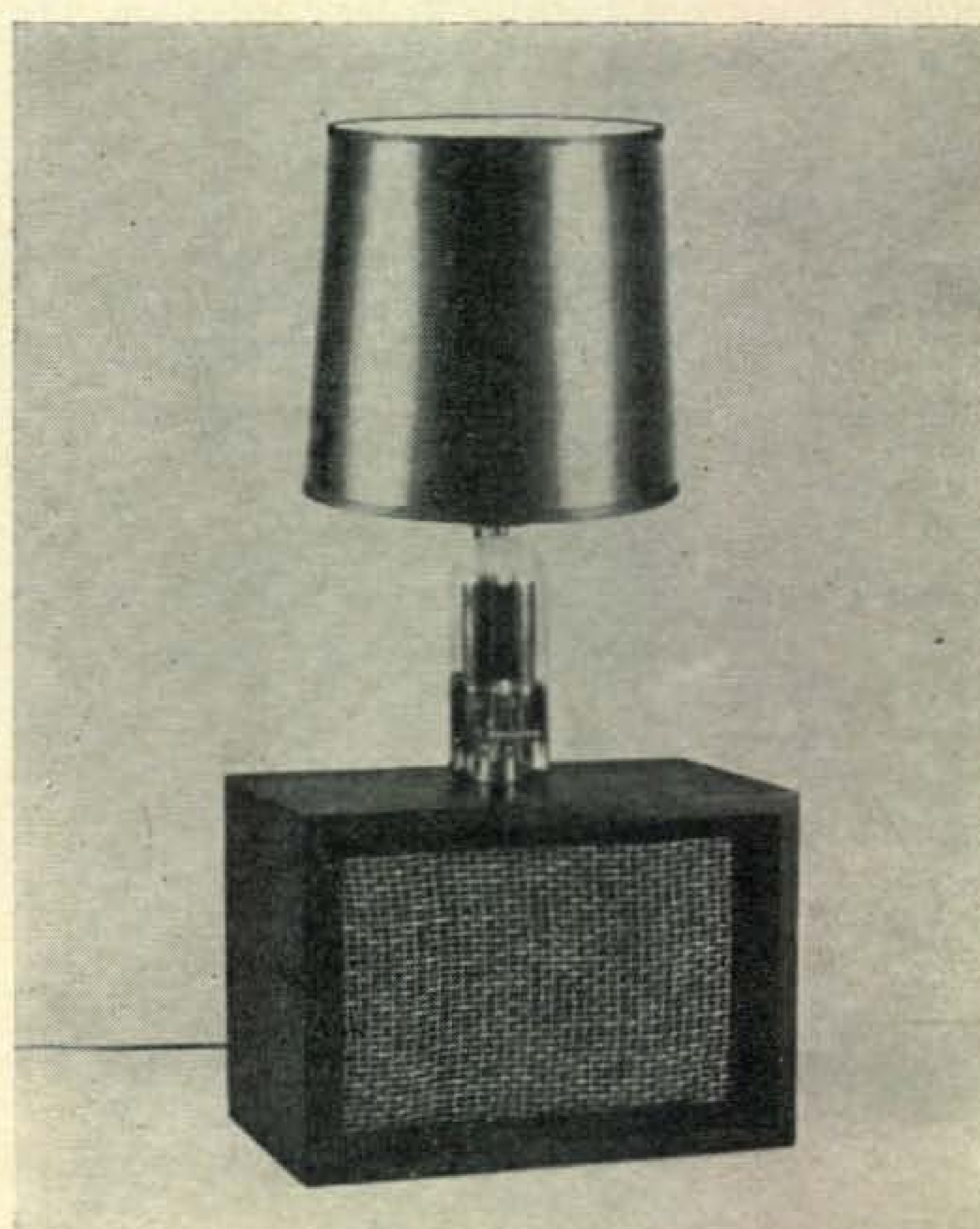
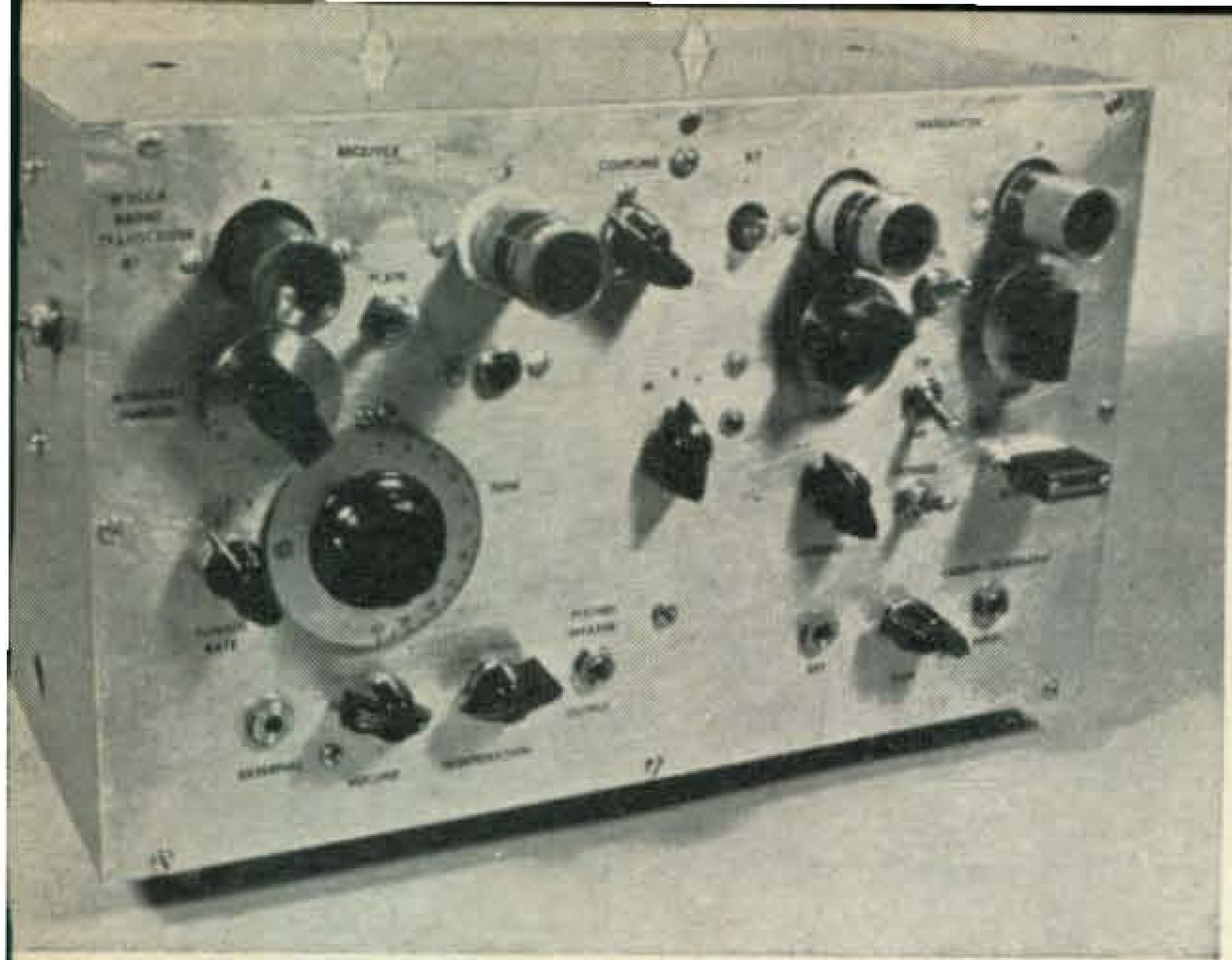
The cord for the lamp socket usually runs through the hollow stem of the lamp; however, using a tube for the stem, the cord has to be run out of the rear of the socket cover and down along the tube. A small hole is drilled in the speaker baffle, just behind the tube, to run this cord through. Cords for the speaker and lamp come out of the rear of the speaker cabinet. A toggle switch was mounted on the rear of the cabinet to turn the speaker off when desired.

To dress up the ham-lamp, a can of spray paint, flat black, was used to finish the wooden cabinet. The speaker grille-cloth happened to be black with gold threads, so an inexpensive gold lamp shade was purchased to top it off. White "Lettraset" lettering, with the OM-XYL call letters, was applied to the front of the glass-tube envelope. To seal the lettering and to give the tube a fancy effect, clear "Krylon" was sprayed on the tube from a distance to get a frosted effect. This keeps the glass tube from reflecting a harsh glare with the lamp turned on.

This particular lamp as shown in the photograph is the one constructed for the living room at WA2GCF-WA2YTK; however, Joan and I now use it to decorate the desk in my study. Other variations of this lamp can be constructed to suit your taste and junk box. This one is shown as an example of what can be done with an old tube. What you do with yours is limited only by your imagination. ■





Front view of the general purpose transmitter-receiver. The receiver section is on the left. Under plug-in coil A (left) we have the two tuning controls and the TUNING RATE switch. Below these are the REGEN and A.F. gain. The receptacles are for phones and an external a.f. input. To the lower right of coil A is S_3 which controls the plate voltage on the receiver section. To the right of coil B is S_1, COUPLING. The T-R switch is below the COUPLING control. In the transmitter section coil D is on the extreme right and beneath it is C_1, DRIVER TUNING. Underneath coil C is C_2 PLATE TUNING, and beneath this is C_3, ANTENNA LOADING. The toggle switches between coils C and D, are, from the top, S_6-TRANSMITTER PLATE VOLTAGE, S_7-C.W.-A.M. and S_8, FINAL CATHODE. The KEY jack, MODULATOR GAIN and MIKE jack are just below. The speaker ports may be seen on the left side along with S_4, the SPEAKER-PHONES switch.

THE SPARE ONE

A General Purpose Transmitter-Receiver

BY ROBERT E. BROWN,* W2CCA

Here is a comparatively simple transmitter-receiver which will cover the spectrum from 10 to 160 meters using plug-in coils. The receiver section can tune down to 14 kc. The rig may be used by Novices without the v.f.o. and modulator sections.

A RECENT purchase of a beautiful s.s.b. transceiver ushered in a new era of enjoyable radio operating for this writer. Never again would I have a room full of electronic boxes connected together with sundry cables when I could accomplish the same thing with such a compact little box. I had, of course, traded in my old faithful general coverage receiver and dismantled the overgrown multi-band transmitter in the interest of neatness and compactness.

The little transceiver which I had purchased was a tri-band unit and although it performed remarkably well on those three bands, I really began to miss some of the other high frequency bands.

The appeal of also being able to listen in on the very low frequencies, the exotic world of NAA, NSS and such, was strong enough to create an urge to design a set of low frequency coils for the regenerative receiver circuit finally decided upon.

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The final design resulted in a little box containing a receiver capable of operating on any frequency between 14 kc and 30000 kc, and a low power transmitter capable of operating on any frequency between 1800 kc and 29700 kc.

Receiver Circuitry

The receiver consists of four stages utilizing three tubes as can be seen by referring to the block diagram (fig. 1) and the receiver circuit (fig. 2). The first stage is an untuned r.f. amplifier using a 12AT7 tube. The second stage uses the pentode section of a 6U8 as a regenerative detector. The third stage makes use of the triode section of the 6U8 as an audio amplifier and the fourth stage uses a 6AQ5 as a power amplifier.

Some wonderment may be expressed at the use of an untuned r.f. stage but it has a very definite advantage when used ahead of a regenerative detector. The r.f. stage used is of the grounded grid type and is quite loosely coupled to the detector. This isolates the regenerative detector from the antenna and in doing so greatly

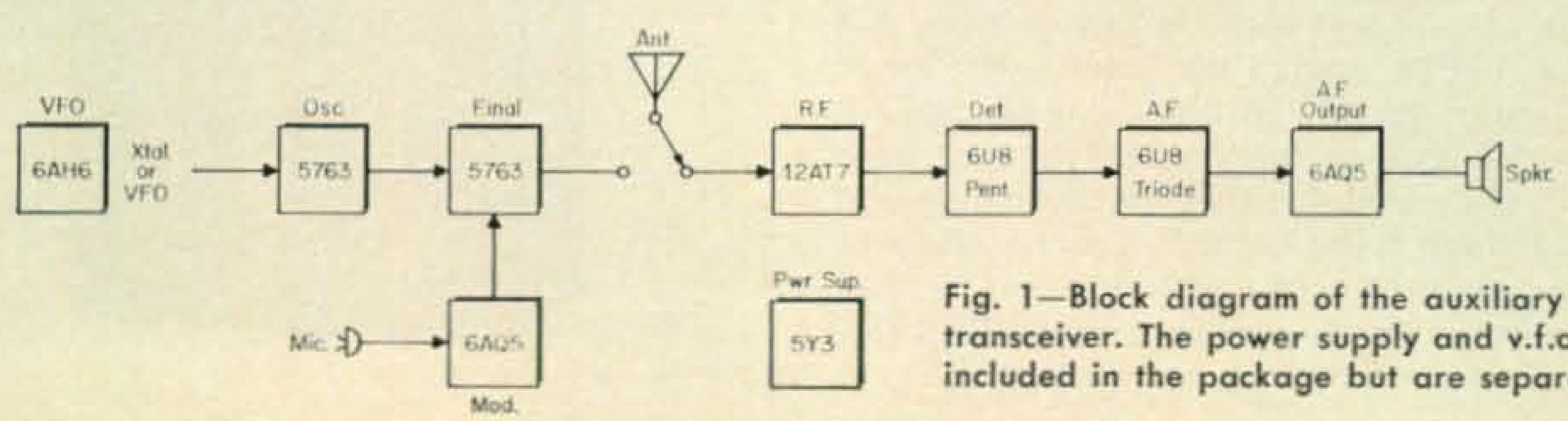
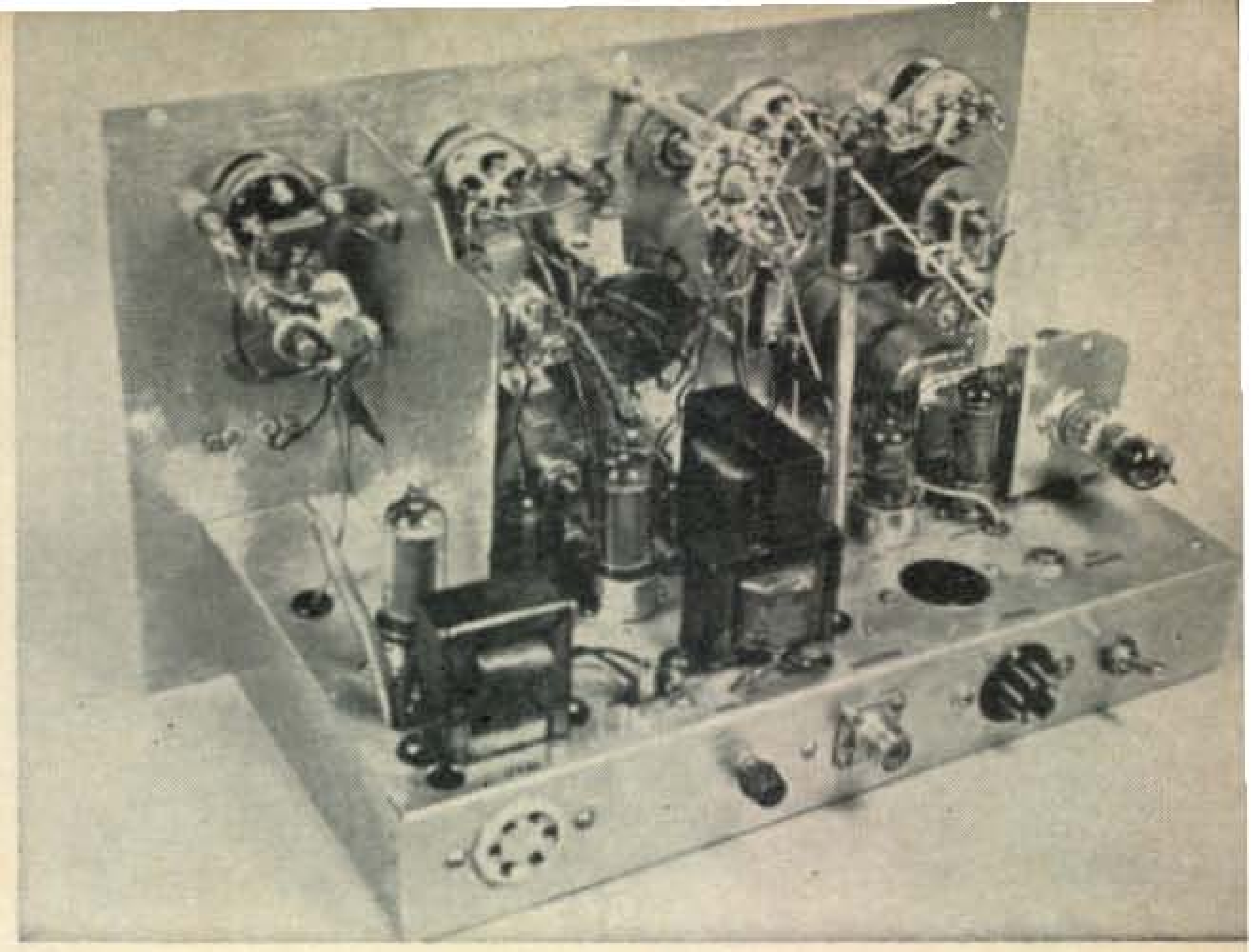


Fig. 1—Block diagram of the auxiliary all band transceiver. The power supply and v.f.o. are not included in the package but are separate units.

Rear top view of the general purpose transmitter-receiver removed from the cabinet. In operation, the cabinet, complete with back panel, should be in place to prevent TVI. The receiver section is on the right with the speaker output transformer, T_1, in the rear center of the chassis above the antenna jack. The mike transformer, T_3, is over the 6 prong v.f.o. socket and the modulator transformer, T_2, is in the center of the chassis. The 8 prong male socket is the power feed and the toggle alongside is the power switch. The speaker jack is on the chassis near the 12AT7 r.f. amplifier (horizontally mounted).



stabilizes its operation. If a regenerative detector is coupled directly to an antenna it is usually plagued by instability and "dead spots" unless it is very loosely coupled which in turn greatly reduces its sensitivity. The r.f. stage can also make use of a loading coil in the input circuit to broadly resonate the antenna on the lower frequencies thereby increasing its effectiveness on these frequencies and reducing the response to strong local broadcast signals. The coupling to the antenna can also be made adjustable at the input of the r.f. stage which will give control over the signal input. These adjustments will have no effect on the tuning of the regenerative detector because of the isolation effect of the r.f. stage. Radiation from the regenerative detector, when it is in an oscillating condition, is also blocked by this r.f. stage. Because of the above reasons it is a worthwhile addition to the circuit.

The regenerative detector is quite conventional. Regeneration is controlled by the potentiometer in the screen circuit of the pentode section

of the detector circuit is the tuning arrangement. Various sizes of tuning capacitors are switched into the circuit by the TUNING RATE switch to provide the proper tuning rate for the band being used. The band desired is chosen by means of plug-in coils.

To insure proper operation of the regenerative detector on each range, the proper tuning rate must be carefully observed. If the wrong tuning rate is used the regeneration control may become very critical in operation as the coils are designed for proper feedback with the tuning rates specified above.

The audio sections of the receiver consist of the triode section of the 6U8 as an audio voltage amplifier and a 6AQ5 as a power output stage.

Transmitter Circuitry

The transmitter consists of a crystal oscillator using a 5763 tube, driving another 5763 as an r.f. power amplifier. As much as 15 watts input can be used on the final r.f. power amplifier without exceeding the plate dissipation. For a.m.

TABLE 1—RECEIVER COILS

Freq. (kc)	L_2	L_3	Short Pins	S_2 Positions
14-30	75 mh RFC (Miller 959)	25 mh RFC (Miller 957)	2 to 3	3
40-80	25 mh RFC (Miller 957)	10 mh RFC (Miller 956)	2 to 3	3
85-150	10 mh RFC* (Miller 4540)	*	2 to 3	3
150-350	2.5 mh RFC* (Miller 4537)	*	2 to 3	3
350-750	1.5 mh RFC* (Miller 4532)	*	2 to 3	3
550-1650	85 t. #36 e. centertap	10 t. #28 e.	None	2
1600-5000	26 t. #28 e. centertap	4 t. #28 e.	None	2
5000-12000	15 t. #28 e. centertap	3 t. #28 e.	None	1
12000-20000	7 t. #28 e. tap at 2 t.	2½ t. #28 e.	None	1
20000-30000	3 t. #28 e. tap at 1 t.	1½ t. #28 e.	None	1

NOTES: All coils are close-wound on 1" dia. 5 prong plug-in coil forms. Where r.f. chokes are employed, they are mounted within the form and cemented in place. Pin connections are made as indicated in fig. 2. *Use all but one pie of choke for grid coil L_2. Remaining pie is wired as tickler coil.

lator. The Triad transformer specified was designed for this application and is a form of autotransformer. It also contains a voice coil winding so that, if desired, the modulator section of the transmitter can be connected to a speaker and used as a small p.a. system. The input transformer to the grid of the modulator is a unit with a high turns ratio and with a good single button carbon microphone (preferably a type F3) very excellent modulation is obtained. The d.c. to operate the carbon microphone is obtained from the cathode circuit of the 6AQ5 modulator.

The antenna circuit is designed to feed a nonreactive load of 50 or 75 ohms.

Plug in coils set up the transmitter for any frequency between 1800 kc and 29700 kc. For straight through operation on 160, 80 and 40 meters it is not necessary to use a coil (L_6) in the plate circuit of the oscillator as fundamental crystals will be used on these bands in all likelihood and sufficient excitation will be available. The 40 meter oscillator plate coil is used when the final is tuned to 20 meters. The final will then be operating as a doubler. Since the final is not neutralized it may not be advisable to operate it on the same frequency as the oscillator plate. When operating on 15 meters a crystal with a fundamental in the 80 meter band can be used. The oscillator plate coil will tune to triple the frequency and the final will double. For 10 meters, a 40 meter crystal should be used. The frequency will be doubled in the oscillator and again in the final.

The neon bulb indicator in the plate circuit will glow brightly when the final is resonated to the operating frequency and will dim slightly from that brilliance as the final is loaded by the antenna circuit. The brightness will again increase slightly as modulation is applied. When the final is being used as a doubler and there is a coil in the plate circuit of the oscillator the neon bulb will glow brightest when the oscillator plate is properly tuned. Thus it makes a very useful tuning aid.

Construction

The unit is mounted in an aluminum cabinet 15" wide, 7" deep by 9" high. A 14 × 7 × 2 inch chassis is bolted to the panel about ½" from the panel bottom.

Placement of the parts is not too critical but try to keep all r.f. leads as well as all grid wiring as short as possible. A shield is placed between the oscillator and final of the transmitter in the interest of stability. The photographs are more eloquent insofar as construction and layout is concerned. There is room for improvement in the layout.

Coil Data

Most of the coils are wound on 1 inch diameter coil forms so the coil sockets can be mounted ½ inch or so behind the panel. The only exception is the coil socket for the detector coil (B) which should be mounted flush with the panel as the low frequency coils for the receiver must be wound on larger forms.

TABLE II
TRANSMITTER OSC. COILS

Output Freq. (mc)	Osc. Plate Freq. (mc)	L_4	Crystals
14.0-14.35	7.0	17 t. #20 e.	80 m or 40 m
21.0-21.45	10.5	10 t. #20 e.	80 m
28.0-29.7	14.0	7 t. #20 e.	40 m

For 160, 80, and 40 meter operation, L_4 is not used. All coils are close-wound on 1" diameter 5 prong forms.

TABLE III
TRANSMITTER R.F. PLATE COILS

Freq. (mc)	L_5	L_6
1.8-2.0	48 t. #28 e.	24 t. #28 e.
3.5-4.0	22 t. #28 e.	12 t. #28 e.
7.0-7.3	13 t. #20 e.	6 t. #20 e.
14.0-21.45	5½ t. #20 e.	3 t. #20 e.
28.0-29.7	2½ t. #20 e.	2 t. #20 e.

All coils are close-wound on 1" diameter 5 prong forms with L_5 and L_6 spaced ⅛" apart.

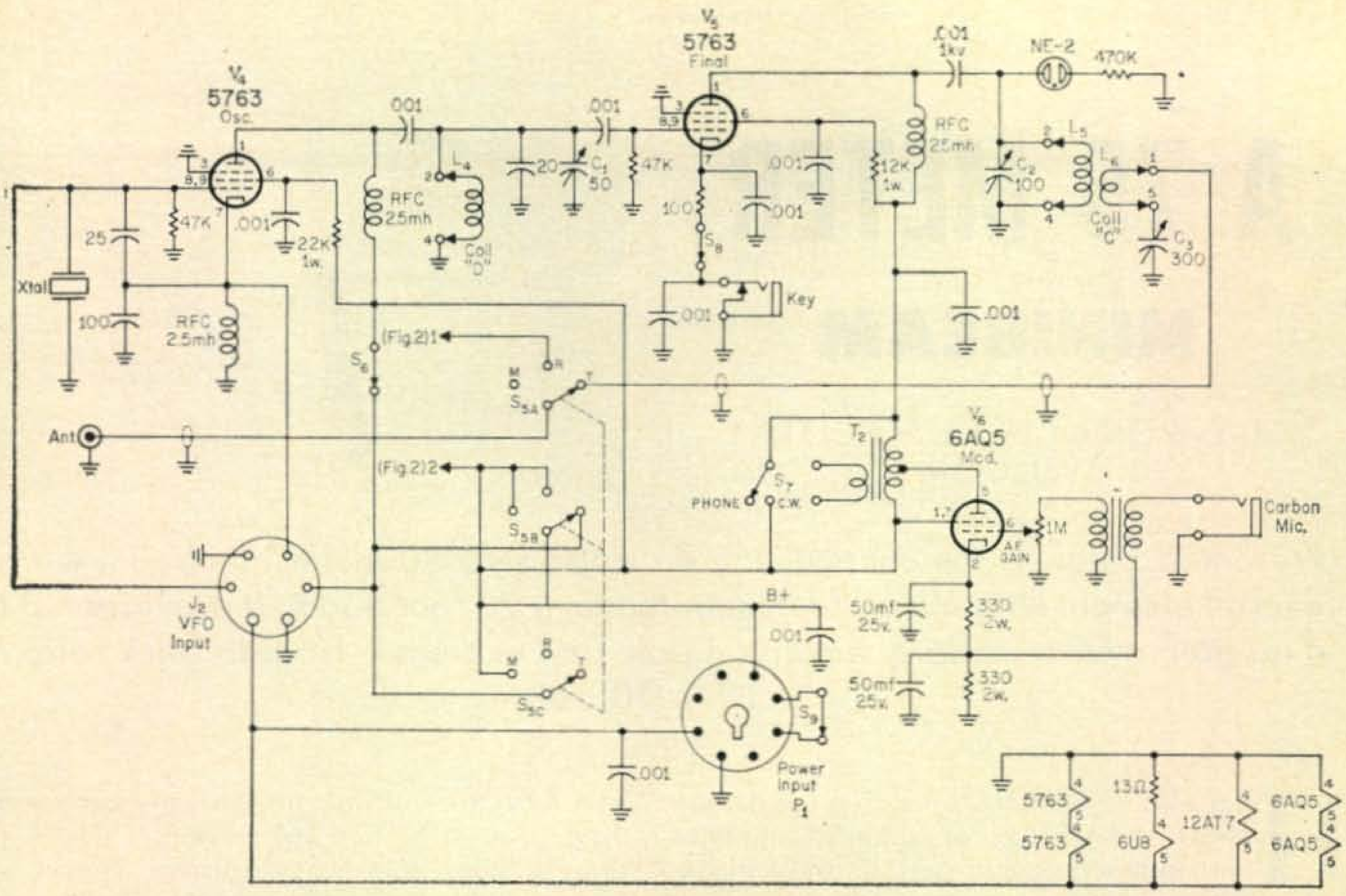


Fig. 3—Circuit of the transmitter section of the auxiliary transceiver. The M position on the T-R switch (S_5) is for monitoring as explained in the text. Also explained in the text are the functions of S_5 and S_7. Capacitors marked SM are silver micas and those polarized are electrolytics. Values less than one are in mf and those greater than one are in mmf. All except electrolytics and silver micas are 500 volt ceramic units. All resistors are ½ watt unless otherwise noted. T_3—Mike trans., Triad A-5X or equiv., T_2—Mod. trans., Triad M-4Z or equiv.

The low frequency coils for the receiver are made up of readily available r.f. chokes. These can be mounted inside of large 1½" diameter 5 prong coil forms or they can be mounted on standard 5 prong plugs or cable connectors. If they are mounted on plugs or cable connectors stiff wire leads should be used to make the connections and the whole assembly covered with plastic tape to eliminate any exposed connections.

The two lowest frequency coils use large pie wound (single pie type) r.f. chokes for both the grid coil and the tickler coil. It is important that the windings on both chokes run in the same direction so it might be advisable to use chokes made by the same manufacturer for both windings. They should be mounted in the same plane and they can be cemented together or held together by an aluminum or brass bolt. For proper feedback and control of regeneration the coils must be properly polarized. If oscillation cannot be obtained, the connections to the one winding should be reversed.

If the exact values called for in the coil data chart are not obtainable the nearest value should be used. It will change the tuning range somewhat but if the available r.f. choke is slightly smaller than the indicated value it should not make too much difference. In the case of the grid coil on the lowest frequency band it is not advisable to use an inductance lower than 70 mh or the receiver will not reach down to the real low end of the spectrum. If a 70 mh choke is used in place of the one called for it may be necessary to place a padding capacitor across the grid winding to get down to the desired frequency. The other low frequency coils are

[*Continued on page 105*]

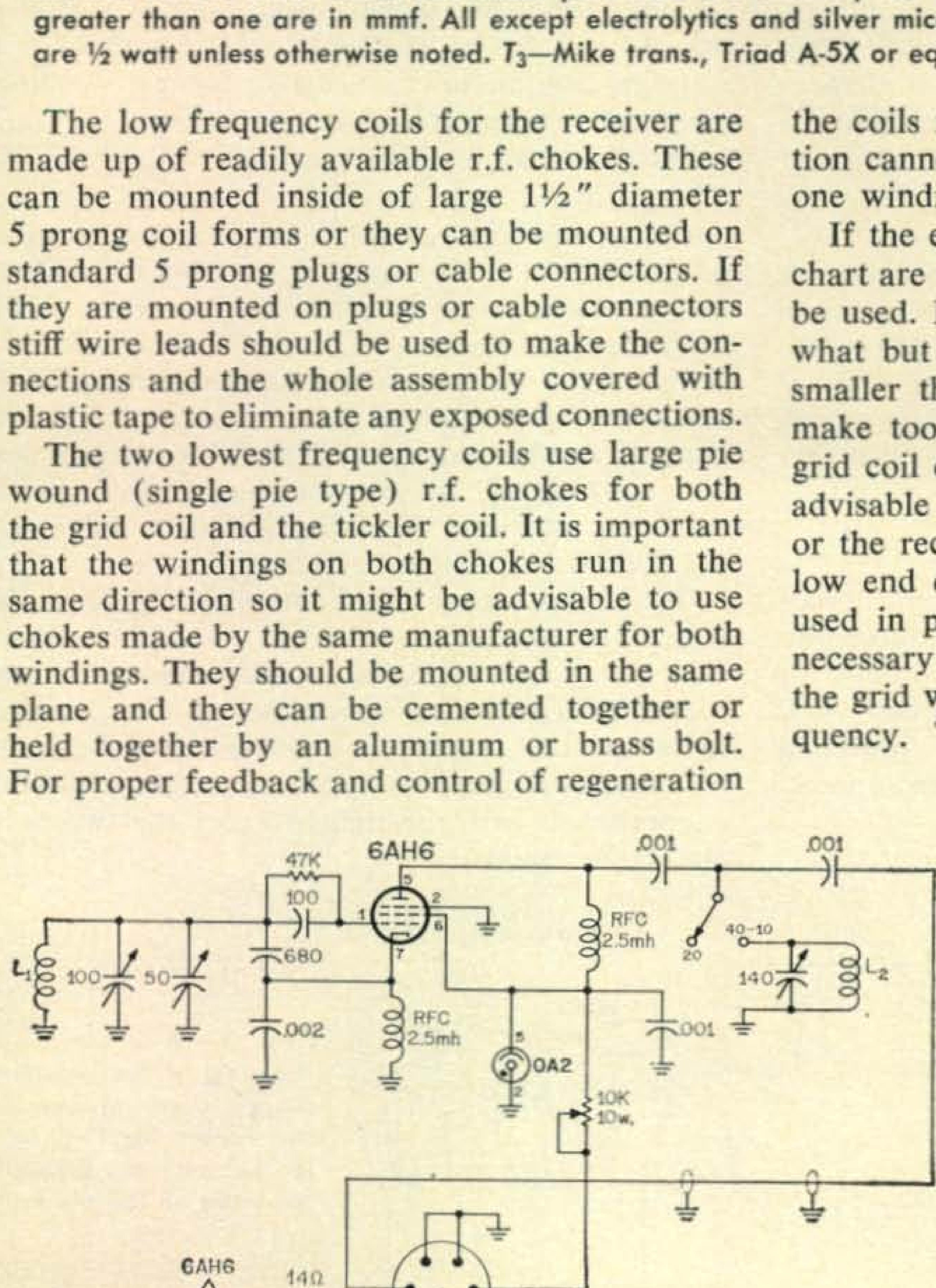
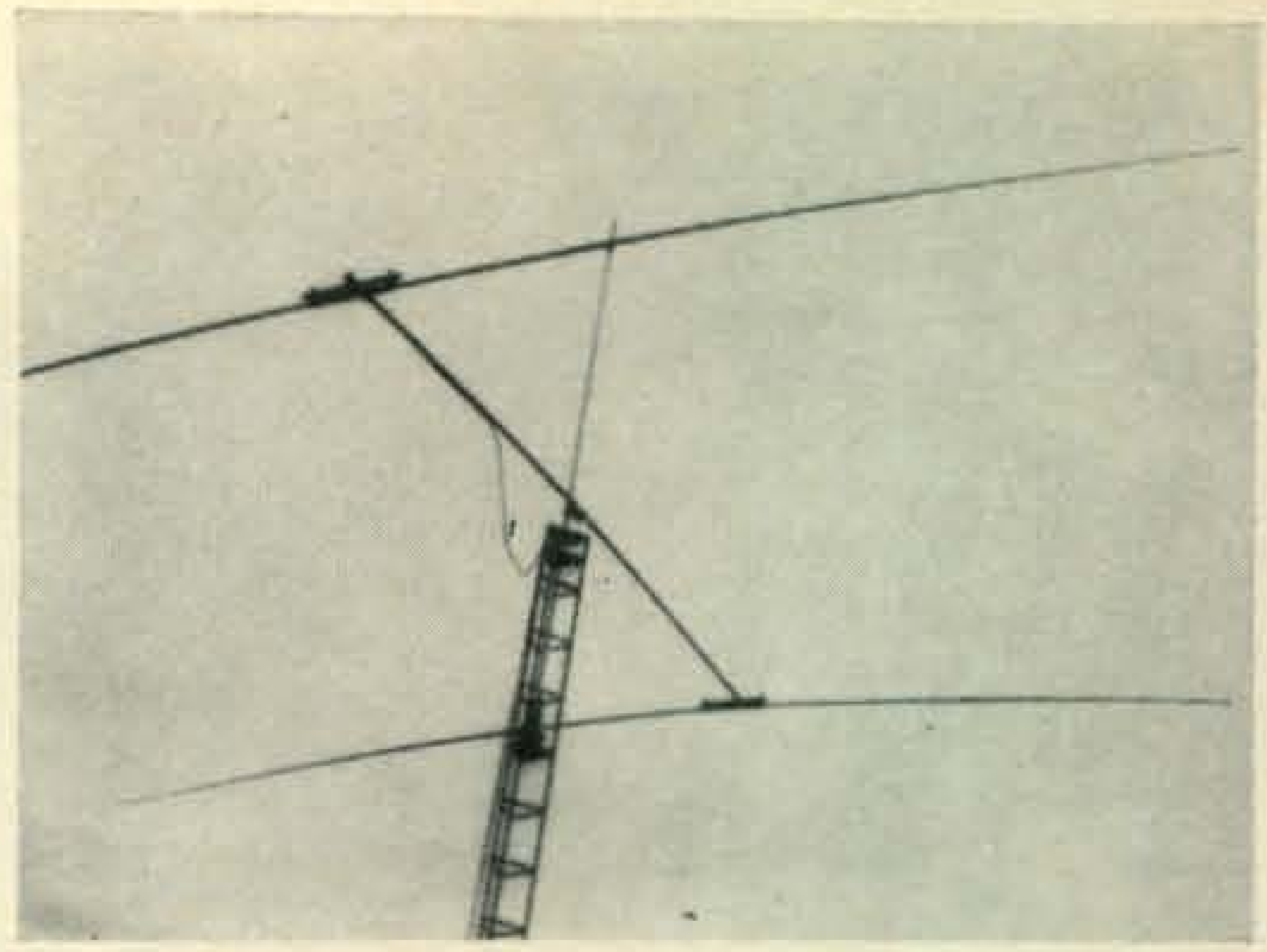


Fig. 4—For those who don't like rock bound operation the v.f.o. shown above will feed the transmitter section of the transceiver.

L_1—20t #24, ¾" dia., ⅝" l. B&W #3012.
L_2—26t #24, 1" dia., ¾" l. B&W #3016.



View of the completed 75 meter minibeam mounted atop the tower.

A 75 METER
MINIBEAM

BY RONALD LUMACHI,* WB2CQM

Presented below is the construction data for a 75-80 meter minibeam whose overall element length is 36 feet mounted on a 20 foot boom. It provides a 3 to 4 db gain over a similarly located dipole and exhibits a front to back ratio of 18 to 20 db.

High gain 75-80 meter operation has always been the product of a linear amplifier in conjunction with some form of dipole antenna. Where erection area is of little concern, long wire or fixed directive arrays are employed with success. However, in the normal situation a rotatable directive array in this amateur band segment has not been attempted. The following text discusses the construction of a two element antenna system featuring ease of construction, a degree of gain and directional properties, minimal costs, and above all an element spacing and breadth no larger than a 14 mc beam.

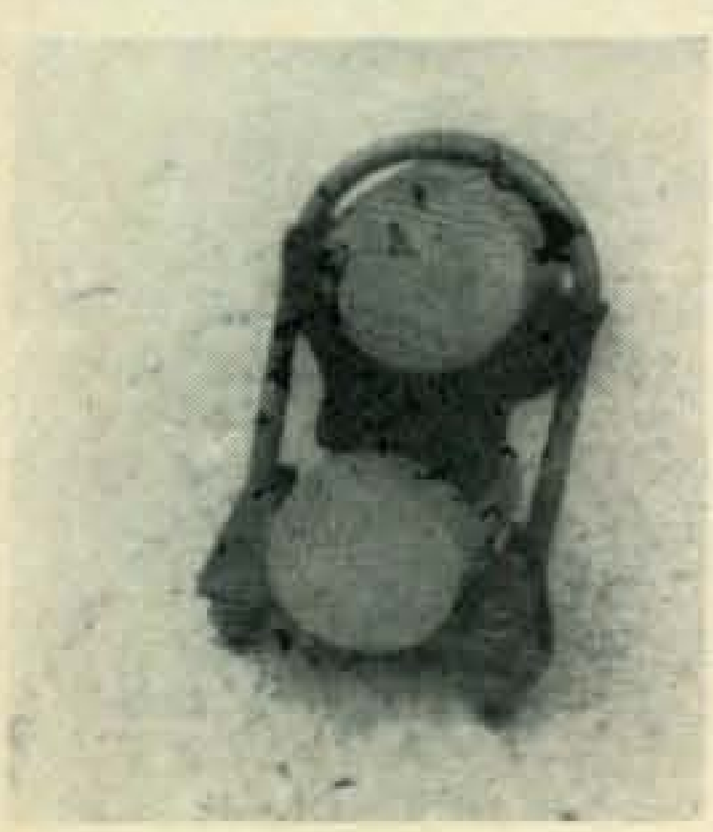
This two element minibeam features complete homebrew construction technique. The antenna is a parasitically phased, center loaded, inductively coupled, horizontally planed yagi exhibiting a minimum of 3-4 db gain over a similarly placed dipole standard. Front-to-back ratio registers a comfortable 18-20 db factor.

