CQ

April 1971
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Construction details begin on . . . . p. 16

The Radio Amateur's Journal

08240

The smile machine...

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Heathkit® SB-102 and SB-220

The "102"... first half of the smile machine – fun to build, a pleasure to use. Backed by a history of sideband engineering advances unequaled in the industry... the famous "100" and "101" series. With an ancestry of top performance, high reliability and unbeatable value like this, you expect the "102" to be a better rig... and it is.

The frequency stability and linearity of the SB-Series has been the standard of comparison for many years ... and the "102" is even better. A new solid-state Linear Master Oscillator cuts stabilization time in half and delivers far greater tracking accuracy.

Modifications in the receiver result in improved sensitivity... now better than 0.35 uV for 10 dB signal plus noise to noise – a healthy increase that gives you more solid copy longer.

The Heathkit SB-102 brings you the versatility, performance and value that made the SB-Series the most popular gear ever made... plus important new refinements. Start being happy with your rig – order your SB-102 now. Another hot one from the Hams at Heath.

Kit SB-102, 24 lbs. **380.00***
Kit SB-600 Speaker, 7 lbs. **19.95***
Kit HP-23A AC Power Supply, 19 lbs. **51.95***
Kit HP-13A DC Power Supply, 7 lbs. **69.95***
SBA-301-2, 400 Hz CW Xtal Filter, 1 lb. **21.95***
HDP-21A Microphone, 4 lbs. **29.95***

SB-102 SPECIFICATIONS – RECEIVER SECTION: Sensitivity: Better than 0.35 microvolt for 10 dB signal-plus-noise to noise ratio for SSB operation. **SSB selectivity:** 2.1 kHz minimum at 6 dB down, 5 kHz maximum at 60 dB down – 2:1 nominal shape factor – 6:60 dB. **CW Selectivity:** (With optional CW filter SBA-301-2 installed) 400 Hz minimum at 6 dB down, 2.0 kHz maximum at 60 dB down. **Input impedance:** Low impedance for unbalanced coaxial input. **Output impedance:** Unbalanced 8 ohm speaker, and high impedance headphone. **Power output:** 2 watts with less than 10% distortion. **Spurious response:** Image and IF rejection better than 50 dB. Internal spurious signals below equivalent antenna input of 1 microvolt. **TRANSMITTER SECTION: DC power input:** SSB, 180 watts P.E.P. continuous voice. CW, 170 watts – 50% duty cycle. **RF power output:** 100 watts on 80 through 15 meters; 80 watts on 10 meters (50 ohm non-reactive load). **Output impedance:** 50 ohms to 75 ohms with less than 2:1 SWR. **Oscillator feed-through or mixer products:** 55 dB below rated output. **Harmonic radiation:** 45 dB below rated output. **Transmit-receive operation:** SSB, Push-to-talk or VOX. CW, Provided by operating VOX from a keyed tone, using grid-block keying. **CW side-tone:** Internally switched to speaker in CW mode. Approx. 1000 Hz tone. **Microphone input impedance:** High impedance. **Carrier suppression:** 50 dB down from single-tone output. **Unwanted sideband suppression:** 55 dB down from single-tone output at 1000 Hz reference. **Third order distortion:** 30 dB down from two-tone output. **RF compression (TALC):** 10 dB or greater at .1 mA final grid current. **GENERAL: Frequency coverage:** 3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 (megahertz). **Frequency stability:** Less than 100 Hz per hour after 10 minutes warm-up from normal ambient conditions. Less than 100 Hz for ±10% line voltage variations. **Modes of operation:** Selectable upper or lower sideband (suppressed carrier) and CW. **Visual Dial Accuracy:** Within 200 Hz on all bands. **Electrical dial accuracy:** Within 400 Hz after calibration at nearest 100 kHz point. **Dial mechanism backlash:** Less than 50 Hz. **Calibration:** 100 kHz crystal. **Audio frequency response:** 350 to 2450 Hz. **Phone patch impedance:** 8 ohm receiver output to phone patch; high impedance phone patch input to transmitter. **Front panel controls:** Main (LMO) tuning dial; Driver tuning and Preselector; Final tuning; Final loading; Mic and CW Level Control; Mode switch; Band switch; Function switch; Freq. Control switch; Meter switch; RF gain control; Filter switch. Audio Gain control. **Internal controls:** VOX Sensitivity; VOX Delay; Anti-Trip; Carrier Null (control and capacitor); Meter Zero control; CW tone volume; Relative Power Adjust control; Bias; Phone Vol (headphone volume); Neutralizing. **Rear Apron Connections:** CW Key jack; 8 ohm output; Spare A; Spare B; Phone patch input; ALC input; Power and accessory plug; RF output; Driver output. **Power requirements:** 700 to 850 volts at 250 mA; 300 volts at 150 mA; – 115 volts at 10 mA; 12 volts at 4.76 amps. **Cabinet dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

The "220"... strong, cheerful voice of the smile machine... designed to give you the happy authority to punch through those pile-ups and the QRM when the other guys are going QRT.

Two conservatively-rated Eimac 3-500z's deliver up to 2000 watts PEP SSB input... a full 1 kW on CW and RTTY. Pretuned broadbanded pi-input circuit provides maximum efficiency and low distortion throughout the 80-10 meter bands... requires only 100 watts PEP drive for full output.

A built-in solid-state power supply permits operation from either 120 or 240 VAC. Circuit breakers provide additional protection and eliminate troublesome fuses. And for greatly extended final tube life and cooler running, idling plate current is substantially reduced by zener diode regulated bias.

A powerful, quiet fan in the PA compartment coupled with a clean, open parts layout allows maximum air flow ... the "220" actually runs cooler than most exciters. Additional features include complete up-front monitoring – two panel meters permit continuous display of plate current plus switch-selected monitoring of relative power, plate voltage and grid current. ALC output to reduce overdriving and distortion... safety interlocked cover... easy, enjoyable assembly in about 15 hours with the famous Heathkit manual.

Put a smile in your signal... order your new SB-220 now – from the Hams at Heath, of course.

Kit SB-220, 55 lbs. **349.95***

SB-220 SPECIFICATIONS – Band coverage: 80, 40, 20, 15 and 10 meter amateur bands. **Driving power required:** 100 watts. **Maximum power input:** SSB: 2000 watts P.E.P. CW: 1000 watts. RTTY: 1000 watts. **Duty cycle:** SSB: Continuous voice modulation. CW: Continuous (maximum key-down 10 minutes). RTTY: 50% (maximum transmit time 10 minutes). **Third order distortion:** –30 dB or better. **Input impedance:** 52 ohm unbalanced. **Output impedance:** 50 ohm to 75 ohm unbalanced; SWR 2:1 or less. **Front panel controls:** Tune, Load, Band, Sensitivity, Meter switch, Power CW/Tune – SSB, Plate meter, Multi-meter (Grid mA, Relative Power, and High Voltage). **Rear Panel:** Line cord, Circuit breakers (two 10 A). Antenna Relay (phono), ALC (phono), RF Input (SO-239). Ground post. RF output (SO-239). **Tubes:** Two Eimac 3-500Z. **Power required:** 120 VAC, 50/60 cycles, at 20 amperes maximum. 240 VAC, 50/60 cycles at 10 amperes. **Cabinet size:** 14⅞" W x 8¼" H x 14½" D. **Net weight:** 48 lbs.

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AM-245

APRIL, 1971 VOL. 27, NO. 4

The Radio Amateur's Journal

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DEPARTMENTS

Offices: 14 Vanderventer Avenue, Port Washington, L.I., N.Y. 11050. Telephone: 516-883-6200.

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Postmaster: Please send form 3579 to CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050

from the Publisher

CQ, like every other publication, is suddenly faced with a serious dilemma. The Post Office has just announced a 142% postage increase to be spread over the next five years. This comes on top of heavy increases for both printing and paper, plus a constant rise in the cost of labor. Thus, we're faced with a situation that screams for additional income, but that only serves to spiral the inflationary trend. What's the solution?

An obvious answer is an immediate increase in subscription rates. This is a step we find most distasteful because we recognize that readers are already strapped to the hilt with increases across the board in the cost of living. And we can't readily justify ad rate hikes without offering extra circulation to the advertiser. The problem is, indeed, quite serious.

We can foresee only one solution that will give our readers the best possible package. This is it: *CQ* will announce a subscription rate hike within the next few months. But in order to forestall that increase as long as possible, and to continue giving our regular supporters a chance to save money, we will now make available long-term subscription packages to readers who wish to take advantage of a bargain. In other words, we'll be swapping long-term dollars at higher rates for working capital to meet the increased costs of publishing. These are the new, long-term rates for *CQ* subscriptions:

10 years	$40.00
15 years	$55.00
Lifetime subscription	$75.00

This package allows each subscriber, depending upon his age, to buy the package that will give him the most magazines for the fewest dollars. The long-term subs will be non-transferable, for obvious reasons, so when you make your choice, select carefully.

– WA2LRO

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is built for and distributed and backed by the R. L. Drake Co.

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Includes transceiver, two channels supplied, mobile mount, microphone, coax cable, Hustler antenna, and built-in AC-DC power supply.

SPECIFICATIONS

General

Frequency Coverage	144-148 MHz
Number of Channels	12 Channels, 3 supplied Channel 1 Receive 146.94 MHz, Transmit 146.34 MHz Channel 2 Simplex 146.94 MHz Channel 3 Receive 146.74 MHz, Transmit 146.34 MHz
Modulation	Frequency Modulation
Transmitter Control	Push-to-Talk
Power Drain	AC: Receive 6 Watts, Transmit 50 Watts DC: Receive 0.5 Amps, Transmit 4 Amps
Power Source (Built-in)	AC: 117 Volts 50-60 Hz DC: 13.5 Volts ± 10%.
Dimensions	7⅞" W x 2¾" H x 10¼" D.
Weight	8¼ lbs.
Standard Accessories	Dynamic Microphone, Hustler Antenna, Antenna Connector Plug, AC/DC Cord, Speaker Plug.

Transmitter—transistorized with 6360 output tube

RF Output Power	Greater than 10 Watts
Frequency Deviation	Adjustable to 15 kHz maximum
Frequency Stability	±.001% or less
Spurious Radiation	Greater than —80 dB below Carrier
Output impedance	50 ohms

Receiver — completely transistorized

Receiver Circuit	Crystal-controlled Double Conversion Superheterodyne
Intermediate Frequencies	1st 10.7 MHz, 2nd 455 kHz
Input Impedance	50 to 75 Ohms
Sensitivity	0.5 µV or less for 20 dB quieting. 1 µV or less (30 dB S+N/N ratio at 10 kHz deviation with 1 kHz modulation)
Spurious Sensitivity	Greater than —60 dB.
Audio Output	0.5 Watt with 10% or less distortion.

Accessory Antenna, Model BBL-144 — Hustler 3.4 dB gain quick-mount with coax— **$34.70**

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OUR READERS SAY

Ten Years of Turmoil

Editor, *CQ:*

In 1956, I entered the amateur radio fraternity with a Novice ticket and a few months later I obtained a Conditional ticket. For the next few years I thoroughly enjoyed myself talking with people of all kinds all over the world and about all kinds of subjects. During those first few years (1956-1960) it seemed that the only differences between *QST* and other ham magazines were over such things as whether or not Danny Weil, VP2VB, should continue his DX-pedition on his boat the *Yasme,* and the only unfriendly words on the air were directed at the "sidewinders" who were sure to destroy ham radio. I don't know what finally happened to Danny. The last I heard of him he was being towed into San Diego by the Coast Guard. The "sidewinders" of course, not only did not destroy ham radio, but instead raised the level of technology to a new and higher plateau of communication efficiency.

Then, for many reasons, I let my license expire and stayed out of ham radio for ten years. This past summer a hurricane struck the Gulf Coast. My wife and I had friends in the affected area and I felt completely helpless to be of any assistance. I couldn't even find out for several days if they were safe. This experience provided the motivation to get me back into active ham ranks. I had to work hard to get my code proficiency back and study hard to qualify for the advanced ticket, but I did it. I'm still waiting for my license to come and while I've been working, studying and waiting, I've been listening for hours on end to activity on the ham bands.

Now I realize that ten years can change a lot in what goes on in a group such as ours, but I just don't know what to think about the things I hear on the air. The infighting, the backbiting, the profanity, the discourtesy, flagrant violation of laws, deliberate QRM on nets, W1AW and on people saying something that doesn't meet with universal approval; all of these things and more besides are unbelievable. This disagreeable activity is not limited to on the air practice. The editors and writers in your and other ham magazines have graduated from venting your spleens on ham activities and practices which displease you. Now you seem bent on destroying the legendary goose that laid your golden egg. The more you talk about how wrong the other group or magazine is, the more I become convinced that all you are really interested in is building your own particular empire. Now don't tell me that honest disagreement is healthy. A running feud such as that between the ARRL and the other ham magazines is sick, not healthy. You all ought to be locked up in a hotel room, with room service, until you can come out shaking hands and presenting a unified plan for improving our hobby and serving the world. Then all of you should go to Washington and camp on the doors of Congress and the FCC until they give you a fair hearing.

With all I've been hearing and reading, I'm not sure that my new license will be worth very much when it does arrive. I hope you or someone in the forefront of our hobby can convince me otherwise in the months to come.

David Cree
Houston, Texas

P.S.: My license just arrived—I'm now W5SPD.