Coil Construction

The key to any shortened antenna is the choice of a suitable coil and resultant Q for maximum bandwidth and power transfer. The two coils for this beam are hand wound at the center of a length of 1⅝" wooden dowel and insulated above the ground potential of the boom support. The reflector and director coils are each wound 9 t.p.i. for 16½" and 16" respectively (c.w. portion) utilizing #14 heavy Formvar copper wire. In order to minimize inductive changes, treat the wood with a thinned varnish or shellac material to close off the wood pores thus preventing water accumulation. Six inches from each end of the dowel, turn down the wood to 1⅛", either on a lathe or circular saw in order to form the rolling pin coil support component. Shape the four standoffs from a small piece of ¾" plywood. This unit not only serves as a support for the entire antenna, but allows for sufficient clearance of thet lower dowel support and boom-to-mast fitting. This component is the Nu Rail #10 aluminum cross (1¼" × 1¼") which is designed for 1¼" pipe (i.d. measurements, 1⅝" o.d.) It is mounted at the center of the lower support dowel and secured with its integral set screws. In order to prevent burrowing, slip a thin strip of metal between the wood and locking screws before final tightening.

The U clamps are the popular Cesco units which are designed for 1½"-2" boom diameters. The lower locking collar is a component from the standard 1¾" automobile muffler clamp. Once the coil is properly formed and the wire wound on the support this area of construction is completed with the tightening of the two collar arrangements.

*73 Bay 26th Street, Brooklyn, N.Y. 11214.



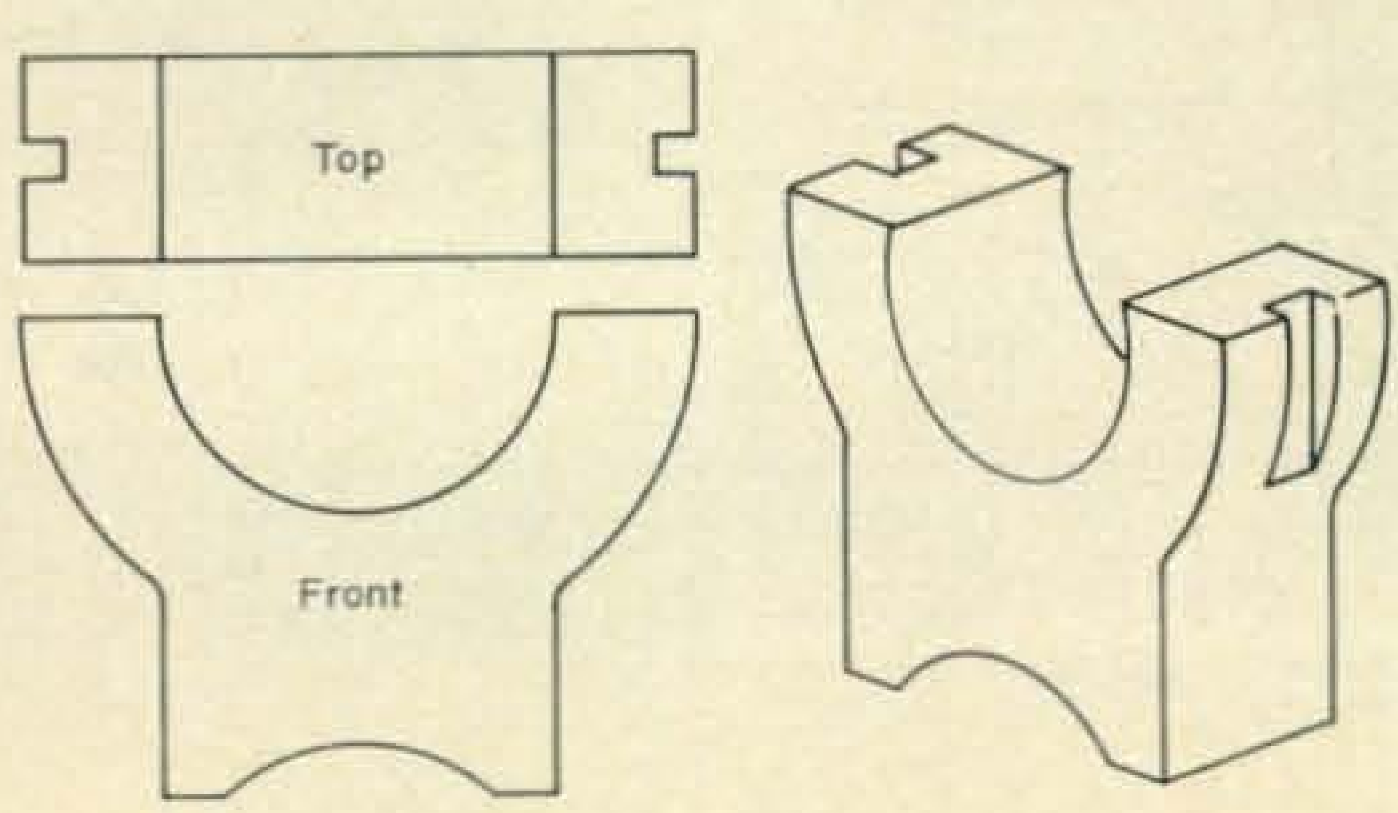
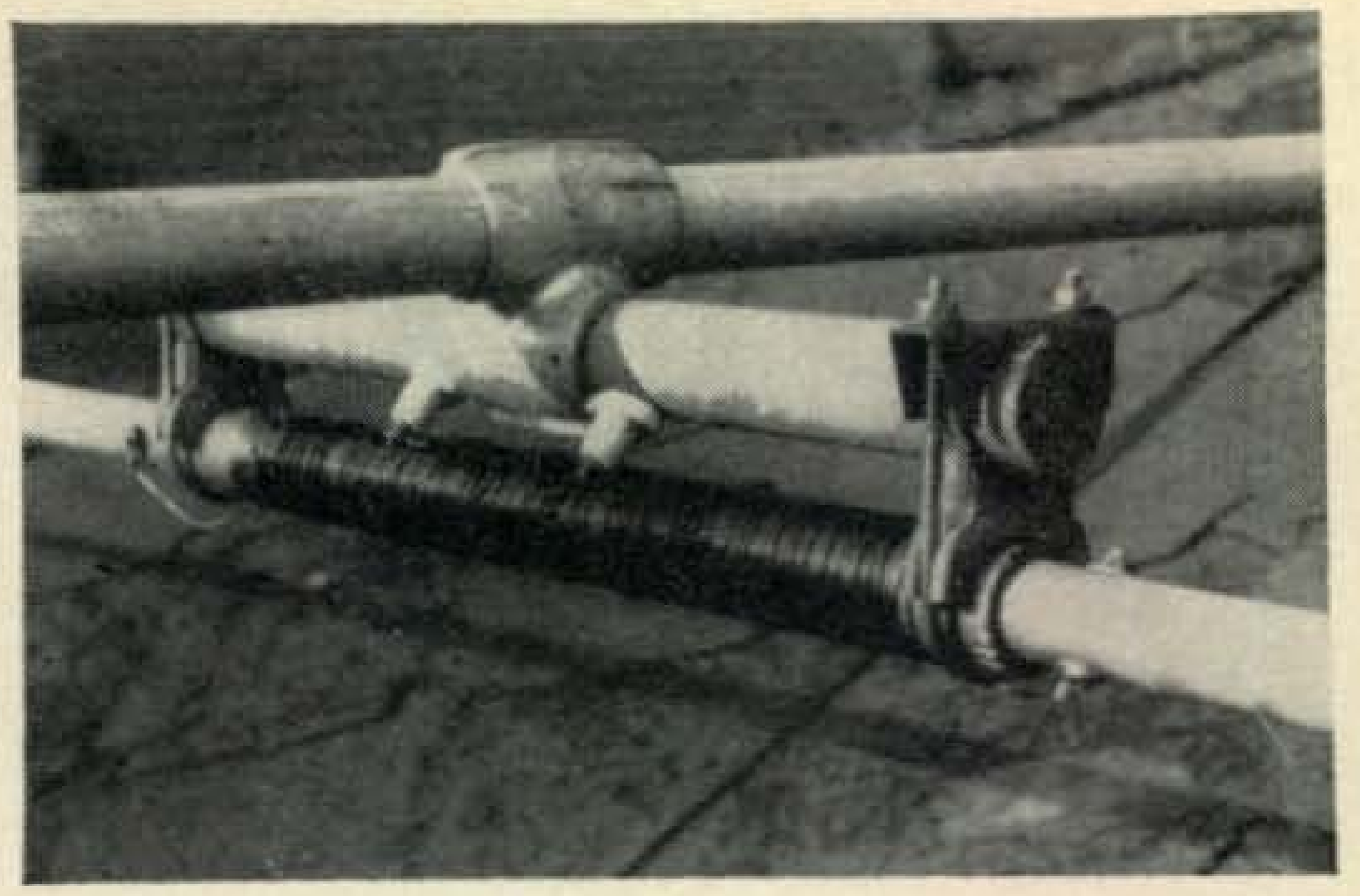


Fig. 1—A view and drawing of the wooden blocks used to secure the center loading coil to the antenna support mounted on the Nu Rail cross.

Freq. (kc)	Coil Length	
	Director	Reflector
C.W. 3710	16"	16½"
A.M. 3870	15"	15½"
S.S.B. 3980	14½"	15"

Coil winding chart. All coils are wound at 9 t.p.i. with #12 copper on a 1⅝" diameter wooden dowel.



Close up view of the coil construction for the driven element of the 75 meter minibeam. The reflector construction is the same except for the coupling link and the stand off insulators.

Element Construction

Element design admittedly presented some degree of concern. The entire antenna had originally been constructed as a center loaded wire beam and the bandwidth suffered greatly due to the narrow band characteristics of the wire supported at the horizontal plane. Each end of the coil had been series connected to a 13' length of wire taped to the outside of a hollow length of fibreglass and measurements taken at about 25-30' above ground. Input impedance was extremely high, however, experiments with a suitable inductive match arrangement lowered the radiation resistance to a tolerable point. After a while it became apparent that the *narrow bandwidth*, not the impedance, was the difficulty to overcome.

In order to lower the Q to provide a wider bandwidth it was necessary to install a 5' length of standard 1¼" TV masting in series with the dowel end of the coil support. The 1⅛" end diameter of the dowel accepts the tubing with a force fit. Drill a ¼" hole through the mast and dowel and install a 1½" × ¼" brass nut and bolt combination. This will bind the dowel support to the mast and will provide the series tie point betwen the coil ends and the aluminum tubing.

At the swaged end of the aluminum tubing, slip on the hollow base end of the fiberglass pole. Drill a small hole for a self tapping screw and connect the length of wire taped to the fibreglass at this tie point. Solder lugs are best at these connections. The 13' and 5' combination completes the construction of one-half a radiating element. The remaining elements are designed in exactly the same manner and dimensions.

Frequency juggling is more simply carried out by altering the number of turns in the coil rather than adjusting element lengths. Consequently the reflector element with the 16½" coil at 9 t.p.i. resonates the antenna for operation at about 3710 kc and no additional adjustment is necessary. All movement upward from this point is therefore carried out at the driven element coil form by simply removing turns of wire or shorting across the unwanted sections. Operation in the c.w. portion of the band requires about 16" of coil whereas s.s.b. operation at about 3970 kc and upwards necessitates removal of coil to about 14½". Refer to the coil length chart for other element relationships.

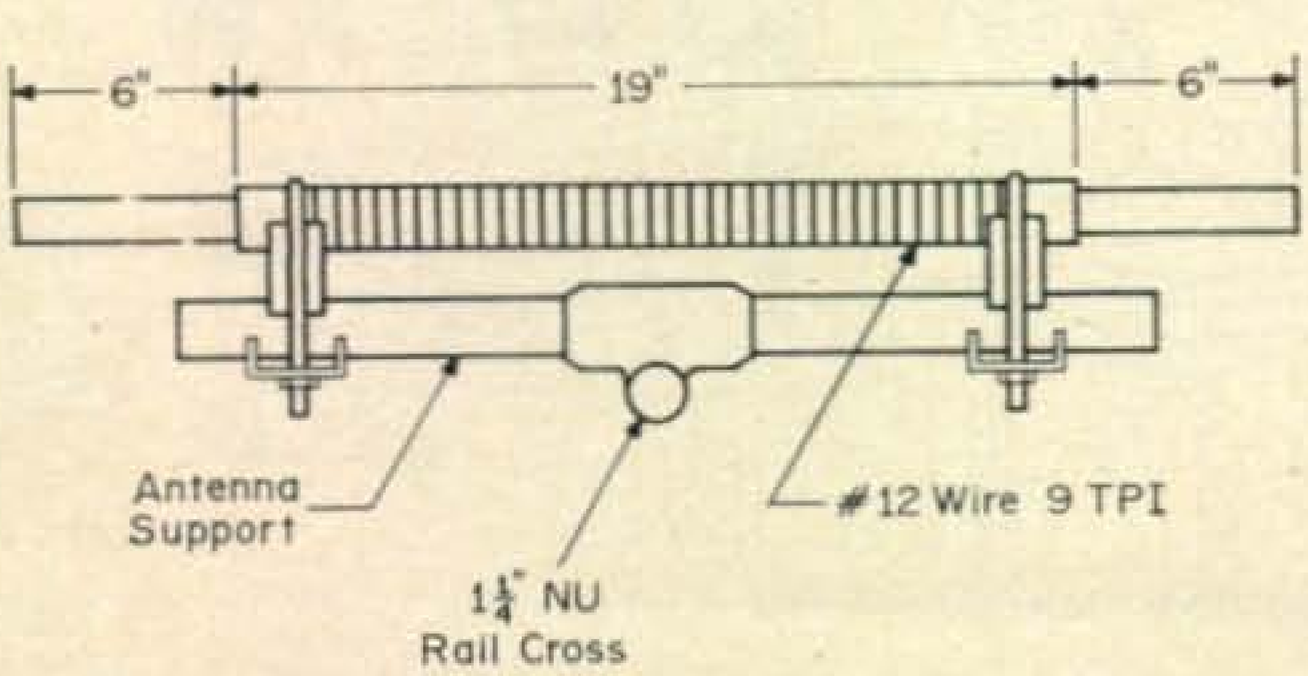


Fig. 2—Coil form and support assembly dimensions.

A one turn insulated link over the coil provides a 50-60 ohm transmission line terminus. Mount a pair of porcelain standoffs on either side of the NU-Rail cross to tie the antenna-transmitter connections together. It might also be advantageous to wrap the coil in plastic tape for protection against weather. This will also serve as an additional insulator between the inductive link and the coil form in the event of an abnormal transient voltage developing at this high current point.

A boom length of 20' provided the element spacing.

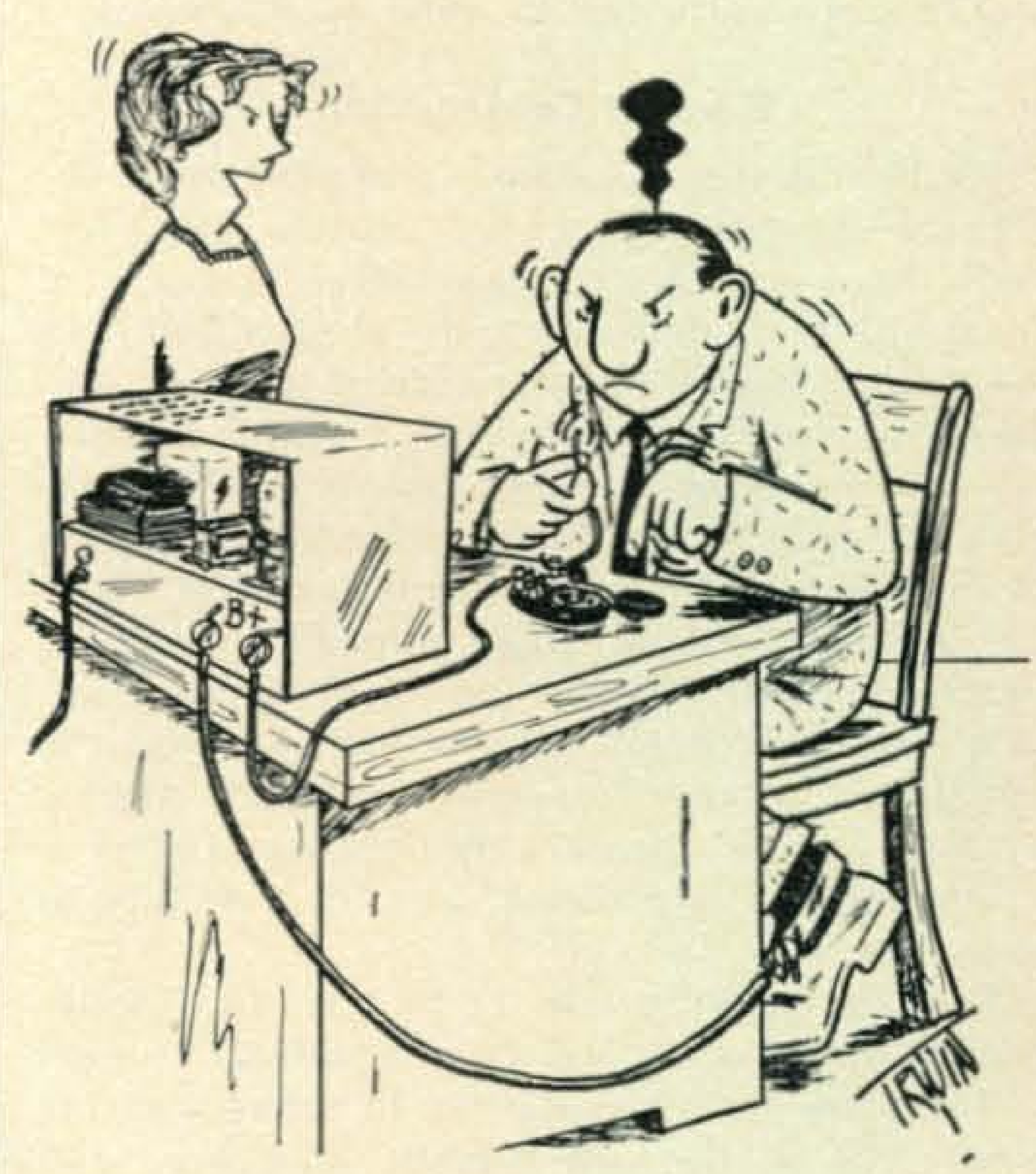
Installation

Height above ground is the most critical feature in this project and its importance is stressed. For example, the reasonable proximity of ground potential can add sufficient inductance to alter

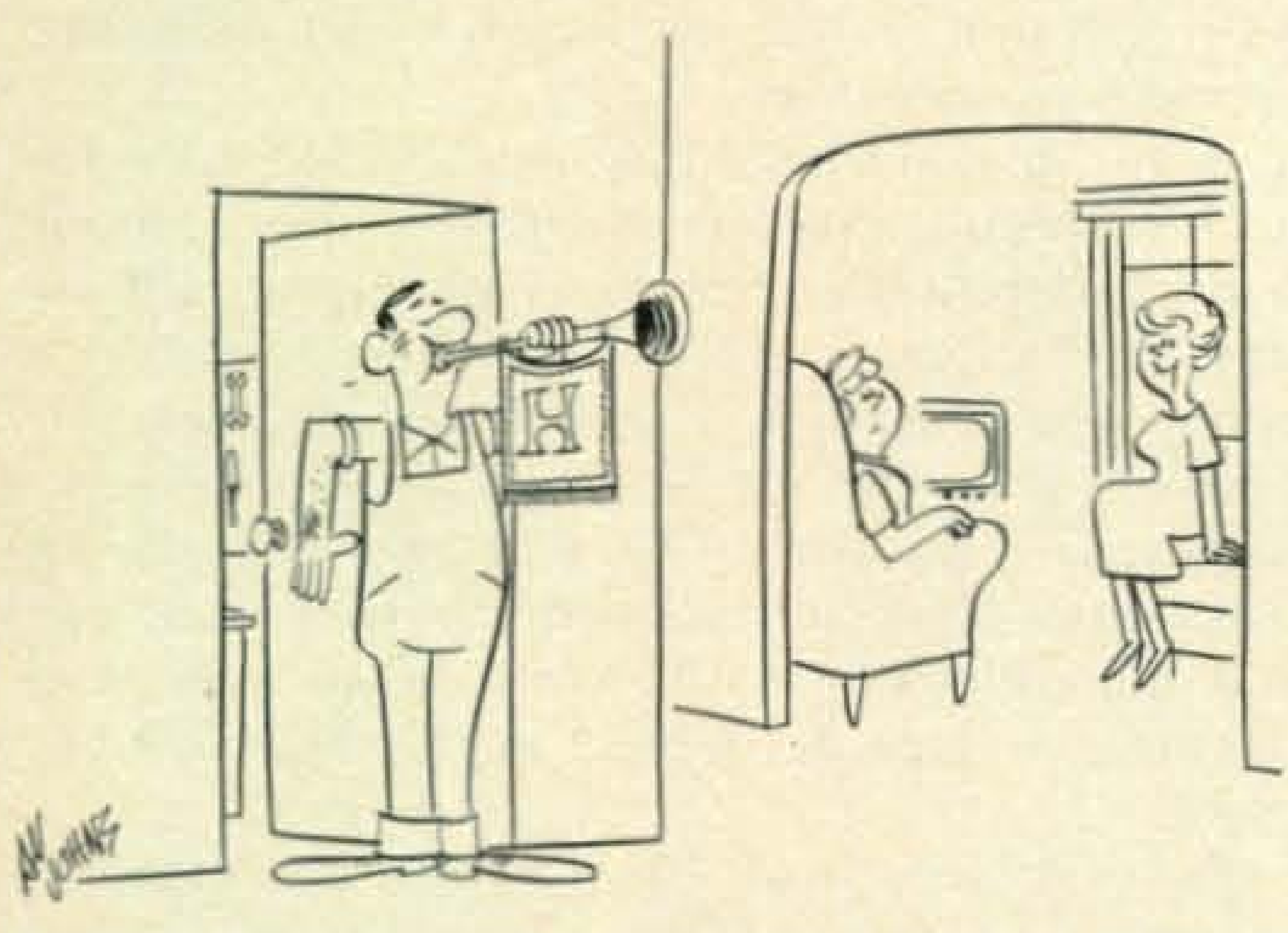
[*Continued on page 106*]

Parts List

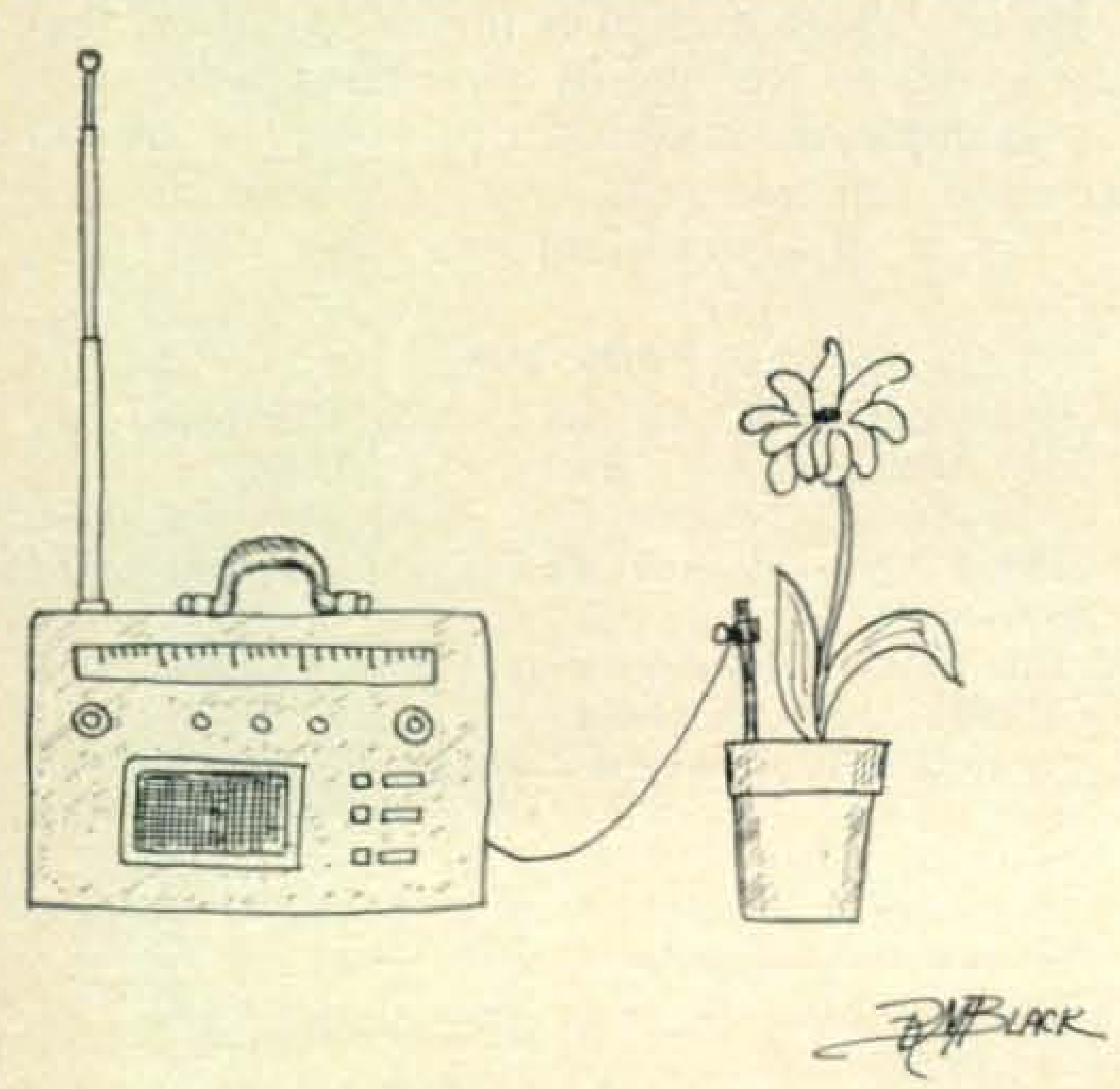
- 4—Fiberglass poles, 13' long. (U.S. Fiberglass Co., 5101 NW 36th Ave., Miami, Fla. 33142.
- 4—5' lengths of TV mast, 1¼" heavy wall aluminum. (18R3618W, Lafayette Radio, 111 Jericho Tpke., Syosset, N.Y.)
- 1—1 lb. spool of heavy duty Formvar copper wire (32R3082, same as above.)
- 2—Nu Rail #10 aluminum crosses, 1¼" × 1¼". Hollaender Man. Co., 3481 Spring Grove Ave., Cincinnati 23, Ohio.
- 4—Cesco size A U bolts (1½ to 2" boom). Continental Electronics & Sound Co., Dayton, Ohio.
- 4—Muffler clamps, 1¾" (only lower clamps used).
- 6—¼" solder lugs.
- 1—9' length of 1⅝" wooden dowel.



"Oh, for heavens sakes, George . . . you'd think you were the only person to ever flunk a code test!"



"I think Harry's completed something in his workshop."



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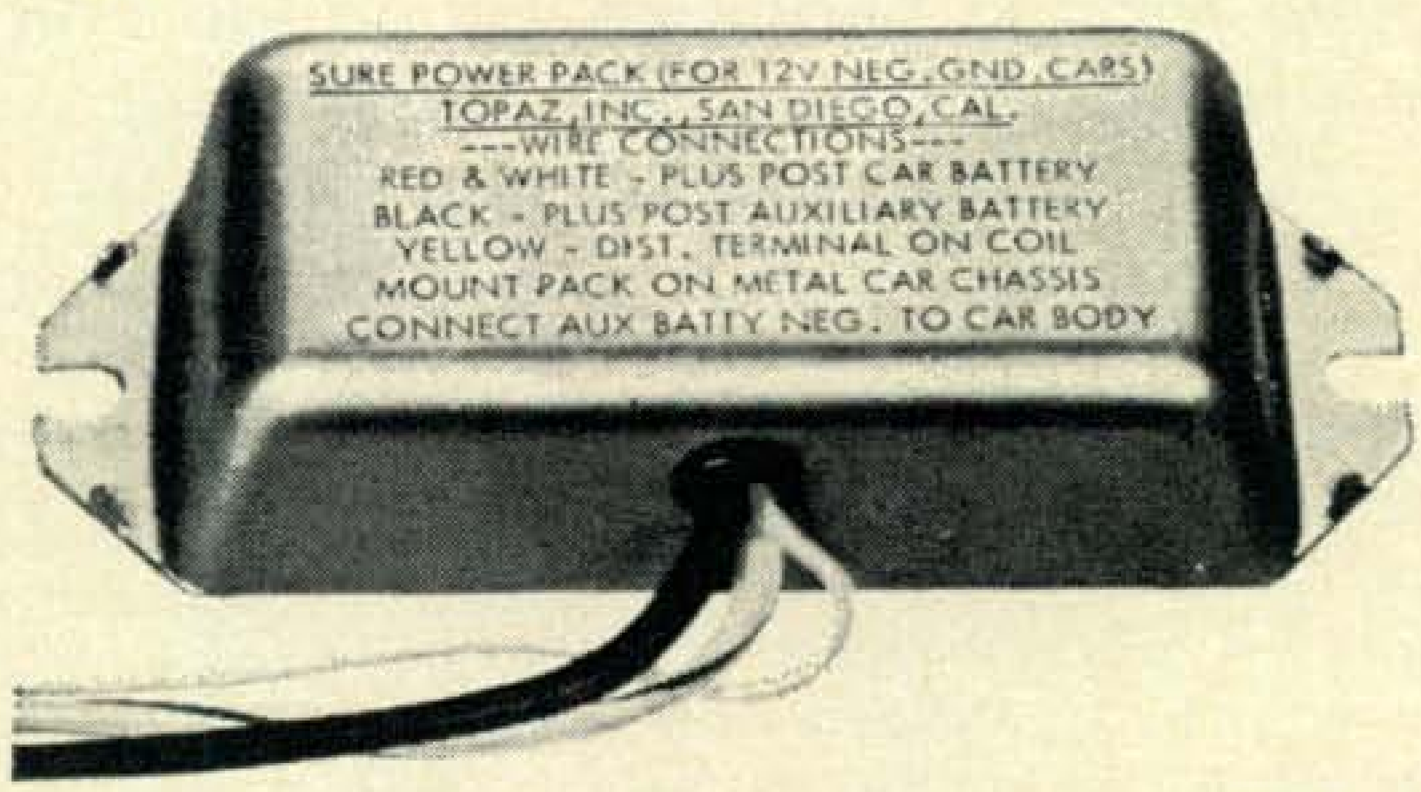

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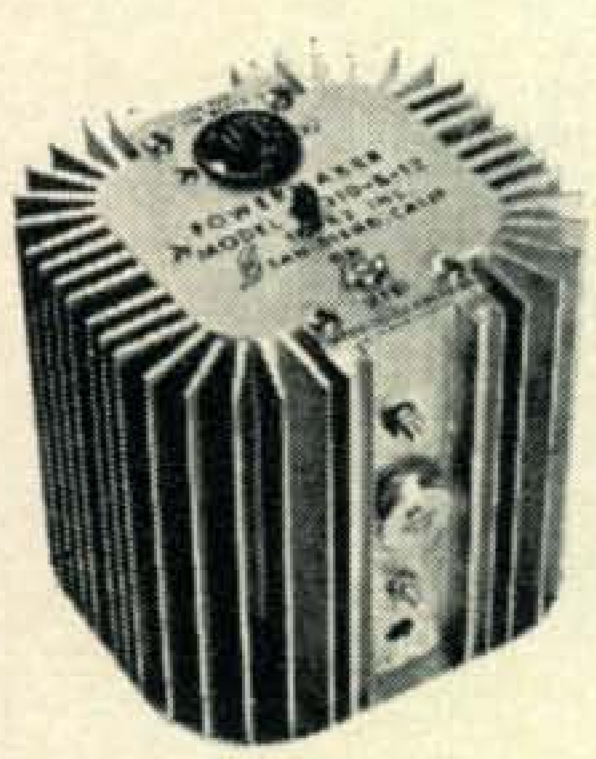

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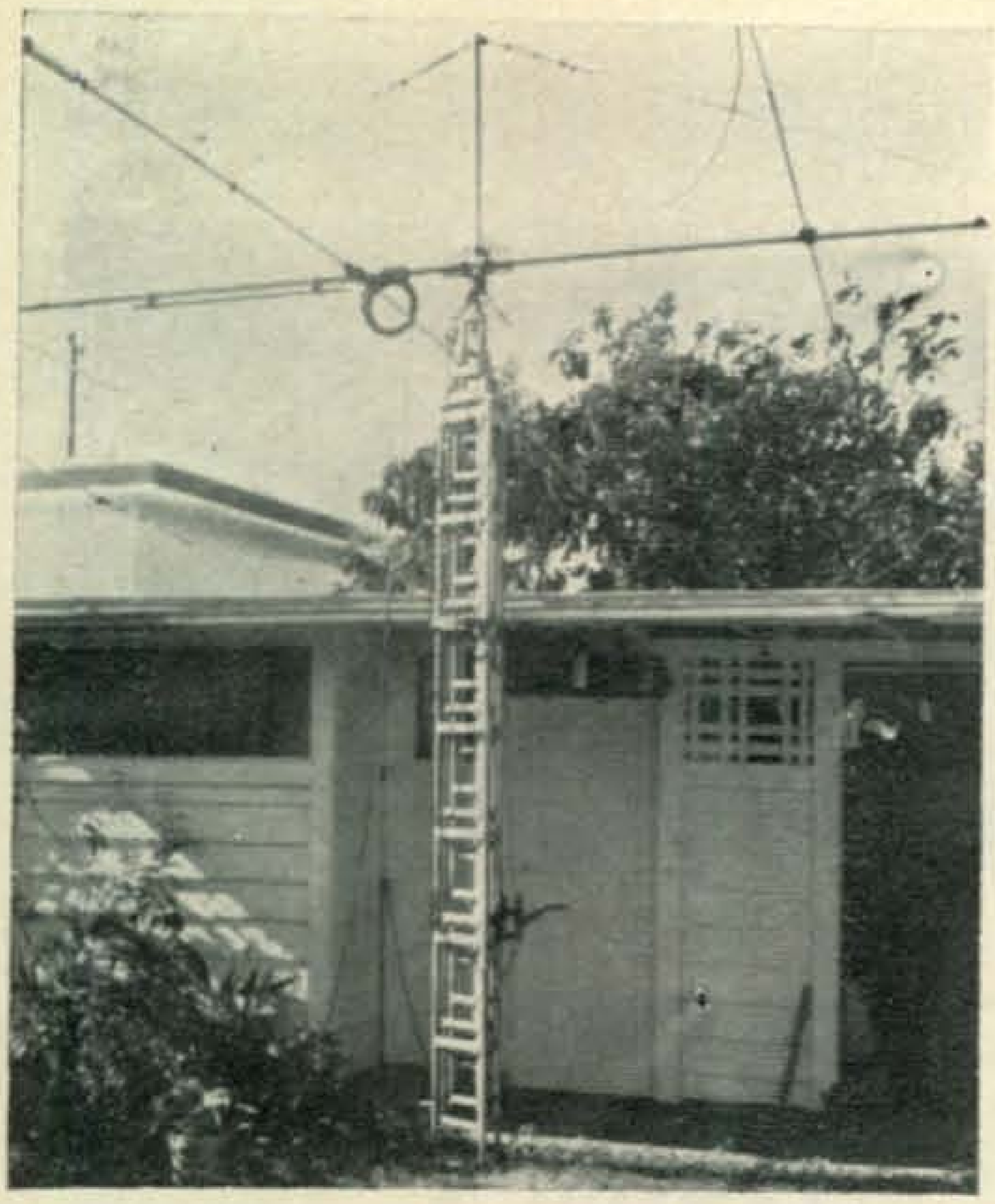


View of the tower cranked down and "snug as a bug in a rug."

A CRANK-UP ROTATABLE TOWER

BY KATASHI NOSE,* KH6IJ

This simple crank up tower requires no direction indicators and no rotator. The 10-15-20 meter triband beam mounts on top and the guys are used for inverted vees, one for 40 and one for 80. The tower can be gamma matched and used for 160 meters.

A CITY dweller living on a 5000 square foot lot and a rented house is not too anxious to pour 27 cubic feet of concrete for footing and guy anchors for his crank-up tower. However, if you limit your height to a reasonable 40 feet, you can get by without concrete footings or elaborate guy anchoring systems. If you are in the 71 foot class, this article is not for you.

The writer has completed the cycle from 30 foot wooden poles[1], to 90 foot telephone poles with tracks running up the side and motorized winches and selsysns, and is now back to a hand rotated crank-up tower with the eyeball for an indicator.

Rotatable Tower

By using a lightweight tower, there is no necessity for an elaborate guying system with its isometric exercise like stresses. Also, if you don't mind pulling on ropes through an open window, you can eliminate, rotor, control cable and indicator.

The secret is to use at least four guy wires, not the conventional three, sloping no more than 45°, and keeping just enough tension to hold the tower upright. By using only one set of guys at the top, fastened to a rotating ring, and resting the tower on a greased peg, one can rotate the whole tower.

Top Guy Ring

It was with some apprehension that the writer used a TV rotating guy ring at the top of the tower, but after a year and half of use, the guy ring shows no sign of deterioration or wear.