Simple answers are best suited to simple problems, not complex ones. To charge that the amateur magazine editors and writers are bent on destroying the golden-egg-laying goose is applying the switch to the wrong end of the beast. A study of almost any critical complaint by any individual or group will almost invariably disclose that the Criticism is at least partially warranted. We agree that some editors and writers are regularly guilty of exaggerated attacks on the prime organization of amateur radio—ARRL. But even these grossly overstated attacks have sizeable doses of truth in them, and thus are worthy of publishing. Many problems exist within and without our hobby which did not exist ten years ago. These problems are, to a great extent, the manifestations of social, political and economic change in the US and the rest of the world. Other of these problems are the result of trying to approach 1970 amateur radio with 1955 tactics. But regardless of the roots of the problems, they will never be solved without innovative approaches, and most certainly, not by pretending that everything's "hunky dorey." Sure, the waters of amateur radio are more turbulent now than ever before in recent history, but a bad storm is usually followed by a clear, fresh smell in the air, which the hobby surely needs. *—Ed.*

10 WPM Code Speed

Editor, *CQ:*

I read with pleasure your ZERO BIAS column in the February issue of *CQ,* regarding the petition to FCC for rule change, especially the first one, for I think I could build my c.w. speed up to 10 w.p.m. without any difficulty.

However, the second part is just as good, although I would go a little further and give the Novice and Technician class licenses a small segment of either the 80 or 40 meter bands, say a band of 10 kc for c.w. only and a request for all others to keep off those frequencies.

It is difficult to understand the thinking of the FCC on some of their rules, for instance, the Novice class license was created for the express purpose of getting more people interested in amateur radio. Then, because some could not make the 13 w.p.m. in one year, they applied for Technician licenses which cut them completely off from the one thing the FCC wanted them to know.

Well, anyway, I like your magazine and I shall continue to read it although I may get disgusted with the 6 and 2 meter bands and get me a CB set and join the dingalings.

Best wishes for your future success.

E. D. Ward Sr., WA5KFY
San Antonio, Tex.

Editor, *CQ*

I disagree with your suggestion to reduce the code requirements for the General class license to 10 w.p.m. I'm not impressed by your example of the "code hump phenomenom." I got over the hump 16 years ago after much effort and now I'm at 20-25 w.p.m. and proud of it. I'm sure there are many who feel the same way about the theory requirements which have very little to do with good operating ability. But primarily, I object when you suggest that the FCC lower a requirement that I was compelled to accomplish. If anything, establish greater privileges for those of us who were denied our already long-enjoyed privileges prior to so-called incentive licensing. Why don't you take a poll?

Hank Roth, K4EVY
Ft. Lauderdale, Fla.

P.S.: I disagree with you sometimes, but you still put out a great mag.

The "I-did-it-and-so-can-they" attitude towards *CQ's* 10 w.p.m. General class code speed proposal is more evident in our incoming correspondence than we had expected, and it's disappointing, to say the least. The proposal has been made to FCC, and only time will tell whether or not we'll ever have to face the reality of 10 w.p.m. General class code, but a very disturbing trend towards selfishness among General and higher class licensees is already becoming clear. Unlike the Incentive Licensing proposals of the '60s, the 10 w.p.m. code proposal is *not* a restrictive proposal, but rather an expansionist one. It takes nothing from any existing license holder, and gives only a more realistic code goal to Novices and Technicians. The only conclusion to which we can jump so far is that most of the amateurs of General class or higher standing who write letters are those who "have theirs" and think anyone who doesn't, can go hang! Somehow, though, that sounds contradictory to the amateur described in the Amateur's Code—number 4. We'd like to think that such attitudes are the exception rather than the rule. Anyone agree?—*Ed.*

Announcements

Buffalo Amateur Radio Day

The Buffalo Amateur Radio Repeater Association will be operating from Squaw Island in the Niagara River from 0000 to 2400 GMT April 1, 1971 in commemoration of Buffalo Amateur Radio Day, which has been so proclaimed by Buffalo Mayor Frank A. Sedita. The specially issued prefix will add a new one to the prefixes claimed roles for WPX; the call will be KD2-UMP. Modes and bands will be 80-10 m. c.w. and s.s.b., and 146.940 mc f.m.

Stolen Equipment

The following equipment was stolen from the emergency communications truck belonging to the American Red Cross in Wichita, Kansas: Drake R-4B receiver, serial #11125G; Drake

T-4XB transmitter less power supply, serial # 16428R; Gonset Communicator II, 2 meter transceiver; Gonset 2 meter v.h.f. power amplifier. Anyone with information concerning this equipment is requested to contact the Wichita Police Dept., 115 E. William, Wichita Kansas 67201, phone 316-262-2611.

Muskegon, Michigan

The Muskegon Area Amateur Radio Council (MAARC) announces the 1971 A.R.R.L. Great Lakes Division Convention, to be held on March 27, at Muskegon Community College, Quarterline Road in Muskegon. Numerous activities are planned. The college is located at Interstate 196 & US-31 to Muskegon; junction of US-31 and Mich. 46. There is parking for 1000 cars. Tickets are $2.00 in advance, $2.50 at the door. For complete details contact Henry E. Riekels, Jr., WA8GVK c/o MAARC, P.O. Box 691, Muskegon, Mi. 49440.

Syracuse, New York

The Radio Amateurs of Greater Syracuse (RAGS) will hold a hamfest on April 17, at Song Mountain, off Exit 14 of Interstate 81 south of Syracuse. For further information check with C. L. Abbott, K2IWQ, Box 88, Liverpool, N.Y. 13088.

Rockaway, N.Y.

The Sprink Auction of the Rockaway Amateur Radio Club will be held Friday evening April 23, 1970 at 8:00 P.M. at the American Irish Hall, Beach Channel Drive at Beach 81st St., Rockaway Beach, N.Y. Doors open at 6:00 P.M. to accept items for sale. One Dollar donation accepted at the door, refreshments included. For more info contact Auction Chairman, Al Smith, WA2TAQ, P.O. Box 341, Lynbrook, N.Y. 11563.

Sullivan, Illinois

The Moultrie Amateur Radio Klub (MARK) is holding its 10th annual hamfest, rain or shine, in the American Legion Pavilion, Sullivan Illinois, on April 25. Auction, food, swap line and other activities. For more information write: MARK Inc., P.O. Box 10, Sullivan, Ill. 61951.

Wabash, Indiana

The Wabash Co. Amateur Radio Club's third annual hamfest will be held on Sunday, May 23, rain or shine. Admission is a $1.00 donation. For information write: Bob Mitting, 663 Spring, Wabash, Indiana 46992.

Frimble, Tennessee

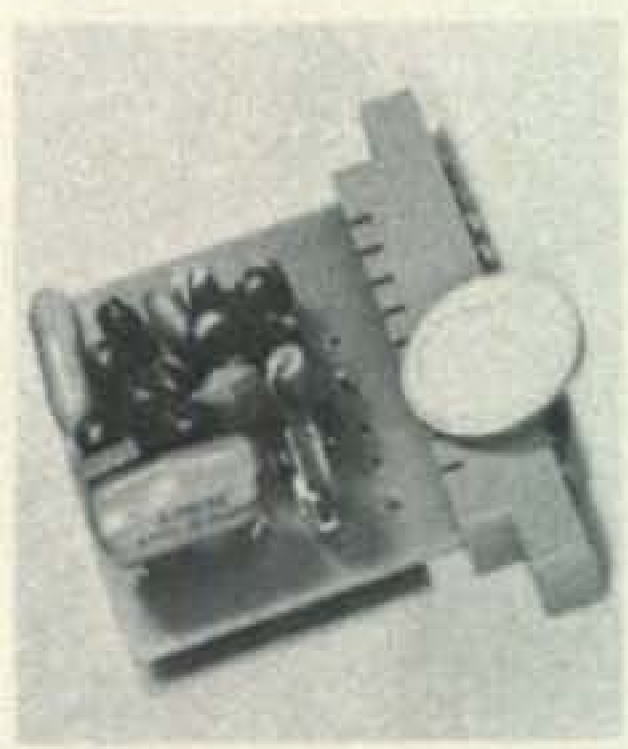
The conglomeration of radio clubs in greater Frimble announce their 72nd annual wireless hamfest to be held on April 20. Swap shop, manufacturers displays, snail races, and ozone smelling contest are planned. The usual boring crowd will be there doing the usual dull things and everyone should have a crummy time. Don't bother to write for details.

New Amateur Products

(A) (B)

Jackson Brothers Miniature PC Capacitors

SEVERAL new miniature trimmer capacitors have been announced by Jackson Bros. They have PTFE dielectric and consist of a brass rotor and PTFE sleeve which can be screwed into a brass stator. All have printed-circuit-board fixing-pins at standard spacing. The 8-mm Tetfer, (A), can be used from h.f. to v.h.f. and has a circular ceramic base only 8-mm in diameter. It tunes from below 2 mmf to over 8 mmf. The Airtune C804-E, (B) is a vane type with air dielectric and a rear shaft extension for ganging. It comes in 25, 50, 100, and 150 mmf sizes. For complete specifications on the capacitor line contact: M. Swedgal, 285 Broadway, New York, N.Y. 10007 or circle 80 on the Reader Service coupon.



Alpha Electronics Services

THE Alpha ST-85H silent continuous tone encoder provides an end to interfering signals and co-channel operation by requiring that incoming signals be accompanied by a predetermined sub-audible tone to activate the receiver. Tone frequencies are available in a wide choice (20.0 to 203.5 c.p.s.) and can be changed by simply plugging in a new tone determining network (TN-91). The device is all solid state and is 1⅛" × 1¼" × 5/8" in size. It has built in voltage regulation and comes with a one year warranty. For full information on the encoder contact: Alpha electronics Services, 8431 Monroe Ave., Stanton, California 90680 or circle 81 on the Reader Service coupon.

Resistor Reference Manual

THE *Compendium of 1/2 Watt Vitreous Resistors*, By Rudolph H. Sibilant, Bench Press

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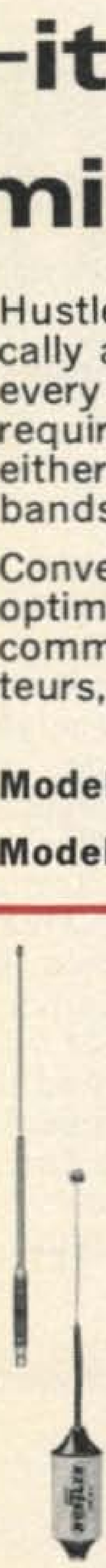
Model MO-2—54″ Mast for Bumper mount—Folds at 27″ above base. . . . . . . Price: **$12.25**



STANDARD HUSTLER RESONATORS—400 Watts Power-Normal SSB Duty Cycle

Model RM-10	10 meter resonator	$ 7.95
Model RM-15	15 meter resonator	8.95
Model RM-20	20 meter resonator	9.95
Model RM-40	40 meter resonator	11.95
Model RM-75	75 meter resonator	13.95
Model RM-80	80 meter resonator	13.95

SUPER HUSTLER RESONATORS—Legal Power Limit—Normal SSB Duty Cycle

Model RM-10S	10 meter resonator	$11.50
Model RM-15S	15 meter resonator	13.50
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Model RM-40S	40 meter resonator	19.50
Model RM-75S	75 meter resonator	24.50
Model RM-80S	80 meter resonator	24.50

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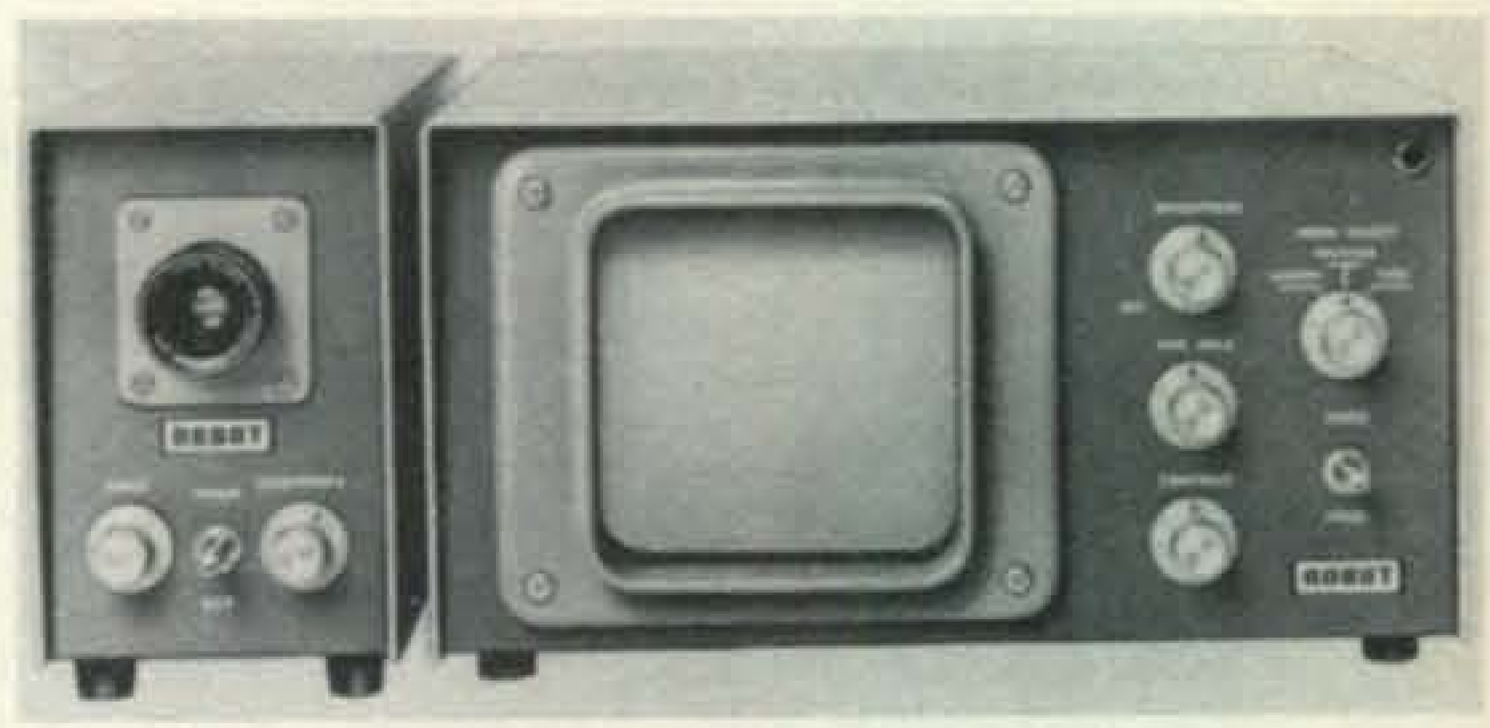