The guy ring floats on an enclosed ball-bearing, is made of non-corrosive aluminum and is

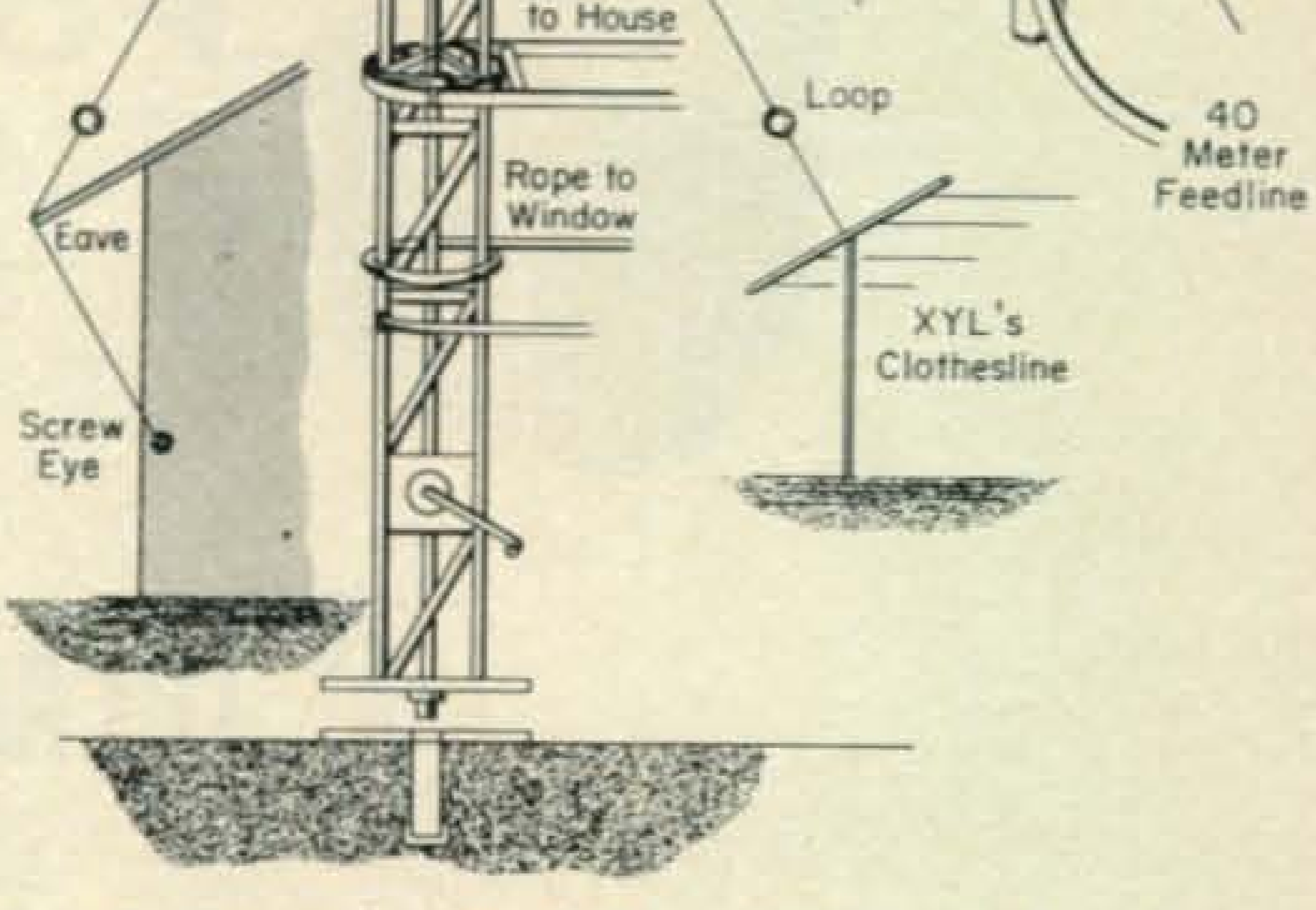


Fig. 1—General view of the rotatable crank-up tower. Directional control is by rope through a window. Four guy lines hold the tower steady when it is cranked up and serve as inverted vees if desired.

*c/o Dept. of Physics, University of Hawaii, Honolulu, Hawaii 96822.

[1]Nose, K., "A 40-Pound 14-Mc. Four Element Beam," *QST*, Dec. 1947, p. 35.

manufactured by the Channel-Master Corp. The catalog listing is "#9525 Ball Bearing Guy Ring" and sells for $5.95 list.

Rotating Tower Ring

Reference to fig. 1 and fig. 2, shows a circular ring cut from a large diameter pipe. It has been turned on a lathe to smooth the inside, arc-welded to brackets and fastened to the eaves or side of the house with lag bolts or carriage bolts.

If this large diameter pipe is unavailable, you can use a discarded flywheel gear obtained from an auto junk yard. It works just as well, only you will not have much leeway in height during installation. The casters must be of the non-swiveling type. An elongated hole either on an auxiliary mounting plate or the base of the caster housing enables you to position the tower within the tower ring for a snug fit.

The ring diameter is chosen so as to enable three casters to be fitted into the space as indicated. This ring is of importance only while erecting the tower or when it is in the cranked-down position. In a Field-Day installation, the ring can be eliminated if there are enough hands to keep the tower upright and if some help is available to pay out the guy wire as needed.

Base Pin and Plate

Figure 3 shows the bottom base plate which is a piece of ¼" steel plate (any shape) to which a 1½" pipe is welded and end capped. A peg with a shoulder must be machined, drilled and tapped as shown. It would be wise to taper the peg slightly to allow for slight misalignment. A thrust bearing using ball bearings was kept on hand but it was not found necessary. After a year and half of constant use the antenna still turns easily.

Fortunately, most tower baseplates already come with a hole at the center of the triangular base plate, and the screw size drilled and tapped in the center of the peg is therefore governed by the size of the hole provided. (It may be enlarged if necessary.)

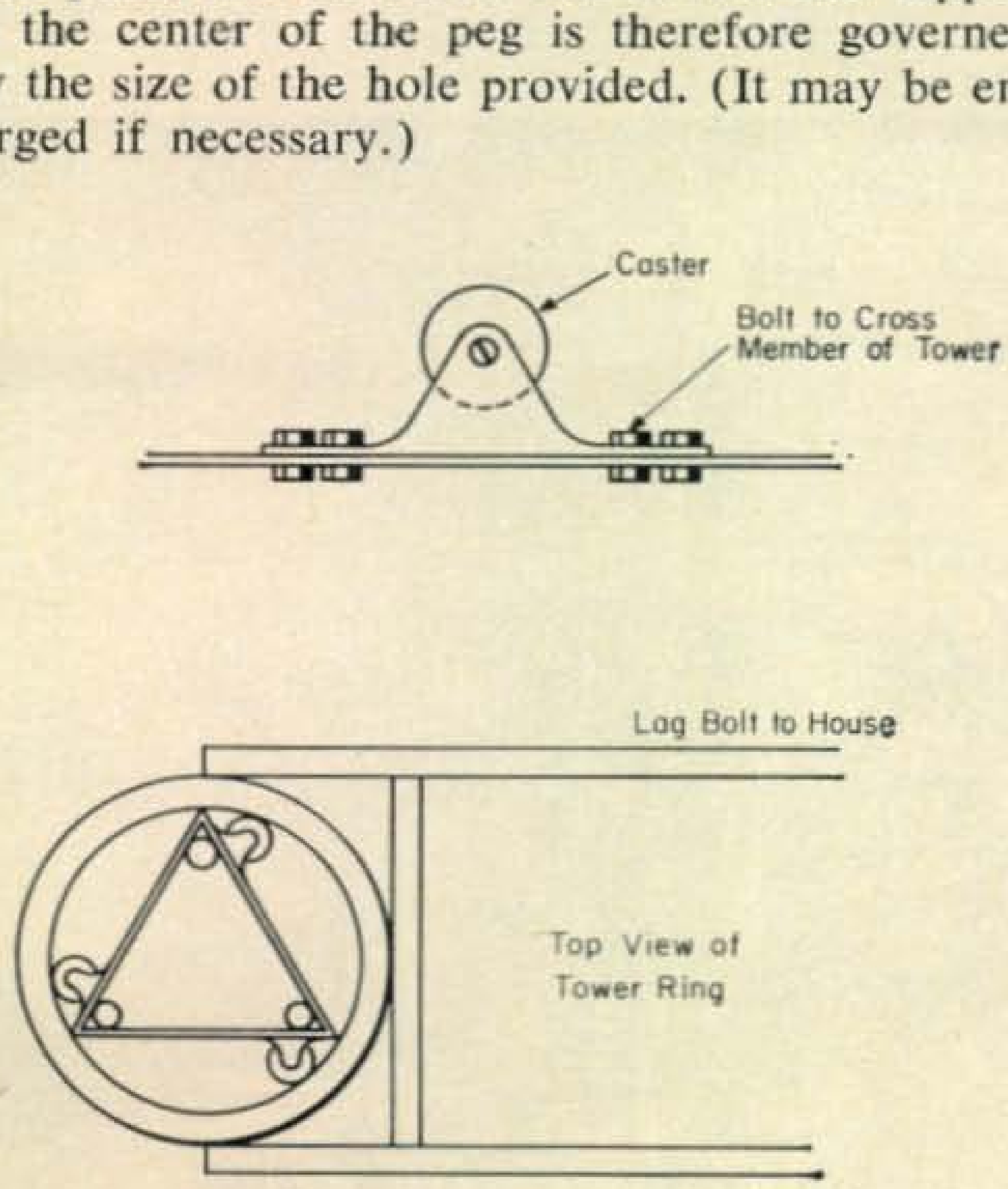
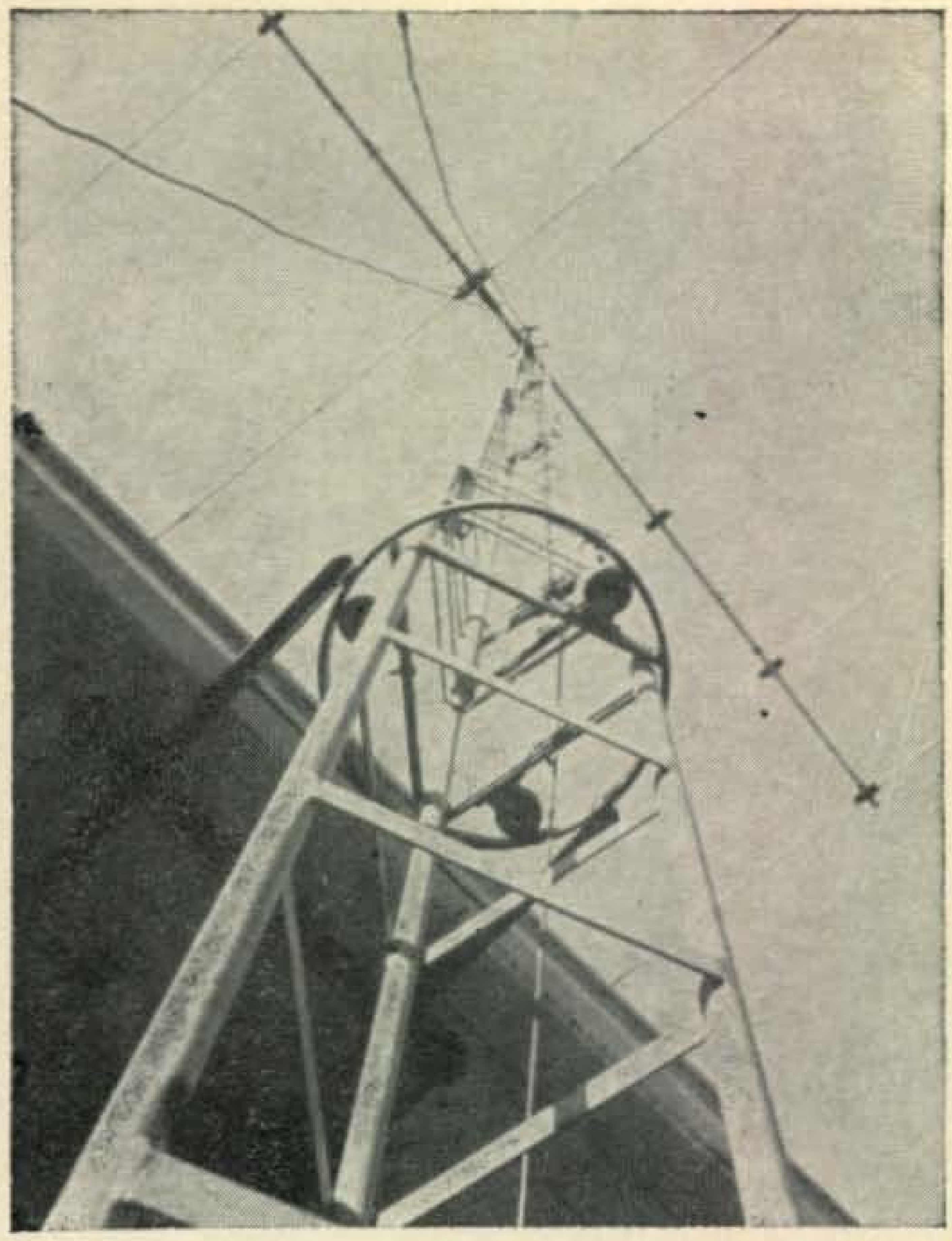


Fig. 2—Tower ring details. The casters must be of the non-swiveling type.



Worms eye view of the tower cranked up.

Although it was not included in the original installation, a refinement is a grease cup or grease fitting for injecting grease into the bottom plate system. The base plate has been under water after every heavy rain since it is located near a gutter drain but the writer has found it unnecessary to replenish the grease.

Guying System

The guy wires are plain heavy duty galvanized laundry line bought at the hardware store. This has more than sufficient strength for this purpose, and is under much less tension than on the XYL's laundry line where extraordinary vector stresses are encountered.

Two of the guy wires are anchored to the top of the XYL's laundry poles. The other two are ancored to the side of the house with screweyes. A direct force on these screweyes will pull them out and it is recommended that the guy wire be lead around the eaves, through a rubber hose, and arrange for a sidewise pull. (See fig. 1.) Turnbuckles at this position enable you to loosen the guy for lowering the tower. Use at least four guy wires sloping off at an angle of no more than 45°. Do not pull the guy wires taut, only enough to prevent loose play.

Installation Of Tower

Use a plumb line to center the tower ring so that the tower just clears the eaves of the house and dig a posthole directly beneath the center of the ring.

Unless you have quicksand, don't worry about the tower sinking into the ground. If the ground does settle because you disturbed the compactness of the soil you can jack up the tower with a car bumperjack and refill with soil as necessary.

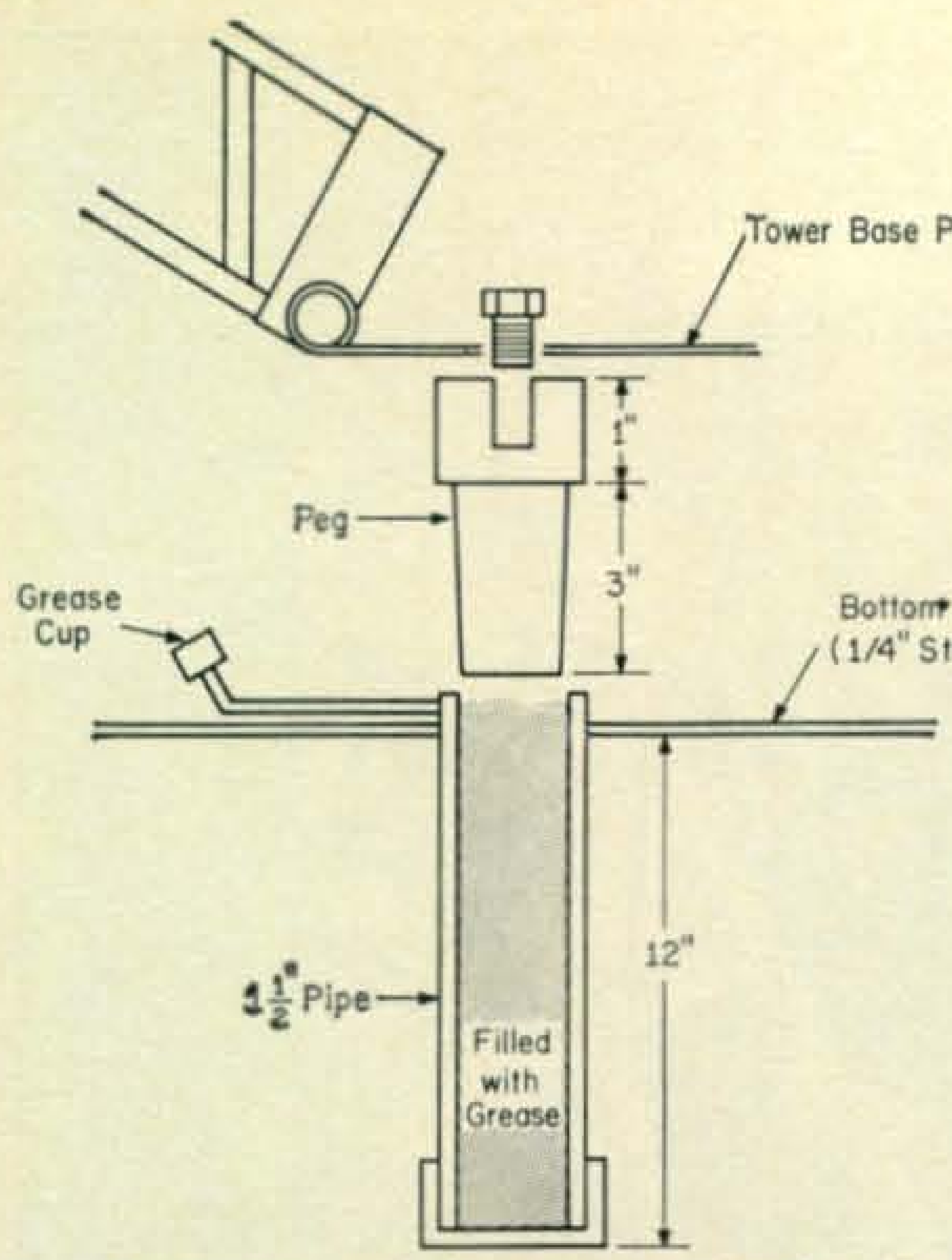


Fig. 3—Bottom and base plate details. The peg is tapered to take care of any misalignment.

Bonus Low Frequency Antennas

Figure 1 also shows the guy wires being used as inverted vees for 40 meter. For this purpose use hard drawn stranded copper wire, not ordinary antenna wire. Note that the ends of the inverted vee are coiled up into a six inch diameter loop. By varying the diameter of the loop you can tune the dipole from the ground through the 40 meter band by watching the s.w.r. meter. Incidently, the 40 meter s.w.r. varies slightly with the heading of the beam and so it is wise to adjust the s.w.r. with the 20 meter beam pointed in your favorite direction.

If you have enough space the other two guy wires can be used as an 80 meter inverted vee hooked to the same feedline as the 40 meter dipole.

The tower can be used as a 160 meter vertical[2] by gamma matching the whole tower. Unfortunately, some resonance occurs in the writer's installation and the balun coil on the triband antenna gets hot, so instead the 40 meter dipole is used as a "T" antenna through a matching network.

Tri-Bander Beam

The crankup tower supports a Hy-Gain TH6DX tri-band antenna which weighs about 47 pounds and is among the largest of the popular triband beams. Do not use TV aluminum towers; the bolts shear off. The tower in use is a four section 36 foot Tri-Ex light duty crank-up tower, Catalog number T436. Its height is ten feet in the lowered position. Better structural strength results if a two section tower is used, but the four section tower has proved entirely adequate in the strongest winds encountered.

As with all guyed towers, when the wind is blowing, it is already too late to take the tower down. You can lick this by assigning one member of the family to each guy to take up the slack as the tower is cranked down.

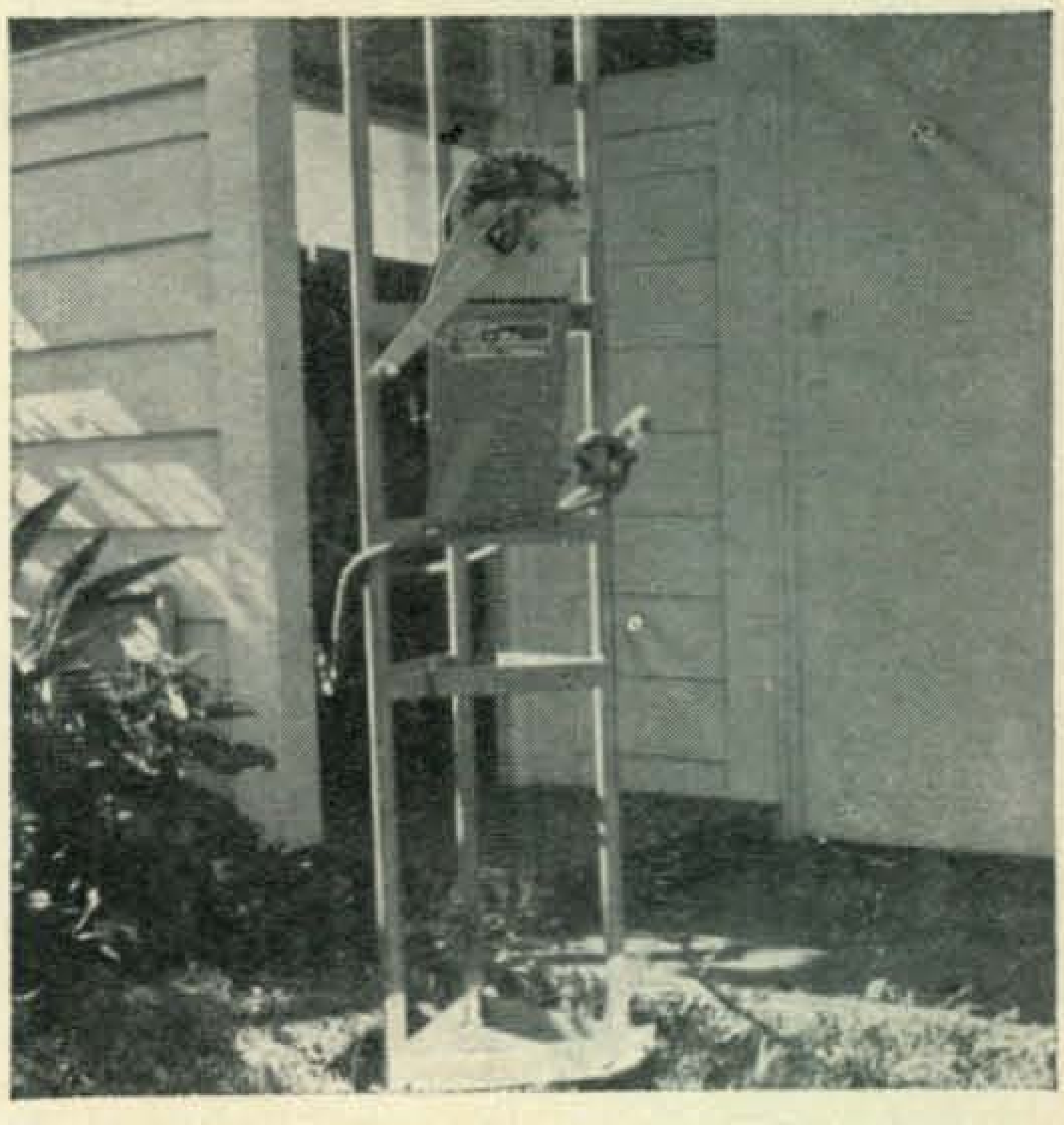
This system evolved as a result of experiments with a 40 foot TV push-up mast on which a Hy-Gain 203B full size 20 meter beam was mounted. This worked satisfactorily except for the grinding noise of the sectional locking system which disturbed the neighborhood on windy days.

Indicator System

The indicator system is by simple visual inspection of the position of the crank on the tower. It is presumed that this installation will be near the window of the operating position (first or second floor). I have had much trouble with electrical indicating systems and so am reluctant to use them again.

There is some doubt as to the wisdom of letting the beam whip around when not in use, but this has proved wiser than trying to hold it in a wind. You would think that the feedline would wrap around the tower and break the guy wire. Note that the feedline comes off the boom at least three feet from the tower and drops to the ground between two guys. The feedline then acts as a limiting stop and brings the antenna system back to a set position, yet enables you to get 360° coverage.

By letting the beam move around in the wind, it automatically positions itself to present the least wind resistance even if at times it whips around like a weather vane in a strong wind. There are no gears to strip. However, during the course of a contact, to maintain beam heading, you can anchor the rope to a cleat should there be a strong wind. I have owned some pretty elaborate antenna systems, but everytime there is a windstorm I wish I never had them. With this crankup system you feel like a boatowner whose boat is drydocked during a storm, "as snug as a bug in a rug." ■



Tower rests on a "Greased Peg" and turns easily.

[2] Nose, K., "Gamma Matched 160 Meter Vertical," *CQ*, May 1961, p. 52.

Tom, WB2FSM, sent along this fine photo of Stefan, YU2GE that he recently received. From a look at the walls, it seems that Stefan has no difficulty in piling up certificates.

This is the "Soap Box Derby" racer sponsored by Larry Ranallo, K8TBQ. Larry assures us that the young lady is not the driver. The races will be held during July and August.

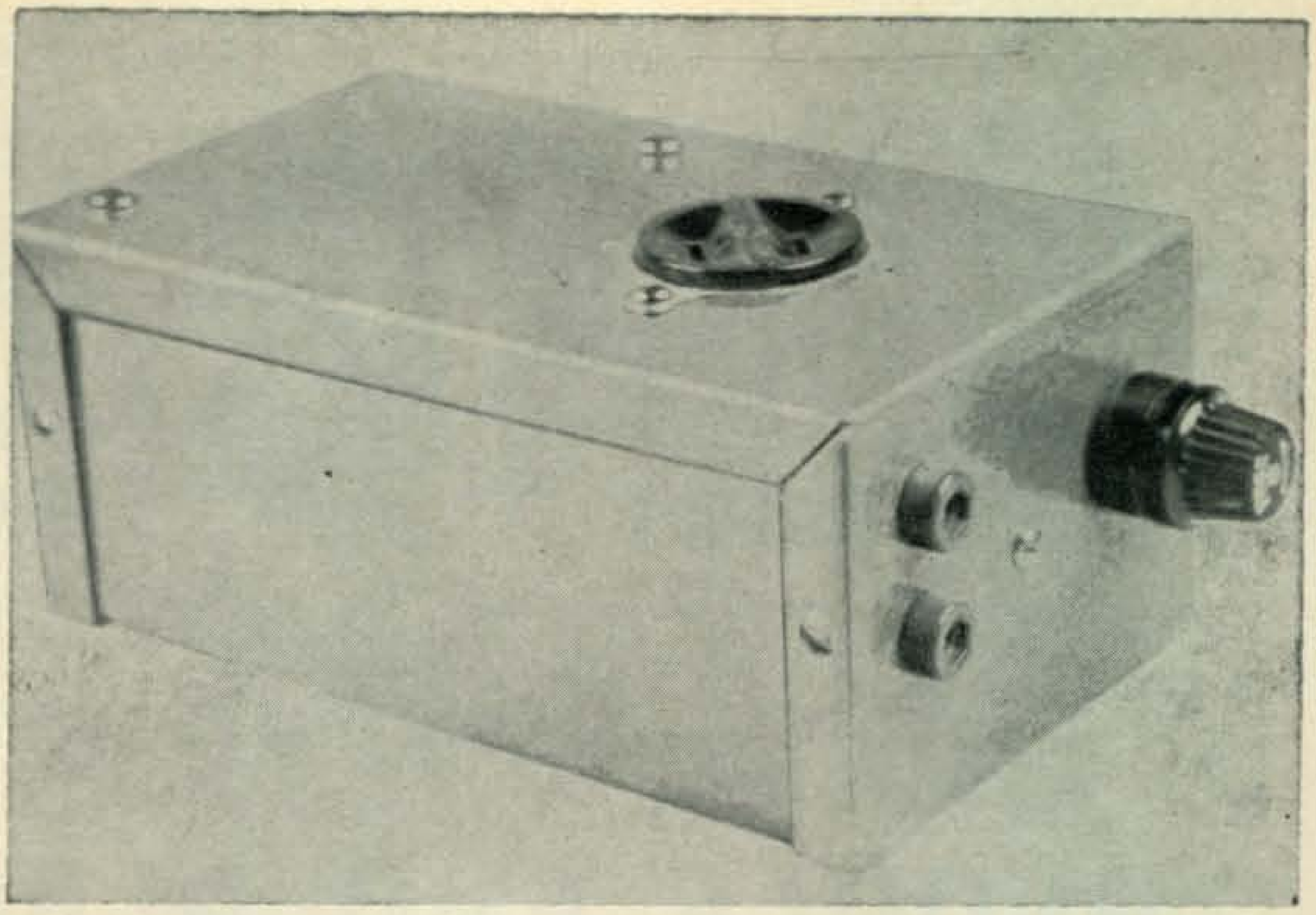
PEOPLE AND PLACES

This is Augie Weiss, WB2NYM, who last April overheard and answered a distress call from Harry, F7AS, seeking medical help for a woman in Paris, France. Harry was looking for a rare drug that according to French doctors was either made or stored in Albany, near Augie's home. With Harry standing by, Augie phoned Uncle Dave Marks, W2APF and told him of the problem. Dave from his office in Albany proceeded at once to call for the drug, and with the help of several doctors was able to locate a supply. Augie stayed at the rig, keeping Harry informed as to the progress. With the cooperation of both Mohawk and TWA airlines the drug was quickly sped on its way to France to save the woman. Augie like many others recently is showing the true spirit of Public Service that is inherent in amateur radio.

The founding meeting of the Medical Amateur Radio Council was held in New York and a slate of Officers elected. They have a total of 93 founding members, most of these residing in the first four call areas. In order, l. to r. Pres. elect, Jack London, M.D., K2JVA, President, Charles H. Gray, M.D., WA1FMY, Secretary, William L. Sprague, M.D., WA6CRN, and Treasurer, John W. Banzer, M.D., W2KDI. The group plans to set up meeting frequencies for members, participating in emergency and consultative medical services through amateur radio. A recruiting program for members will begin in the fall for all those who are interested.

Pictured at Coolidge Airport, Antigua, West Indies are l. to r. C. Clabough, ZD8BC, Harold Lund, ZD8HL, Gerald Price, VP2AC, Woody Zellers, ZD8WZ and Bruce Delamore, VP2AL. Harold led the Ascension Island team to a DXpedition on Montserrat Island. Later Harold was transferred to ZS6-land where he has not yet received permission to operate and must travel several miles to ZS8-land if he hopes to get on the air.

The a.c. wattmeter is built in a regular minibox. The line cord comes out of the back, with the load plugging into the top receptacle. Metering is done through the banana jacks in front.



A LOW COST A.C. WATTMETER

BY R. P. BINTLIFF,* K1YDG

Although a useful instrument, the relatively high cost of the wattmeter limits its use by many amateurs and experimenters. The device described in this article will permit most ac voltmeters to be used as a direct-reading wattmeter at normal ac line voltages. The unit can be constructed in about one hour, at a cost of approximately five dollars.

ALTHOUGH several methods can be used to perform a.c. power measurements, a fundamental arrangement is shown in fig. 1. By measuring the supply voltage (E) and the current flow (I), the power consumed by a resistive load may be calculated by the formula P-IE. With reactive loads, this method will indicate *apparent* power, in terms of volt-amperes, and the power factor must be considered to calculate *true* power.

Commercially available wattmeters are usually of the dynamometer type which produce readings in *true* watts. However, most electronic devices present loads which are nearly resistive and therefore, the volt-ampere method will provide measurements of reasonable accuracy.

If it is assumed that the input voltage will be maintained at a constant value, then the voltmeter is not required, and it may be eliminated from the test arrangement shown in fig. 1. Further, with a constant input voltage, the ammeter

*2 Powder Horn Lane, R.F.D., West Acton, Mass.

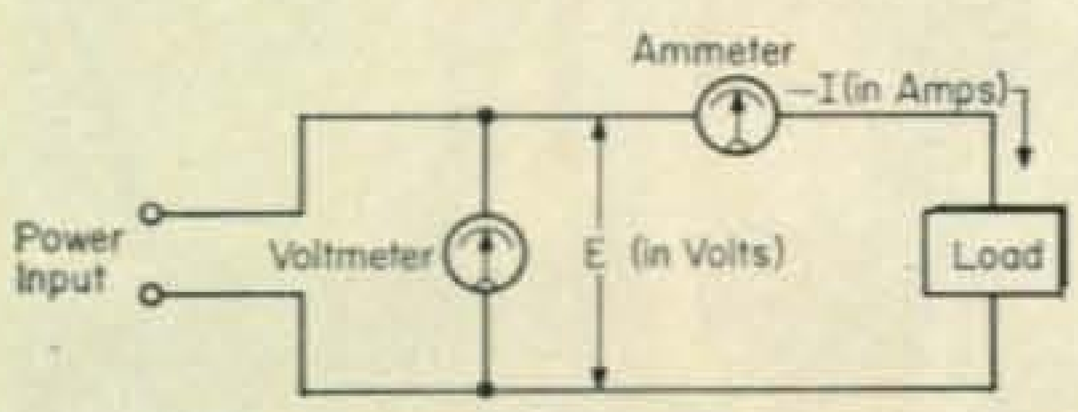


Fig. 1—Fundamental method of measuring power. With an a.c. input and a reactive load this method indicates apparent power rather than true power.

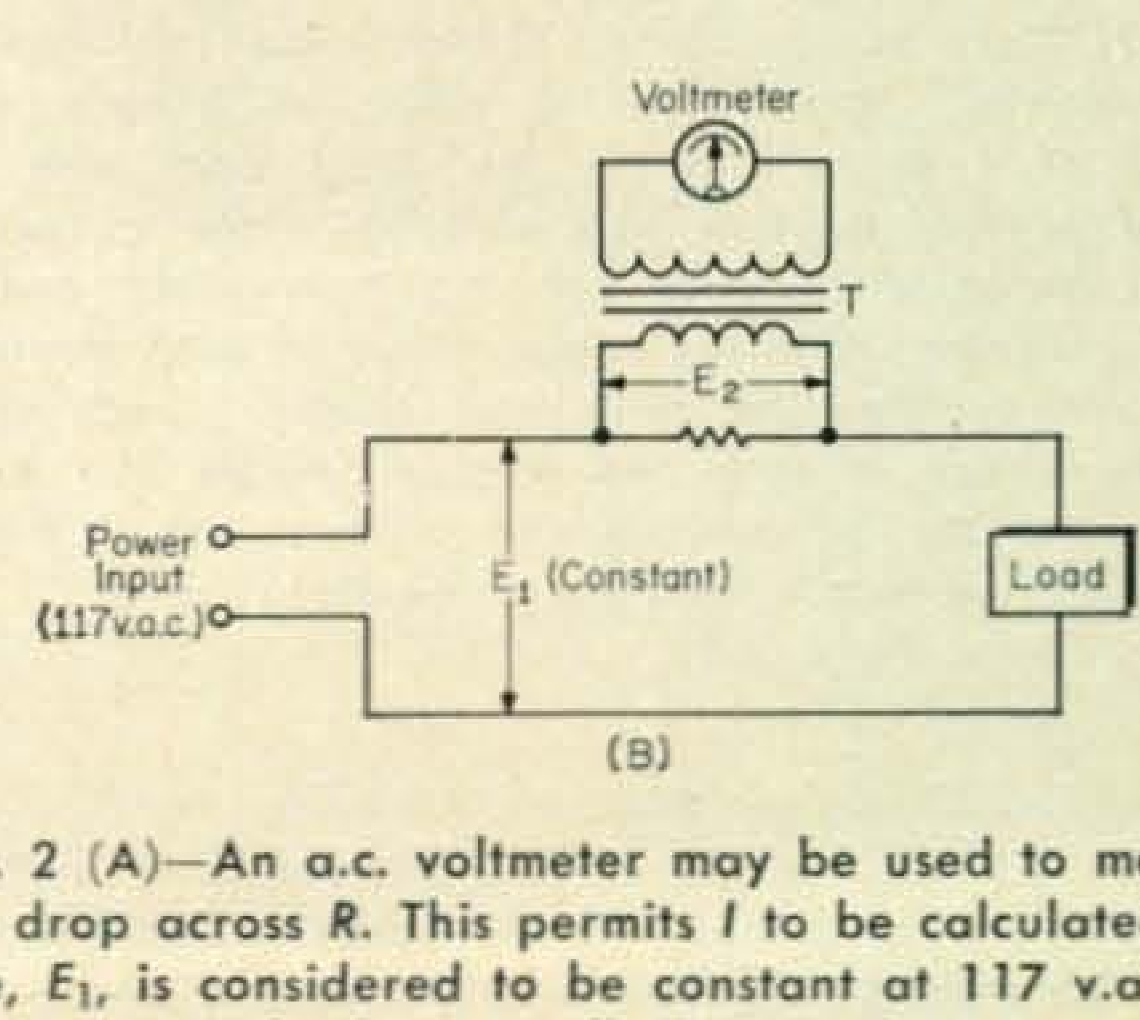
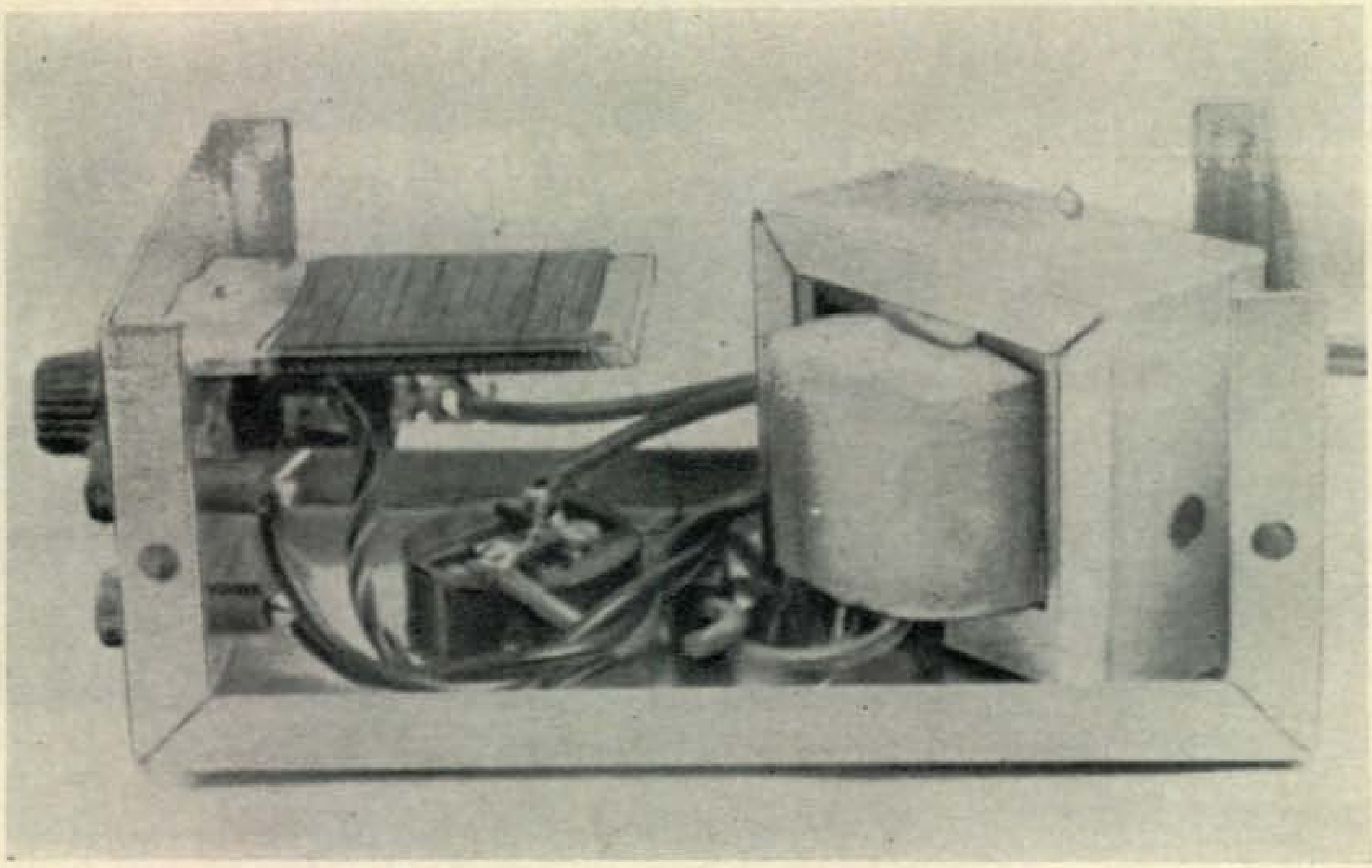


Fig. 2 (A)—An a.c. voltmeter may be used to measure the drop across *R*. This permits *I* to be calculated. The line, E_1, is considered to be constant at 117 v.a.c. (B) Since *R* must be kept small, *T* is used to step up the reading.