Robot Research

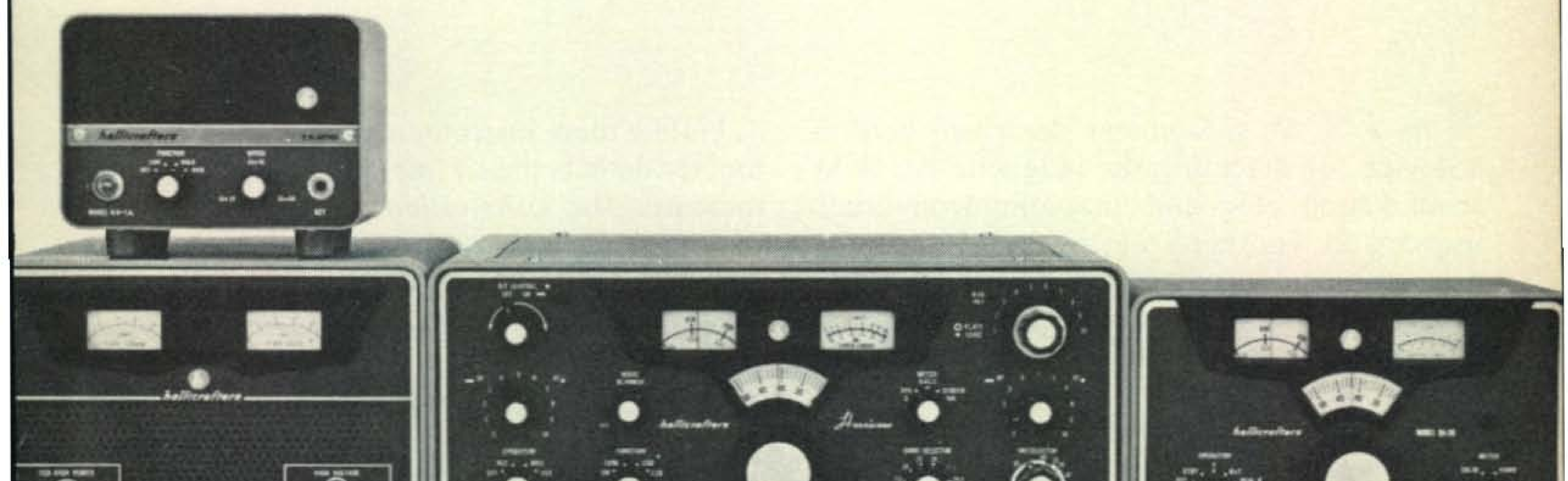
ROBOT Research announces the availability of their Model 80 slow scan TV camera and Model 70 slow scan TV monitor. Using your present amateur equipment you can quickly adapt your station to SSTV. The Model 80 plugs into the Model 70 monitor which easily connects to your transmitter and puts you on TV. The monitor demodulates and displays pictures transmitted by other stations on a 6 in. diagonal screen. The camera features a digital timing chain, built-in modulation calibration and vidicon camera tube. Model 80 camera (less lens) sells for $3.95.00, Model 70 monitor sells for $395.00 and the lens sells for $30.00. For complete technical specifications write to: Robot Research Inc., 7591 Convoy Court, San Diego, California 92111 or circle 83 on the Reader Service coupon.

Murdock Cordless Headphone System

THE Murdock cordless headset (CH-2) and audio room loop (RL-2) combine to form an instant classroom out of any area. The headset is activated by audio frequency energy radiated from a loop of wire consisting of one or more conductors placed around the perimeter of the

[*Continued on page 90*]

be a big sender.



send big with perfect CW, SSB. lots of watts power. sensational DX'ing. try *hallicrafters* SR-2000 transceiver system. and the power-full line of accessories. put them all together. they make you a big sender. and we mean big. just get a load of this:

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HA-20 Remote VFO
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Part I

BY WILFRED M. SCHERER,* W2AEF

Twenty-four years ago W2AEF popularized the Grid Dip Meter, and twenty-one years ago it was the Antennascope. Both instruments have long-since become standards in the amateur radio field. Now, Bill introduces another instrument new to the amateur fraternity, but certain to become as popular as its predecessors: The R.F. Magnetometer. Part I of this two-part article describes its operation and construction. Part II, next month, covers its use.

THE R.F. Magnetometer described here is a device for detecting the magnetic r.f. field around conductors and emanating from other sources. It is, therefore, a useful tool for determining r.f. radiation and current distribution in respect to antennas, transmission lines, ground leads, building wiring, enclosure shields, etc. In addition, it may be employed as a sensitive field-strength meter to augment its use as a magnetometer.

Heretofore radio amateurs have employed a simple field-strength (f.s.) meter or a wavemeter for some of this work. Another device sometimes used for detecting r.f. energy is a broadband capacitance probe, both of which instruments have serious drawbacks in their use.

*Technical Director, *CQ*.

Unlike these instruments, the R.F. Magnetometer detects the r.f. magnet field, but it also indicates the *orientation* of the field. R.f. pickup is by inductive coupling only. Capacitance coupling is avoided, eliminating the hand- or body-capacity effects and confusing

The R.F. Magnetometer is built into a Bud Minibox measuring 5½"H. × 3"W. × 2½"D. The pickup inductor is electronically shielded in a modified 1⅛" square i.f. transformer can which is mounted atop the Minibox. Frequency ranges corresponding to the Range switch letters are marked on a small chart cemented on the side of the instrument. A plate of 1/8" thick aluminum is bolted to the case bottom, and is drilled and tapped 1/4-20 to mate with standard photographic tripods for convenient field use.

or erroneous readings so often experienced with the garden-variety of f.s. meters or similar gadgets.

In addition, the R.F. Magnetometer is a high-Q device tunable over a 1.8-150 mc range, making it highly discriminatory as to frequency. This enables its use for indicating the frequency of a magnetic field produced by individual r.f. harmonics within its range.

It may also be used as an ordinary field-strength meter by plugging in a short antenna strength meter by plugging in a short antenna. The body-capacity effects usually associated with such meters, as previously mentioned, can be minimized as will be explained later.

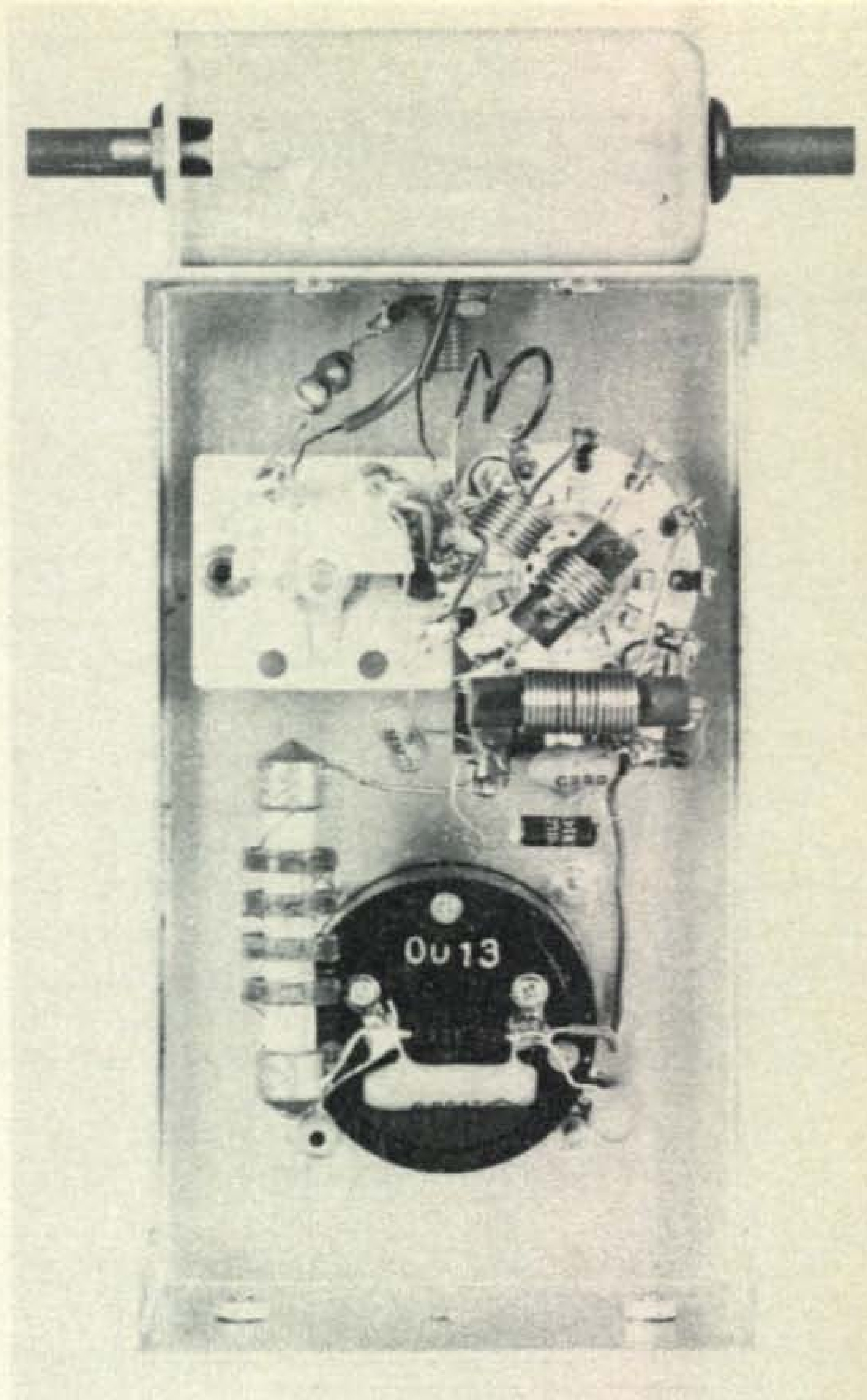
No doubt, the first application that comes to mind for the R.F. Magnetometer is determining antenna characteristics or optimum tuneup, particularly with beams. This concerns not only maximum efficiency, gain, front-to-back ratio, etc., but also r.f.-current distribution, polarization and radiation patterns. Other uses in this area are the indication of transmission-line radiation due to a high s.w.r., ineffective shielding, antenna unbalance and antenna currents on the line. In respect to the latter two, before-and-after comparative readings will indicate whether or not a balun employed at the antenna has accomplished its intended purpose.

Re-radiation also may be detected from other elements such as rain gutters, leader pipes, metal fencing and railings, masting or towers, guy wires, etc. that may distort antenna-field patterns or introduce undesirable radiation.

The detection of r.f. or radiation from ground leads, appliance power cords or building wiring may indicate a potential cause of RFI or TXI[1] from such leads. *Hidden* building wiring that radiates r.f. may also be located, as well as the direction in which the wiring runs. whether or not the ground system for the transmitting equipment is effective may also be determined.

Certain characteristics of mobile antennas can be found with the Magnetometer which will also indicate radiation or r.f. fields and their polarization from various sections of a vehicle body.

Used as a probe, the R.F. Magnetometer will accurately pinpoint the leakage of fundamental or harmonic r.f. energy from joints, holes or slots in shielded enclosures, thus indicating the effectiveness of the shielding or



Interior view of the R.F. Magnetometer. See pictorial wiring diagram, fig. 3, for identification of components

where corrective measures should be taken to eliminate r.f. leakage.

Details on these applications will be described later.

Theory of Operation

Referring to the circuit diagram at fig. 1, the R.F. Magnetometer is similar to a conventional absorption-type wavemeter, except that the pickup inductor is electrostatically shielded, eliminating capacitive coupling and permitting only inductive coupling to the r.f. source rather than a nebulous combination of both capacitive and inductive coupling.

The inductor is wound on a ferrite rod which ensures a very high *Q* and which also provides a sensitive inductive-pickup element.

The diode detector is lightly coupled to the tuned circuit in order to minimize circuit loading and thus maintain the high-*Q* properties of the circuit. Link coupling for the detector could be used to maintain the *Q*, but in a model designed for a wide frequency range, the self resonance of the link circuit can impair operation by causing "suckout"

[1]Q & A Column, *CQ*, Aug., Nov., Dec. 1969 and Jan. 1970.