Interior view of the wattmeter adaptor unit. The resistor, *R*, may be seen mounted on the left wall with the fuses. The outlet and transformer are mounted on the base. The two meter terminals may be seen on the left.

may be calibrated directly in volt-amperes, or in watts, if the power factor is neglected.

If a resistance (R) is substituted for the ammeter, as shown in fig. 2A, then a voltage (E_2) will be developed across the resistance which is proportional to the current flow. If an a.c. voltmeter is placed across this resistor (refer to fig. 2A) then the voltmeter can also be calibrated directly in watts.

Two important considerations are: (1.)–The value of R must be one ohm or less, otherwise the voltage drop across it will be excessively high. (2.)–The voltage drop must be large enough to be measured by an a.c. voltmeter of average sensitivity.

Both requirements can be met by the use of a step-up transformer (T), as shown in fig. 2B. The transformer will raise the relatively low voltage (E_2) to a level that can be measured by an a.c. voltmeter with a sensitivity of 1,000 ohms per volt, or better.

The test arrangement shown in figure 2B was chosen as the basis for the wattmeter adaptor. A complete schematic of the adaptor is shown in fig. 3. The circuit components were selected so that for a fixed input of 117 volts, the load consumption in watts will be equal to 10 times the voltage developed at J_1 and J_2. Therefore, with an a.c. voltmeter plugged into J_1 and J_2, power can be calculated by multiplying the voltmeter reading by ten. The useful range of the adaptor is approximately 15 to 1,200 watts.

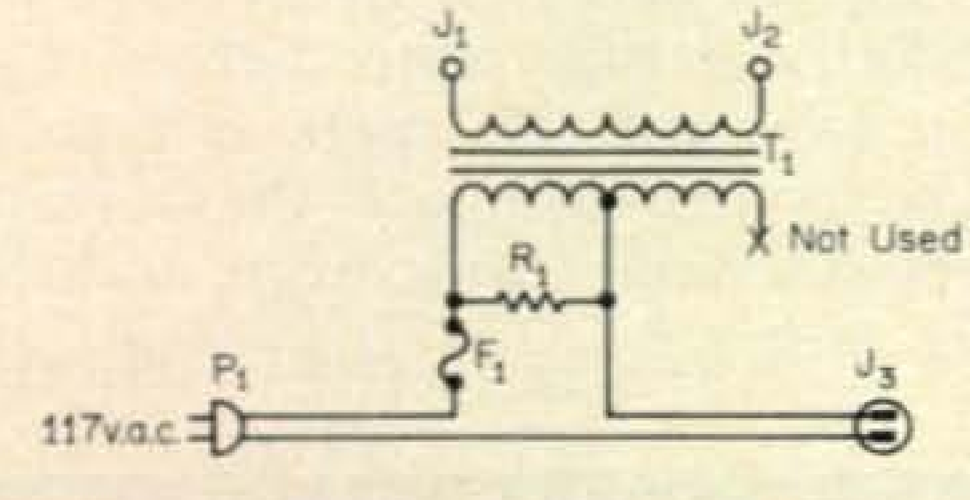
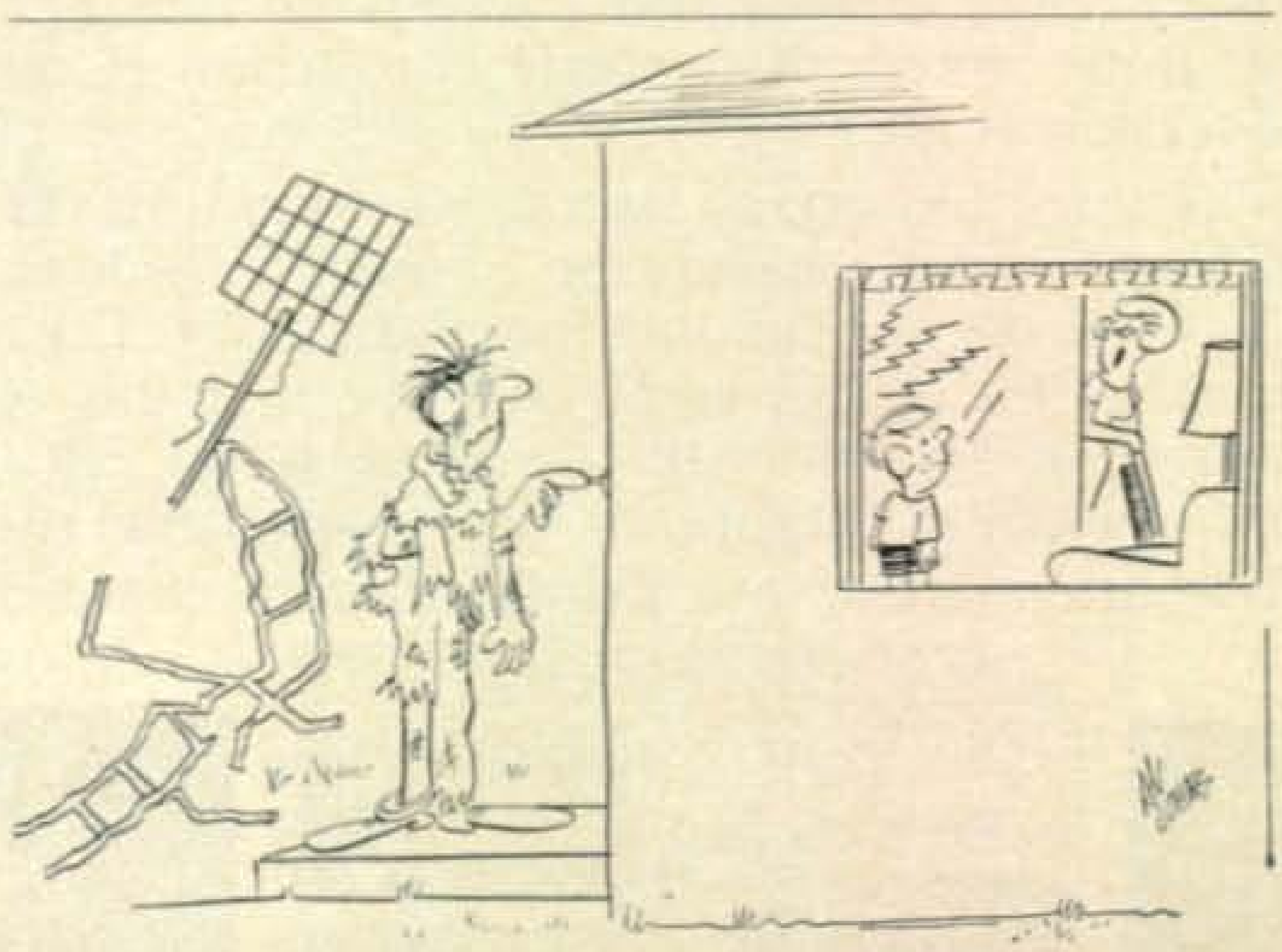


Fig. 3—Circuit of the complete a.c. wattmeter. The value of R_1 has to be adjusted as described in the text.
F_1—10 amp slo-blo fuse.
R_1—0.044 ohms (See text).
T_1—6.3 v 3a. filament transformer Allied 62G031 or equiv.

Construction

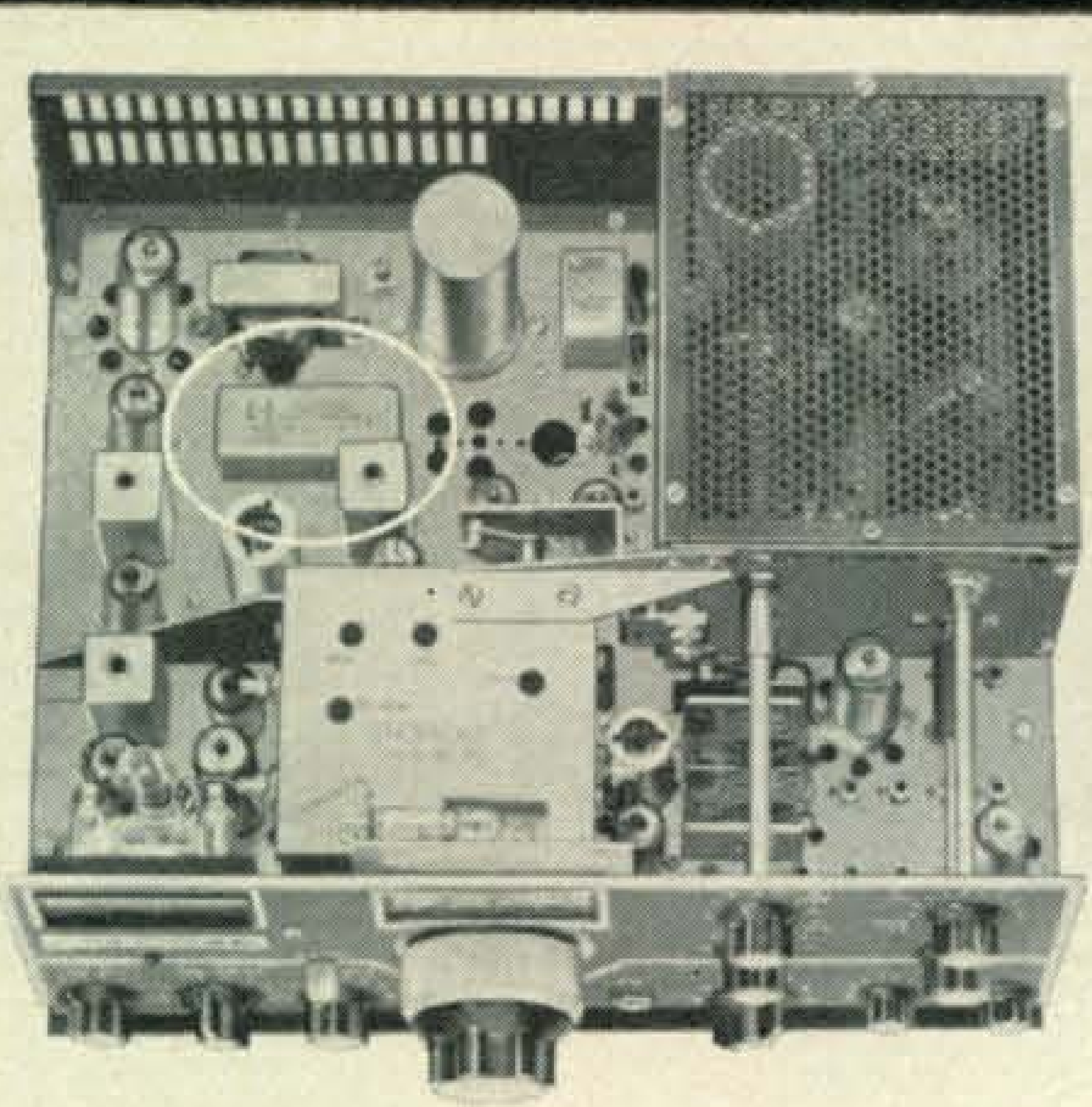
The adapter is housed in a 5¼" × 3" × 2⅛" minibox, and the layout is shown in the accompanying photograph. Transformer T_1 is a 6.3 volt filament type used in reverse for a step-up. One half of the 6.3 volt winding is used to provide a step-up ratio of approximately 1 to 37. R_1 consists of about 18 feet of number 24 enameled copper wire. The resistor is wound on a 2⅛" × 1½" piece of 3/32" epoxy glass board, but any convenient form may be used. Low temperature materials such as polystyrene or plexiglass should not be used because R_1 does run warm under high power loads. Since the value of R_1 will vary slightly, depending upon the particular transformer used, it should be cut slightly longer than 18 feet, and then pruned to the exact length required.

The exact value of R_1 is determined as follows: (1)–Connect a 150 ohm, 100 watt resistor to the load socket. Be careful, the resistor will run hot. (2)–On a cut-and-try basis, shorten the length of R_1 until the voltage at J_1 and J_2 measures exactly 9.1 volts. It is recommended that the adapter be unplugged during the wire cutting and soldering operations. This operation completes the calibration and our adapter is ready for use. ■



"Jimmy, if that's for your father, tell them he's on the roof installing an antenna."

IF YOU'RE LOOKING FOR

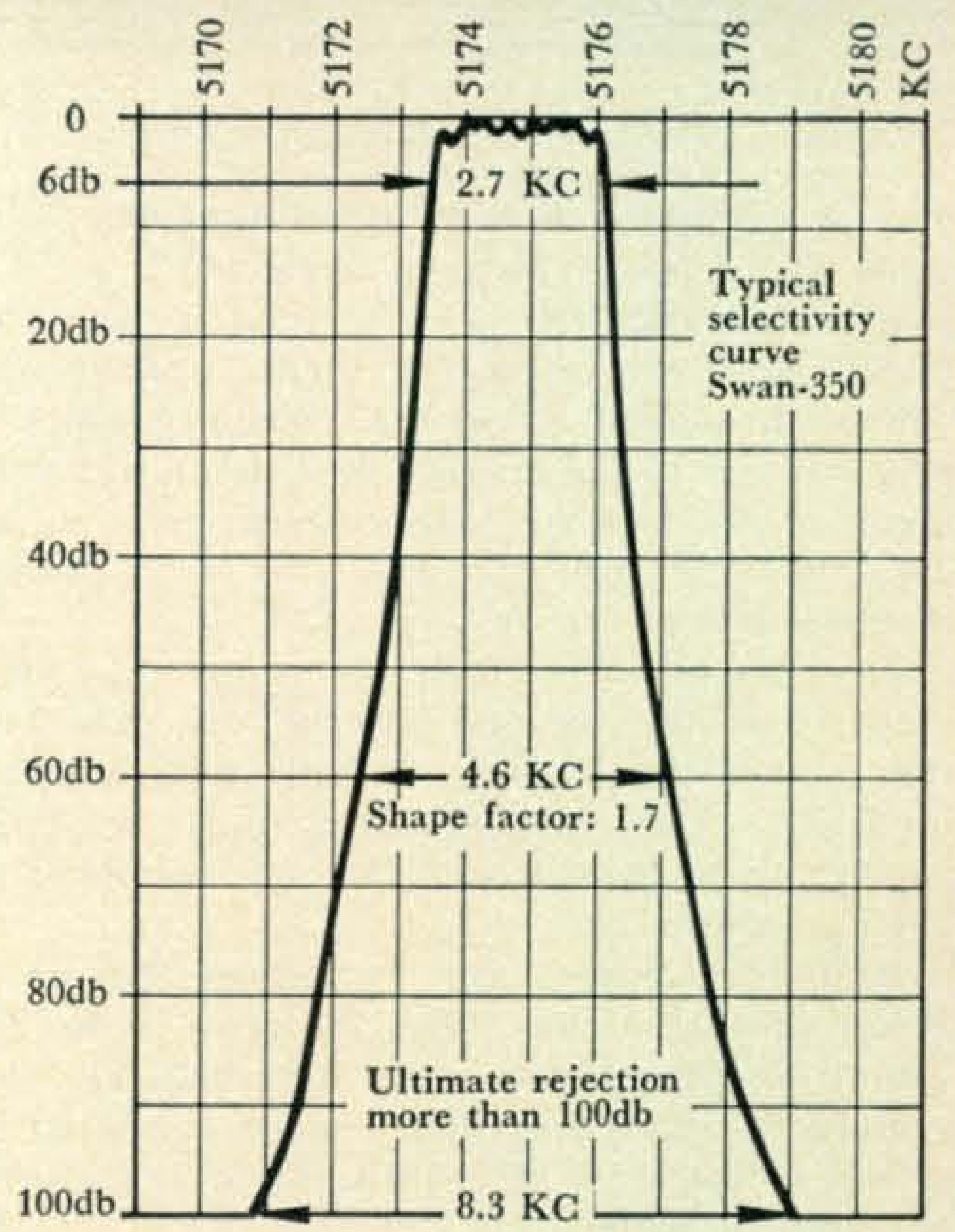


SELECTIVITY

LOOK INTO THE

SWAN-350

AND ITS HIGH FREQUENCY CRYSTAL LATTICE FILTER



One of the reasons why the Swan-350 is the top selling transceiver today is its exceptional selectivity provided by a new crystal filter which we began installing in all production units a few months ago. This amazing little gem is made exclusively for Swan by C-F Networks. The selectivity it provides for voice communication is as good or better than the selectivity provided in any other sideband equipment, regardless of price.

There are 3 important factors about a filter which determine what the overall selectivity will be. One of these is its *bandwidth* at the 6 db points, and here we have carefully selected 2.7 KC in order to give you good channel separation, and still retain the smooth, natural audio for which Swan transceivers are so well known.

The next consideration is *shape factor,* or the ratio between bandwidths at 6 and 60 db. In this respect the Swan filter gives you a "shape factor" of 1.7 to 1. This is substantially better than the 2 to 1 ratio of the mechanical filter, or 3 to 1 of the average 9 mc crystal filter. Best shape factors are achieved right around 5 mc, and this is one of the main reasons for selecting 5175 KC for the Swan I.F. (This choice of I.F. also permits single conversion design which results in fewer images and spurious signals. The only thing better than single conversion is no conversion at all.)

The third important factor, but by no means the least, is the measure of *ultimate rejection,* or how far the skirts fall before flaring out. Take a look at the graph and you'll see that this is better than 100 db with the Swan filter! Ultimate rejection determines how well your receiver attenuates those strong adjacent channel signals, especially the guy down the street with the big linear. In this respect, the Swan filter is superior to others being used in amateur sideband gear.

In Swan transceivers, the filter is also used when transmitting, of course, and in this mode the shape factor determines what your unwanted sideband suppression will be. We have been advertising 40 db, but this is a conservative figure, since it is really better than 50 db. Also, we've been advertising only 400 watts PEP input to the 350, but actually the average production unit peaks over 500 watts before flat-topping, which is why the 350 gets out so well, and sounds so good. Compare these features with any other sideband transceiver, and they all sell for more money!

73 Herb Johnson W6QKI

SWAN
ELECTRONICS
Oceanside, California

For further information, check number 6, on page 110

Using a modest and relatively quiet spark coil transmitter, this pioneer ham station of Thomas Appleby operated under the self-chosen call letters HN in 1908-1909. Later replacement with a higher powered transmitter with consequent increase in the noise generated, drove Tom from the comfortable bedroom quarters shown here in his West Philadelphia home, to a more remote and soundproof shack. In recent years Tom again operates from the house with the call W3AX.

Evolution * of the * Ham Shack

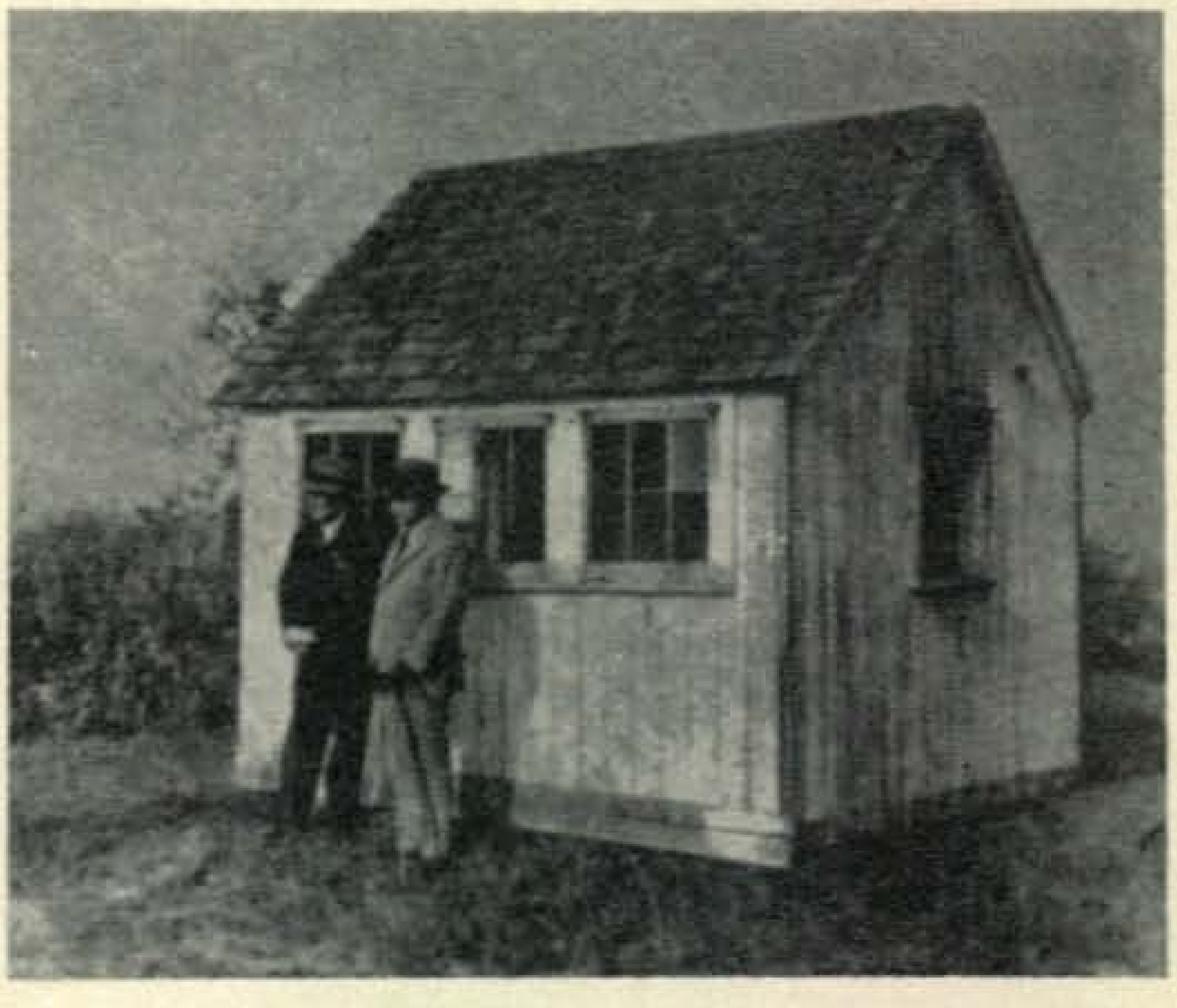
BY HOWARD S. PYLE,* W7OE

ORDINARILY the word "shack" immediately gives us a mind picture of a small shed or lean-to, perhaps even a ramshackle house or an abandoned barn, maybe a construction crews' temporary tool-house. Webster defines "shack" as a "small, rough cabin". How come then that the structure or even a room in the home which houses hundreds, often thousands of dollars worth of intricate amateur radio electronic equipment, is almost invariably labelled as a "shack" by the ham radio fraternity? Suppose we do a little research on this question and see what we can come up with.

We all know that amateur radio came into being as an experimental hobby way back around the turn of the present century. Marconi, by the successful demonstration in 1901 of his ability to span the Atlantic Ocean with a "wireless" signal, provided tremendous impetus to pioneer amateur radio experimentation. Gernsbacks' Electro Importing Company, J. J. and Wm. B. Duck companies, Manhattan Electrical Supply, Bunnell Electric and other "wireless" equipment suppliers of that early era, enjoyed rapidly increasing sales of spark coils, helixes and sundry similar items. Much equipment was built by the experimenter of course, but the heart of a wireless sending station was the spark coil which in most cases was rather beyond the do-it-yourself constructors' tools and ability although a few courageous experimenters *did* make their own.

These little coils with their stringy sparks, the aural sound of which was seldom audible for more than a few feet, were often housed with their accessory equipment on a corner table in a bed-room or equivalent quarters right in the experimenters' home and seldom caused annoyance to other members of the household.

While such simple equipment was capable of wireless communication for a distance of several miles, it was not long before the dyed-in-the-wool ham of those days (where the designation 'ham' originated has never been satisfactorily explained) began to reach out for greater worlds to conquer. Taking his cue from the commercial ship and shore station installations of that period, high voltage transformers which would provide much more power than the modest little spark coils, became a must. Using either a straight or later a rotary gap, these monsters produced an ear-shattering crash every time the key was pressed!



The historic shack of the worlds first amateur Guglielmo Marconi, located in Babylon, L.I. built in 1900. The photo shows Senatore Marconi (left) and David Sarnoff of RCA, just prior to the removal of this pioneer shack, in 1930.

*3434-74th Ave., S.E., Mercer Island, Wash., 98040.

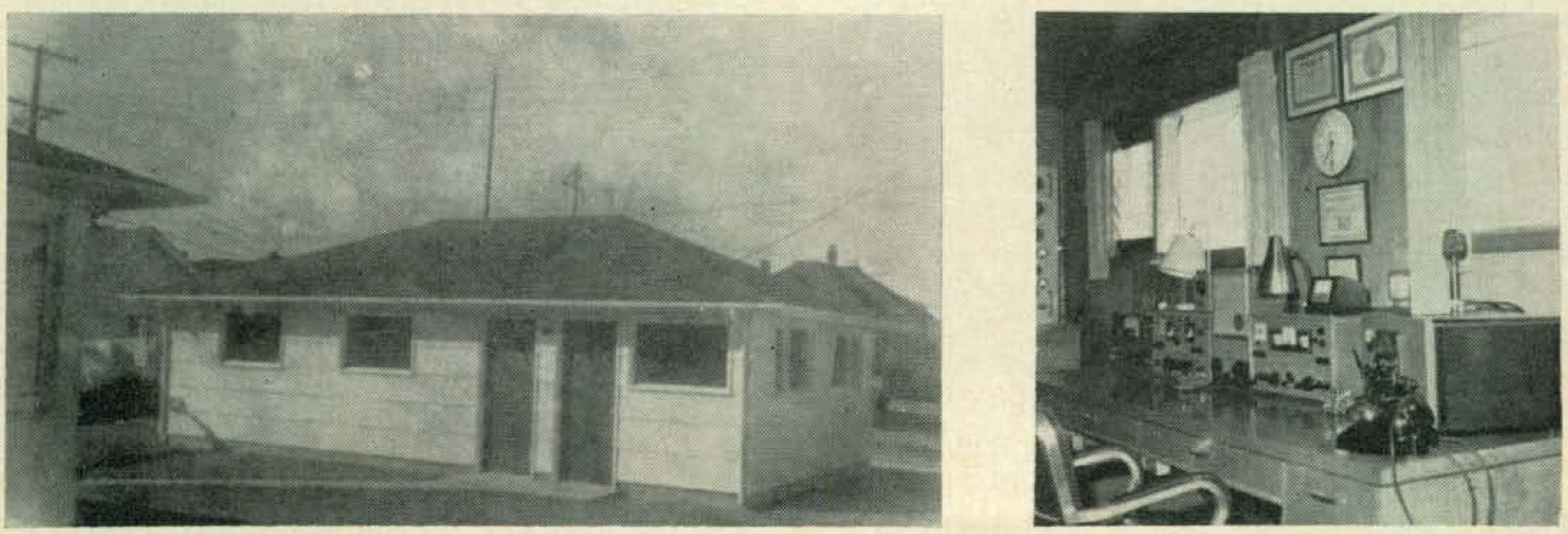
This neat and substantial shack houses the equipment of W6ASV providing comfortable and quiet operating convenience.

Modern silent equipment can also be located in the corner of most rooms as evidenced by this neat arrangement of Wilson H. Moore's station in suburban Seattle.

The family ultimatum was promptly delivered to Johnny Ham; "get that fool thing out of the house where you won't deafen all of us or quit playing around with it!" Johnny did, sometimes being relegated to space behind the basement furnace or in the attic high above, where his crashing spark discharges were greatly muffled. For those to whom this offered at best a rather unsatisfactory solution, succeeding only in somewhat mollifying the household grumbling, he was faced with something of a dilemma; what to do? Most certainly he had no desire to abandon his experiments but where could he carry on? Some of the more fortunate ones were able to wangle a corner in the wood-shed or some other outbuilding, but as most of these 'shacks' were not wired for electricity and almost always had no heating facility, this presented an additional problem. Two rather heavy wires (the wireless transformer was a juice-greedy device) between the house and the new-found shack, took care of the light and power problem. Heating was often accomplished with a smelly kerosene stove . . . pretty much of a fire hazard in a wood-shed, but our hero was once again in business!

As greater and greater distances were being spanned with this more powerful equipment, the greater the desire for the powerful transformers grew with those who were still limited to the puny little spark coil. Soon small structures, many of which could not be dignified by the name 'building' began to appear on the back lots of many wireless experimenters. Most of these were definitely of the 'shack' variety, hastily built of unpainted lumber and provided with light, power and heat of sorts. Invitations tendered to visit such stations almost immediately took the form, "Come on over to my wireless shack tonight and we'll see who we can work." The designation "shack" was thus borne and became generally accepted by the ham fraternity as applying to whatever type of structure was being used to house the wireless equipment.

As time went on and equipment became increasingly more elaborate, more substantial structures began to appear to house the ham station but the word "shack" carried on. Special



An outstanding example of a modern ham shack is the station of Herman F. (Hap) Helgesen, W7AIB, of Port Angeles, Washington. It is housed in one half of a two car garage, with a separate entrance.

Pioneer hams were not the only ones housing equipment in detached buildings. Shown above is the radio shack used by the United Wireless Telegraph Company in Walla Walla, Wash., in 1908-1909. It now serves as a storage shed for garden tools in the Walla Walla City Park.

shacks were sometimes built on lots remote from a residence; many of these were sufficiently elaborate to warrant a more dignified appellation but the word had come to stay and even to this day, "shacks" they remain to the ham fraternity!

Detached structures to serve as amateur wireless stations remained far in the forefront for many years. However, a new era was dawning; vacuum tubes were making themselves increasingly felt as generators of radio frequency energy. After the almost unbelievable increase in communication distances covered with far less power than required by spark equipment, as demonstrated by some early pioneers, the rush was on. Tubes became the demand item at the radio supply stores and every night dozens more "c.w." stations as they were immediately dubbed (and still are) came on the air and chalked up many distance records previously unheard of with spark transmitters; vacuum tubes were here to stay.

Another tremendous advantage immediately became apparent in using these awesome little "Aladdin's Lamps"; they were completely silent in operation! During periods of transmission, no sound other than the almost inaudible clicking of the key, could be heard! Outdoor shacks were almost immediately abandoned in favor of a warm, carpeted and curtained corner in a room in the home. Some of the more substantial detached structures continued to serve as they were generally comfortably livable and provided a greater measure of privacy and sound-proofing, both important in receiving weak signals. In the main however, most experimenters rejoined the family under a common roof and their silent new c.w. equipment drew no household protests as had been the case with spark. Did the designation for the quarters housing the radio equipment in the home become "radio room"? Not by a long shot! Be it an entire room in the house or just a corner, it remained "the shack" and still does today!

Meanwhile, the term 'shack' had been adopted by commercial sea-going operators. Invariably they, as well as the officers and crews of their vessels, referred to the radio cabin as the "radio shack" and this too still persists. A large majority of the pioneer marine operators had formerly been radio hams and it was but natural that much of their ham lingo including 'shack' had gone to sea with them.

Nowadays you will find ham radio stations housed in almost every conceivable spot in the home. Even apartment dwellers have ingeniously contrived space for their gear. Many of the more affluent hams have fondly clung to the detached building for their station, some even having had comfortable quarters built for them in an appropriate location on their property. A large number of these include such refinements as electrical heating and even air-conditioning!

Regardless of the choice of quarters for the ham station and with no regard for its' degree of luxury, it is and probably always will be, still "the shack"! ■

New Amateur Product

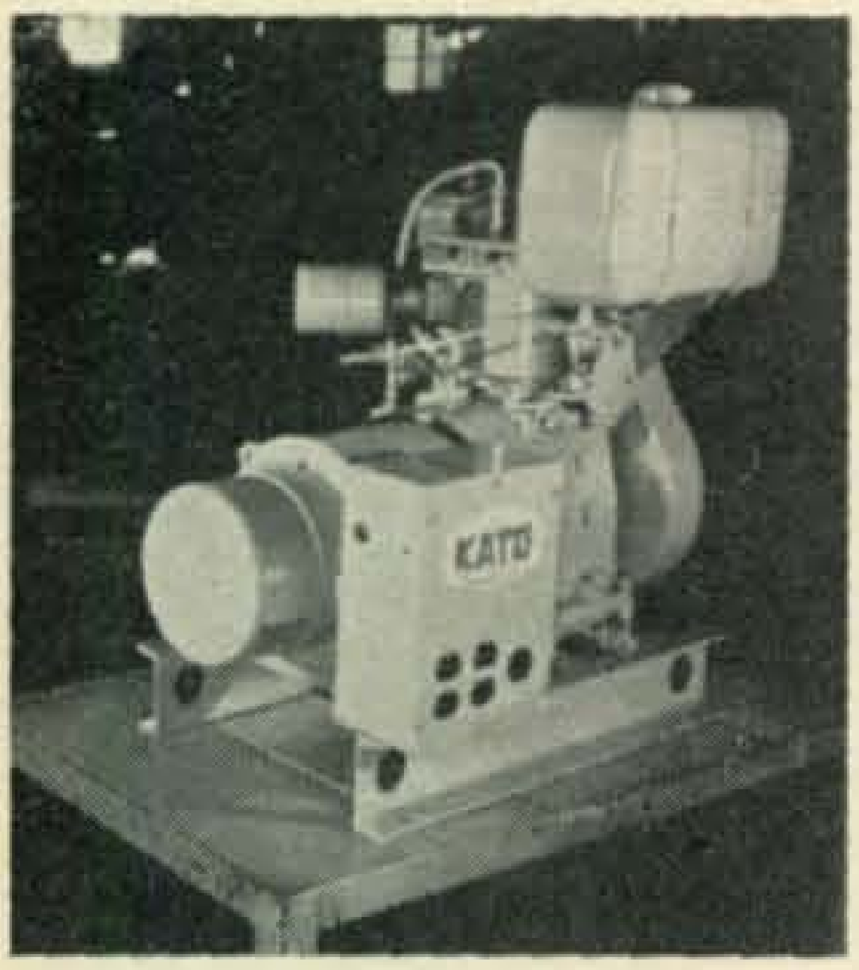
Scientific Associates Converters

A NEW line of solid-state converters for auto or home radio use is being manufactured by Scientific Associates Corp. The unit contains five transistors and a built-in variable squelch circuit. Two basic models are available: a crystal controlled fixed frequency unit for any 1 mc segment and a tunable one for several bands from 80 through 2. Prices range from $24.00 to $35.00. Free literature is available from Scientific Associates Corp., P.O. Box 276, S. Glastonbury, Conn., or circle 65 on page 110.

New Amateur Products

Simpson

A 90 page, paper-backed book titled 1001 Uses for the 260[R] Volt-ohm-Milliameter has been published by Simpson. The book is available from electronic distributors for 75 cents, or by sending $1.00 (postage and handling) and your name and address directly to Simpson Electric Co., 5200 West Kinzie Street, Chicago, Illinois, 60644. For further information either write direct or circle 65 on page 110.



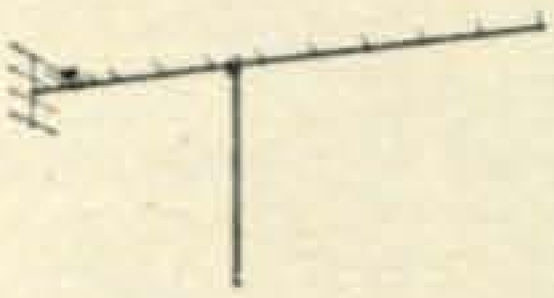
Kato Kub Generator

A new 4kw a.c. generator has been developed for general purpose, standby or emergency use. It features a Kato revolving field a.c. generator with separate rotating exciter direct connected to a Wisconsin engine. It has optional accessories available such as larger gas tank, push-button start, fuel pump, etc. Approximate shipping weight 450 lbs. It is 30" long and 18" wide. Complete details, price and delivery information is available from Kato Engineering Co., 1415 First Ave., Mankato, Minnesota, 56002, or circle 66 on page 110.

Clevite ED-150 Headphone

A set of Clevite Brush magnetic headphones designed to perfectly match the requirements of prerecorded instruction has been introduced by Piezoelectric Division, Clevite Corporation. Some specs are: frequency response—80 to 4,000 c.p.s., sensitivity—104 db sound pressure level ± 4 db at 1 kc with 1 mw input, impedance—600 ohms at 1,000 cps. For additional information on the headphone write to: Piezoelectric Division, Clevite Corporation, 232 Forbes Road, Bedford, Ohio, or circle 67 on page 110.

SKYBEAM 14 ELEMENT YAGI



Supplied complete with Balun and Mast Mounting Bracket

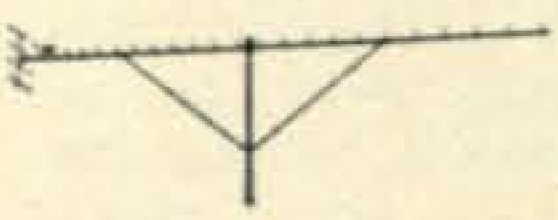
Overall Dimensions:-
Length 110" Width 15"
" 278cm " 38cm

Horizontal Beamwidth 28°

Frequency Coverage 420-437mcs

Cat. No. 70/14Y

SKYBEAM 24 ELEMENT YAGI



Supplied complete with Balun, Mast Mounting Brackets and Support Struts

Overall Dimensions:-
Length 160" Width 15"
" 406cm " 38cm

Horizontal Beamwidth 24°

Frequency Coverage 420-440mcs

Cat. No. 70/24Y

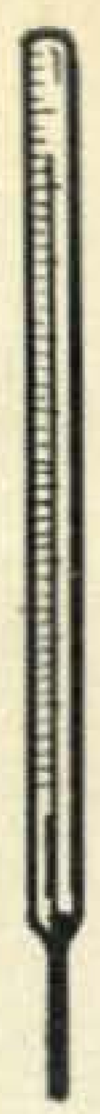
Gain, Inc.

GAIN, Inc. announces the release of two new 432 mc antennas in the Long John class replete with multiple reflectors which greatly improve the over all performance of the antennas.

The 70/14Y has a claimed gain of 16 db, weighs 7 lbs and sells for $33.45. The 70/24Y has a claimed gain of 17.5 db, weighs 9 lbs and sells for $47.50. For complete details write to: Gain, Inc., 24 East 112th Place, Chicago, Illinois, or circle 68 on page 110.

Keating Display

KEATING announces a photo album that uses no paste or mounting corners. The special paper is self-adhesive. Holds photos or QSL cards firmly in desired position, but permits them to be removed or rearranged any time, simply by easing them off the page. A transparent film over each page enhances the appearance of all cards, clippings, etc. Available in Silver-Blue, Green, and Reddish-Tan. The album measures 11⅜" x 9⅜" and contains 20 pages. Each album is $5.95 postpaid. Write Keating, 3524 Brighton Road, Pittsburgh, Pennsylvania, 15212, or circle 69 on page 110 for more details.



S. W. R. And Tank Coil Heating

BY P. M. CHAMBERLAIN,* K5KEO

The concept of reflected power, produced by a mismatched load, and the effect of this reflected power, is apparently a confusing matter to many radio amateurs. Many, who have had lots of practical experience, insist that the reflected power must be absorbed in their transmitter tanks, and is what produces heating in the tank circuit. This article is an effort to analyze standing waves on a transmission line, the reflected power, their actual effect on a pi-network in an amplifier, and what does cause heating in a tank circuit.