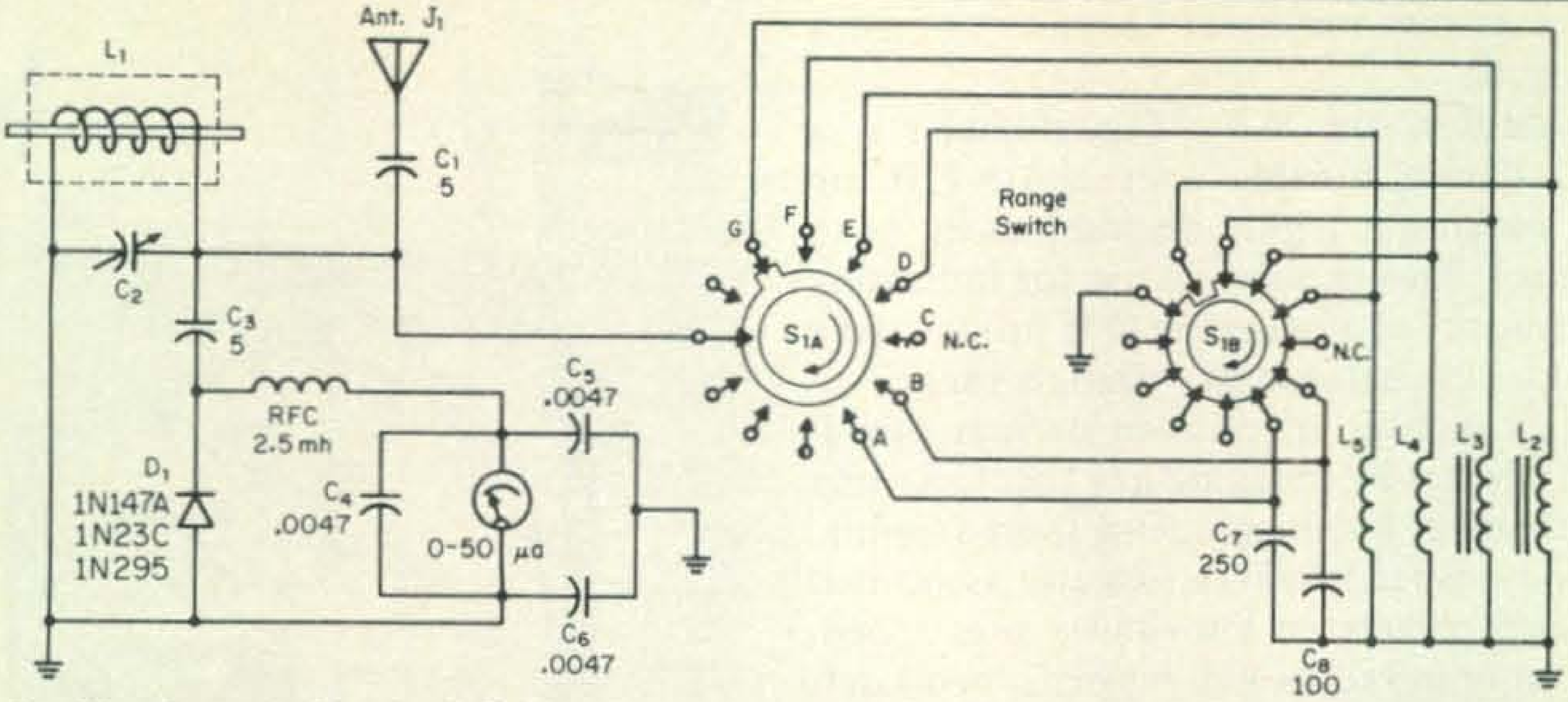


Fig. 1—Circuitry used in the R.F. Magnetometer. L_1 is the ferrite pickup inductor enclosed in an electrostatic shield. The circuit is adjusted to resonance by C_2, detuning of which also may be used as a sensitivity control. Inductors L_2-L_5 are added in parallel with L_1 by S_{1A} to extend the range as needed to higher frequencies. Similarly, C_5-C_6 are switched in for the lower-frequency ranges. S_{1B} shorts the unused range-extending coils and capacitors to ground for preventing "suckout" on the v.h.f. ranges.

Increasing C_1 to 10-15 mmf will provide greater sensitivity at the lower frequencies when an antenna is plugged in for using the instrument as an ordinary field-strength metetr.

C_1, C_3—5 mmf tubular or disc ceramic.
C_2—5-120 mmf variable capacitor. Millen #20100.
C_4, C_5, C_6—.0047 mf tubular or disc ceramic capacitor.
C_7—1.8-2.2 mc—250 mmf tubular ceramic or mica capacitor.
C_8—2.2-3.2 mc—100 mmf tubular ceramic or mica capacitor.
L_1—3.2-8.5 mc—22 t. #22 on 4½" × 1/4" d. ferrite rod—see text.
L_2—6.3-17 mc—16 t. #22 on 1" l. × 1/4" d. ferrite rod.
L_3—14-38 mc—6 t. #22 on 5/8" l. × 1/4" d. ferrite rod.
L_4—26-70 mc—7 t. #22 air-wound, self-supporting, 1/4" i.d.
L_5—60-150 mc—2 t. #22 air-wound, self-supporting, 1/4" i.d. with 3/16" spacing between turns, spread or squeezed as needed to cover v.h.f. range.
D_1—H.f. diode—1N21C, 1N23C, 1N147A, 1N295, etc.
J_1—Insulated banana jack.
M_1—0-50 μa, 1 9/16" square, Lafayette Radio Cat. No. 99E50494, price $3.25.
RFC—2.5 mh r.f. choke.
S_{1A}, S_{1B}—Centralab PA-300 index assembly, (Allied Radio No. 56 D 5092, price $1.50), and PA-11 or PA-18 ceramic wafer section, 1-pole, 11-position, unused contacts shorted out (Allied Radio No.'s 56 D 5238 or 56 D 5240, respectively, price $1.38).

in the v.h.f. range.

A pickup antenna for conventional f.s.-meter operation may be plugged into a jack that lightly couples the antenna to the tuned circuit, which under these conditions minimizes loading by the antenna and holds up the circuit Q.

The frequency range of the instrument is extended by switching inductors across the pickup inductor to decrease the overall inductance as needed. A similar scheme is often used in bandswitched receivers. The overall Q in these cases also is maintained high by winding the range-extending inductors on ferrite cores or by using self-supporting air-wound coils.

A high degree of sensitivity is obtained through the use of a 0-50 μa meter.

Construction

The electrostatic shield for the pickup inductor consists of an aluminum i.f.-transformer can with a slot cut through its length at one side and half-way down the end as shown at fig. 2. A separate slotted plate, installed at the open end, is fastened to this end by spade bolts. The ferrite rod, on which the pickup inductor is wound, is supported at each end of the shield by a 1/4" i.d. rubber grommet installed in a 5/16" hole.

The shield prevents penetration of the electrostatic field, while the slot keeps the shield from being a shorted turn and permits inducement of just the magnetic field.

The pickup-inductor shield is installed on the top of a 5¼" × 3" × 2⅛" Minibox which houses the remainder of the components. The inductor leads pass through a 1/2″ hole at the bottom of the shield and top of the box. The other elements are thus completely shielded from both electrostatic and magnetic fields.

The i.f.-transformer can used for the electrostatic shield may be either a 1⅛″ or 1¼″ square type with a length of 2″-2½″. Similarly, a different size box may be used, but the dimensions of that for the model shown here were selected as those most convenient for utilizing the instrument as a probe.

If the same size box is used, the identical type tuning capacitor and bandswitch should be employed with their location and wiring as shown in the drawing at fig. 3.

A 1/8″ thick aluminum plate with a 1/4-20 tapped hole at its center is installed on the bottom of the box using two flat-head countersunk screws. This enables the device to be mounted on a camera tripod for field use as explained later.

An insulated banana-plug jack for a pick-up antenna is mounted on top of the box at the front of the electrostatic shield.

Note that one section of the switch shorts the unused inductors. This is necessary to prevent "suckout" at the higher frequencies that would otherwise take place due to the self-resonance of one or more of these inductors.

The ferrite rod is 1/4″ in diameter and is Ferramic type Q_1.[2] It is supplied in a 7½″ length and must be cut down to a size that allows it to protrude 1/2″-3/4″ from each end of the electrostatic shield. The left-over piece is subsequently cut to smaller lengths on which some of the range-extending inductors are wound. A clean cut may be made by filing or scribing a slight groove around the place at which the rod is to be cut. Then, clamping pliers at each side of the groove, the rod may be easily snapped in two.

Any type diode may be used; however, a high-frequency type is preferred for maximum rectification efficiency and best sensitivity, particularly for operation at the upper frequencies.

A piece of good white paper is pasted to the front of the box, and India ink used for marking the control identifications. The bandswitch positions are marked with letters cor-

[2]Obtained rom Newark Electronics Corp., 500 North Pulaski Road, Chicago, Illinois 60624. Catalogue No. 59F1519, Indiana General part No. CF501, price $1.25 each.

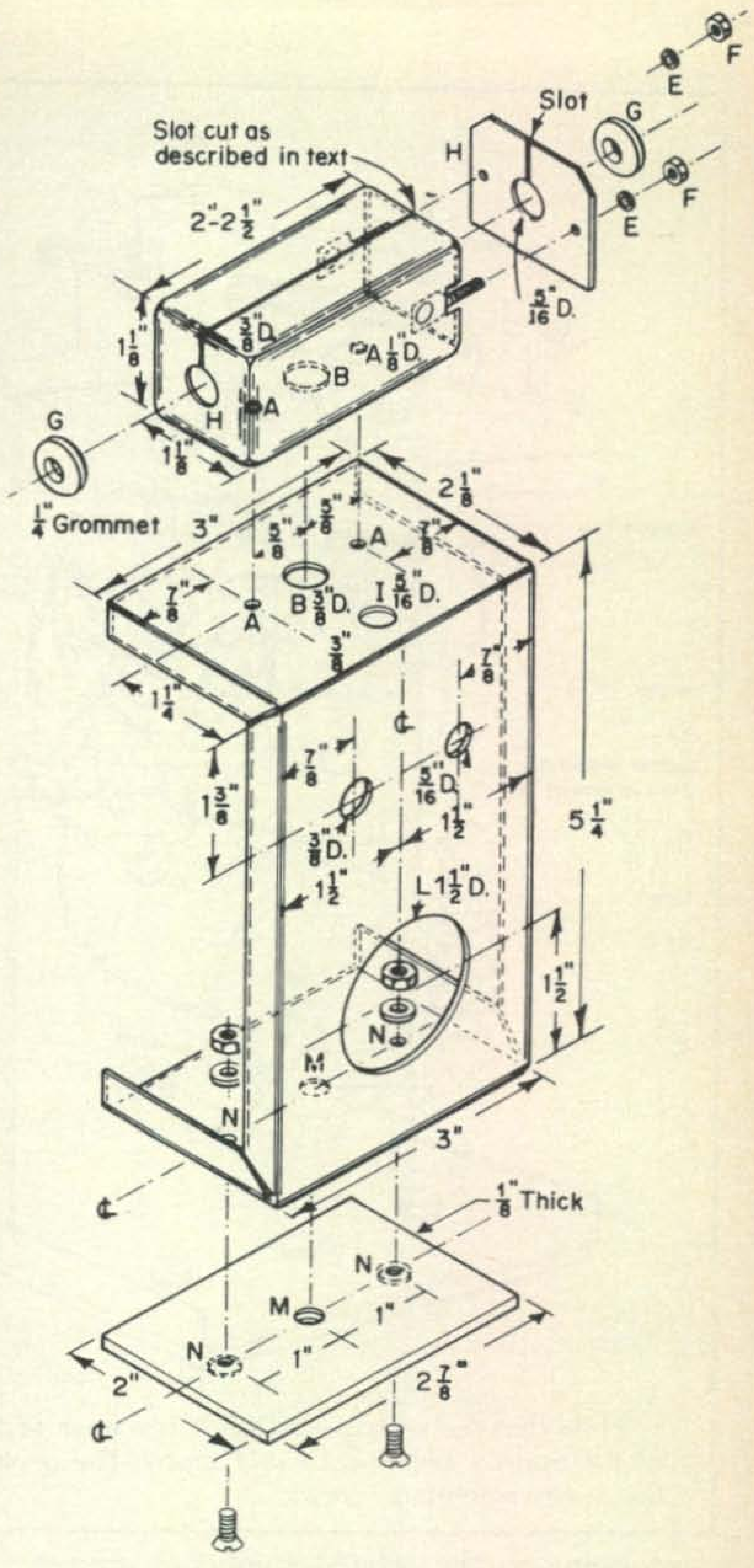


Fig. 2—Method of assembly at box and dimensions for Magnetometer model described herein using 1⅛″-square i.f. can for the electrostatic shield. The can is secured with 6-32 hardware at holes A. Holes B line up together and are used to pass the leads from the pickup inductor. 1/4″ rubber grommets G require 5/16″ dia. holes at H. These holes should be made before the slots are cut. Spade bolts, D, are secured with 6-32 hardware E & F. Hole I is for the antenna's insulated banana jack. Hole J is for the bandswitch; hole K for the variable capacitor. The meter mounting-stud holes may be determined from the meter case itself. The bottom plate is insulated at the base of the box using flathead (countersunk) screws and 6-32 hardware. Holes M line up and are tapped for 1/4-20 thread.