We never hear of standing waves *inside* a high frequency transmitter, where all the r.f. leads are short, even though the condition that produces standing waves is present—an impedance mismatch. It's not until we couple a transmitter to a feed line and antenna that we begin to worry about standing waves or the v.s.w.r. Let us understand that reflected power and the resulting standing waves of voltage or current are of little concern until r.f. is carried along a line that is some appreciable fraction of a wavelength long.

There are many cases in electronic circuits where we *do not* want an impedance match. In fact, the only cases where we do is where we want to transfer maximum power, regardless of the efficiency. In Class A or voltage amplifiers the mismatch is very high, because we don't really want to transfer any power at all. But when we couple a transmitter to an antenna, we usually want to get out the maximum amount of power we can, let the efficiency fall where it may. Thus, we match impedances.

To investigate the problem, let's begin by coupling a transmitter with a pi-output network directly to a dummy load—with no feed line at all. We will assume that we apply 500 volts to the final tank, and that the current at full load is 200 ma. Therefore, our transmitter is capable of putting 100 watts into the final tank circuit. (The d.c. input to the final tube will be up to double this power, depending on the circuit efficiency.)

*3131 Manor Way, Dallas, Texas.

The primary function of the pi-tank circuit is to match the impedance of some load to the impedance of the final tubes in order to get the maximum power transfer from the tubes to the load. The properly tuned pi-network presents a resistive load to the tube, having transformed the impedance of the actual transmitter load to a much higher value. The type of load that can be matched or properly transformed by the pi-network depends entirely on the characteristics of the network—or the range of values over which the tuning capacitor, loading capacitor, and tank coil can be varied.

If the transmitter is always to be worked into the same load impedance, the components of the network can be fixed, and not variable at all. This is done in some transmitters. More commonly, the capacitors are variable so that the transmitter can be worked into loads that vary over a small range of impedances—say 40 to 80 ohms. A few transmitters have networks that will feed a much wider range of impedances, as much as 10 to 600 ohms. These usually include a variable inductor as well as the variable capacitors in the tank construction.

Impedance, of course, is the ratio of the voltage to the current it produces in an electrical component. The impedance may be purely resistive, purely reactive, or, as is most common, a combination of resistance and reactance. Power can only be dissipated in a resistance, so for r.f. power transfer we usually "tune out" any reactance. For example, a mobile antenna is capacitive because it is short. We tune out the

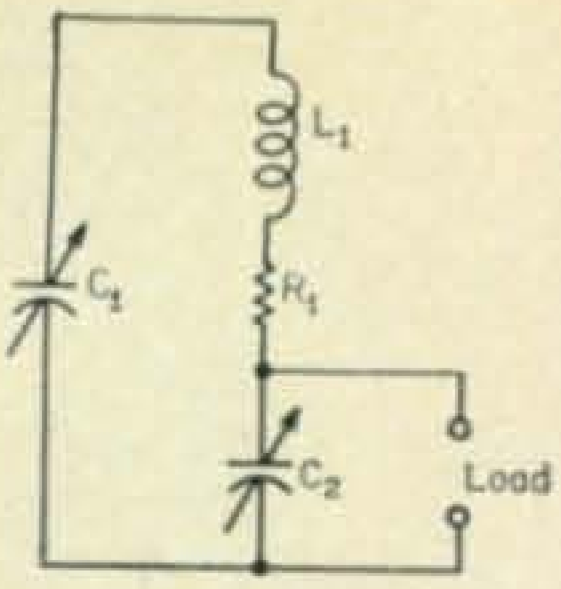


Fig. 1—Basic pi-network output circuit. Resistor R_1 is the coil resistance.

capacitance by adding series inductance in the form of a loading coil, meaning a coil that facilitates loading the transmitter.

Pi-Network Operation

As a rough description of the pi-network operation, we might make some observations about fig. 1. When the reactance of the loading capacitor, C_2, is very high compared to the load impedance, the load is effectively in series with the inductive leg of the tank. The tuning capacitor C_1 is adjusted to resonate with whatever resistance and reactance is in the leg with the inductor. When the reactance of C_2 is low, the parallel circuit formed by C_2 and the load has a lower resistance than the load itself, and is reactive as well. By converting this parallel circuit to its series equivalent, we can find its effect on the over-all tank circuit. Again, C_1 must be adjusted to resonate with the impedance of the leg of the tank with the coil.

If we make the load on the transmitter 50 ohms of pure resistance we can calculate the capacitor settings necessary to load and tune our network. There will be some loss of power in our tank circuit because of the resistance of the coil. We'll come back to this in a moment. For the time being, neglect it. If we want to put 100 watts of power into the load, we must put 100 watts into the tank circuit. Or, at 500 volts, our transmitter is loaded to its full 200 ma. The impedance of the tank circuit *as seen by the final tube* is 500/0.200 or 2500 ohms—purely resistive. Our pi-network has transformed a 50 ohm load to a 2500 ohm resistive load. One might note that from the standpoint of power transfer, we could run a linear power tube directly into a 2500 ohm load (or antenna, if we had one). Thus we would need no tank circuit or loading circuit at all if we were willing to do away with the harmonic suppression we get from a tuned circuit and were willing to deal with the high r.f. voltages. Another method that has been described is to run a number of tubes in parallel to increase the total current and decrease the impedance. For example, at 300 volts, 6 amps of current will feed a 50 ohm load directly, with no matching network. At 250 ma per tube this would require 24 tubes in parallel.

Let's assign values to the pi-network in fig. 1. These values are shown in Table I. The 2 ohm resistance is the resistance of the tank coil. All reactances are at a specific frequency, of course, in this case 3.9 mc.

When the network is loaded and tuned for the 50 ohm dummy load, the values are as in Table II. The loading capacitance and the load can be transformed into an equivalent series circuit, and appear as shown in fig. 2, where X_e and R_e are the equivalent series components. For the example above, $X_e = -j24.6$ ohms and $R_e = 20.7$ ohms. We know we are putting 100 watts into our pi-network. This 100 watts must be consumed in the resistances. The current is the same in all parts of a series circuit, so 100 watts is dissipated in $R_1 + R_e$ or in 22.7 ohms. Since

$$I = \sqrt{P/R} = \sqrt{100/22.7} = 2.1 \text{ amperes.}$$

Of the 100 watts, 91.2 watts are used in the load and 8.8 watts are dissipated in the tank coil. (Isn't that a good argument for keeping the Q of the tank coil high?) This, of course, is still the series equivalent circuit. The 91.2 watts in the load is used in the real 50 ohm load. The actual current in the real load is

$$\sqrt{91.2/50} = 1.35 \text{ amperes.}$$

Now let's see what happens when we replace the 50 ohm dummy load with one of 100 ohms. In order to feed power to this new load, we find that we must adjust both the tuning and loading capacitors in the pi-network. If they have sufficient range so that we can tune and load our final to 200 ma with the new load, the input to our tank is exactly the same as it was before, 200 ma at 500 volts. The tank impedance is exactly the same—2500 ohms. Our pi-network has simply been re-adjusted to transform a 100 ohm load to a 2500 ohm load. Table III shows the new tank component values. In the equivalent circuit of fig. 2, X_e now is $-j38.5$ ohms and R_e is 18 ohms. Now the current in the resistances

$$\sqrt{100/20} = 2.24 \text{ amperes.}$$

Of the 100 watts input, 90 watts reaches the load, while 10 watts are lost in heating the tank coil. All of this is *without* any standing waves or reflected power, mind you, since the transmitter is connected directly to the dummy load.

Table I

C or *L*	*R* or *X*
C_1 . . 15 to 210 mmf	$-j2040$ to $-j145$
C_2 . 100 to 1500 mmf	$-j272$ to $-j26$
L . . . . 10.6 μh	$+j260$
R_1 . . . . —	2

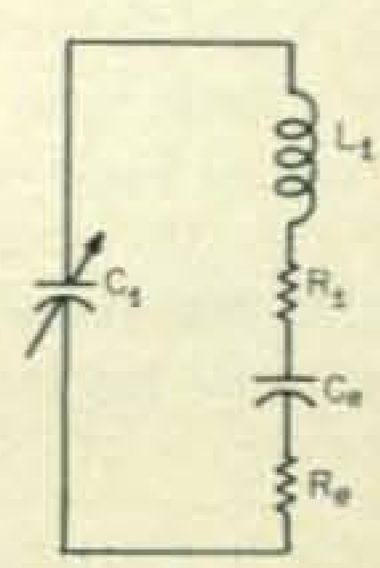


Fig. 2—The equivalent series circuit of fig. 1 with the load connected, as explained in the text.

Table II

C_1 .... −j237	C_2 .... −j42
L .... +j260	Load 50

By the same reasoning, with a 25 ohm dummy load, the settings on our pi-network would be still different. With the network components we have chosen, we cannot quite fully load the transmitter into a 25 ohm load. About 185 ma, or 92.5 watts is the best we can do. The values would be as shown in Table IV. The power lost in the tank coil would be 6.8 watts and the power trasferred to the load would be 85.7 watts.

We might note at this point that if our load is not a pure resistance and contains either inductive or capacitive reactance, it can still be transformed to a pure resistance, depending only on the range or capabilities of the variable components of the pi-network. It is important to keep in mind that power is not dissipated in a reactance—only in a resistance.

As one example of a reactive load, if the load consisted of 25 ohms resistance and 25 ohms inductive reactance in series, the tuned pi-network would have the values shown in Table V.

One other bit of data that we should look at in all four examples is the voltage across the load, and therefore across the loading capacitor. These voltages (r.m.s.) are shown in Table VI. The important thing to note is that the voltage increases with the load resistance, and that a given reactance has a greater effect than the same value of resistance.

Transmission Line

Now let's retune our final to the same condition we had with the 50 ohm dummy load, hook in onto a transmission line, and hang a load on the end of the line. This is where the fun starts. Let's assume to start with that we use a 50 ohm line of some random length, with a 50 ohm resistive load on the far end of it. It makes no difference whether this load is a dummy or a real antenna. All we need to know is its electrical characteristics. Note that the "impedance" of a 50 ohm line is *not* 50 ohms of resistance. No power is dissipated in the line as a result of this impedance. The impedance is simply the ratio of the voltage applied to the current produced in the line by that voltage.

The whole problem of standing waves arises because the load is an appreciable fraction of *time* away from the transmitter, or is some part of a wavelength or cycle away. At the first instant the transmitter is keyed it sees the nominal impedance of the feed line, 50 ohms, as its load. The voltage and current relationships are established. No matter how long the transmission line is, the ratio holds (excluding line losses). The load on the end has the same impedance in this case, and since this is a resistance, all the power from the transmitter is dissipated in the load. The impedances are matched all the way along. We have no s.w.r. and no problems.

Table III

C_1 .... −j223	C_2 .... −j47
L .... +j260	Load 100

Table IV

C_1 .... −j260	C_2 .... Maximum
L_1 .... +j260	Load 25

Mismatch

If the resistor is now removed from the end of the line, so that the line is open-circuited, the r.f. reaches the end of the line and has no place to go. Exactly the same situation exists as on the end of an antenna. No current can flow in the open circuit. So the current bounces back, or is reflected, and started back towards the transmitter 180° or half a cycle out of phase with the outgoing current. At the very end of the line, the forward and reflected current are always equal and opposite and cancel each other out completely and exactly, so that the net current is zero. However, by the time the reflected current has traveled 90° or ¼ cycle later in time back towards the transmitter, it is meeting forward current sent out ¼ cycle *earlier* than at the end of the line. So there is another 180° phase difference between the forward and reflected currents at this point, or a total of 360°, or a full cycle. Instead of cancelling, the two add together, producing a current maximum or loop on this line at this point. This current is twice the original line current (again momentarily neglecting all line losses).

At the same time, the voltage at the *end* of the line goes to a maximum of twice the original line voltage. The outgoing and reflected components of the voltage are in phase and add together. By the time the reflected voltage has traveled 90° or ¼ cycle back towards the transmitter there is 180° or ½ cycle difference between the forward and the reflected voltage, so the two cancel completely, producing a null or zero voltage at this point. Voltage nulls always appear at the same point as current loops. If we move another 90° or ¼ cycle back towards the transmitter the same situation that existed at the open end of the line repeats itself—maximum voltage, zero current, and infinite impedance.

Impedance

Even though we're using a feed line with a "nominal" impedance of 50 ohms, the impedance that our transmitter sees is no longer 50 ohms. It depends, in fact, on just how long the line is. If the line is exactly ¼ wavelength long, the transmitter sees a maximum current and zero voltage—which is the same as zero impedance

Table V

C_1 .... −j237	C_2 .... −j92
L .... +j260	Load .... 25 + j25

Table VI

25 .... 48.3v.	100 .... 94.9v.
50 .... 67.5v.	25 + j25 .... 71.4v

Table VII

C_1 .... −j260	C_2 .... Anything
L_1 .... +j260	

or a short circuit. *No* pi-network can be tuned to load a dead short. If the line from the transmitter is a half wave or 180° line, the transmitter sees an infinite impedance. Again, *no* pi-network can feed an infinite impedance. It may be shown that for any other length line except a half wave (or multiples thereof) and a quarter wave (or odd multiples thereof) the impedance of either a shorted or an open line as seen by the transmitter is a pure reactance—with no resistive component. Since a reactance uses no power, we can't load a transmitter into a reactance either, and so *no power* can be taken from the final.

In any event, regardless of the line length, once the initial surge that occurred when we keyed the transmitter has reached the end of the line and been reflected back, the transmitter finds itself trying to feed an impedance radically different from 50 ohms. It is not tuned for this, and the plate current may swing up to a much higher value, depending on how the pi-network is adjusted.

Let's see what happens in our tank in the event it is looking into a dead short. Whether we have produced the short by wiring across the output terminals of the transmitter, or by hooking on an *open* circuited quarter wave line, or a short-circuited half wave line, makes no difference. In any case the transmitter sees a zero impedance. Yet in the first case we have no transmission line and no standing waves at all, and in the other two cases the s.w.r. is *extremely high*. If we tune and then try to load our final, we find that the loading control has no effect at all. Our tuned values are given in Table VII. The only thing that keeps C_1 from being exactly −j260 ohms is the 2 ohms of tank coil resistance. If we transform the entire circuit into its equivalent series circuit, we find that it appears to the final tube as a pure resistance of 33,800 ohms. At 500 volts the power is then 7.5 watts, all of which is dissipated in the tank coil resistance.

If we disconnect the transmitter from the line, or hook on a *shorted* quarter wave line, or an open-circuited half wave line, the transmitter sees an infinite impedance. And again, in the one case we have no standing waves, while in the other cases the s.w.r. is nearly infinite. In trying to load into this, start with the loading capacitor fully counter-clockwise or at minimum reactance. The reactance or loading is then gradually increased, keeping the final tuned or dipped as long as possible. Table VIII shows what happens. The figures in parentheses are not obtainable, either because the tuning capacitor won't cover the range, or because the final cannot supply that much power. In this case, it makes little difference what its Q is. Within practical limits, it will dissipate the same amount of power regardless of its resistance. Under the conditions just outlined, we could surely damage the final tank coil or the final tube. It is *not* the reflected power that does the damage, however, but the high internal current in the tank coil. The example has been for an infinite impedance at the feed point. A very high impedance resistive or capacitive load will have the same effect. A highly inductive load is not so much of a problem.

There are four points that can be made about either of the foregoing situations:

1. The s.w.r. on the line is extremely high, approaching infinity.

2. 100% of the outgoing power is being reflected.

3. The effect of this reflected power is to completely cancel the outgoing power.

4. The net effect is that no power is taken from the transmitter.

Now, let's forget these tank coil losses awhile and go back to our 50 ohm line, but with a 25 ohm load on the end of it. When we first key the transmitter, it feeds current into the line at 70.7 volts and 1.414 amps for the first cycle or so. But when our r.f. hits the 25 ohm resistor at the end of the line there is a mismatch. The ratio of current and voltage at this load must be 25, not the 50 of the line.

The formula for the reflected voltage at an impedance change point is

$$E_r = \left(\frac{Z_1 - Z_0}{Z_1 + Z_0}\right) E_0$$

where Z_o is the line impedance, Z_1 is the load impedance, and E_o is the line voltage. In our example the reflected voltage is −23.57 volts. The load voltage is $E_o + E_r = 47.13$ volts.

Reflected current $I_r = (Z_1 - Z_o/Z_1 + Z_o)I_o = 0.4713$ amps. The load current is $I_o + I_r =$ 1.8853. The voltage and current at the load now match the impedance since $47.13/1.8853 = 25$. The power used in the load is (47.13) (1.8853) = 88.9 watts. The reflected power = (0.4713) (23.57) = 11.1 watts.

The reflected power of 11.1 watts has subtracted from the forward power of 100 watts so that only 88.9 watts is being taken from the transmitter. We cannot actually transfer power simultaneously in two opposite directions. It's like trying to pump water in both directions in a pipe at the same time.

One quarter wavelength of line back towards the transmitter from the load, the forward and reflected voltages are in phase on the line and reinforce or add. $E_{max} = 70.7 + 23.57 = 94.27$ volts. At this point the currents are out of phase and cancel or subtract. $I_{min} = 1.414 - 0.4713 =$ 0.9427. If the transmitter feeds the line at this point, the feed point impedance is 94.27/0.9427 *or 100 ohms*. If the line is half wavelength long, the impedance at the transmitter will be the same as at the load, or 25 ohms. If the line is some other length, the resistive component of the feed point impedance will be between 25 and 100 ohms, but the impedance will also be reactive.

In any event, once the effect of the reflected voltage and current appears at the transmitter end of the line, the pi-network sees a different impedance than it is tuned for. For practical purposes, of course, this happens instantly, even though it is an appreciable amount of time so far as r.f. is concerned.

With a quarter wave line and a feed point impedance of 100 ohms, we must adjust the tuning and loading capacitors to transform this load, or we must set them to the values of Table III. When we have done so, the voltage at the feed point is 100, and the current is 1.00 amps. Now following the line back to the load, we find these values.

Forward Voltage	$= 75$
Reflected Voltage	$= 25$
Load Voltage	$= 75 - 25 = 50$
Feed Point Voltage	$= 75 + 25 = 100$
Forward Current	$= 1.5$
Reflected Current	$= 0.5$
Load Current	$= 1.5 + 0.5 = 2.0$
Feed Point Current	$= 1.5 - 0.5 = 1.0$

Forward Power	$= (75)(1.5) = 112.5$ Watts
Reflected Power	$= (25)(0.5) = 12.5$ Watts
Load Power	$= (100)(1.0) = 100$ Watts

The v.s.w.r. $= E_{max}/E_{min} = 100/50 = 2:1$. An s.w.r. meter will indicate a ratio of 2:1—or a forward power of 112.5 and a reflected power of 12.5—or a reflected power of 11.1%, depending on the meter. The only power actually being transferred is 112.5 − 12.5, or 100 watts.

General Observations

Now let's make some general observations about s.w.r., reflected power, tank coil heating, and what concern the amateur should have about them.

1. Most transmitters today are designed to feed a low impedance, unbalanced line, 50 or 72 ohm coax. This means low voltage, high current output. Only occasionally does an antenna have an impedance that exactly matches the feed line, and then usually only at one frequency.

2. An impedance mismatch between the feed line and the load produces standing waves of voltage and current on the feed line.

3. Standing waves produce these effects:

a. The feed point impedance at the transmitter will vary above and below the nominal feed-line impedance, depending on the length of the feed line and the magnitude of s.w.r.

b. Power losses in the feed line will be increased. There is always *some* loss. With short lines at the lower amateur frequencies, and with any reasonable s.w.r., the additional loss caused by standing waves is negligible.

Table VIII

X_{C_2}	X_L	X_{C_1}	Plate ma	Power (W)
26	260	234	18	9.0
50	260	210	23	11.5
100	260	160	39	19.5
189.3	260	(70.7)	200	100
200	260	(60)	(278)	139
250	260	(10)	(10 amps)	(5000)

c. The voltage across the loading capacitor may be increased. The higher or the more reactive the feed point impedance is, the higher the voltage across this capacitor.

d. If the s.w.r. is quite high and the line length is such that the feed point impedance is very high, or very capacitively reactive, attempts to load the transmitter may result in severe tank coil heating.

4. Since most amateurs don't know the load impedance, which will vary with frequency in any event, an s.w.r. bridge is the most convenient instrument for indicating whether or not the impedance mismatch is moderate or severe.

5. The objective is *not* to lower the s.w.r. for s.w.r.'s sake, but to produce a feed point impedance the transmitter can safely feed into. In general, if the s.w.r. is not greater than 2 or 3 to 1, and the transmitter can be loaded fully and tuned, there is not any object in trying to obtain any further decrease in the s.w.r. Its only effect is to very slightly increase your losses and it's negligible unless you have a very long line or are operating on 28 mc and up.

6. The "reflected power" simply subtracts from the forward power to give the load power, or the power taken from the transmitter. The reflected power is *not* being absorbed or used up in the transmitter.

7. Heating of the tank coil occurs because of its *own* resistance. It depends on the *r.f. current in the coil,* which in turn depends on the feed point impedance of the feed line, *not* the s.w.r. itself.

8. If the feed point impedance is not satisfactory for the transmitter, it may be transformed to a different value by

a. Altering the antenna length or location. This changes, or may change, the antenna impedance.

b. Putting a matching device between the end of the feed line and the antenna. This changes the s.w.r. but leaves the antenna alone.

c. Putting a matching stub at the appropriate place in the feed line. This lowers the s.w.r. from that point in the line back to the transmitter.

d. Changing the length of the feed line. This leaves the s.w.r. alone, but changes the feed point impedance.

e. Changing the impedance of the feed line. This alters both the s.w.r. and the feed point impedance. It is quite possible it may produce a higher s.w.r., but a better feed point impedance.

[*Continued on page 106*]

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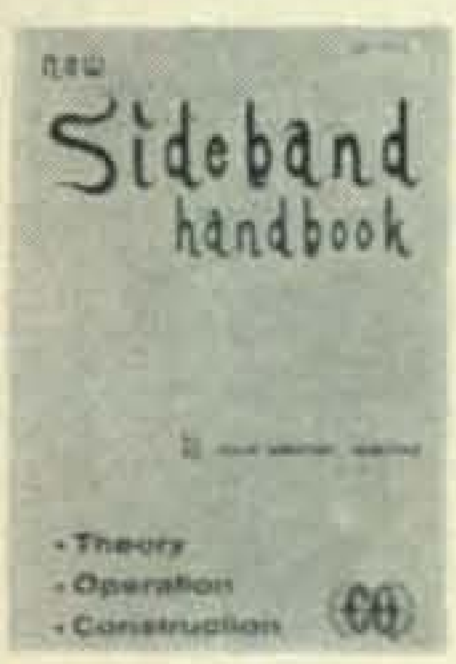

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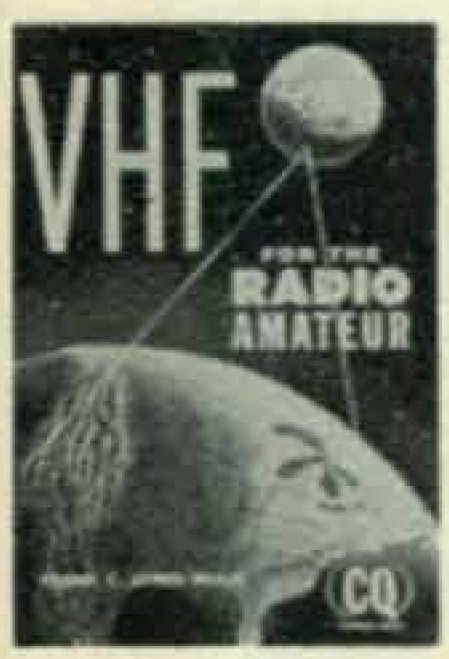

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DX

BY URB LE JEUNE,* W2DEC

Ted Thorpe Fund

Letter from Gay, W4NJF, Virginia Century Club: ". . . We thank you profusely for your club's contribution to the Ted Thorpe (ZL2AWJ) Fund. A letter has just been received from Mrs. Thorpe proclaiming her deep appreciation for what you are and have been doing . . . Please help by taking this up on the air and maybe we can produce a real nest egg for the children because they are the ones who are going to suffer in the long run. . . ."

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100 TWO-WAY SSB

489	UA1CX

Here and There

FW8 Wallis: Robert, FW8RC, is almost a Sunday regular at 0700 GMT on 14241 kc. *(Tnx LIDXA).*

HL Korea: Chuck, HL9TS, is active on 14235 between 1300 and 1800 GMT. Operation is permitted only every third day. *(Tnx WA6PQI).*

KC6 Western Carolines: KC6BO on Palan 14305 kc at 0830 GMT. *(Tnx LIDXA).*

KH6 Kure Island: WA7EZW/KH6 active on 14315 kc at 0445 GMT. *(Tnx LIDXA).*

KJ6 Johnston Island: KJ6DA is now QRT after 10,000 QSOs. His QSL Manager, Jessie, WA6OET, sent out over 3000 cards. *(Tnx WA6MWG).*

KS4 Swan Island: WA9LCY was erroneously listed as QSL Manager for KS4AB a few months back. Sorry.

LU South Orkneys: LU1ZG has been active on 21251 kc *c.w.* around 1700 GMT. *(Tnx VERON).*

MP4T Trucial Oman: MP4TBO and MP4TBV will be on almost nightly either hadling the pile-up themselves or having Ray, VS9ARV, emcee for them. They will be on 14198 at 2200 to 2300 GMT. *(Tnx LIDXA).*

OK Czechoslovakia: The rare OK4 prefix is now active. OK4CM is Michael, OK3CM, operating aboard the M/S *Bognice*. He uses 3505, 7010, 14020, 21040 mostly between 2000 and 2300 GMT. QSL via OK3UL. *(Tnx OK3EA and OK3UL).*

OY Faroe Islands: OY7ML advises that OY7U and OY2G are pirates. OY2YL, OY3H and OY7J are newly licensed. OY7YL is first licensed YL.

TN8 Congo Republic: Stan, TN8AF, has been quite active on 14055 kc starting at 2000 GMT. *(Tnx LIDXA).*

TU2 Ivory Coast: TU2AM, 21385 at 1730 GMT. TU2BA, 14130 at 0800 GMT. TU2AN, 14323 at 0630 GMT. *(Tnx LIDXA).*

VKØ Macquarie Island: Colin, VKØMI, active most weekends around 14050 kc between 0430 and 0600 GMT. *(Tnx LIDXA).*

VP8 Falkland Islands: John, VP8CW, on 28,600 s.s.b. at 1800 GMT. *(Tnx LIDXA).*

VS5 Brunei: VS5JC, a newcomer, may be worked on 14035 kc at 1600 GMT. He is ex-G3DPS/ZC4XX. *(Tnx LIDXA).*

VS9O Sultanate Of Oman: VS9OC is QRV every Saturday starting at 2100 GMT. He transmits on 14195 kc and listens on 14203. Occasionally QRV during the week at 0100 GMT.

XV5 Viet Nam: K1YPE/XV5 will work Ws after he finishes skeds which is about 1220 GMT. Usually on 14270 kc. *(Tnx NEDXA).*

YS El Salvador: Tom, YS1THM, is active daily on one of the following frequencies: 14250, 14290, 14050, 21350, 21150 or 28800 kc. He promises 100% QSL.

ZS8 Basutoland: Ulli, ZS8L, is quite active on 15 and 20 meter s.s.b. He prefers 21400 or 21420 about 16-1800 GMT and 14105 or 14110 about 08-1000 GMT. *(Tnx LIDXA).*

QTHs and QSL Managers

EL2D—Richard G. Miller, Box 98, Monrovia, Liberia.
EP3AM—Armin H. Meyer, American Embassy, APO, New York 09205.
ET3AC—via W4NJF
FG7XX—via K5AWR
GD5ACI—via W6RGG
GM5AAI—via W4SZE
HL9TH—via K1ERT
HR5MR/2—via W8QEO
K6KII/KG6—via K6JIC
KA7AB – John S. Lawrence, CMR #1, Box 860, 1955 Comm Sq. APO San Francisco, 96529.
KB6CB—via K6JAJ
KB6EPN—via K6JAJ
KW6EL—via K6JAJ
KW6EM—via K6JAJ
KR6BD—via K6JAJ
OK1APN—via WA4UOE
OK4CM—via OK3UL, Josef Straka, Box 44, Malacky, Czechoslovakia.
ON4NM/LX—via K2MYR
PJ2MI—via VE3EUU

[*Continued on page 100*]

*Box 35, Hazlet, New Jersey 07730.

the USA-CA PROGRAM

BY ED HOPPER,* W2GT

THE "Story of The Month" is about "Otts," K8CIR. Awards issued: Victor, WØGYM earned USA-CA-2500; Jim, WA4MGC received USA-CA-2000 Award endorsed All s.s.b.; Curt, WA4EBE who received #1 USA-CA-500 issued to a Novice in 1962, earned USA-CA-1000 and USA-CA-1500. Big Mike (Bertha), WA4BMC received USA-CA-1000 Award and will she have a BIG signal on 7 mc now! Fletcher, W4DRK earned a USA-CA-500 Award endorsed mixed and Tom, WB6KIL received a USA-CA-500 Award for All A-1 operation.

Oscar "Otts" Beyer, Jr., K8CIR Holder of #3 USA-CA-3000 Award

"Otts," as he is popularly known, is a contractor and has built about 250 small homes in the last 18 years. For the past 15 years he has lived on a small lake called Pottawattomie a few miles outside Grand Haven, Michigan, right smack dab in the middle of 10 acres. This would seem like an deal setup for an antenna farm, but because of the amount and size of the oak and pines, he is restricted *almost* like a city dweller.

The family includes Wife, Lorraine, "Lorie," K8CTY, a daughter now in college and a younger son.

Otts interest in amateur radio started indirectly through his daughter. When she was in grade school, she became acquainted with a very intelligent young man, he was blind as is she. He was an amateur radio operator and secured his license at the ripe old age of 14. This would not be very outstanding except you must realize the difficulty of a blind person passing the theory and code tests. This young man's ability to hold an entire QSO and at its conclusion to log in braille the starting and finishing time (they have braille watches) and all the other interesting and pertinent information is unbelievable and it is not unusual for him to have a round table on c.w. keeping full data on 4 stations and at the conclusion to fill out a complete log perfectly.

*103 Whitman St., Rochelle Park, N.J. 07662.

COUNTY HUNTER NETS

1200-1800 GMT 7223 s.s.b.
1800-2400 GMT 14295 s.s.b.
0200- GMT 3947 s.s.b.

C.W.

Mon-Tues-Friday 1700-2000 GMT 7035
Tues and Thursday 2300- GMT 7035

USA-CA HONOR ROLL

2500	**1500**	WA4EBE 100
WØGYM 15	WA4EBE 48	**500**
2000	**1000**	W4DRK 570
WA4MGC 28	WA4BMC 99	WB6KIL 571

But this story is about Otts, so back to him.

Otts is a member of the Muskegon Area Amateur Radio Council, a fine club and the instigator of the Michigan Week Amateur Radio Award. Otts was instrumental in securing the simplified address for sending QSLs for this award—The Governor's Office, Lansing, Michigan (makes no difference who might be governor at the time).

It seems that he gets involved in everything, even helping with communications for air races —see photo page 65, *CQ*, January 1966. He was one of the originators of the County Hunters Net on 7223. This has now blossomed into a CHN on 14295, 3947 and a new c.w. CHN on 7035 5 week days from 1700-2000 GMT with K3WWP and WA8EOH as net controls.

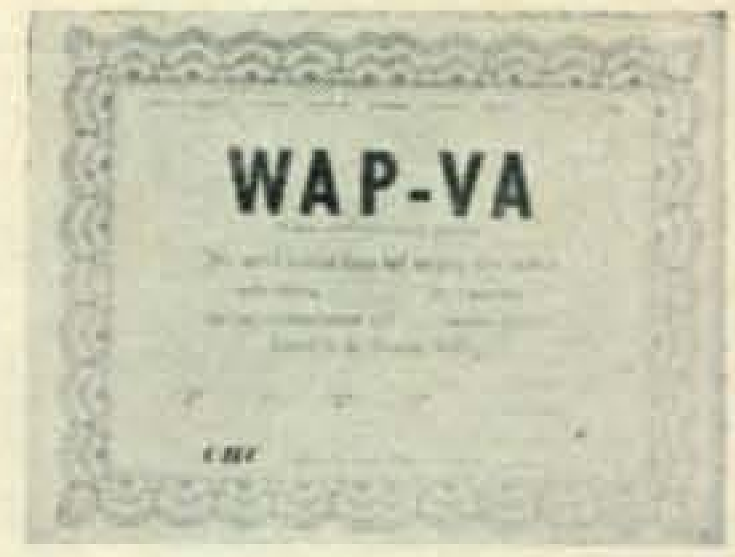
K8CIR has about 350 amateur radio awards and certificates including 3 service awards and he spends at least one evening each week on the Novice bands trying to help these new hams. Another favorite activity is mobiling, and on one trip K8CIR traveled 1300 miles and made 500 contacts and he went over 11,000 miles DX-peditioning in one summer. He has traveled through all but one Michigan county, made 2 complete trips around Lake Michigan and even operated Maritime Mobile on the deck of the Milwaukee Clipper and he had to pick a time when one of the worst storms in years hit the lake.

His two other hobbies are stamp collecting and model trains, and he specializes in air mail stamps, U.S. and Canada. Of course stamp collecting and amateur radio go hand in hand, and Otts has won honors with his fine collections.

As of this writing, Otts would like some leads on help in getting Boise, Lewis and Oneida counties in Idaho; Garfield in Montana; Emery and Wayne in Utah; and Kauai and Maui in Hawaii.

Otts won 3rd place at a Stamp Show.

New awards. L. to r. the K9YHB Worked Five Members Award, Worked Trumull County Award (WTC), Worked All Pomona Valley Award (WAP-VA).



Space does not permit more details of his well rounded amateur radio and associated activities, but he sure is in there pitching and helping all the time. For a look at K8CIR, equipment and list of USA-CA Awards see photo page 79, *CQ* November 1965.

Letters

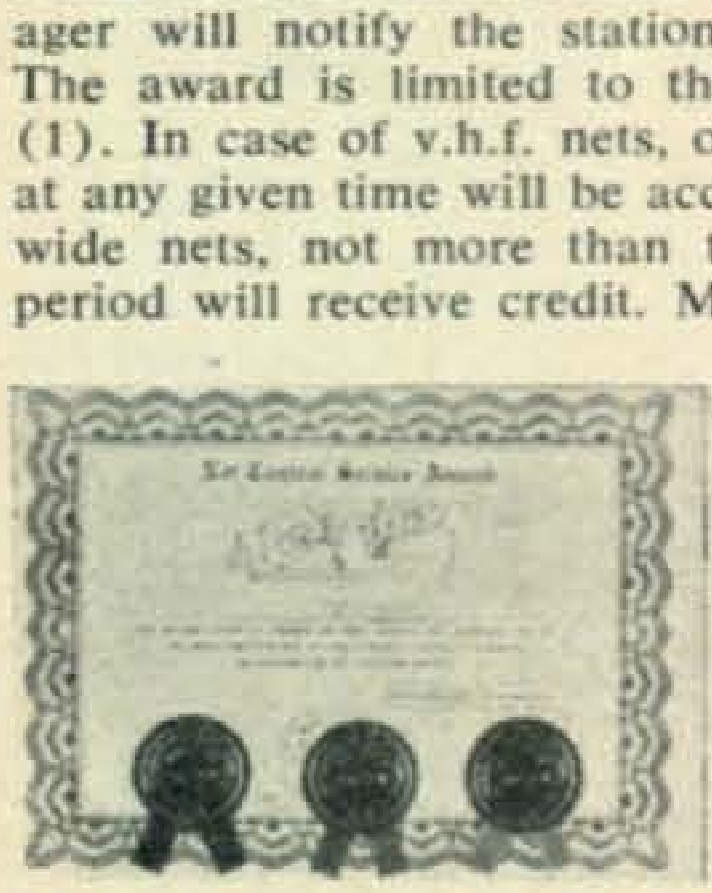
David, K5MDX, writes, "There will be an operation between August 25 and Sept. 3 by WA4MIV and myself. No exact place has been selected but rest assured that several rare counties will be activated. Three of the sites for our fixed portable operation under consideration are Clingmans Dome, Grandfather Mt., and Whitetop Mt. in Va. I also hold in some consideration Mt. Magazine, Ark. No matter where we go, our operating frequencies will be 3942, 3950, 7223, 14295, 14338, 14325, 21385 and 28.7. No. c.w. frequencies listed but we will listen for c.w. at any time and there will be c.w. operation but most of it will be in testing the DX ability of the portable location.

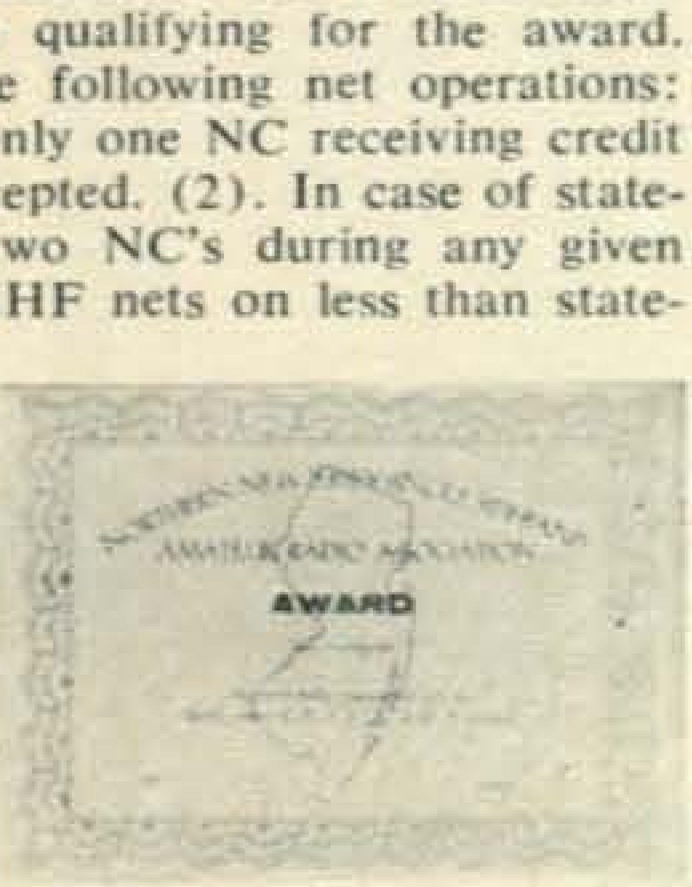
I have all the logs as does W2GHK for Operation Skytop II in 1964 and Arnold, WA4MIV has all the logs for Skytop I 1963. An s.a.s.e. will bring the needed QSL to any who might have been missed. For this operation, we each will handle our own cards, so send s.a.s.e. to Arnold Constable, WA4MIV, 212 Stonecreek Road, Smyrna, Ga. 30080 and David L. Thompson, K5MDX, 104 Dana Road, Natchez, Miss. 39120."

Mike, WB2PPE, writes, "To the best of my knowledge, I am the only active operator in Seneca County, N.Y. I would be glad to arrange skeds on 80, 40 or 15, preferably on c.w. and during weekdays, afternoon or evenings. I am most interested in working Ark., Idaho, Kan., Miss., Mont., N.D., Neb., N.M., Utah and Wash. which I need for WAS, but I'm willing to arrange a sked with ANYBODY. Oh yes, I'd like to work KH6 and VE4. Write Mike Hagen, II, WB2PPE, R.D. No. 2, Box 233, Brewer Road, Waterloo, N.Y. 13165."

Awards

Net Control Service Award: The Neighborhood Electronics Club of Oak Park, Ill. issues this award to amateurs for having served as an official Net Control. Requirements: Furnish proof of having been an officially assigned or recognized control station for an organized controlled net on at least 25 different half-days (a half-day is equivalent to 4 *continuous* hours of operation as a control station) on or after January 1, 1965. Proof may be furnished by requesting a regular member of the net to confirm control operation by submitting a statement to the Awards Manager that includes call of control station, date of control operation, duration of control operation, name of net, net frequency and net days and times of operation. See item (3) below for conditions governing National and International Service Nets. Awards Manager will notify the station qualifying for the award. The award is limited to the following net operations: (1). In case of v.h.f. nets, only one NC receiving credit at any given time will be accepted. (2). In case of state-wide nets, not more than two NC's during any given period will receive credit. MHF nets on less than state-wide basis do not count. Roundtable type nets do not count. (3). For National and International Service Nets, all officially assigned NC's may receive credit simultaneously providing the half-day period is covered by each and confirmed by Master Control Station. Basic award D—25 half-days; endorsement C—50 half-days; B—75 half-days; A—100 half-days. Basic award is $1.00 or 10 IRC. Subsequent seals: s.a.s.e., 10¢ or 1 IRC. Note: Once Class A is won, one may start a 2nd or 3rd, etc. award with 50¢ fee for basic. No band/mode limitations. No AOMB/M endorsements. TCR and MER apply. Award Manager: Hector Otero, WA9CNN, 201 North Harvey Ave., Oak Park, Illinois 60302.





Net Control Service Award NNJ SSB ARA Award

The Claremont Ham Club: WAP-VA Award: The Claremont Ham Club of California is proud to announce their Worked All Pomona Valley Award which is open to all amateurs and s.w.ls. There are over 600 licensed amateurs in the valley, of which ⅓ are active on all bands and modes. There are no date restrictions. The award is issued in 4 classes, plus the basic award and is endorsed for c.w., phone, or mixed operation.

AREA	BASIC	D	C	B	A
W1, 2, 3, 4, 8, 9, KH6, KL7, VE.	3	5	7	9	12
W5, 6, 7, Ø.	5	7	9	12	15
Calif. So. of Kern-S.B. Co.	7	10	12	17	20
DX	2	4	6	8	10
V.h.f. under 150 miles	10	13	16	20	25
V.h.f. over 150 miles	3	5	7	9	12
S.w.l. unconf.	5	10	15	20	25

The cost of the award is $1.00 for U.S. (KH6,KL7) and Canada. For DX stations no cost but postage would be appreciated and for s.w.l.s, 75¢. For the basic award send GCR list, cards will only be needed for cases of no listing and any calls before 1962. For endorsements W/K send s.a.s.e., others send s.a.e. and IRC. Valid cities in the Pomona Valley include Chino, Claremont, LaVerne, Mount Baldy, Montclair, Ontario, Pomona, San Dimas, Upland. For any additional details send s.a.s.e. Apply to Claremont Ham Club, c/o Tom Frenaye, WB6KIL, 617 Purdue Drive, Claremont, Calif. 91711.

The Worked Trumbull County Award: The Warren (Ohio) Amateur Radio Association is happy to offer this award designed to promote increased amateur radio activity among and with Trumbull County Amateur Radio Operators. Send application and all correspondence to Don Lovett, K8BXT, Awards Chairman, W.A.R.A., P.O. Box 809, Warren, Ohio 44484. Cost to W, K, and VE amateurs is 50¢ all others will send 3 IRCs. Trumbull County applicants must submit actual QSL Cards, all others will send GCR list and all must send list including all log data. For each certificate or endorsement, Trumbull County applicants must have 20 contacts with other Trumbull County Amateurs, 10 of whom must be W.A.R.A. members. Other W, K, and VE stations must contact 10 Trumbull County amateurs including 3 WARA members, while DX applicants must contact 5 stations including 3 WARA members. A certificate will be issued on each approved application but in order to appear on the certificate, special endorsements must be filed with the initial filing and each must contain at least 25% new contacts. Initial endorsements are free, but later endorsements will take the form of WTC certificates and applications for these must contain proper filing fees. Endorsements may be all one mode;

[*Continued on page 104*]

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

August 6-7	**CQ VHF Contest**
August 6-7	Illinois QSO Party
August 13-15	WAEDC C.W.
August 13-15	Indiana QSO Party
August 13-21	Dale County Activity
August 20-21	New Jersey QSO Party
August 27-28	QRP QSO Party
August 27-28	All Asia DX C.W.
September 10-11	WAEDC Phone
September 10-11	Pan American Contest
September 17-19	Washington QSO Party
October 1-3	Massachusetts QSO Party
October 22-23	**CQ WW DX Phone**
November 26-27	**CQ WW DX C.W.**

CQ VHF Contest

Starts: 1:00 P.M. Local Time August 6
Ends: 8:00 P.M. Local Time August 7

Rules on this one appeared in last month's CALENDAR.

DARC WAE DX

C.W.—August 13-14 **Phone** September 10-11
Starts: 0000 GMT Saturday
Ends: 2400 GMT Sunday

Rules in details and the WAE country list appeared in last month's CALENDAR.

Logs go to: Dr. H. G. Todt, DL7EN, Chlodwigstr. 5, 1 Berlin 42, Germany. Mailing deadline, September 15th for c.w. and October 15th for phone.

Illinois QSO Party

Starts: 1600 GMT Saturday, August 6
Ends: 2200 GMT Sunday, August 7

Activity in all 102 counties is promised for the fourth annual Illinois QSO party.

Use all bands, c.w. and phone; a.m. and s.s.b. classified as phone. The same station can be worked and counted for QSO points on each band and each mode.

Exchange: QSO number, RS/RST report, state, province or county. (Ill. stations, county).

Points: 1 point per contact for out of state as well as Illinois stations who are permitted to work in state stations for QSO points.

Multiplier: Out of state, total QSO points multiplied by number of Ill. counties worked. Illinois stations will use States, Canadian provinces and countries as their multiplier.

Frequencies: 3600, 3900, 7040, 7220, 14080, 14300, 21100, 21300, 28100, 28700 kc.

Awards: Illinois, single and multi-operator stations in separate categories, with 1st, 2nd and 3rd place certificates. Out of state, a certificate for each State, VE call area and country.

Logs: Must show: Date/time in GMT, exchange sent and received, band, mode and points. A summary sheet with scoring and name and address in BLOCK LETTERS, and other information.

Mailing deadline is September 1st, to: Cliff Corne, K9EAB, 711 West McClure Ave., Peoria, Illinois 61604. Include s.a.s.e. for results.

Indiana QSO Party

Starts: 2200 GMT Saturday, August 13
Ends: 0000 GMT Monday, August 15

*14 Sherwood Road, Stamford, Conn. 06905.

No, I didn't goof. But evidently two separate organizations in Indiana did, with two Indiana parties within a month of each other. This one organized by the Michigan City ARC is going to have tough going bucking the WAE contest on the same week-end.

Rules are the conventional state party type. Indiana stations will send their QSO number, RS/RST report and county. All others, their state, province or country. Each completed contact counts 5 points. Final score, QSO points times their respective multiplier, state and provinces for Ind. stations, Ind. counties for all others.

Use all modes and bands, including v.h.f. Suggested spots are 35 kc up from bottom of each c.w. and phone bands.

Certificates to the top scores in each Indiana county, state, province and country. And a plaque to the highest scorer in the contest.

Mailing deadline is September 15th and your logs go to: MCARC, c/o Steve Malott, WA9IZR, 522 Miller St., Michigan City, Ind. 46360.

Dade County Activity

Starts: 0001 EST Saturday, August 13
Ends: 2359 EST Sunday, August 21

This is not a contest but stations in Dade County (Miami and vicinity) will be active during this period which has been proclaimed "Ham" Radio week.

Stations in the USA can earn a special certificate by working five stations, DX need only two.

Contacts can be made on any band or mode. Send your report of stations worked, time/date, RS/RST, etc. along with an s.a.s.e. to: North Miami ARC, 776 N.E. 125th St., North Miami, Fla. 33161.

New Jersey QSO Party

Starts: 2300 GMT Saturday, August 20
Ends: 2300 GMT Sunday, August 21

Use all bands and modes. The same station may be contacted on each band and mode.

Exchange: QSO number, RS/RST and QTH. ARRL section or country, county for N.J. (max. of 21).

Scoring: Multiply number of contacts by the N.J. counties; N.J. stations will use ARRL sections and countries for their multiplier.

Frequencies: 1810, 3530, 3900, 7030, 7250, 14075, 14275, 21100, 21300, 28800. Also v.h.f. bands.

Awards: Certificate to high scorers in each N.J. county, ARRL section and country. Novice and Technician certificates will also be awarded.

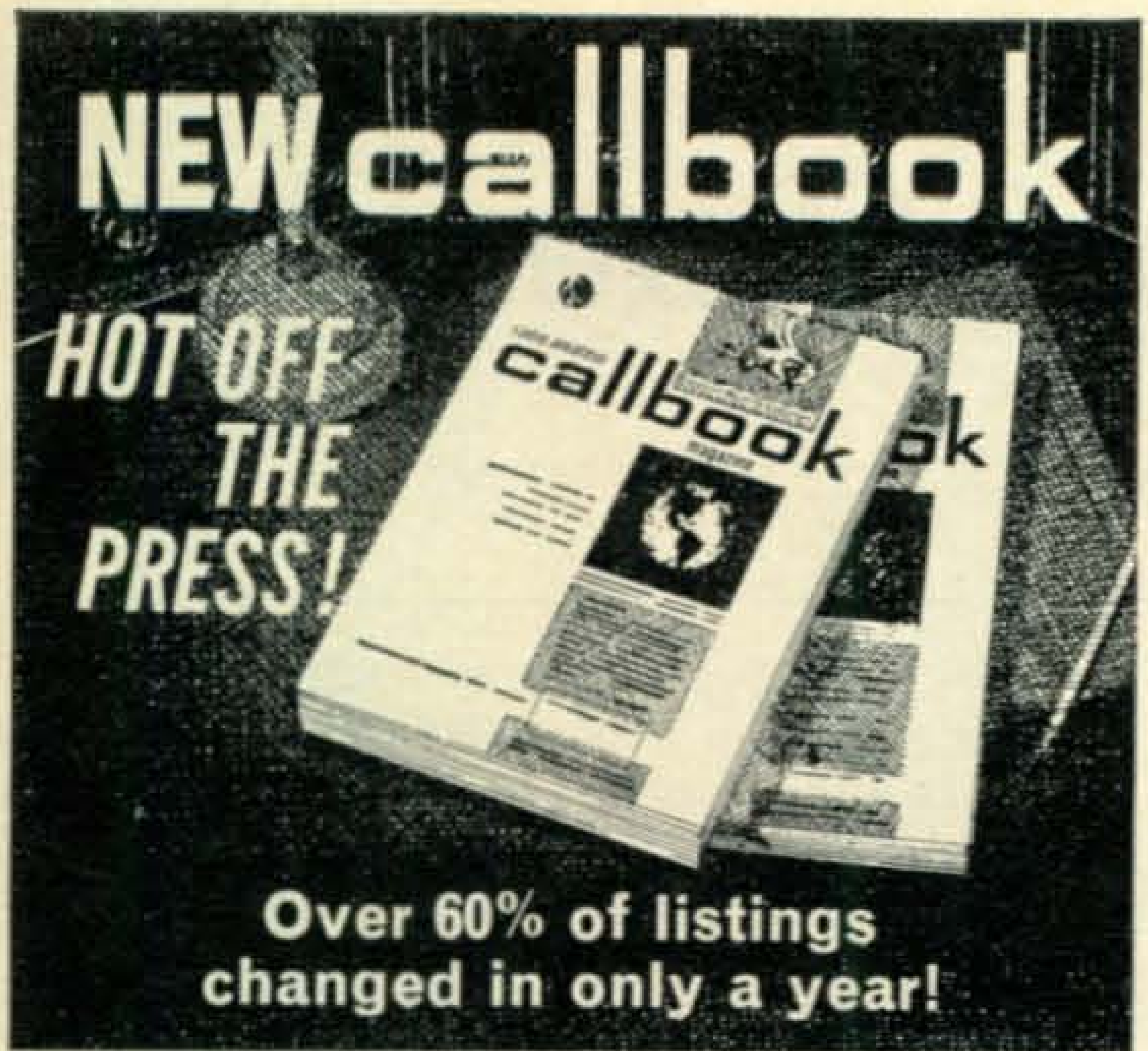
New Jersey stations planning active participation are requested to advise the EARA.

Mailing deadline is September 17th and logs go to: Englewood Amateur Radio Ass'n., 303 Tenafly Road, Englewood, N.J. 07631.

QRP QSO Party

Starts: 0200 GMT Saturday, August 27
Ends: 2300 GMT Sunday, August 28

QRP Radio International is a dedicated group



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of amateurs with a membership of about 3000 who by their own volition, maintain the power of their transmitters to below 100 watts.

Operation during their party is limited to 20 hours out of the 45 hour period, and all bands and modes may be used. Contacts will be between members and non-members, as well as between members.

Exchange: QSO Nr., RS/RST, ARRL section and QRP member number (NM for non-members).

Scoring: Each contact 1 point, DX 5 points. VE KH6 and KL7 considered DX. Multiply contact points by different sections and countries worked, and again by power multiplier if applicable. (1 watt—5, 1 to 10—2, 11 to 20—1.6, 21 to 30—1.2).

Frequencies: 3540, 3855, 7040, 7260, 14065, 14260, 21040, 21300, 28040, 28540, 50350 kc.

Awards: 1st and 2nd place certificates in each ARRL section and country for members and US/VE call areas and countries for non-members.

Mailing deadline is September 30th and logs go to: Bob Liggett, K8TBR, 817 Springdale Drive, Charleston, West Virginia 25302.

All Asia DX

Starts: 1000 GMT Saturday, August 27
Ends: 1600 GMT Sunday, August 28

We just received announcement of this contest which has always been held the last week-end in August. It is a c.w. only contest and rules have been the same for the past six years. See *CQ* Aug. 1965 for rules.

Logs go to: JARL Contest Committee, P.O. Box 377, Tokyo Central, Japan.

CQ World Wide DX Contest

Phone—October 22-23 **C.W.**—November 26-27
Starts: 0000 GMT Saturday
Ends: 2400 GMT Sunday

Rules will be the same as previous years and will be given in detail in the next issue. However, following is a brief rundown for the benefit of our friends in remote areas:

1. All bands may be used, 1.8 thru 28 mc.
2. Contest exchange, RS/RST plus your Zone.
3. QSO point value: (a) 3 points between stations in different continents. (b) 1 point between stations on the same continent but in different countries. (c) Contacts between stations in the same country are permitted for Zone and/or country multiplier, but have NO QSO point value. (d) Exception: Contacts between stations on the North American continent *only* will count 2 points. (This rule applies to stations in North America *only*.)
4. Your multiplier is determined by the number of Zones and Countries worked on each band.
5. Final score: (a) Single band, Zones plus Countries multiplied by QSO points. (b) All Band, the sum of the Zones and Countries from each band multiplied by the total QSO points from all bands.
6. Competition is in three divisions: (a) Single operator. (b) Multi-operator, Single Transmitter. (c) Multi-operator, Multi Transmitter.
7. Single operators have the option of operating on all bands or on a single band. Multi-operator stations, however, are judged on all band operation only.

The definition of a Multi-operator, Single Transmitter station is one in which only ONE signal is on the air at the same time. In Multi Transmitter operation, all bands may be activated at the same time, however only ONE signal is permitted per band.

These rules in detail and a list of 10 Trophies donated by prominent hams, as well as official log forms and summary sheets are available from *CQ*. Include a large self-addressed envelope with sufficient postage or IRC's with your

[*Continued on page 99*]

Propagation

BY GEORGE JACOBS,* W3ASK

PROPAGATION conditions on the h.f. bands during the spring months were observed to be considerably better than originally predicted. More ten meter openings took place than expected, and the 15 meter band opened to more areas of the world, more frequently and for longer periods of time than originally forecast. Although excellent world-wide propagation conditions were forecast for 20 meters, observed conditions seemed to be even a bit better, with the band open 24 hours, day after day. A sharp rise in sunspot activity is probably responsible for these improved conditions.

Typical summertime shortwave radio propagation conditions are forecast to continue through the month of August. Some fairly good 10 meter daytime openings are expected on north-south paths to Latin America, Africa and Australasia. An occasional east-west opening may be possible towards the end of the month. Good DX openings to many areas of the world are predicted for 15 meters during the daylight and early evening hours. Signal levels are expected to be exceptionally strong during many of these openings. Twenty meters is expected to be the optimum band for DX to most areas of the world during August. Peak conditions are forecast for the period shortly after sunrise, local time, and again during the late afternoon and evening hours. During many days of the month, the band should remain open around-the-clock.

Despite seasonally high static levels, fairly good DX propagation conditions are forecast for 40 meters during the night hours. Some DX openings should also be possible on 80 meters during the hours of darkness. Not many DX openings are expected on 160 meters, due to the high static level and the short hours of darkness during August. Some may occur, however, during the hours of darkness and at sunrise.

This month's column contains a detailed propagation forecast to DX areas of the world for use during August and September, 1966. Instructions for the correct use of this data appear directly below the "Last Minute Forecast" at the beginning of this column. For a detailed forecast of short-skip propagation conditions expected during August, over distances ranging between approximately 50 and 2300 miles, see the *CQ* Short-Skip Propagation Charts which appeared in last month's column.

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

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for August

Days	*Forecast Rating & Quality* (4)	(3)	(2)	(1)
Above Normal: **3-4, 13, 25, 30**	A	A-B	B-C	C
Normal: **1-2, 5-8, 10-12, 14-16, 18-20, 23-24, 26-27, 29**	A-B	B-C	C-D	D-E
Below Normal: **9, 17, 21, 28**	C	C-D	D	E
Disturbed: **22**	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.

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 DX Propagation Charts are based upon a transmitter power of 250 watts c.w.; 500 watts s.s.b., or 1000 watts d.s.b. into a dipole antenna a quarter-wave above ground on 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wave-length above ground on 15 and 10 meters. For each 10 db gain 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—The Eastern USA chart can be used in the 1, 2, 3, 4, 8, KP4, KG4 and KV4 amateur call areas; The Central USA Chart in the 5, 9 and Ø areas, and the Western USA Chart in the 6 and 7 areas. The Charts are valid through Aug. 31, 1966, and are prepared from basic propagation data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado

V.H.F. Ionospheric Openings

One of the year's most prolonged and intensive meteor showers, the *Perseids*, is expected to take place during August. The shower should begin during late July, and reach a peak during mid-August. The ionization produced by this shower is expected to make possible numerous meteor scatter openings on both 6 and 2 meters.

Some fairly good 6 meter short-skip openings should be possible during August as a result of sporadic-E ionization. These openings generally take place over distance of between approximately 750 and 1300 miles. During periods of intense sporadic-E ionization, 6 meter "two-hop" openings may be possible up to distances of approximately 2600 miles, with some 2 meter openings also possible over distances ranging between 1000 and 1400 miles.

During periods of ionospheric disturbances it is often possible to reflect 6 and 2 meter signals from the ionosphere for distances ranging upwards to approximately 1000 miles. The reflections take place from intense ionization associated with auroral displays which usually occur during disturbed periods. Check the "Last Minute Forecast" appearing at the beginning of this column for the periods that are expected to be below normal or disturbed during August.

Sunspot Cycle

The Swiss Federal Observatory at Zurich reports a monthly sunspot number of 44 for May, 1966. This results in a 12-month smoothed sunspot number, upon which the sunspot cycle is based, of 22, centered on November, 1965. A smoothed sunspot number of 46 is predicted for August, 1966 as solar activity continues to increase at a somewhat more rapid pace than earlier during the cycle. 73, George, W3ASK

CQ DX PROPAGATION CHARTS

AUGUST & SEPTEMBER 1966

Time Zone: EST (24-Hour Time)
EASTERN USA To:

	10/15 Meters	*20 Meters*	*40 Meters*	*80/160 Meters*
Western & Central Europe & North Africa	12-14 (1)* 08-12 (1) 12-14 (2) 14-17 (1)	05-06 (1) 06-07 (2) 07-09 (4) 09-11 (2) 11-15 (3) 15-17 (4) 17-18 (3) 18-19 (2) 19-22 (1)	18-20 (1) 20-22 (2) 22-01 (3) 01-02 (2) 02-03 (1)	20-22 (1) 22-00 (2) 00-02 (1) 22-00 (1)†
Northern Europe & European USSR	09-14 (1)	05-07 (1) 07-09 (3) 09-13 (2) 13-15 (3) 15-16 (2) 16-18 (1) 21-00 (1)	19-21 (1) 21-23 (2) 23-02 (1)	21-01 (1)
Eastern Mediterranean & East Africa	09-12 (1) 12-15 (2) 15-17 (1)	05-06 (1) 06-08 (2) 08-14 (1) 14-18 (2) 18-20 (3) 20-21 (2) 21-23 (1) 23-01 (2) 01-02 (1)	19-23 (1)	21-23 (1)
West & Central Africa	13-14 (1)* 14-16 (2)* 16-17 (1)* 07-09 (1) 09-11 (2) 11-14 (3) 14-16 (4) 16-17 (2) 17-18 (1)	02-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-17 (4) 17-20 (3) 20-21 (2) 21-23 (1) 23-02 (2)	20-23 (1) 23-02 (2) 02-03 (1)	00-02 (1)
South Africa	11-13 (1)* 07-10 (1) 10-11 (2) 11-12 (3) 12-14 (4) 14-15 (2) 15-17 (1)	07-14 (1) 14-15 (2) 15-17 (3) 17-18 (2) 18-20 (1) 00-01 (1) 01-03 (2) 03-04 (1)	20-22 (1) 22-00 (2) 00-02 (1)	22-00 (1)
Central Asia	08-10 (1) 19-21 (1)	06-09 (1) 19-22 (1)	04-06 (1) 18-20 (1)	*Nil*
Southeast Asia	09-12 (1) 18-20 (1)	06-07 (1) 07-09 (2) 09-11 (1) 17-21 (1)	*Nil*	*Nil*
Far East	07-09 (1) 17-19 (1)	06-07 (1) 07-09 (3) 09-10 (2) 10-12 (1) 16-19 (1) 19-22 (2) 22-23 (1)	05-07 (1)	*Nil*
Guam & Pacific Islands	15-17 (1)* 08-10 (1) 13-15 (1) 15-17 (2) 17-18 (3) 18-19 (2) 19-20 (1)	04-06 (1) 06-07 (2) 07-09 (3) 09-12 (1) 16-20 (1) 20-22 (2) 22-00 (3) 00-04 (2)	00-02 (1) 02-05 (3) 05-07 (2) 07-08 (1)	03-07 (1) 04-06 (1)†
Australasia	17-19 (1)* 08-10 (1) 15-17 (1) 17-19 (2) 19-21 (1)	04-07 (1) 07-09 (3) 09-10 (2) 10-15 (1) 15-17 (2) 17-21 (1) 21-23 (3) 23-04 (2)	02-04 (1) 04-06 (2) 06-08 (1)	04-06 (1) 04-06 (1)†
Northern & Central South America	13-14 (1)* 14-15 (2)* 15-17 (3)* 17-18 (2)* 18-19 (1)* 07-10 (1) 10-12 (3) 12-14 (2) 14-15 (3) 15-17 (4) 17-18 (3) 18-19 (2) 19-21 (1)	06-07 (2) 07-09 (4) 09-15 (2) 15-18 (3) 18-21 (4) 21-23 (3) 23-01 (2) 01-06 (1)	18-19 (1) 19-20 (2) 20-03 (3) 03-05 (2) 05-07 (1)	21-01 (1) 01-03 (2) 03-06 (1) 01-04 (1)-
Southern Brazil, Argentina, Chile & Uruguay	12-15 (1)* 15-17 (2)* 17-18 (1)* 07-08 (1) 08-10 (2) 10-13 (1) 13-15 (2) 15-17 (4) 17-19 (2) 19-20 (1)	04-07 (1) 07-09 (2) 09-15 (1) 15-17 (2) 17-19 (4) 19-23 (3) 23-04 (2)	20-23 (1) 23-04 (2) 04-06 (1)	03-05 (1)
McMurdo Sound, Antarctica	15-17 (1)* 13-16 (1) 16-18 (2) 18-20 (1)	07-09 (1) 15-17 (1) 17-19 (2) 19-21 (3) 21-23 (2) 23-01 (1)	00-04 (1)	*Nil*

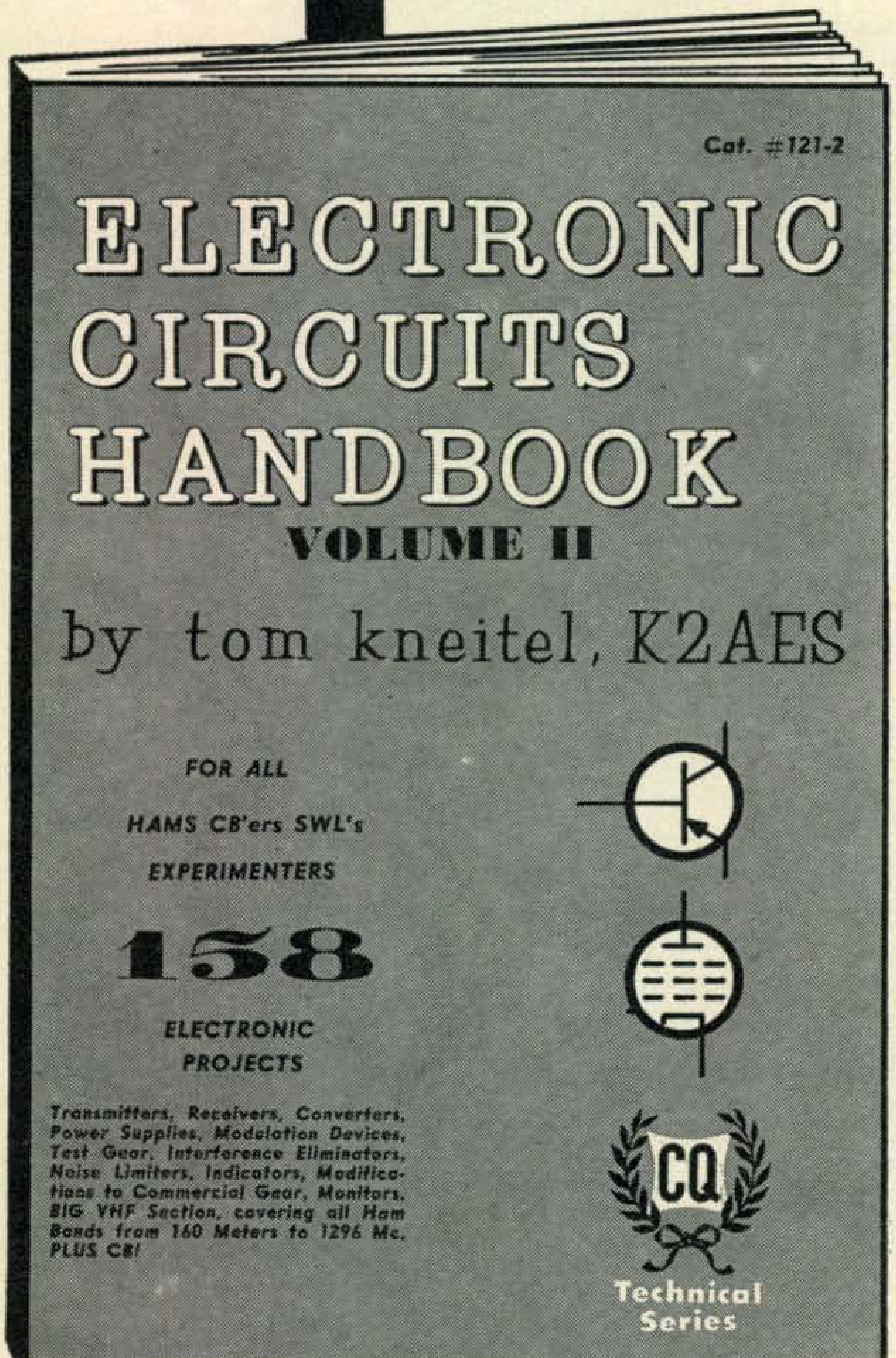
*Predicted 10 meter openings, all others in column are 15 meter openings.
†Predicted 160 meter openings, all others in column are 80 meter openings.

Time Zone: CST & MST (24-Hour Time)
CENTRAL USA To:

	10/15 Meters	*20 Meters*	*40 Meters*	*80/160 Meters*
Western & Central Europe & North Africa	08-11 (1) 11-13 (2) 13-16 (1)	05-06 (1) 06-09 (2) 09-12 (1) 12-14 (2) 14-16 (3) 16-19 (2) 19-21 (1)	20-22 (1) 22-00 (2) 00-03 (1)	21-01 (1)
Northern Europe & European USSR	09-13 (1)	05-06 (1) 06-09 (2) 09-12 (1) 12-15 (2) 15-18 (1) 21-23 (1)	20-01 (1)	21-00 (1)
Eastern Mediterranean & East Africa	09-11 (1) 11-13 (2) 13-14 (1)	06-13 (1) 13-18 (2) 18-20 (1) 20-22 (2) 22-00 (1)	19-22 (1)	20-22 (1)
West & Central Africa	10-13 (1)* 07-10 (1) 10-13 (2) 13-15 (3) 15-17 (2) 17-19 (1)	05-06 (1) 06-08 (2) 08-13 (1) 13-16 (2) 16-19 (3) 19-21 (2) 21-00 (1)	21-23 (1) 23-00 (2) 00-01 (1)	23-01 (1)
South Africa	11-13 (1)* 07-09 (1) 09-11 (2) 11-13 (3) 13-14 (2) 14-16 (1)	06-13 (1) 13-17 (2) 17-20 (1) 22-23 (1) 23-01 (2) 01-02 (1)	20-21 (1) 21-23 (2) 23-00 (1)	21-23 (1)

[*Continued on page 102*]

ONE MORE TIME



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HAM CLINIC

CHARLES J. SCHAUERS,* W6QLV

The questions and answers you see in Ham Clinic are those gleaned from your letters and cards. Your confidence is respected so we print no names or calls.

We select questions for publication on the basis of possible overall general interest. When we receive the same question from more than 10 readers and the question has not appeared before we give it publication priority.

Make your questions brief and to the point but include sufficient background information so that we can answer properly—especially questions on troubleshooting.

Questions

Marine Mobile—"I just acquired a new boat (24 footer) in which I plan to install my newly acquired Galaxy V transceiver. Any suggestions that will help me on installation, operation, etc.?"

Yes. First pick a good comfortable operating location. You might consider using two locations —one in the cabin and one on deck—the latter for those calm balmy days. Next, use a good vertical antenna located as far away from the engine as possible, then make sure you have a good copper ground plate. Before the set is mounted (preferably on rubber shock mounts), connect it and make checks for ignition noise. You may have to do some special ignition suppression work before the set operates properly. I would suggest that you install both a.c. and d.c. supplies, because when the boat is at dock, a.c. power is generally available. Do cover your set with a plastic covering when it is not in use— this will help to minimize corrosion.

Hallicrafters SR-2000—"I plan to buy a new Hallicrafters SR-2000 transceiver to take with me on a 3 year job assignment in a South American country. I have chosen this set because it has 5 bands, 2000 watts PEP input power and a variable pi network. Any recommendations?"

A couple. I hope you are going where you are *allowed* to operate—better check this. Next, if you can operate, you will have to observe transmitter power limitations. I would suggest you take along an auto-transformer and even possibly an a.c. voltage regulator for you will encounter various line voltages and various levels of line voltage regulation.

Ham Satellite Channel—"Why doesn't the ARRL get into the forthcoming communications satellite picture? I understand that in addition to satellites we now have in space, within five years there will be a large number of commercial satellites in operation. What I have in mind is for the ARRL and other national radio amateur radio societies to provide a 2 meter relay channel through subscriptions in one of the satellites. What are your ideas? Some of my friends say I'm 'off my rocker'."

Well, let me tell you, your idea is not as "far out" as your friends think. With the proper amount of money (through subscriptions from the ham populace throughout the world) channels could be rented—perhaps not for 2 meters but for other bands in the s.h.f. regions. Let us hope that the "brains" and "doers" work out the details and carry on from here. The possibilities are limitless.

Apache Conversion—"I have a Heath Apache transmitter which I would like to rebuild for higher power. What I have in mind is to remove the a.m. speech and modulating components, put in 8122 final tubes and beef up the power supply but still retain the power supply and continue to use my SB-10 s.s.b. exciter. What do you think?"

I think you have an overly ambitious project. What you would like to do *can* be done, but you would also have to replace final tuned circuits, use an outboard power supply for the 8122's (which will give you 1000 watts c.w. or 2000 watts PEP s.s.b. input) and make a number of other changes. You lack space for an integrated unit.

Drift and RTTY—"I recently acquired a used RTTY setup. After hooking it up I made a few short contacts and had a lot of fun. Later on I contacted a friend of mine and he had no trouble receiving me but I had a terrible time keeping his signals tuned in. My receiver is a late model

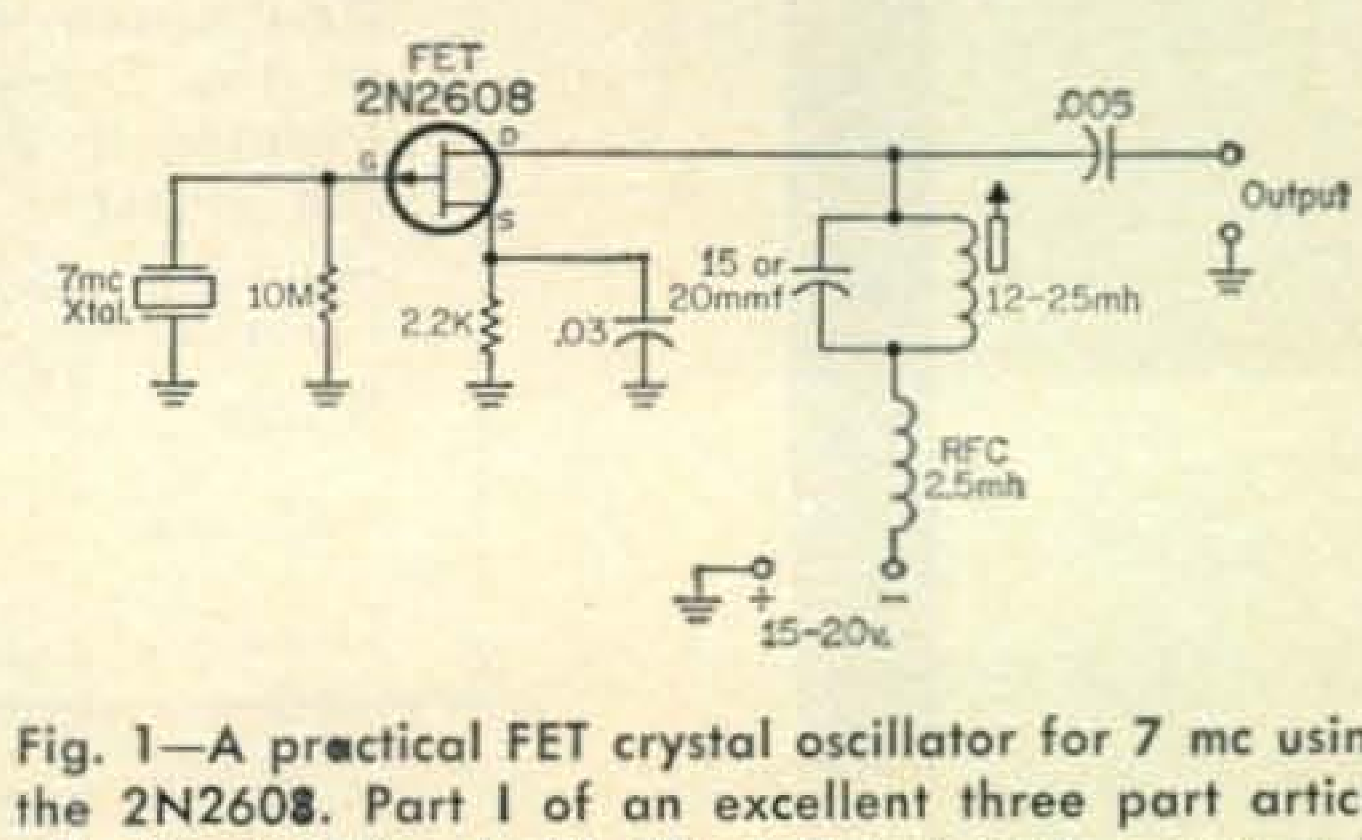

Fig. 1—A practical FET crystal oscillator for 7 mc using the 2N2608. Part I of an excellent three part article all about FET's (Field Effect Transistors) appears in this issue.

*c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y.

Ham Clinic is a free technical question and answer service provided exclusively by *CQ*. Every attempt is made to answer each reader's question as promptly and accurately as possible. Occasionally, even Ham Clinic is stumped, but it rarely happens. Readers are requested to enclose a stamped, self addressed envelope with their questions, to facilitate fast replies. For *extra* fast service, write directly to: Ham Clinic, c/o Chuck Schauers, W6QLV, 4 Lutzelmatte Str., Luzern, Switzerland. Enclose two IRC's. Normal inquiries: Ham Clinic, c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

and seems stable enough for s.s.b. voice. What should I check?"

First check your receiver again for frequency drift. Next, ask your friend to check his transmitter frequency drift. If you are using a.f.c. (which I doubt) in your receiving setup, check this. Overheated components (even low frequency ones) will cause drift.

Storing Tape—"I understand that when magnetic recording tape (reels) are stacked on one another that there is the possibility of one reel magnetizing another. Is this true?"

No. Recorded tape should not be stored near a.c. or d.c. magnetic sources, however. Ask your informants what happens when a tape contains two or more recorded channels! *These* do not magnetize each other.

FET Crystal Oscillator—"Please publish a circuit using a Siliconix 2N2608 field effect transistor (FET) given to me by a friend. I need such an oscillator that will operate at 7 mc."

See fig. 1. This oscillator will work well. Be sure to keep all connecting leads as short as possible. The coil can be air-wound or a permeability tuned unit. If desired, the tuning capacitor can be a variable unit and the value of the coil fixed. The amount of r.f. output will depend on the crystal (activity) and the voltages used.

GPR-90 and MR-4—"I have a used TMC GPR-90 receiver and a MSR-4 s.s.b. adapter. I note that when used together that I hear a high frequency whistle, even with the GPR-90 r.f. and a.f. gains turned down all the way. I do not hear the whistle when using the GPR-90 alone. What cooks?"

When the MSR-4 is connected to the GPR-90 it is connected to the latter's i.f. output and the GPR-90's a.f. output is usually (wrongly) left unterminated. This lack of termination causes the GPR-90 a.f. amplifier to oscillate at a supersonic frequency. This then enters the MSR-4 and appears in the speaker connected to it as an audio whistle. To cure this, simply terminate the GPR-90's a.f. output speaker terminals with a 1 watt, 4 ohm resistor.

807 Tube Fluorescence—"I have an a.m. transmitter which uses two 807's as modulators. I note that there is a purplish glow in each tube on the inside of the glass bulb. The transmitter works ok but I am worried about the glow. What is the answer?"