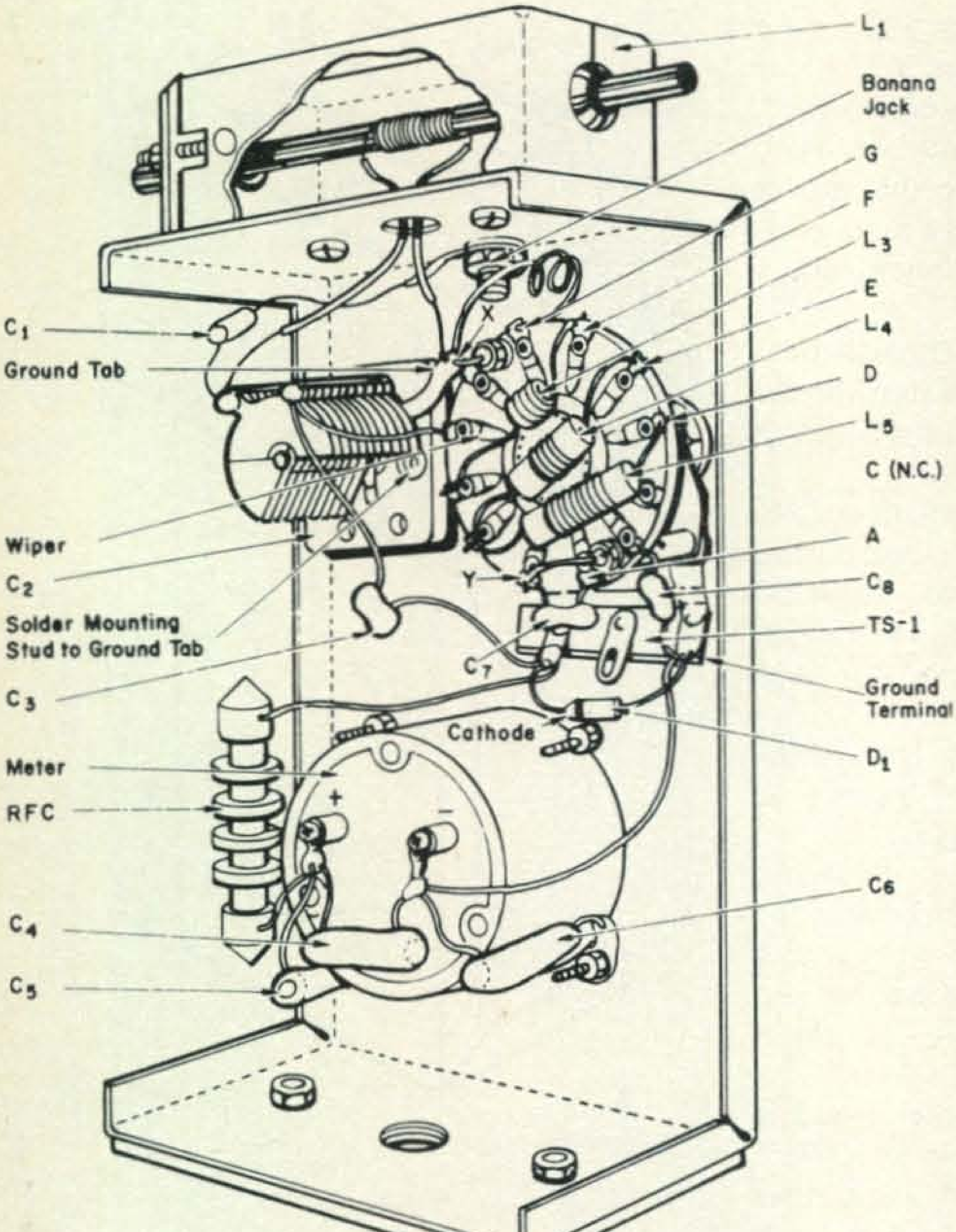


Fig. 3—Pictorial wiring diagram of the R.F. Magnetometer as viewed from the rear. C_2 should be mounted with nuts at the shaft bushing, so that the square mounting studs clear the panel by 1/16" (no contact). On the other hand, if the square mounting studs are used instead, the capacitor-rotor ground tab should be soldered to the eyelet of the nearest stud.

The switch should be assembled for a minimum total depth, so that the side of the ceramic wafer that faces the rear of the box is about 7/8" from the front of the box. This will necessitate cutting down the length of the switch shaft and assembly screws. The switch wafer should be installed on the assembly so that the side of the wafer that has the 1-pole 11-position section faces the rear. The side with the shorting ring (that has a single notch in it) faces the index-assembly detent. No connections need be made to the tabs on this side of the wafer, since they are connected through eyelets to the tabs on the side to which the inductors are shown connected.

Note that the switch tabs X & Y are each separtely grounded by a lead soldered to the end of the nearby switch-assembly screw. The ground connections for C_5-C_6 are made to lugs at the meter-mounting screws.

responding to the related frequency ranges listed on a white-paper chart on the side of the box.

The various ranges may be checked using a grid-dip oscillator as a signal source in which case the Magnetometer meter will peak when the instrument is tuned to the signal frequency. For these tests the g.d.o. inductor may either be placed near the range-extending inductors while the box cover is removed or at one end of the ferrite pickup rod. The band ranges should overlap and each amateur band except 3.5 mc should fall near the high-frequency end of the corresponding range.

The frequency coverage below 3.5 mc is extended by adding fixed capacitance across the circuit.[3] This reduces the ratio of the tuning range with the values shown here) and an overlap between the two lower-frequency ranges may not be found. In any event, the aim is to at least cover the 1.8 mc band and for some applications the 2.5 mc marine band.

Next month the operation of the r.f. magnetometer will be discussed as well as detailed instructions on its applications. In the meantime, components may be ordered, and assembly begun, which together should occupy much of the month. ■

[3]When not needed, these capacitors also are shorted out.

Tips And Tidbits For The F.M. Newcomer

BY GLEN E. ZOOK,* K9STH

THE time: late afternoon. The place: Joe Ham's shack. The reason: Joe's new f.m. rig arrived today. The result: Probable chaos on the local repeater. Why? Amateur f.m. procedures are quite different from those used on any other mode.

The analysis of Joe Ham's new f.m. rig resulting in chaos on the repeater is not as far fetched as most non-f.m. amateur radio operators may think. Amateur f.m. operation and techniques are much more closely aligned with the commercial radio services (yes, including legitimate CB) than with the normal 75 meter phone type of amateur QSO. The purpose of this article is to give a brief insight to the amateur who is planning to operate amateur f.m. Each locality has its own idiosyncrasies in operating techniques, but most principles remain constant. These local preferences can be easily picked up by the newcomer. The principles outlined herein are to aid the newcomer and prevent him from making a fool of himself in the eyes of the more experienced f.m. operator.

I believe that it is a safe assumption to say that most of the amateurs now operating on the 160 through 10 meter bands (d.c. bands to v.h.f. amateurs) came into the amateur ranks through the Novice class license. Before operating on the Novice band most amateurs had a more experienced amateur standing by to give a helping hand. The basic techniques for establishing a QSO, calling CQ, giving signal reports, locations, names, etc. have been established into a ritual established oved many years of operation. This basic ritual has been carried over into the phone operation on the "d.c. bands." The reasoning behind the normal amateur QSO type of operation is fairly simple, the equipment used is tunable, range or distance of communications is highly dependent on propagation conditions, and although some stations are worked over and over, the majority of stations worked by the average amateur are a once in a lifetime experience. This, for the most part is not true on the v.h.f. f.m. bands.

*FM Editor, *CQ*.

First of all, the equipment used by most amateur f.m. operators is fixed frequency. That is, the transmitters and receivers are crystal controlled on one or more fixed frequencies. Once the unit has been aligned for operation on the desired frequencies, only routine maintenance is required. There is no tuning around the band looking for a desired station. Most f.m. equipment has a squelch circuit in the receiver, so there is not even any background noise during standby periods.

Next, the v.h.f. bands tend to be of short to medium range stable communications. This is not to say that six, two, or even 432 do not have band openings. Many amateurs have worked thousands of miles on all three bands. However, for the most part, these bands are much more desirable for ranges up to 100 miles on a day in and day out basis. Thus, the majority of amateurs worked on amateur f.m. (excluding 29.600 mc activity) will be worked again and again. Repeaters greatly extend the range of the majority of stations, but again these repeaters have the same basic coverage for long term operation.

Finally, the technical standards used to measure the performance of f.m. equipment is different from the standards used on the other types of operation. Terms such as "capture" and "20 db quieting" and similar statements are not heard anywhere else in amateur radio. Power is measured in watts output and at a much lower power level than most 80 through 10 meter operation. Antenna polarization is vertical in most localities. Things like this tend to make normal amateur phone practices useless for v.h.f. f.m.

Before continuing, it is imperative to establish that this article is intended to help and encourage the *potential* amateur f.m. operator. Up to now the article has been a bunch of don'ts or its not like this or not like that. This is all true, but amateur f.m. is a world of its own, a very enjoyable world, and for the new f.m. operator to enjoy this new world a bit of preparation is necessary. Preparation was necessary before operating c.w., it was necessary before operating s.s.b., so it is logical that preparation is necessary before operating f.m. The remainder of the article is divided into two sections: The first section deals with operating techniques. The second section deals with a short course in amateur f.m. technical standards.

Operating Hints

After checking out a new rig the first urge is to make a contact. Most amateurs who have operated the lower bands exclusively before purchasing an f.m. rig tend to make a long-winded CQ. This is considered very discourteous in amateur f.m. circles. Since the vast majority of equipment is crystal controlled, many amateurs will hear your transmission from the start to finish. This is especially true when operating through a repeater. Each locality has its own preferred method of calling CQ. When this method is unknown, a statement such as "this is WA5-XXX monitoring nine-four" (the nine-four indicating 146.940, the actual received frequency should be indicated) will usually meet everyone's approval. The announcing of the receiving frequency is especially useful in areas in which several repeaters are operating. Many amateur f.m. operators monitor two or more frequencies and this tells them which mike to grab. Some areas prefer the terms using "Q" signals, such as "QRZ nine-four, this is WA5XXX." Still other areas have gone to the 10 signals used by commercial and public safety services (many amateurs do not like 10 signals because they are used on CB). In the case of 10 signals, something like "WA5XXX 10-8" usually suffices. No matter what the local practice, do not, repeat, do not make a long-winded CQ.

Another tendency of the new f.m. operator is to give everyone "S meter" readings. Many of the amateur-only f.m. units have a tuning meter incorporated into them. Most obsolete commercial equipment do not have such a built-in meter. This should tell you something. This meter is virtually useless, especially when using a repeater, for operation. The tuning meters are very useful when aligning the unit, but during normal operation they should be ignored. Why? When using a repeater every signal is received, demodulated, and rebroadcast on the same transmitter, using the same antenna, and the same power. The result is that every station will have the same meter reading for a given location. Besides that, the meter in f.m. units usually read a limiter stage, because they do not have an a.v.c. line to measure as do a.m. types of receivers. A meter in a limiter circuit presents a very unusual situation. As the circuit approaches saturation the meter readings increase. At saturation the meter peaks and remains constant for a higher signal level. Then, at some higher level than saturation many limiters will show a decrease in meter reading which may be interpreted by the unknowing as a weaker signal. Thus, a mobile running a given power level outside your house may have a lower meter reading than a mobile half way across town running less power. A better method of giving signal reports (again especially through the repeater) is in terms of noise received along with the signal. Statements such as you're full quieting in the repeater or you have a bit of noise on you are much more meaningful to the amateur f.m. operator.

Next, don't talk too long. Many repeaters have a time-out timer to keep transmissions to three minutes or less. Try to keep transmissions short. Virtually everyone is using push-to-talk on f.m. Also, this allows someone else to break with information or emergency traffic. Many repeaters have free use of select sites because of the benefits to the community because of the extended communications coverage. In many large cities a significant number of automobile accidents are reported by amateur f.m. operators. Do not spoil this record by talking too long and not allowing breakers. Also, remember that f.m. operation is a party-line with, in some cases, several hundred users.

Repeaters are nice, they extend your range considerably, provide a standard calling frequency, and are a great aid in emergency communications. Thus, doesn't it seem silly to talk to someone only a mile away using a repeater ten or even twenty miles away? Whenever possible, move long-winded QSO's off the repeater. Also, when talking a short distance, go direct (using the repeater output frequency or another channel). Most amateur f.m. transceivers now marketed have this option built in.

A courtesy carried over from commercial regulations is clearing. When a station is through on a channel, it is considered proper in f.m. circles to say that he is "clear" the channel. Most amateurs say something to this effect when operating the lower frequencies. A statement such as "WA5XYZ this is WA5-XXX clear" at the end of a QSO lets everyone on the channel know that you are finished

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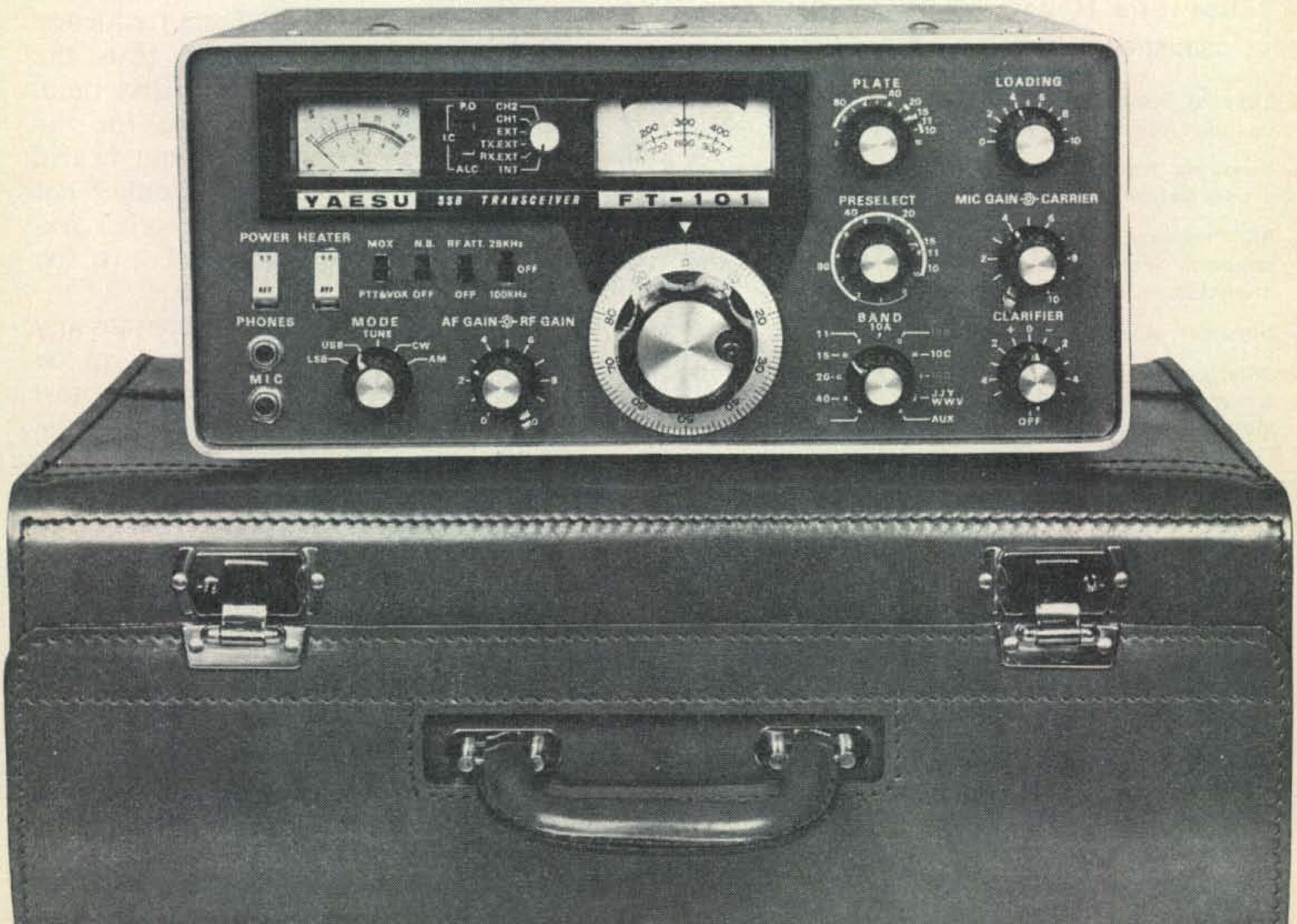

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and that the channel is open for anyone else to use without interfering with your contact. There is, in some areas, a tendency to overuse the clearing technique. Commercial regulation (except public safety and certain taxi and similar frequencies) require a station to "clear" whether or not a contact is made This has been carried over into f.m. by some amateurs, especially those who have graduated from the CB ranks in which clearing is required. This, in turn, is picked up by newcomers who think they are doing the correct thing. When a station is called or an equivalent of CQ is called and no station returns it is not necessary to make some statement such as "no station heard, WA5XXX clear" or "WA5XXX clear after negative contact." It is quite obvious to everyone on the channel that no station answered you. Why clutter the air with statements that have no practical or enjoyable use? If no station comes back to you on 20 s.s.b. you don't say anything. So, why announce to the f.m. world that you didn't contact anyone.