Nothing to worry about as this seems to be common with many 807 tubes and is a problem of glass chemistry. The condition is not due to gas. Gas is indicated when the glow is close to and between tube elements. The glow you see is due to glass fluorescence caused by stray electronic bombardment.

Vertical Radials—"I ordered and received an inexpensive vertical antenna. The instructions with it do not mention radials at all. Should I install them or not?"

Yes, if you are so inclined. Six or eight wires twice the length of the vertical can be installed in shallow trenches and you will note improved performance.

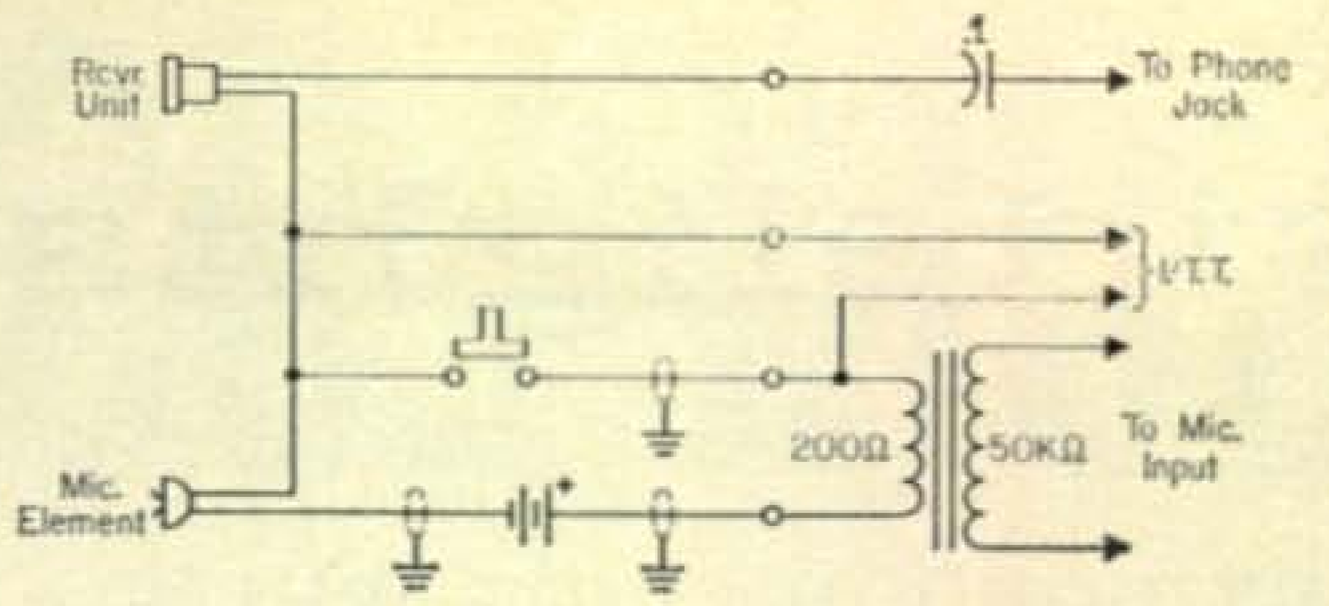

Fig. 2—Suggested rewiring for a telephone handset with a push-to-talk switch, for use with amateur equipment.

Surplus Queries—HAM CLINIC has stopped collecting information on surplus equipment for a number of reasons. We suggest that you direct your queries to the SURPLUS SIDELIGHT editor rather than to us on late equipment.

Article References—We have assumed in the past that when we receive 10 or so queries (see above) asking for article references on the same subject that even more hams are interested so we researched the data and presented it in the column. As a result, a number of hams who wanted the data complained that some of our references were unobtainable, so we will not publish this kind of information in the future. For information on back articles please write to the editors of the magazines involved. If they cannot help you then write to HAM CLINIC as a last resort.

Novice Questions—"I am a Novice but I see little usable information published in the magazines. The information I see is usually who has what rig and works who, or else is way above our heads. How about publishing some questions from Novices for a change?"

See next month's column—it will be devoted to the Novice. Three of the questions above were supplied by Novices. I believe HAM CLINIC helps more Novices than it does Extra class hams. We all have problems from the simple to the extremely complicated and no one has all the answers. If you are a Novice, gentle reader, write to us if you think we can help you.

Backlash in Dials—SX-28A, etc.—"I recently acquired an old SX-28A receiver and have a lot of trouble with backlash with the dials (tuning mechanism)—any suggestions?"

If that receiver has been used a great deal no doubt there has been a lot of wear and short of replacing complete tuning mechanisms there is little you can do. New gears (in some tuning assemblies) will solve the backlash problem, but in others using pinch (friction) rim type drive assemblies parts replacement can be a problem.

Quick Diode Check—"What is a good quick way to check a power diode?"

This is a question from a Novice. A good ohmmeter when connected to the power diode will show a very *low* reading in one direction and a *high* reading in the other direction. A shorted diode will show a very low reading in *both* directions. An open diode will give an infinite reading. To match diodes (approximately) choose diodes

[*Continued on page 101*]

SURPLUS sidelights

BY GORDON ELIOT WHITE*

As I promised last month, this column will be a roundup of surplus Radioteleprinter converters. I dealt with the Boehme 5-C in July, and will now look at the AN/FCC-3 and some of the military and commercial units becoming common on the surplus circuit. While RTTY'ers can still build better terminal units than they can buy, it is often handy to pick up a ready-to-go converter to use for testing, or as a first unit when you are just beginning RTTY.

I warned in the July column to stay away from *time-division multiplex* units, a warning I want to repeat. I went to quite a bit of trouble some time back to collect a beautiful huge rack of AN/FGC-5 equipment. The book was not immediately available, and when I finally got a manual I nearly cried. I had a fairly nice oscilloscope, but the rest of the beast was worthless except as a six foot tall junk box.

To paraphrase the handbook, the FGC-5 system uses a transmitter section which detects TTY stop-start signals, stores them, adds a sixth code element, actuating an electronic univibrator which transfers the signal to a very accurately calibrated distributor, in effect sampling each signal pulse, and taking a small percentage of the signal, then going on to the next channel and sampling it, and so on. Ordinary RTTY signals cannot be handled by the system, as certain pulses in each character are added and subtracted by the multiplexing process.

Time-division multiplex is commonly used by the telephone companies for certain long-haul circuits such as undersea cables where voice traffic is carried. The ear cannot detect the fact that it is hearing only bits of the voice on the other end. You may have heard "flutter" or similar distortions on long-distance lines: this is probably a badly-adjusted multiplexing fault. While it is certainly a useful method of putting several TTY channels into a single circuit, its complexity makes it a bit tricky for the military, and useless to the amateur.

The FGC-5 was built by Teletype Corp., part of A. T. & T., and is probably an adaptation of some phone company gear.

As far as I know now, a majority of the multiplexing on tactical military circuits uses the simpler frequency-division method. Narrow-shift frequency shift keying is used, and the different audio tones simply combined as either an a.m. or f.m. signal which is divided at the receiving end by very sharp filtering systems. You might have eight 85-cycle channels in an audio bandwidth reaching from 382.5 to 1657.5 c.p.s. in a typical application, in this case the AN/FCC-3.

Of course computer techniques are coming along. The new Autodin, or automatic digital terminals for the Defense Communication Agency will store TTY traffic, encode it for security, and transmit it in bursts at 3,000 words per minute. The companion Autovon, for voice circuits, will someday do the same for voice messages, eventually using pulse modulation to "digitalize" voice traffic. For the present however, Autovon uses conventional voice techniques. One wonders how digitalized voice will sound. Certainly the "burst" technique would be impractical there.

But I digress. Stay away from the AN/UGC-3, another time-division unit.

The CV-2 is a facsimile receiving converter, so is the CV-172 (NavShips 91394) and the KY-44 is a FAX transmitting keyer. Not much use for RTTY.

The CV-57 is a very nice i.f. type RTTY converter. It usually comes in a rack with two converters and the CM-14 comparator, for double diversity operation. This system is known as the AN/URA-6 (NavShips manual 91355). It requires an input from a receiver i.f. falling in the 395-470 kc range, although I have operated a CV-57 satisfactorily with 500 kc and 200 kc inputs. You must tune the input section to operate with your receiver, a fairly simple operation.

The converter "converts" the incoming receiver i.f. down to 40 kc for use in the discriminator portion of the terminal, so tuning-up means you have to adjust the CV-57's local oscillator 40 kc above or below the i.f. of your particular receiver.

The CV-71 is identical to the CV-57 but is designed for an i.f. input in the 47.5 to 52.5 kc band. Many of these converters bear the CV-57 tag, but a look inside will reveal the low i.f. input section. The entire low-band setup is known as AN/URA-7. Same NavShips handbook number.

The converter operates off 117 volts a.c., and has a built-in monitor scope with the flipping-line display that I, personally, prefer to the + pattern. You must provide a local loop d.c. supply for the CV-57, and CV-71. They have the usual high-low, wide-narrow, tune-operate, normal-reverse controls. The converters and the comparators use the same keyer module, but the power supply units are *not* interchangeable. The keyers also put out on-off keyed audio tones that are not generally used by amateurs, but at least have some value in tune-up and testing.

The CV-60 is the audio version of the URA-line. This unit looks identical to the CV-57 and the CV-71, but takes an audio tone input. It will accept shifts from 10 cycles to 1,000 c.p.s. Controls are much like the i.f. units. So is the monitor scope. The diversity system is the AN/URA-8, and it uses the CM-14 comparator as well (strapped internally for audio or i.f. as required). The NavShips number is 91339.

The CV-89 is the audio converter unit in the

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Receivers: AN/APR-9, 13, 14, R-388A, R-274, R-390A, R-391, R-392, etc.

Indicators: ID-250, 251, 387, 257A, etc.

Aircraft: AN/ARC-27, 34, 38, 44, 52, 55, 57, 73, 84
AN/ARN-14, 59, 67, 70
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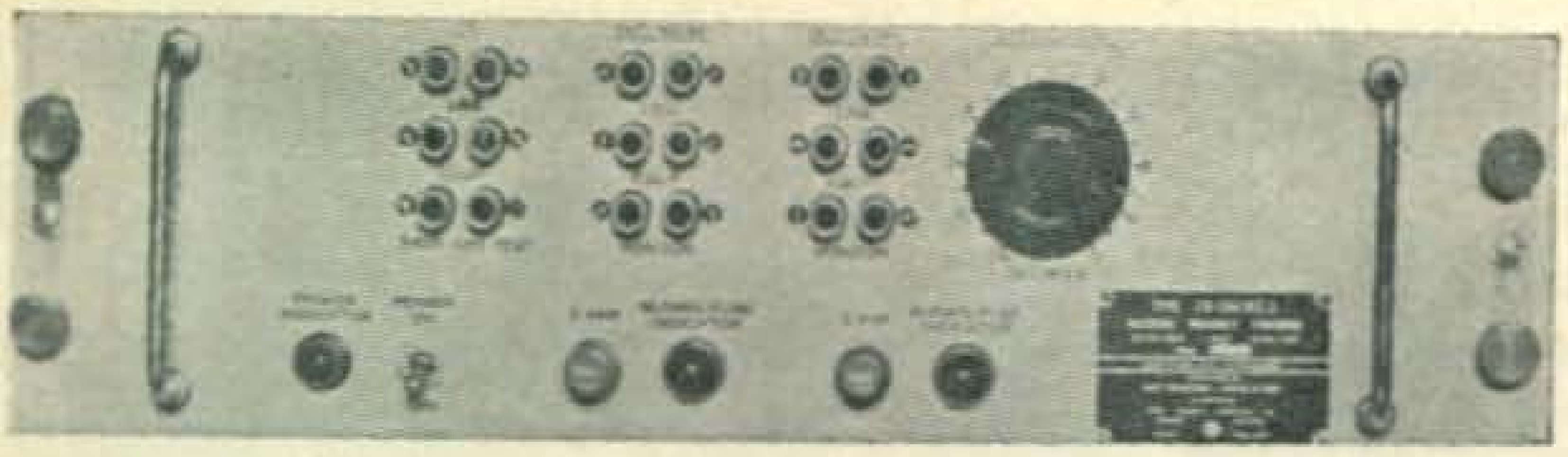

Fig. 1—Front view of AN/FCC-3 receiving converters R-525 through R-536. The TH-21/UC converter-keyer looks much like the FCC-3, and uses many of the same components.

AN/URA-8-A and -B set. The CV-89 is almost identical to the CV-60 as far as the circuit is concerned, but in some ways it is a little nicer in details such as finish. The monitor scope is in the center of the 4 × 19 inch front panel and there is a variable shift control. I do not believe either the CV-60 or the CV-89 is actually "better" on the air. I find the CV-57 is as good as the audio types at least following a good receiver such as the Collins' R-390-A/URR which has good selectivity curves. The i.f. type converter does away with b.f.o. drift problems at any rate. The CV-57 and CV-71 units both include automatic frequency control circuits. The CV-89 books, NavShips 91278, is very scarce.

The URA-8-A system has a slightly different comparator, nomenclature CM-22 but it does the same job as the CM-14.

One other point: the URA-6, -7 and -8 systems use the 1Z2 rectifier tube in the power supply section. This is an extremely fragile diode, it costs about $5 in surplus, and has no practical substitution. You might use a high p.i.v. silicon. The 1Z2 is rated at 15,000 volts however.

As was pointed out in the RTTY column a few years back, you can get low-impedance i.f. voltage from your receiver by winding about 30 turns of #24 enameled wire around the last i.f. transformer winding. Ground one end and take your i.f. off the other. You may have to touch up that last i.f. trimmer after you put the shield can back in place. This is a 20 minute job on most receivers and shouldn't affect the trade-in if you do a nice job; put a BNC female connector on the rear panel of the set for a professional-looking job. A cathode-follower is better, but the CV-57 will work very well with the i.f. taken as indicated above. I have modified two Super Pro's this way and have had no regrets. You may notice a slight loss in gain when the converter is attached, but increasing the audio on most receivers will compensate nicely.

The CV-62/U is a relatively straightforward converter for FSK or make-and-break keying. It is quite similar to the Boehme 5-C we described last month, both in operation and in physical appearance. This unit was made by Radio Frequency Laboratories of Boonton, N.J. The manual is Army TM 11-5524.

The CV-62 weighs in at 60 pounds, and cost the government $8.60 a pound. The unit includes a scope monitor and operates off 117 volts a.c. power. It requires 600 ohm audio and will accept inputs from two receivers for diversity work.

The CV-81 "converter" is part of the AN/FGC-5 system, which as I say, is relatively useless to the amateur. The CV-94 is the receiving end of the FCG-5. Forget it.

The CV-115/URR is a very nice i.f. type converter, designed for a 455 kc input. This unit is a companion to the R-392/URR receiver, a ruggedized Collins digital-tuned set very similar to the beautiful R-390-A/URR. The R-392 uses 28 volts for both filaments and B+, and both the receiver and the CV-115 are built into heavy waterproofed square aluminum cases for use in combat situations.

The CV-115 will accept i.f. inputs ranging beyond 450 and 510 kc. It will copy shifts from 150 to 1,000 cycles, and according to the book, requires 117 volt a.c. power. Hoffman Labs got $2200 each for these beauties. The TM is number 11-5085. The unit weighs 40 pounds.

The CV-116 is a rack-mounted unit, obviously a companion to the R-390 receiver. Also built by Hoffman, it is not as ruggedized, as the CV-115 and cost a few dollars less. It weighs 65 pounds, and is normally installed as part of the AN/FRR-38 system.

The CV-116 requires 117 volt a.c. power, and can operate either in diversity, from two receivers, or in single-channel mode. It has input and discriminator current meters, but no scope presentation. The book is TM 11-2241. This converter requires i.f. inputs in the 450-510 kc area (although it can be tuned a little higher or lower than that).

This unit is basically much like the URA-7 systems, in that it accepts the i.f. at, say, 455 kc, and converts the signal to a lower frequency, in this case 50 kc for channel A and 29.3 kc for channel B. The local oscillator can be either variably tuned or crystal controlled. In v.f.c. mode a motor-driven capacitor provides automatic frequency control. The converter provides markhold in case the carrier is lost in both channels. As far as I can determine the circuit is more complex but basically no better than the CV-57, CM-14 setup of the URA-7.

The CV-157 is also a companion to the R-390 receiver, but is strictly a single sideband converter, not an RTTY terminal. This is, incidentally, the most complex single chassis I have ever seen. It weighs 104 pounds and must have 90 tubes in it. It has 20 front panel controls, two meters, and must be impossible to repair if it ever goes on the blink. I shudder to think of it being "fixed" in some jungle signal shop. The converter has an associated power supply in an attached rack beneath the main chassis.

The CV-205 is the alarm unit of the old AN/FGC-1 set which has been described in past RTTY columns. As far as I can say the FGC-1 must be used as an entire system, all 425 pounds of it in a seven-foot rack. The system can be set for 850 cycle shift or, for low-frequency use in the

[*Continued on page 97*]

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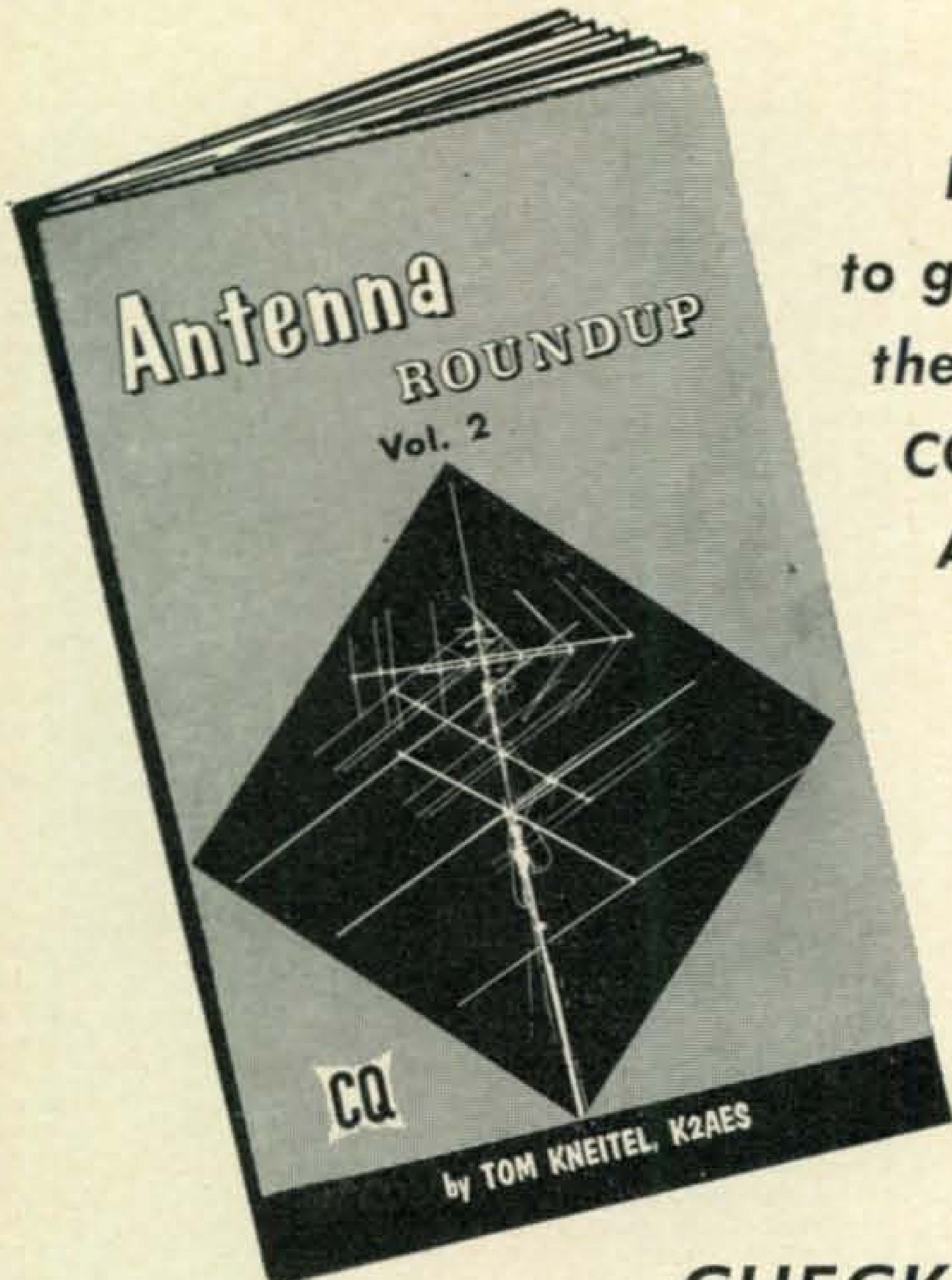

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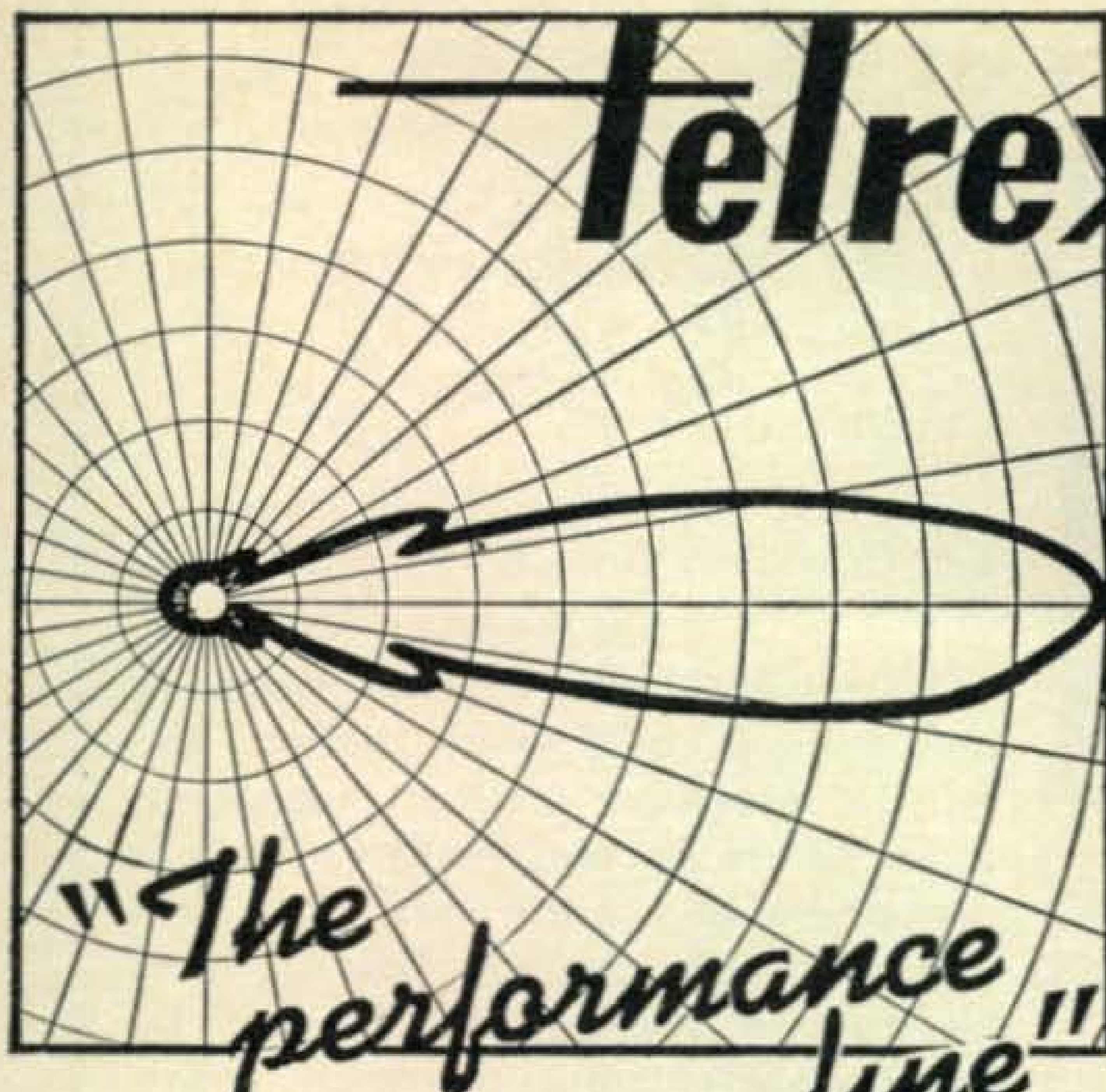

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Surplus [*from page 94*]

10-600 kc spectrum, to 170 c.p.s. FSK. This is a beautiful diversity terminal if you have the room.

The AN/URA-17 converter set has replaced the earlier URA's in the Navy. It uses the CV-483 converter which is a transistorized version of the CV-89. The unit looks a little like the CV-89, and has a small meter monitor. The URA-17 book is NavShips 94028. This ought to be a very nice unit.

The FRA-4 is an i.f. type converter, capable of accepting three diversity inputs and combining them into a single printer channel. It is designed for a 50 kc i.f.

The FRA components are comparator CM-26 and keyer KY-60. The NavShips book is 94196. I understand these have been converted in some instances to audio inputs. The set normally has a separate power supply, PP-561/FRA. All told it weighs 160 pounds. The FRA-4 will also convert frequency-shift facsimile signals for use in a recorder.

The O-5/FR unit is a keyer for transmitting FSK. It is part of the FRA "family" and was built by Press Wireless during World War II, and is similar to the old Prewi FS-12-A unit. The book is TM 11-2205.

The last of the FRA types was the FRC diversity converter, a Navy set similar to the FSC. It is designed for standard 2,975 and 2,125 c.p.s. mark and space frequencies. This is a big one, weighing 150 pounds. It is designed to drive a polar relay. The book is NavShips 900,078.

To shift from the ancient to the modern, the CV-972-UGC is part of a frequency division multiplex system that might have amateur possibilities. The NavShips number is 93847. The entire system is AN/FGC-60, a modern 16 channel shore-type station made by Telesignal Corporation. The overall instruction manual is NavShips 93841. This is a huge piece of equipment, with 32 converters for diversity work. Shifts are 170 cycles. I will not go into this deeply, since that would take the entire magazine, but I want to alert the amateurs to look for the components of the FGC-60, as individually they may be very useful items.

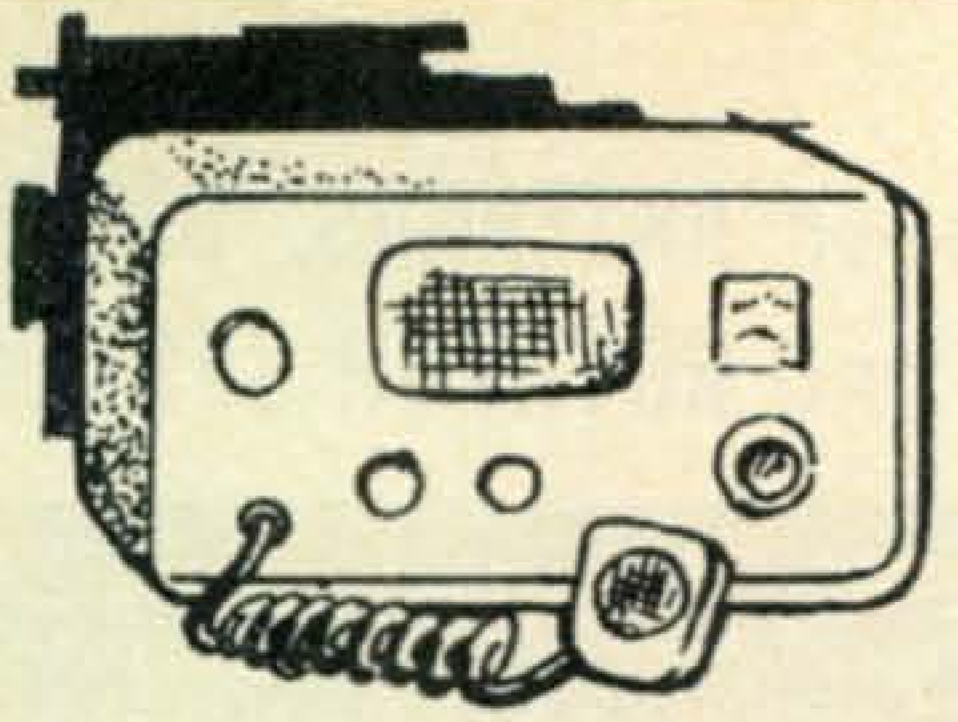
The AN/FCG-61 is another transistorized, 16-channel frequency-division multiplex system, made by Northern Radio Company. The commercial versions are models 230 and 235. Converters under commercial numbers in the FGC-61 are numbers 212, 245, 246, and number 217 is a regenerative repeater.

Northern Radio has long made FSK terminals. Their type 107 is a diversity converter with scope monitor, much like the Boehme 5-C described previously. This is a very nice rig for amateurs. The Northern Radio type 174 is a later model, using plug-in frequency determining modules. It may also be variably tuned. The company claims it will copy FSK that is 14 db below the white noise level.

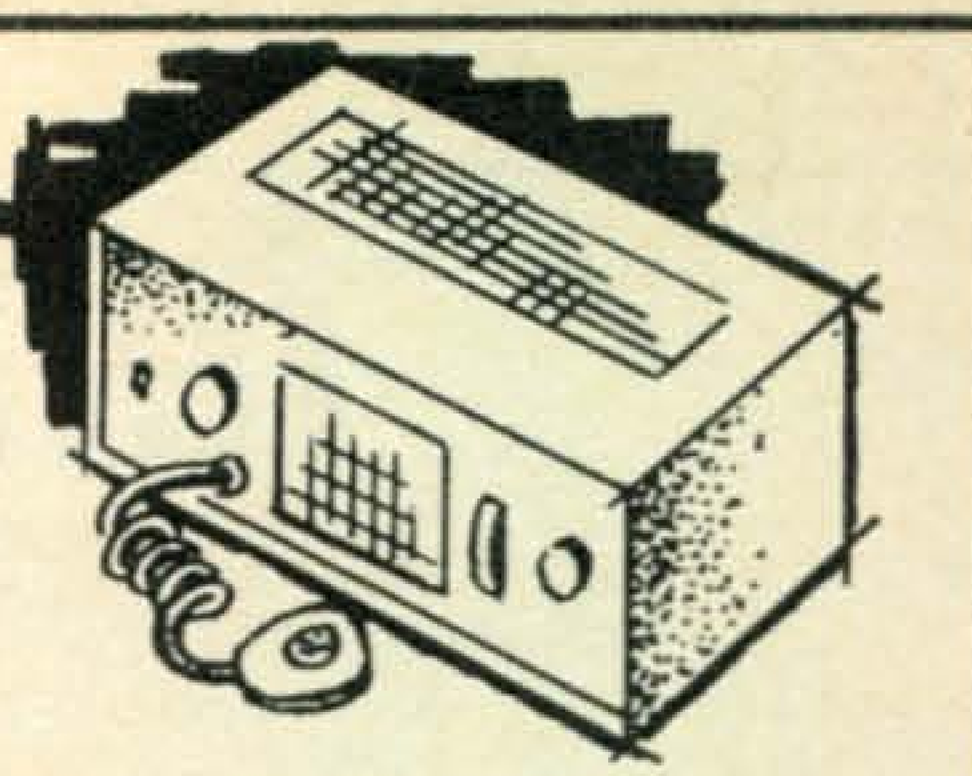
The N.R. 107 and 174 units are especially designed for use on high-frequency radio circuits. Many of the converters in surplus are not: they are designed for reception over wire lines or microwave circuits which show much less fortuitous distortion, multipath, etc., than h.f. radio. The amateur requires a relatively sophisticated converter to combat all the problems on the amateur h.f. bands, and the simpler wire-line terminals will not satisfy that need, even if they will do a fair job under good conditions.

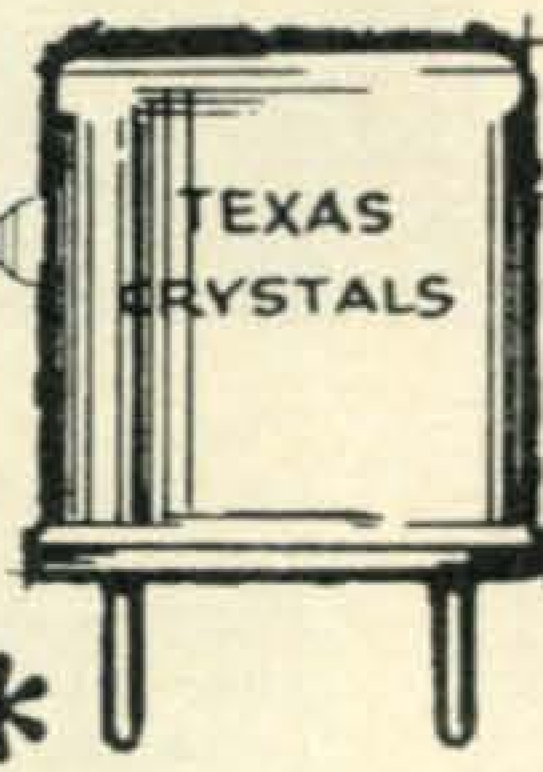
The AN/FCC-3 set is one of the simpler designs, built for wire circuits, but containing converters (called receivers in the manual) that can be altered to serve as amateur terminals. (The FCC-7, FCC-8 and FCC-16 use identical com-

[*Continued on page 99*]



The Heart of your Radio is Its





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Surplus [*from page 97*]

ponents in different rack arrangements.)

Since the FCC-3 units have schematics on the bottom cover plate of each piece, we will not go into great detail, except to say that the plug-in frequency determining circuits can be easily constructed to amateur frequencies. These sets used 85 or 170 c.p.s. shifts, so unless you are working on narrow shift, throw the heavy bandpass filters out and jumper their sockets, or replace them with appropriate home-brew filters.

The discriminators can be replaced by line matching transformers with the secondaries tuned to appropriate frequencies by R/C or L/C networks. The usual 88 mh toroids work very well. Joe Folinus, who is with United Press International in Atlanta, tells me he uses a transformer with two inputs of 600 ohm impedance and three outputs, tuning two secondary windings in series to feed the discriminator tubes and using the third winding to get keyer bias. If Joe sends me a schematic I'll include it in the column one of these months.

The NavShips book on the FCC-3 is number 91901.

I have used the transmitter sections of the FCC-3 as AFSK oscillators here. Both sections have their own 117 volt a.c. power supplies and provide loop d.c. power. They are very nice and simple units if you can see through the forest of interconnecting wiring. The audio inputs are designed for twin type plugs, so you may want to connect them all in parallel to use ordinary single patch cords. ■

Contest Calendar [*from page 86*]

request. *CQ* World Wide Contest, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050

Editor's Note

June has been an eventful month highlighted by a visit to Washington, D.C. and attending a meeting of the Potomac Valley Radio Club after having dinner with some of the boys. A presentation was made to Vic Clark, W4KFC and Ed Bissell, W3MSK of the Trophies won in our last contest, and the *CQ* Plaque won for the second straight year by the PVRC.

Equally delightful was K2HLB's Annual DX Cookout and Swim Party, which was highlighted by Don Miller's illustrated talk about his recent DXpeditions thru the Far East and Pacific areas. Now we know what constitutes a "new country." Don also received the Trophy he won for his record breaking score at VR2EW in the C.W. Contest. It was quite a party, and Doc Megibow is to be congratulated for organizing this annual affair. It seems that the doubtful FP8CQ in the Phone Contest was legitimate after all. QSLs go to Terry Appleton, W4GSM, P. O. Box 1383, Newport News, Va. 73, Frank, W1WY

The Oscilloscope [*from page 52*]

should be adjusted to produce a pattern of one or two cycles of the signal. Also, the equipment

For further information, check number 37, on page 110

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under test should be terminated with a properly matched load.

2. With the second method, a sample of the input signal for the equipment under test is applied to the vertical section of the scope and the output signal is applied to the horizontal side. If the two signals are in phase and if distortion is not present, the trace will be a *straight* solid line as shown at fig. 1A. Any departure from a straight line is indicative of distortion as shown at fig. 6B and 6D. Since the eye can distinguish a straight line more accurately[2] than a true sine wave, this method is better suited for distortion observations. It also is good for any type waveform.

If the two signals are not in phase, resulting in an elliptical pattern, distortion is indicated when both halves of the ellipse are not symmetrical or if their curvatures are not smooth.[3] See fig. 6C, 6E and 6F. At fig. 1B and 1C, a lack of distortion is indicated by a symmetrical ellipse and a perfect circle, respectively. If required for a closer determination, a solid trace may be obtained by engaging a phase-shifting network at one of the scope inputs as described earlier.

The preceding method is most useful for harmonic-distortion observations either in a.f. systems or s.s.b. r.f. amplifiers. Those concerned with the latter will be discussed later.

Although the first method may also be used to indicate harmonic distortion on sine waves, it is better suited for square-wave tests where the results will be more indicative of frequency-response distortion, examples of which are shown at fig. 7.

It should be noted that oscilloscope observations are practical only for indicating the *presence* of distortion. The actual *percentage* of distortion is difficult to analyze with the oscilloscope, so special distortion-*measuring* instruments are used instead.

For the radio amateur, probably the most useful applications of the oscilloscope involve checking the performance of and monitoring a.m. and s.s.b. transmitters. These will be taken up the next time around. ■

[2]A straight-edge rule may be used as a reference guide.
[3]When the signal *source* is a distorted sinewave or if it has some other waveform, such as a square wave, distortion in the equipment will be recognizable with this method only when no phase shift is present or when a solid line is obtained, in which case the intensity of the line may vary at different points. Ellipses will appear bumpy and thus can cloud the situation.

Ham Clinic [*from page 91*]

having similar forward and backward resistance readings. NOTE: Those tiny 1N34 "signal" diodes are sure to be damaged by the same test, so beware!

Handset with Transceiver—"I want to use a telephone handset with my transceiver. How do I go about hooking it up?"

First take out all the wiring and rewire (with shielded wire) as follows: two leads to the mike element through the push-to-talk switch (with an extra wire for the push-to-talk switch position); then connect two wires to the receiver unit. These wires can all be in the same cable. Connect the mike wires (through a 200 ohm to 50K transformer) to the set and connect up the ground wire (switch side). Mike current for the carbon unit can be supplied by a couple of small mercury cells. See fig. 2.

The handset receiver unit can be connected through a .1 mfd capacitor to the headphone jack on the transceiver (if there is one); otherwise on the speaker primary side (of the output transformer). I would suggest replacing the carbon mike element with a high impedance mike unit and the handset receiver unit with a 2K or 4K headphone unt. This does away with batteries and transformer as well as coupling capacitor. If you are planning mobile operation using the handset I would consider an operator's headset with mike if I were you. Driving with two hands is safer.

Southsea Cruise Operation—"I am going on a long Southsea cruise. Do you think I can obtain permission to bring my KWM-2 aboard and operate while at sea?"

No. However, you might check with the shipping company to find out if one of the operators on board has a ham set. No doubt he would let you use it.

New Circuit and Patent Search—"Recently while putting together a transistorized receiver I was experimenting with some noise limiter circuits and I believe I have run into an unusually good one. I drew up the diagram and then tried to find it in various magazines and books but without success, and the few that I did see were not even close. How do you suggest I find out if I can patent this circuit or not?"

Engage a good patent lawyer who will make a patent search for you. The charge is nominal and worth the effort. Keep the information to yourself until your lawyer has determined patentability and applied for a patent or told you that it cannot be patented. Good luck. If it can't be patented I hope you send HAM CLINIC the details for publication first.

Thirty

Please be patient for your replies from HAM CLINIC. All communications will be answered after [a much deserved—*ed.*] vacation.

73, Chuck, W6QLV

DX [*from page 82*]

SVØWH—via W3PZW
SVØWR—via WA4AYX
TA2BK—via DJ2PJ
VP5AR—via WA8GUA
VQ9EF—J. W. Fleurdelys, Satellite Tracking Stn. Box 191, Mahe, Seychelles.
VQ9RH—via K5QVH
VR4CR—Arthur W. Carter, Weather Office, Honiara, Solomon Is.
VS9OC—Maserah Island, BFPO 69, London, England.
XW8BD—via K1BFX
YV5BIG/YV7—via K3SLP
ZD8J—via K4LJV
ZD8TV—via WA4AYX
4X4FV—via K2IXP
5N2AAW—via K5OQO
7Q7PS—via W1MRQ
9Y4VU—via WA2CBB

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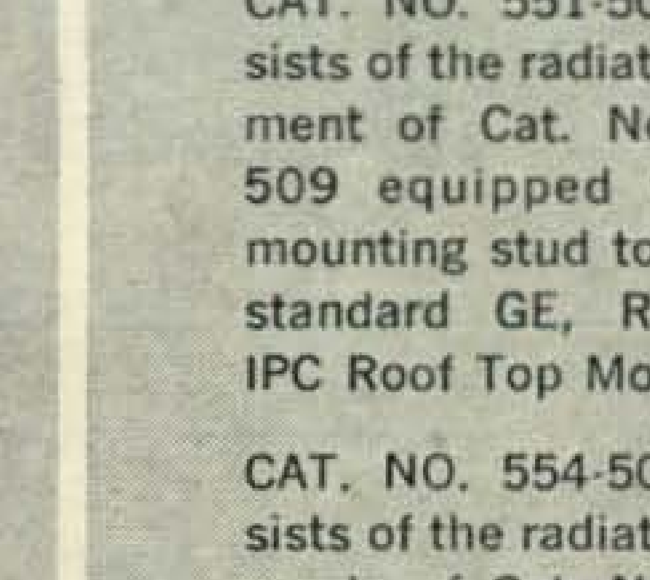

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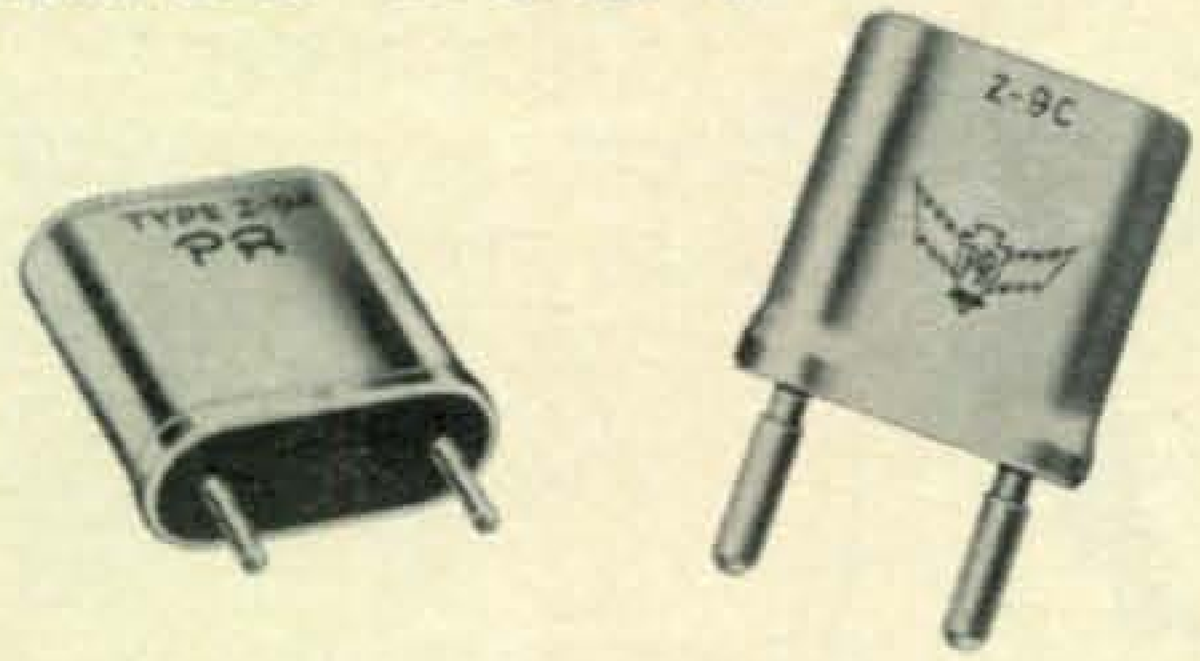

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For further information, check number 43, on page 110

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Propagation [*from page 88*]

Central Asia	07-11 (1) 18-21 (1)	06-07 (1) 07-09 (2) 09-10 (1) 18-21 (1)	05-07 (1) 18-20 (1)	*Nil*
South-east Asia	08-11 (1) 17-20 (1)	06-07 (1) 07-10 (2) 10-12 (1) 19-00 (1)	05-07 (1)	*Nil*
Far East	07-10 (1) 14-16 (1) 16-19 (2) 19-21 (1)	06-07 (1) 07-09 (3) 09-10 (2) 10-18 (1) 18-22 (2) 22-00 (1)	02-05 (1) 05-06 (2) 06-07 (1)	05-06 (1)
Guam & Pacific Islands	15-18 (1)* 08-14 (1) 14-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	06-07 (2) 07-09 (3) 09-11 (2) 11-19 (1) 19-21 (2) 21-00 (3) 00-04 (2) 04-06 (1)	23-00 (1) 00-05 (3) 05-07 (2) 07-08 (1)	01-03 (1) 03-05 (2) 05-06 (1) 04-06 (1)†
Aus-tralia & New Zealand	16-19 (1)* 08-10 (1) 13-16 (1) 16-20 (2) 20-23 (1)	16-20 (1) 20-22 (2) 22-00 (3) 00-04 (2) 04-06 (1) 06-07 (2) 07-09 (3) 09-10 (2) 10-16 (1)	01-03 (1) 03-06 (2) 06-08 (1)	03-04 (1) 04-06 (2) 06-07 (1) 04-06 (1)†
North-ern & Central South America	13-14 (1)* 14-15 (2)* 15-16 (3)* 16-17 (2)* 17-18 (1)* 07-09 (1) 09-11 (3) 11-13 (2) 13-14 (3) 14-16 (4) 16-17 (3) 17-19 (2) 19-21 (1)	06-07 (2) 07-09 (3) 09-15 (2) 15-17 (3) 17-20 (4) 20-22 (3) 22-00 (2) 00-06 (1)	18-19 (1) 19-20 (2) 20-02 (3) 02-05 (2) 05-06 (1)	20-23 (1) 23-02 (2) 02-05 (1) 00-04 (1)†
South-ern Brazil, Argen-tina, Chile & Uruguay	12-14 (1)* 14-16 (2)* 16-17 (1) 06-08 (1) 08-10 (2) 10-13 (1) 13-15 (2) 15-17 (4) 17-18 (3) 18-20 (2) 20-21 (1)	02-06 (1) 06-09 (2) 09-14 (1) 14-16 (2) 16-17 (3) 17-19 (4) 19-00 (3) 00-02 (2)	20-23 (1) 23-03 (2) 03-05 (1)	01-04 (1)
Mc-Murdo Sound, Antarc-tica	14-16 (1)* 12-16 (1) 16-18 (2) 18-20 (1)	07-09 (1) 15-17 (1) 17-19 (2) 19-21 (3) 21-23 (2) 23-00 (1)	00-05 (1)	*Nil*

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	10/15 Meters	*20 Meters*	*40 Meters*	*80/160 Meters*
Western & Central Europe & North Africa	09-10 (1) 10-12 (2) 12-14 (1)	05-06 (1) 06-09 (2) 09-11 (1) 11-14 (2) 14-16 (3) 16-17 (2) 17-19 (1) 22-00 (1)	19-20 (1) 20-22 (2) 22-23 (1)	21-22 (1)
North-ern Europe & Euro-pean USSR	09-12 (1)	05-06 (1) 06-09 (2) 09-14 (1) 14-16 (2) 16-18 (1) 21-23 (1)	19-23 (1)	*Nil*
Eastern Mediter-ranean & East Africa	08-11 (1)	06-11 (1) 11-14 (2) 14-16 (1) 19-21 (2)	19-22 (1)	*Nil*
West & Central Africa	08-10 (1) 10-11 (2) 11-13 (3) 13-15 (2) 15-17 (1)	05-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-18 (3) 18-20 (2) 20-21 (1)	20-00 (1)	*Nil*

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For further information, check number 22, on page 110

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South Africa	07-09 (1) 09-11 (2) 11-12 (1)	05-13 (1) 13-16 (2) 16-18 (1) 20-21 (1) 21-22 (2) 22-00 (1)	19-20 (1) 20-21 (2) 21-22 (1)	19-21 (1)
Central Asia	07-09 (1) 16-17 (1) 17-19 (2) 19-20 (1)	06-07 (1) 07-09 (2) 09-12 (1) 16-18 (1) 18-20 (2) 20-22 (1)	05-07 (1)	*Nil*
South-east Asia	08-10 (1) 13-15 (1) 15-17 (2) 17-19 (1)	07-08 (1) 08-10 (2) 10-12 (1) 19-21 (1) 21-23 (2) 23-00 (1)	00-02 (1) 02-05 (2) 05-07 (1)	*Nil*
Far East	13-15 (1) 15-17 (2) 17-20 (1)	06-07 (1) 07-09 (3) 09-11 (2) 11-13 (1) 18-20 (1) 20-22 (3) 22-00 (2) 00-01 (1)	00-02 (1) 02-06 (2) 06-07 (1)	02-06 (1)
Guam & Pacific Islands	16-18 (1)* 08-13 (1) 13-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	06-07 (2) 07-09 (3) 09-11 (2) 11-14 (1) 14-18 (2) 18-20 (3) 20-22 (4) 22-00 (3) 00-02 (2) 02-06 (1)	21-22 (1) 22-05 (3) 05-07 (2) 07-08 (1)	22-01 (1) 01-04 (2) 04-06 (1) 01-04 (1)†
Australia & New Zealand	14-18 (1)* 12-16 (1) 16-17 (2) 17-19 (3) 19-20 (2) 20-22 (1)	18-20 (1) 20-22 (2) 22-00 (4) 00-02 (3) 02-04 (3) 04-06 (1) 06-07 (2) 07-09 (3) 09-10 (2) 10-13 (1)	23-01 (1) 01-03 (2) 03-05 (3) 05-07 (2) 07-08 (1)	01-03 (1) 03-05 (2) 05-07 (1) 03-06 (1)†
Northern & Central South America	13-14 (1)* 14-16 (2)* 16-17 (1)* 08-10 (1) 10-14 (2) 14-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	07-09 (3) 09-15 (2) 15-18 (4) 18-20 (3) 20-00 (2) 00-05 (1) 05-07 (2)	18-20 (1) 20-00 (3) 00-02 (2) 02-06 (1)	19-21 (1) 21-01 (2) 01-04 (1) 00-03 (1)†
Southern Brazil, Argentina, Chile & Uruguay Africa	12-13 (1)* 13-15 (2)* 15-16 (1)* 06-07 (1) 07-09 (2) 09-13 (1) 13-15 (2) 15-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-09 (2) 09-15 (1) 15-17 (2) 17-19 (3) 19-23 (2) 23-02 (1)	20-00 (1) 00-02 (2) 02-04 (1)	00-03 (1)
McMurdo Sound, Antarctica	13-15 (1)* 11-16 (1) 16-18 (2) 18-20 (1)	07-09 (1) 16-18 (1) 18-20 (2) 20-22 (3) 22-23 (2) 23-00 (1)	00-04 (1)	*Nil*

USA-CA [*from page 84*]

all one band; or all mobile. Net contacts and contacts made before January 1, 1959, can not be counted. A coupon waiving all initial fees will be included with each copy sold of the 1963 Directory of Amateur Radio Operators.

NNJ SSB ARA Award: The Northern New Jersey Single Sideband Amateur Radio Association is happy to offer this award free to amateurs who QSO 10 members of the association. When an amateur works his 10th member, he sends a list of his 10 QSOs with time, and date of the QSOs to this last station and that member will do the rest. Members are: K2CEM, DVJ, HLK, MHE, MZJ, QHI, QLW, UDZ, VAC and YCB. W2BBE, CCS, FGV, GNQ, HIN, ISN, KKK, LE and MIK. WA2GBH, GSP, MMD, NWR, OAO, OCE, PJU, PJV, and VID. WB2BGV.

Worked Five Member Award: The Lawndale Chicago Boys' Club Amateur Radio Association (K9YHB, Young

Healthy Boys) is very pleased to offer this attractive award. The basic award is sent free of charge to any amateur submitting log data showing contacts with 5 or more members; gold endorsement seals will be sent for 10 and 25 members worked. Any one person can qualify in two separate categories: 1—Worked members on 6 meters only, and 2—Worked members on any other band or combination of bands (with AOMB/M endorsement if desired, however only one certificate will be issued, in addition to the 6 meter award). The 25% rule for mixed band/mode awards applies. An additional specially endorsed certificate will be awarded to anyone who contacts 40 club members.

DX stations, including KH6, KL7, and VE/VO, need work only 3 members for the basic award, and totals of 5 and 10 members for the endorsement seals. Any DX station who received the K9YHB award becomes an honorary DX associate member, and thus other stations may claim contact with him as awards credit, up to a maximum ratio of ⅓ DX associates to ⅔ regular members. Applicants should send a copy of their log data to James Novak, WA9FIH, 2513 South Austin Blvd., Cicero, Illinois 60650. Lists of club members are available from WA9FIH for an s.a.s.e. or s.a.e. and IRC. All awards are free of charge.

Well that does it for another month, sorry space did not permit printing the Top Twenty-Five County Hunters but only two changes were made since last month. Sorry to record the passing of another old friend Doc (Joe) Anderten who sent me all data on the NNJ SSB ARA AWARD, I could write a whole column on his services to amateur radio and CD but this is a county hunters and award hunters column. Although I do not have room to repeat items from CONTEST CALENDAR but I must mention the New Jersey QSO Party August 20-21. This is the weather for mobiling and filing-in your applications for Awards. Write often, enjoy your vacations, how was your month? 73, Ed., W2GT

The Spare One [*from page 57*]

fabricated from smaller pie wound chokes (multiply pie type). One pie is carefully disconnected from the others and is used as the tickler coil. Proper polarization must be observed here also.

The loading coil used in the r.f. stage of the receiver (coil A) was simply a 2½ millihenry r.f. choke in the writer's case. It is possible that some other value might work better with other types of antennae but it would be best to try the 2½ mh value first. This choke is important to make the average antenna more effective at the low frequencies and it will also serve to attenuate strong local broadcast signals. It is mounted in a 4 prong 1 inch diameter coil form.

Tuning and Operation

The tuning procedure for both the receiver and transmitter section is standard. With the desired coil in the receiver detector socket (B) and the TUNING RATE switch set on the proper position, the receiver REGENERATION control should be advanced until the detector just breaks into oscillation. This will be indicated when a slight plop is heard in the speaker or phones followed by a gentle hiss. The audio gain should be set a little more than half way up for normal reception. C.w. signals or phone carriers will produce a beat note with the regeneration control at the point where the detector is oscillating gently. By careful tuning, s.s.b. signals can also be copied with the detector oscillating. For a.m. reception the regeneration control should be turned back to the point where the detector just stops oscillating. The antenna COUPLING should

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be set to a minimum position which will give satisfactory signal strength to assure proper operation without overflowing.

On the very low frequency bands the tuning will seem to be relatively broad but this is normal. Since this is not what might be termed a high performance receiver, the use of a good outdoor antenna is recommended for best results. Of course, because the transmitter is of the low power variety the best possible antenna will pay off here also.

When carefully tuned, the transmitter will give a very good account of itself on either c.w. or a.m. Again, be sure to resonate the final for the brightest glow of the neon indicator. When the antenna is loaded properly the neon bulb will decrease slightly in brilliance from its maximum intensity. As stated before the transmitter antenna circuit is designed to feed non-reactive loads of 50 or 75 ohms approximately. A simple field strength meter will be of assistance in the final tuneup. ■

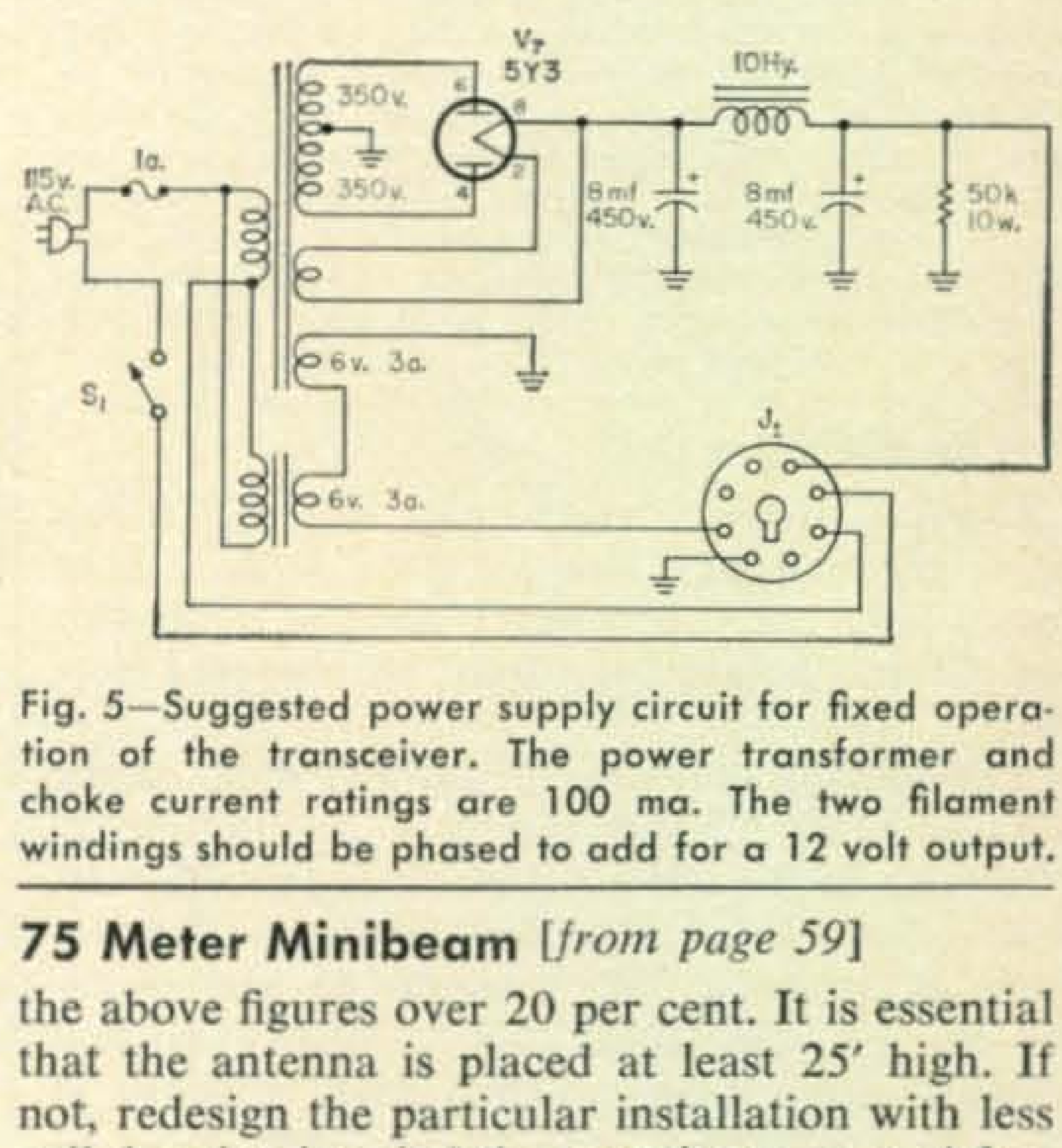

Fig. 5—Suggested power supply circuit for fixed operation of the transceiver. The power transformer and choke current ratings are 100 ma. The two filament windings should be phased to add for a 12 volt output.

75 Meter Minibeam *[from page 59]*

the above figures over 20 per cent. It is essential that the antenna is placed at least 25′ high. If not, redesign the particular installation with less coil, bearing in mind the capacity-to-ground factor. No data is available for heights other than those mentioned in the foregoing text.

Results have been most gratifying and signal reports from various areas while running low power, have been exceptionally high. Antenna characteristics are consistent and do not vary in abnormal weather conditions. The minibeam is truly a worthwhile investment in time and effort for the serious 75m operator. ■

S.W.R. & Tank Coil Heating *[from page 77]*

f. Putting a matching device (or coupler) between the transmitter and the end of the feed line. This leaves this s.w.r. alone but transforms the feed point impedance to one the transmitter can handle better.

These various alternatives and how they work can be explored further. However, if you are on the lower amateur frequencies, quit worrying about your s.w.r. if you can load your transmitter to full output. Just QSO and enjoy it. ■

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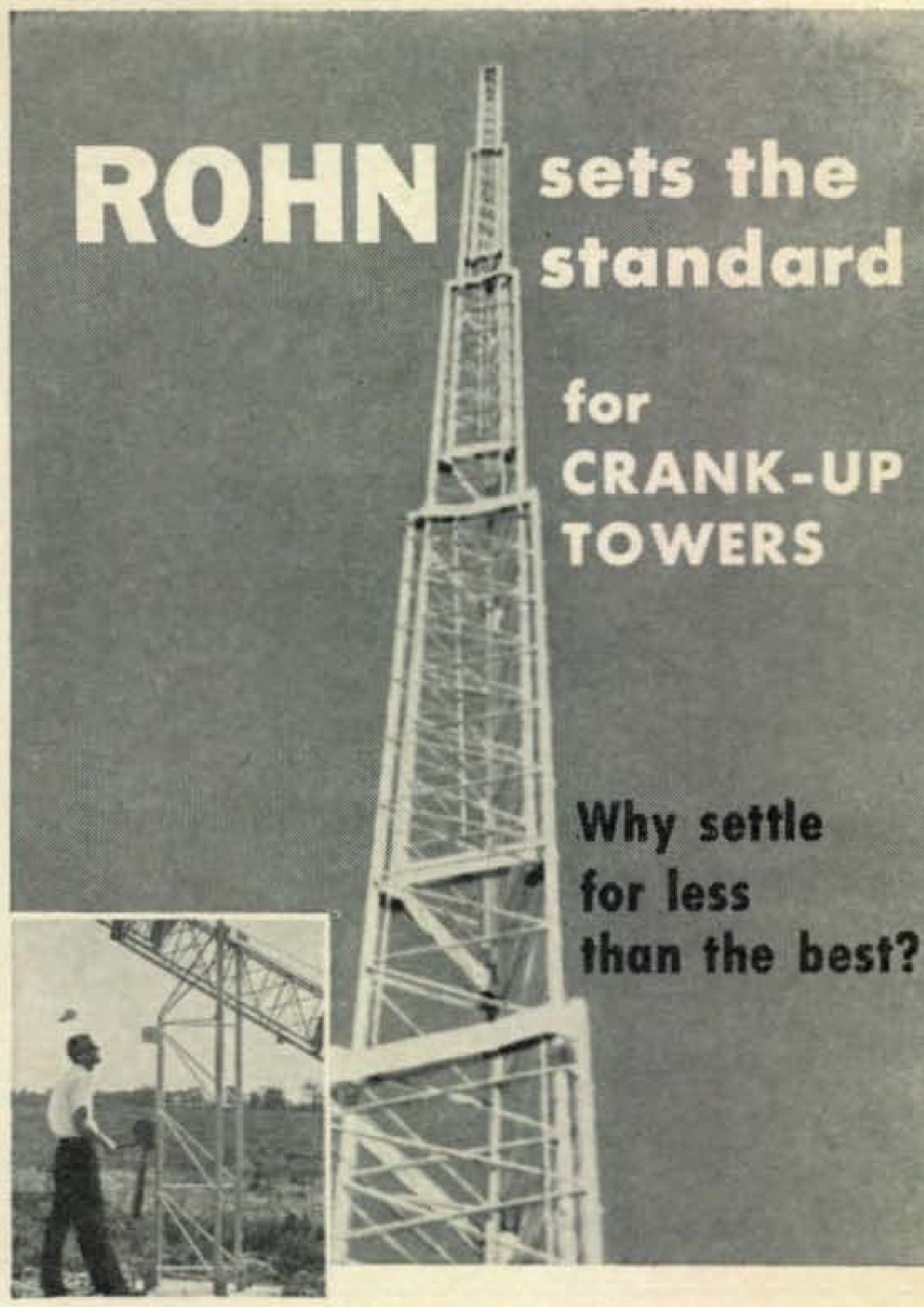

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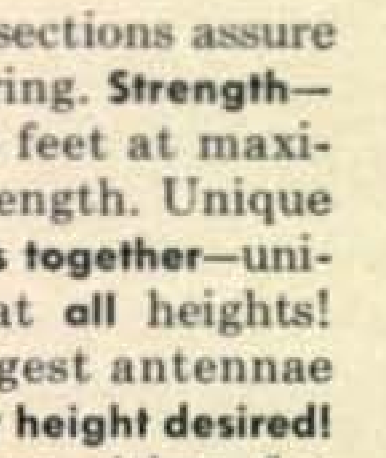

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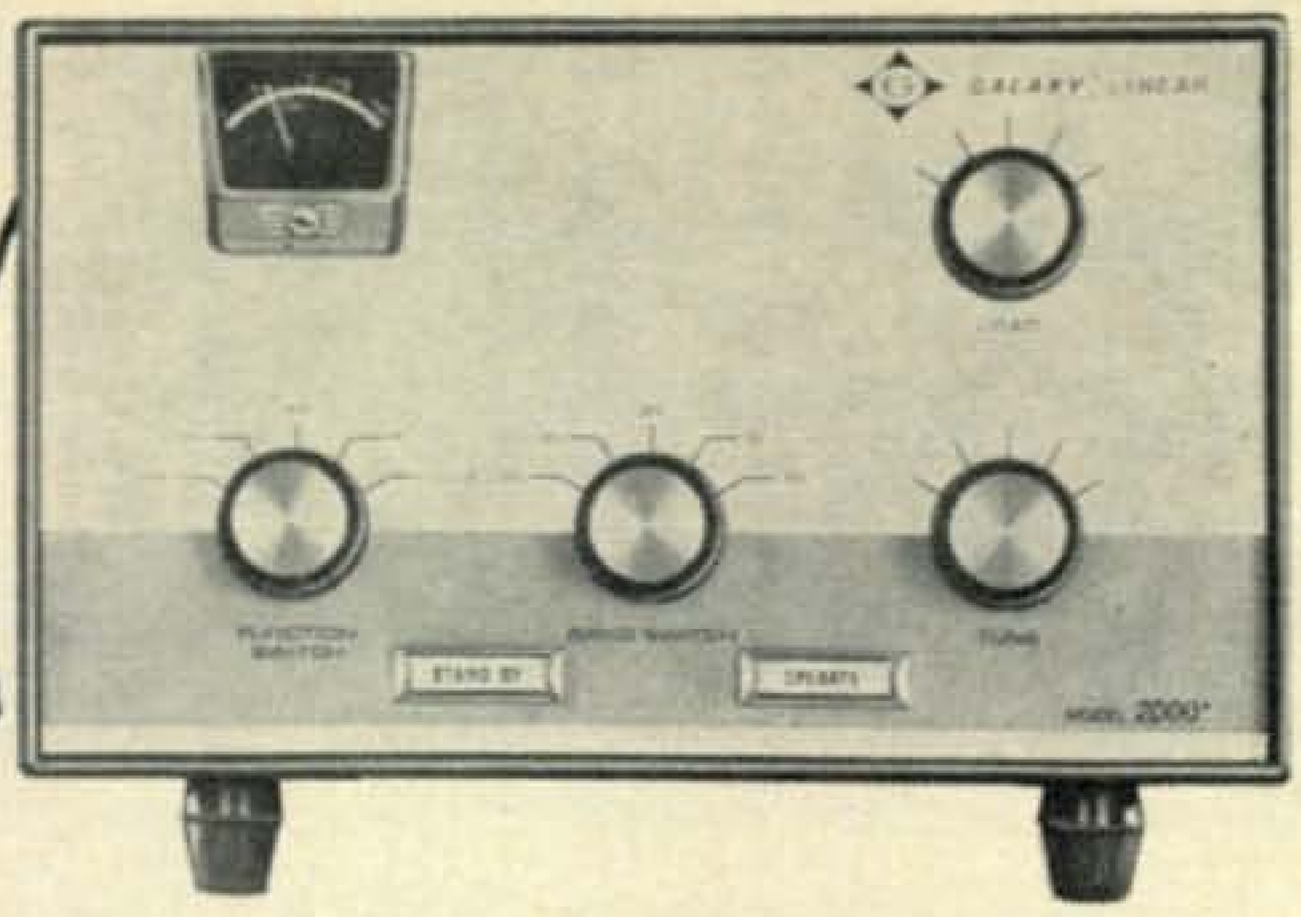

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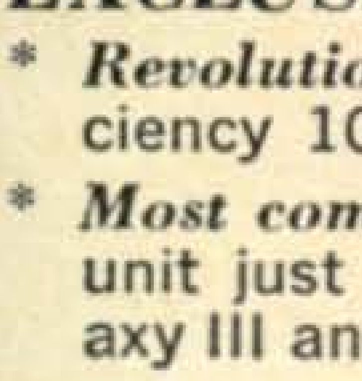

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Order direct from International Crystal Mfg. Co.

Model SBA-50

SPECIFICATIONS:
Mixer-Amplifier 50-54mc

Tubes:	6U8A Oscillator-Mixer 12BY7A Amplifier 6360 Linear power amplifier
Drive:	Requires 9mc sideband signal from SBX-9
Output:	SSB single tone 10 watts
Controls:	On-Off Power PA Grid Tune PA Plate Tune PA Load Tune Metering Switch
Metering:	Oscillator 9mc Drive Buffer Grid PA Grid RF Out
Crystals:	Three positions, uses 3rd overtone 41-45mc range. Crystal frequency = final frequency —9mc
Misc:	Accessory socket provided for connecting keying circuit to SBX-9. Comes with three crystals. Specify frequency when ordering. For operation on 117 vac 60 cycle power.

$145.00

INTERNATIONAL

CRYSTAL MFG. CO., INC.
18 NO. LEE · OKLA. CITY, OKLA. 73102

For further information, check number 10, on page 110

six pack

National offers six of the world's finest receivers to meet *your* particular requirement.

Receiver number one provides greater amateur band performance and features than any amateur receiver ever built.

Receiver number two has the widest frequency range (from 5 kc to 30 Mc) of any general coverage communications receiver ever built for lab or commercial application.

Receiver number three is *completely* solid-state for high reliability, versatility and portability. It operates from 12/24 V.D.C. or 115/230 V.A.C. This receiver draws less current than a couple of dial lamps (when its dial lamps are switched off), and provides instant-on operation.

Receiver number four incorporates specific features for high selectivity and has a six-pole filter to provide built-in steep-skirted 500 cps, 2.5 Kc, 5.0 Kc, and 8 Kc bandwidths with *passband tuning* for CW and SSB. Also *AGC threshold control* to knock out background QRM. Also a 50 db notch filter.

Receiver number five has a phase-locked frequency synthesizer to replace conventional high frequency oscillator crystals for superior stability and over-all calibration.

Receiver number six offers frequency meter performance with 1 Kc dial calibration and accuracy over its entire tuning range, 24 feet of bandspread per megacycle, and 10 Kc per turn tuning rate.

Each of these receivers is called the HRO-500. National's new HRO-500, at $1560. is the finest *total* receiver you can buy . . . at any price.

Interested in trying out National's new sixpack?
See your National dealer for an opener.

NATIONAL RADIO COMPANY, INC. ® 37 WASHINGTON STREET, MELROSE, MASS. 02176

World Wide Export Sales: Auriema International Group, 85 Broad St., N. Y. C.;

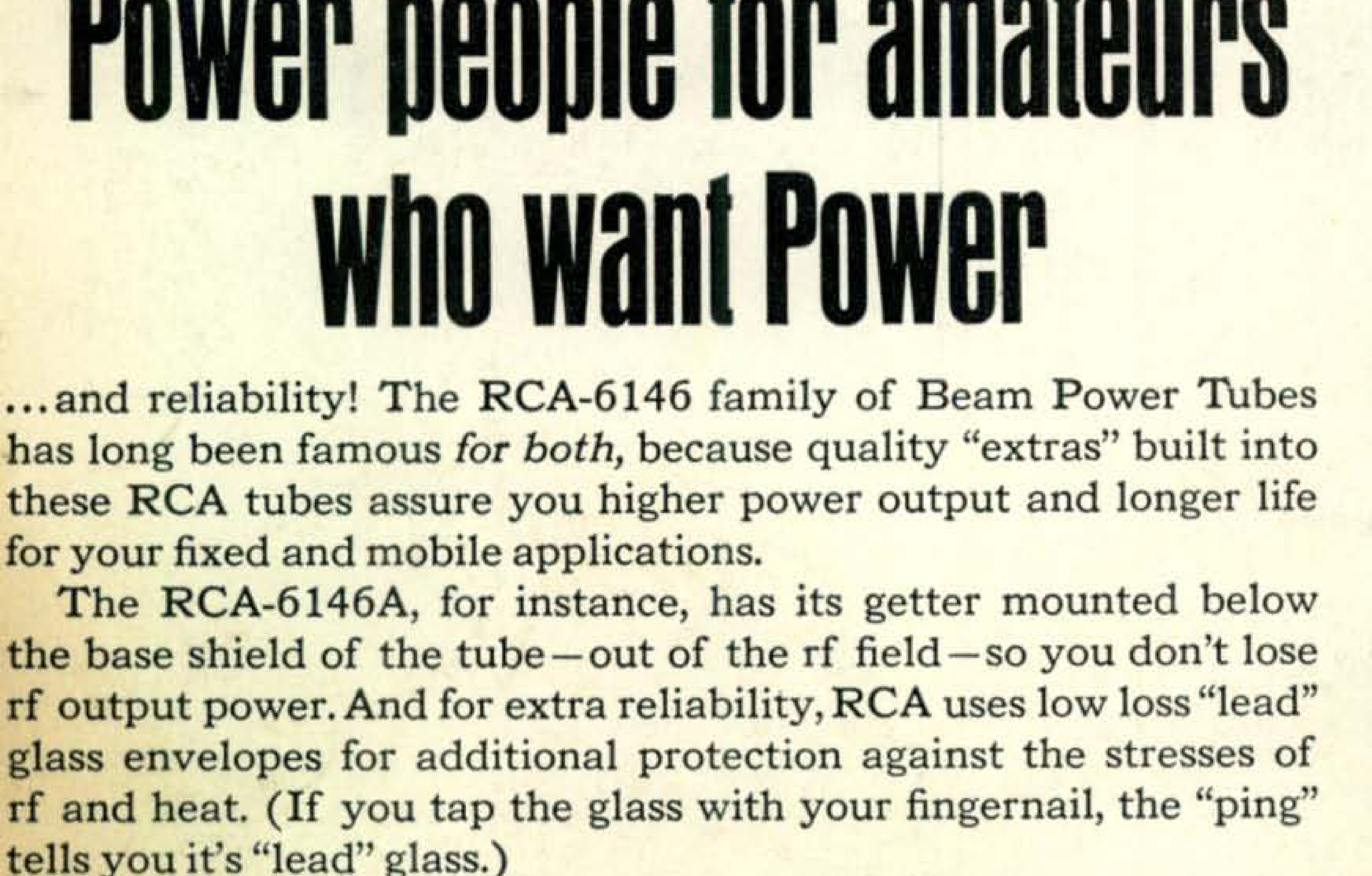
For further information, check number 15, on page 110

"QRO"...WITH RCA BEAM POWER TUBES

Power Tubes made by Power people for amateurs who want Power

...and reliability! The RCA-6146 family of Beam Power Tubes has long been famous *for both,* because quality "extras" built into these RCA tubes assure you higher power output and longer life for your fixed and mobile applications.

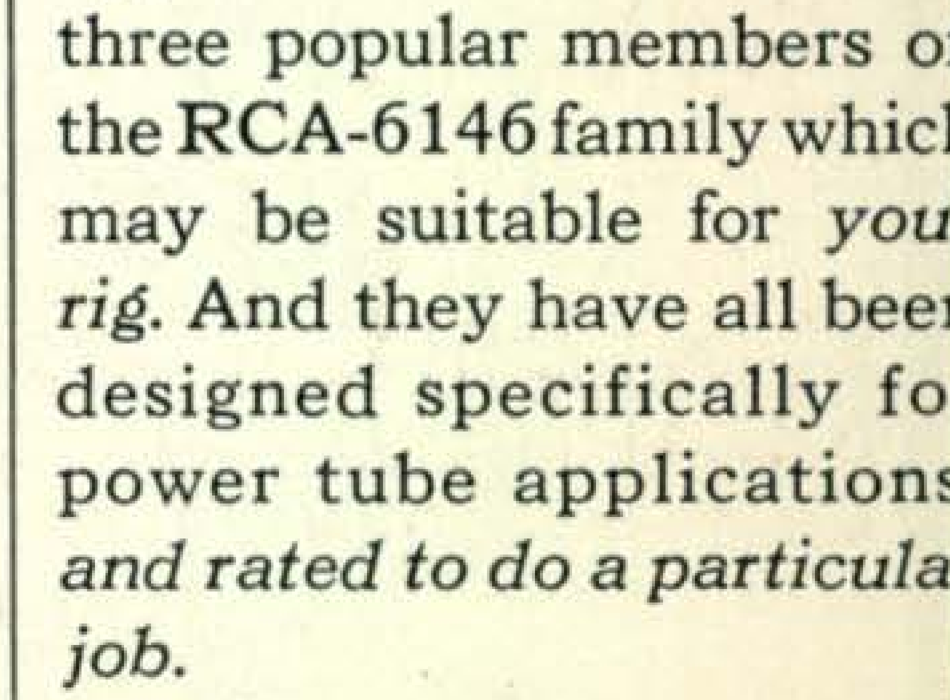
The RCA-6146A, for instance, has its getter mounted below the base shield of the tube—out of the rf field—so you don't lose rf output power. And for extra reliability, RCA uses low loss "lead" glass envelopes for additional protection against the stresses of rf and heat. (If you tap the glass with your fingernail, the "ping" tells you it's "lead" glass.)



THE RCA 6146 FAMILY

RCA-6146A	For 6.0-volt mobile and fixed equipment applications.
RCA-6146B/8298A	Modified RCA-6146A with higher power output for critical 6.0-volt mobile applications.
RCA-6883B/8032A/8552	Modified RCA-6883 with higher power output for critical 12.0-volt mobile applications.

The RCA-6146B/8298A and RCA-6883B/8032A/ 8552 have the same built in, extra RCA advantages afford higher power inpu for AM and CW, and ar designed for critical mobil applications. The chart list three popular members o the RCA-6146 family which may be suitable for *you rig.* And they have all beer designed specifically fo power tube applications *and rated to do a particula job.*



For tabulated data of tech nical information on spe cific tube types, see you RCA Industrial Tube Dis tributor and ask for you copy of "Product Guide fo RCA Power Tubes" (PWR 506A).

Available Through Your Authorized RCA Industrial Tube Distributor

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