Finally repeated calls either to a certain station or as a general call serve no purpose except to antagonize everyone else on the channel. Remember that receivers are crystal controlled on either the local direct frequency or the repeater output frequency. Thus, the station called will hear you the first time. Repeated calls will not be heard for the simple reason that if the first is not heard, the desired station or operator is either not home, or he is operaitng on some other frequency. So, space your calls and give the other guy a chance to come home.

Another bit of advice, do not operate any contests on a repeater. Not only will you be branded a complete lid by everyone, most contests do not allow contacts made on the repeaters to count. So, all you do is cause hard feelings.

Technical Specifications

The technical specifications used on f.m. equipment is generally much different from a.m., c.w., or s.s.b. As mentioned before most amateur f.m. activity uses vertical polarization. This is a result of the desirability of omni-directional coverage. More than half of f.m. activity is mobile, thus the need for omni-directional coverage. It is quite possible to use a directional antenna and get both gain and directivity along with vertical polarization. The simplest way is to flip a yagi 90°.

[*Continued on page 95*]

A Camper Mobile Installation

BY HARRY R. HYDER,* W7IV

A MOBILE installation can be nothing more than a pleasant Saturday afternoon's work. It can also be quite a bit more, if something out of the ordinary is wanted.

My own problem was a mobile installation in a pickup truck-camper combination. The main problem was the power supply system, but there were others, too. Where to mount the antenna? And where to put the transceiver itself? I will describe my personal solutions to these problems, and maybe they will give you some ideas for your own installation.

The Power Supply System

The main difficulty with the power system was that I really didn't want mobile operation in the literal sense of the word. What I really wanted was fixed portable, engine-off operation. The idea of having a few QSO's after a camp dinner at some remote spot was appealing. But the types of camping spots I favor are not the miniature cities our park campgrounds have become. I like to get out at the end of some barely-passable dirt road, with preferably no one else around for miles. And it doesn't take too many QSO's to run down a battery to the point where it would not be possible to start the engine the next morning—a real disaster in the wilderness. Of course, I could keep the engine running while on the air, or get one of those small gas-driven generators, but neither of these appealed to me. I like as much silence as possible in the woods or desert.

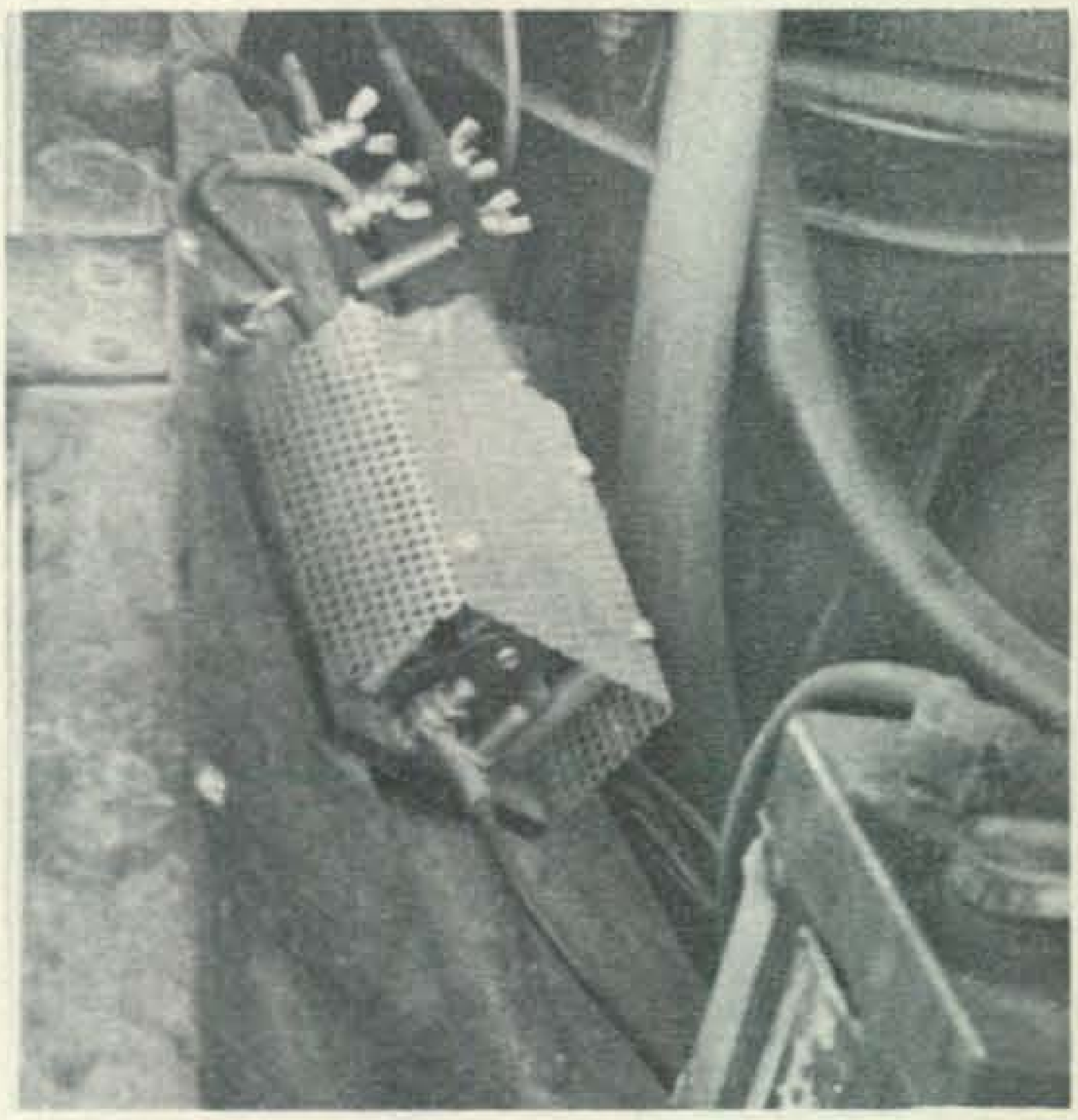
The answer, of course, is an auxilliary battery. If the auxilliary battery is independent of the vehicle's normal electrical system, one can operate until the battery is exhausted, yet have the main battery, fully charged, available to start the engine. Of course, it is desirable to charge the battery from the truck's alternator after the engine is started.

*2523 North 57th St., Scottsdale, Arizona 85257.

In its simplest form, an auxiliary battery could be connected in parallel with the main battery through a switch or relay. The switch would be open while the rig is in use, and closed *after* the engine is started. Needless to say, the switch or relay must have contacts capable of carrying the full current output of the alternator.

A much more elegant arrangement uses two silicon diodes to do the switching, and is completely automatic. Figure 1 shows the basic arrangement. The batteries charge in parallel, but discharge independently. The diodes, like the previously described switch, must be able to carry full charging current.

Silicon diodes are ridiculously cheap these days. The units I used are rated at 78 amperes



Close-up view of the battery isolating diodes mounted on angle aluminum heat sinks within a perforated cover. Just to the rear of the diode enclosure is the battery disconnect (wing nuts). Both are mounted within the engine compartment of the camper truck on the inner fender well. *(Photos by Ted Stites).*

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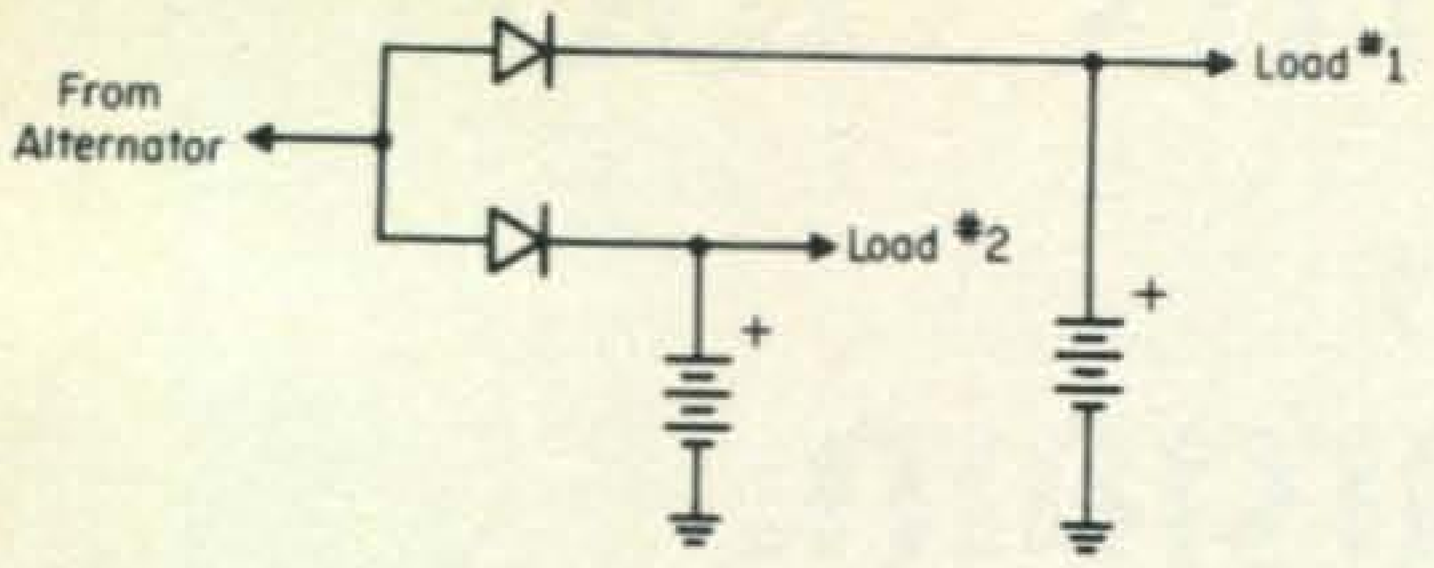


Fig. 1—Simple battery isolating system permitting two batteries to be charged simultaneously from the vehicle's alternator, and to be used independently without discharging the other. Diodes are Motorola MR1200FL or MR1200FLR 78 amp. silicon types.

d.c. at 150° C. case temperature. They cost only $3.20 each. They are Motorola type MR1200FL. These units can be obtained with reverse polarity, in which case the number is MR1200FLR. "Reverse" means that the anodes, rather than the cathodes, are connected to the case. In some rectifier applications, this permits back-to-back diodes to be mounted on a common heat sink.

There is only one disadvantage to this scheme. There is a drop of about 0.6 volts across the diodes, and depending on the design of the alternator and regulator system, the batteries may never reach their fully-charged potential of 14.4 volts. Actually, very little effective battery capacity is lost of the terminal voltage is restricted to 13.8 volts rather than 14.4 volts, and it can be ignored. But in most cases it is easy to compensate for the drop across the diodes. Regulators of the electro-mechanical type are usually adjustable, either by a screw or by bending contacts, and the voltage can usually be brought

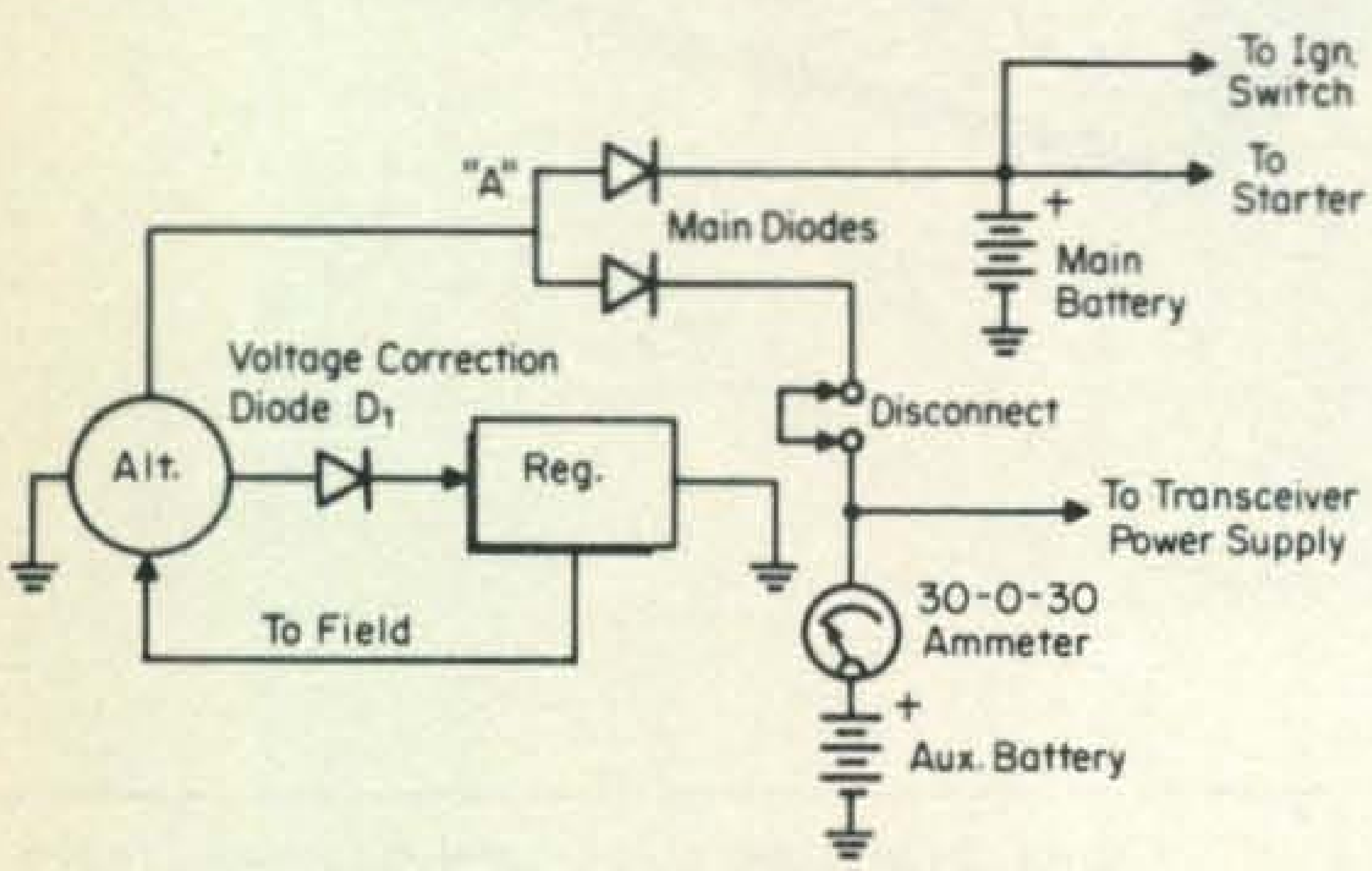


Fig. 2—Wiring system for the camper mobile installation. Diode D_1 is used to alter the alternator voltage output signal to the regulator to permit a higher battery charging voltage at point "A". The main diodes isolating the two batteries produce a voltage drop at the batteries equal to the voltage drop across D_1, resulting in a normal charging rate.

back to normal after installing the diodes. I strongly recommend that the car or truck's service manual be read carefully before this is attempted.

In my own case, the regulator was completely electronic (Motorola) and had no adjustments. The voltage was determined by a zener diode, contained in a sealed housing. However, I reasoned that if I could produce a voltage drop in the lead going from the alternator to the regulator which would be equal to the drop across the diodes, I could fool the regulator into raising the alternator's output voltage. I measured the current in this lead with the engine running, and found that it was less than one ampere. I then inserted a small one ampere diode in this lead, and as predicted, the alternator output voltage rose to 15 volts, thus making the voltage on the battery side of the series diodes 14.4 volts. All of this is shown in fig. 2.

Alternators and regulators are designed in many different ways, and there is no single way of raising the voltage that is applicable to all types. A little study and thought, though, will usually produce a workable scheme.

Two additional items are strongly recommended when an auxiliary battery is installed. The battery should have its own ammeter; these can be bought for a couple of dollars, and can be very informative about the general operation of the system. If the car or truck has an "idiot light" rather than an ammeter for the main battery, it would be a good idea to install one in the main system too. An "idiot light" is merely a failure indicator; an ammeter can tell you that something is going to happen, and you may be able to avoid it.

The other recommended item is a means of disconnecting completely the auxiliary system. This could be a heavy-duty switch or circuit breaker, connected at the output of the auxiliary battery's diode. The reason for this is that you may want to remove the auxiliary battery for an extended period, say if the battery in your other car goes dead and you need a temporary replacement. In my own case, the battery is also used for my outboard motor boat, and is frequently removed. Without a disconnect, you will have a hot battery lead dangling around inside the engine compartment.

The disconnect in my system is a removable link. This is about as fool-proof an arrangement as there is. The connecting and disconnecting must be done deliberately;

Front view of the camper truck showing the system used to elevate the whip antenna to a position even with the hood of the truck.

unlike a switch, it can not be done accidentally. The disconnect consists of two bolts mounted on a block of insulating board. The circuit is closed by a short strip of brass, drilled to match the bolt spacing. The two studs that hold the disconnect's protective cover are on the same spacing, and the brass strip is stored there when the circuit is open. Wing nuts are used, so no tools are necessary for the operation.

All of the auxiliary battery wiring was done with #10 stranded wire. I used crimp type solderless terminals throughout; a crimping tool is a worth while investment and should be in every ham's tool box. Cable clamps should be used generously, and it is also a good idea to slip plastic tubing over wires that may rub against any sharp edges.

Battery racks can be bought at automobile junk yards for a dollar or two, or one can be worked up from aluminum angle stock, as mine was. The "hold down" can be bought at any large auto parts store, as can battery terminals.

The diodes should be mounted on a block of insulating board. The only heat sinks I used were a couple of 3-inch lengths of 1″ × 1″ × 1/8″ aluminum angle from my scrap box. A perforated metal cover was made up for the diode assembly. Service station attendants are frequently careless of what they do with oil cans, dip sticks, and other metallic objects. Exposed terminals should be avoided where possible.

The Antenna

The normal place to mount a mobile antenna is on the rear bumper or deck. On a truck-camper, that is obviously impossible, so the front bumper is frequently used. On most trucks, this puts the antenna two or three inches away from sheet metal for about two feet of its length. I didn't care for this; the efficiency of a mobile antenna is low enough without shielding it for a good part of its length.

In my installation, the base of the antenna is level with the top of the hood, as can be seen in the photograph.

The mount consists of a length of 1/2″ steel pipe, resting on a conventional adjustable-chain bumper mount. On top of this is a rigid angle bracket, made of 1/8″ aluminum plate. The antenna is mounted on this plate. A length of 1/2″ diameter threaded rod passes through the pipe, holding the bracket, pipe, and bumper mount together firmly. The pipe is supported towards its upper end by a metal plate that passes through the gap between the grill and hood, and is screwed to the truck's internal bracing.

The whole thing was made of scrap materials at hand, but has worked out beautifully.

If you are wondering what the little thing is sticking out at the base of the antenna, it

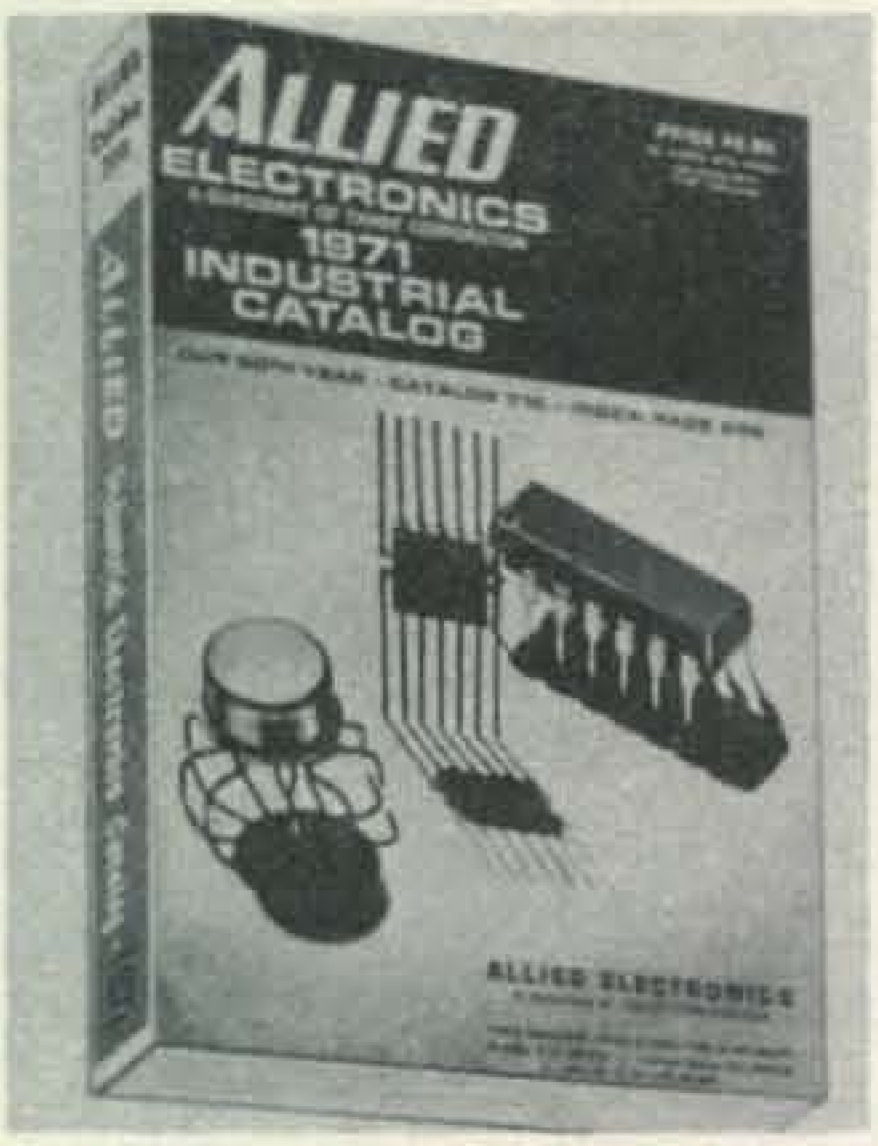
[*Continued on page 92*]

Perched neatly beside the driver is the SB-33 transceiver sitting atop a simple frame of 1 × 2 lumber. The "seat belt" for the rig can be seen in the compartment beneath the rig. On the dashboard is an aluminum panel containing an ammeter, an antenna connector and a power socket from the SB-33 mobile supply in the engine compartment. Beneath this panel is a small s.w.r. bridge.

New Amateur Products

Varitronics AS-2HG

VARITRONICS introduces the "Redhead," their two meter groundplane antenna, rated at 3.4 db gain. It is adjustable for v.s.w.r. over the entire two meter band. Both radials and radiator are built of heavy gauge aluminum conduit, and the loading coil is well protected by a metal shield which is painted red (hence the nick-name). The antenna is rated at 500 watts s.s.b., 250 watts c.w., a.m., f.m. It sells for $18.95. For more information write to Vantronics, 2321 E. University Dr., P.O. Box 20665, Phoenix, Arizona 85036 or circle 84 on Reader Service coupon.



Allied Electronics 1971 Catalog

ALLIED Electronics' new 616-page 1971 catalog of electronics parts and supplies, considered by many as the bible of the industry, is now available. Listing over 70,000 separate stick items from more than 700 manufacturers, Catalog No. 710 sells for $2.00 (or no charge with order), and represents the most comprehensive catalog of its type in the field.

Semiconductor Cross Reference Guide Motorola's HEP

MOTOROLA's HEP sales has announced a new cross-reference and replacement guide, HEP HMA07, available free through HEP distributors nation-wide. This guide cross-references more than 25,000 devices to HEP replacements including 1N, 2N, 3N, JEDEC, Japanese, Dutch and other foreign numbers in addition to thousands of manufacturer's regular and special "house" numbers.

Motorola HEP Hobby Kits

TWO new construction kits with special "How To" project brochures have been introduced by Motorola HEP. The HEK-3 Radio Amateur Hobby Kit, retailing for $5.95 contains two RF-IF linear integrated circuits and an RTL integrated circuit in addition to the HMA-36 special project brochure. Other circuits in the brochure includes a 6-meter pre-amp a.m. modulator; a 40-meter transmitter; a 6-meter pre-amp; video amplifiers and a microphone amplifier. For complete details write to Motorola, Information Service, 5005 E. McDowell Rd., Phoenix, Arizona or circle 85 on Reader Service coupon.

Heath IB-101 Frequency Counter

THE new Healthkit IB-101 uses computer-type integrated circuitry to provide accurate counting from 1 cycle to over 15 mc and elimination of divider chain adjustment.

An exclusive Heath-designed input circuit uses a dual-gate, diode-protected MOSFET to provide proper triggering from less than 100 mv to greater than 200 volts, without input level adjustment. Input impedance is 1 megohm shunted by less than 20 mmf to minimize circuit loading and error. The kit sells for $199.95.

Other features include fast five hour assembly on one double-sided, plated-thru circuit board, dual primary power transformer, sockets for all 26 IC's and five display tubes, and a combination handle/tilt stand. For additional information on the new Heathkit IB-101, write Heath Company, Benton Harbor, Michigan 49022, or circle 86 on Reader Service coupon.

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500CX

550 WATT 5 BAND SSB-CW-AM TRANSCEIVER

SPECIAL DESIGN FEATURES

All Swan Transceivers feature single conversion which results in greatly reduced image and spurious response. The successful application of this design is made possible by the unique combination of a high frequency IF system and a multi-range variable frequency oscillator. The only thing better than single conversion is no conversion at all.

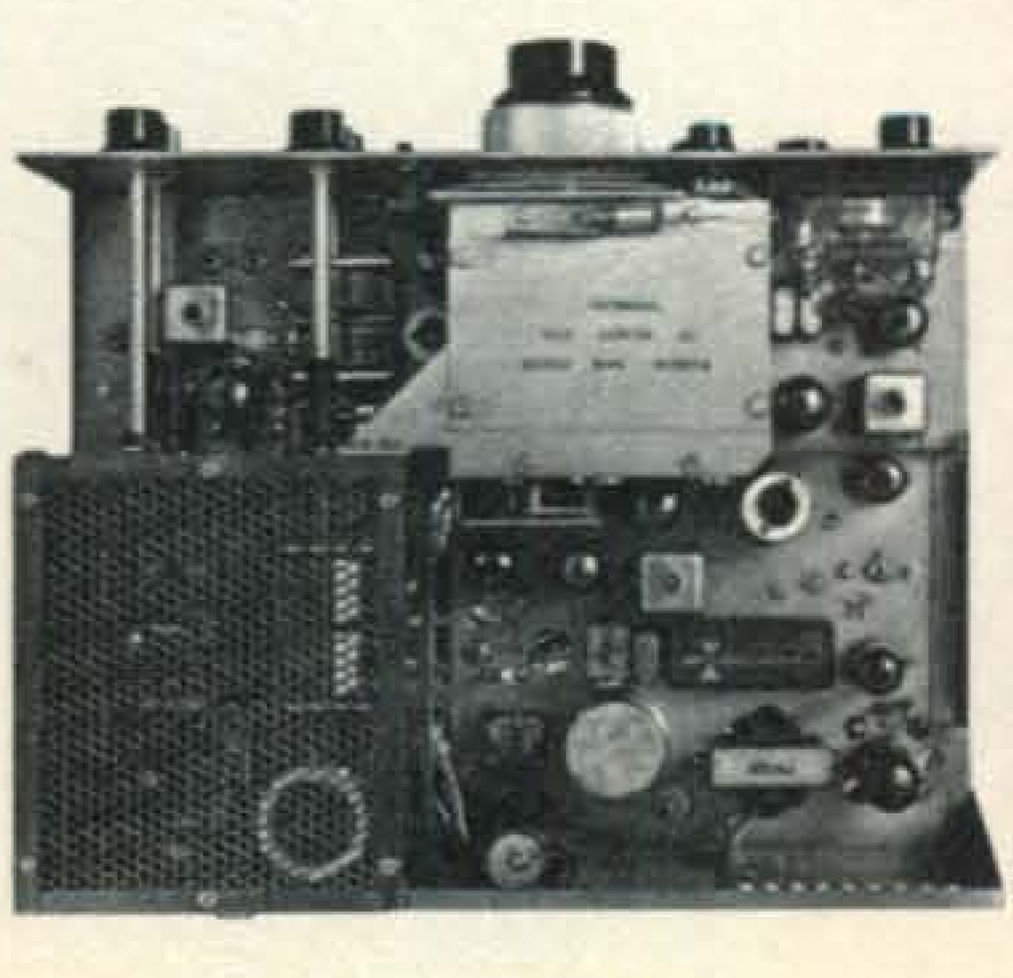
Selectivity is provided by a high frequency crystal lattice filter second to none. The 5.5 mHz carrier frequency and 2700 Hz bandwidth were carefully selected for optimum results. Swan's 5.5 mHz design produces the optimum shape factor, steepest skirts and greatest ultimate rejection. The more commonly used 9.0 mHz filters simply cannot provide comparable skirt selectivity or ultimate rejection of strong adjacent signals. The 2.7 kHz bandwidth was chosen for maximum readability of voice under conditions of noise, and QRM. As this bandwidth is reduced the transmission and reception of intelligence is rapidly depreciated. Swan Transceivers both transmit and receive audio which is virtually flat from 300 to 3000 Hz, resulting in truly natural sounding voice quality. This is why Swan Transceivers consistently sound better than others which pass 300 to 2400 Hz or less.

Superior selectivity is available with the optional SS-16 filter. This is a special 16 pole network designed exclusively for Swan by CF-Networks. A shape factor of 1.28 to 1 and ultimate rejection greater than 140 db provide the highest degree of selectivity ever offered in amateur or commercial gear. Bandwidth is the same 2700 Hz as the standard Swan filter, for the same reasons of high voice quality and readability under adverse conditions.

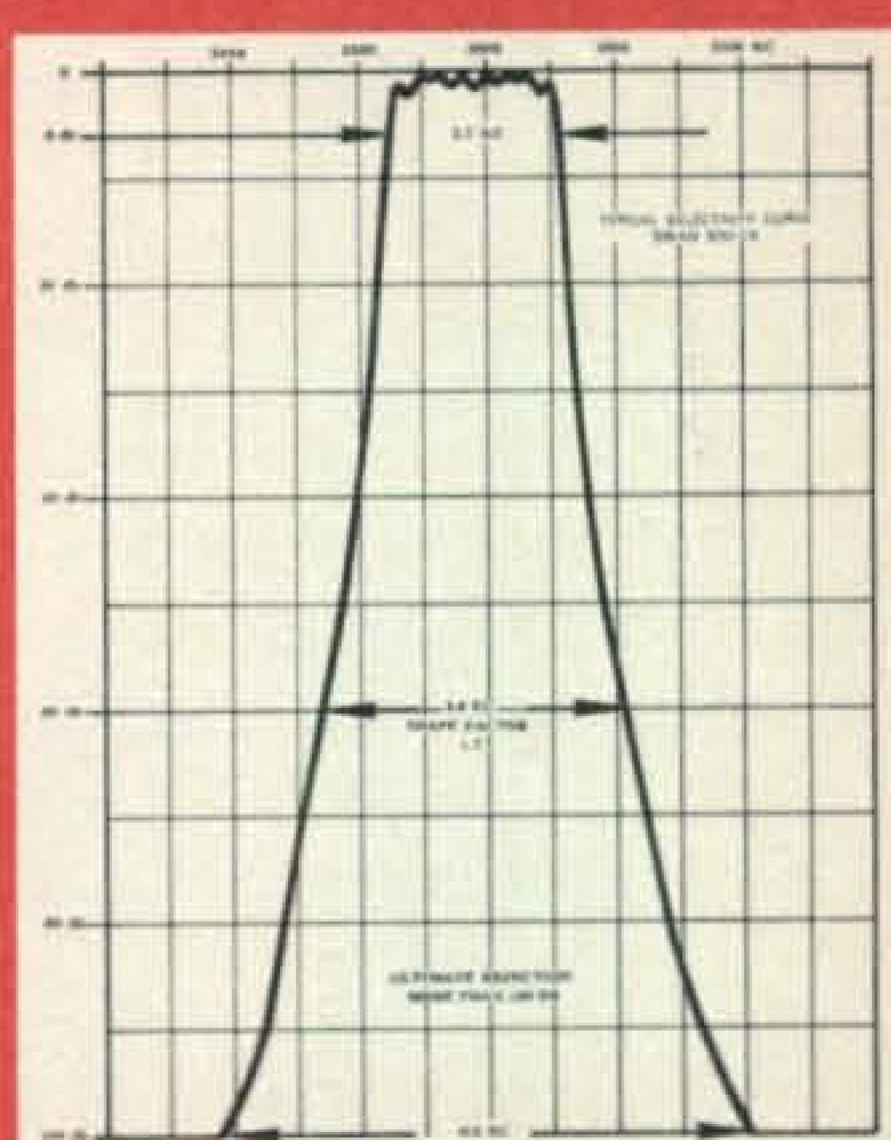
$449

Sensitivity of the Swan receiver circuitry is second to none. Using the best vacuum tubes available for the R. F. amplifier, signal to noise ratios run as high as the state of the art permits, without the inherent overload problems found in solid state receivers. The new automatic gain control circuit employed in the 500CX further reduces cross modulation and front end overload to extremely low levels.

The Velvet Tuning dual-ratio planetary dial drive in the 500CX is without question the smoothest system you'll find. It is virtually free of backlash!



TOP VIEW



SWAN'S HIGH FREQUENCY CRYSTAL LATTICE FILTER

There are 3 important factors about a filter which determine the overall performance. One of these is its 6 db Bandwidth. After careful examination, we selected 2.7 kHz in order to give you good channel separation, maximum intelligence, while retaining the smooth, natural audio for which Swan Transceivers are famous.

The next consideration is shape factor, or the ratio between bandwidths at 6 and 60 db points on the skirts. Because best shape factor can be achieved at approximately 5 mHz, we selected 5.5 mHz for the Swan I.F. Due to this I.F. Frequency selection, the Swan filter gives you a "shape factor" of 1.7 to 1, which is substantially better than the 2 to 1 ratio of the mechanical filter. The third factor, but by no means the least important, is the measure of ultimate rejection, or how far the skirts fall before flaring out. Ultimate rejection determines how well your receiver attenuates those strong adjacent channel signals, particularly 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. Take a look at the graph and you'll see that this is better than 100 db with the Swan filter.

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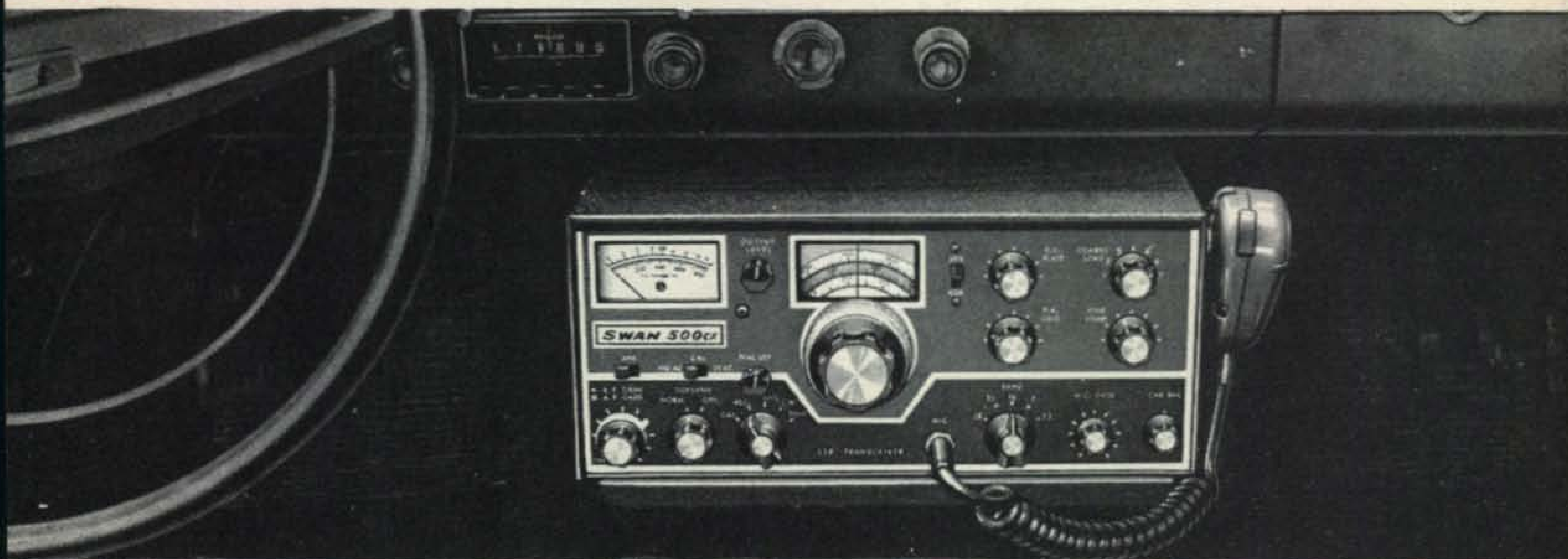

SPECIAL FEATURES:

- Power rating increased to 550 watts P.E.P. input.
- New amplified Automatic Gain Control circuit. Faster attack results in exceptional receiver control with no "pumping" effect.
- Amplified Automatic Level Control provides greatly improved transmitter control, reduces flat-topping, makes Mic. Gain adjustment less critical.
- New solid state crystal calibrator provides choice of markers every 25 kHz or 100 kHz.
- Improved Balanced Modulator circuit increases carrier suppression to well beyond the 60 db rating.
- New Product Detector circuit reduces distortion products and provides greater audio power output.
- Narrow band CW filter, accessory model AF-800, available for improved CW reception.
- Improved sidetone oscillator with pleasant sounding sine wave for CW monitoring.

GENERAL SPECIFICATIONS:

- Frequency range: 3.5-4.0 mHz, 7.0-7.45 mHz, 14.0-14.45 mHz, 21.0-21.45 mHz, 28.0-29.7 mHz.
- Extended frequency coverage for MARS operation with plug-in crystal oscillator accessory, model 510X.
- 5.5 mHz quartz crystal filter. Finest in the industry. 2700 Hz bandwidth, 1.7 to 1 shape factor at 6 and 60 db, more than 100 db ultimate rejection.
- Selectable Upper and Lower Sideband.
- Solid state VFO, highest stability, temperature and voltage compensated.
- 13 vacuum tubes, 7 transistors, 11 diodes.

TRANSMITTER SPECIFICATIONS:

- Power Rating: 550 watts, P.E.P. Input, 360 watts CW input, 125 watts AM input. Two 6LQ6 tubes.
- Suppression: Unwanted sideband down more than 50 db, carrier down more than 60 db, third order distortion down approx. 30 db.
- Audio Bandpass: 300 to 3000 Hz, ±3 db.
- Output Circuit: Wide range Pi, coarse and fine adjustment.
- Amplified ALC, increased voice power.
- Automatic voice controlled transmit with plug-in VX-2 accessory.
- CW keying, grid-block system, off-set transmit frequency.
- Break-in CW operation with plug-in VX-2 accessory.

RECEIVER SPECIFICATIONS:

- Sensitivity: Requires less than ½ microvolt at 50 ohms for 10 db S + N/N ratio.
- Precision Tuning: Velvet smooth, dual ratio, zero backlash. The finest tuning system on the market.
- Audio fidelity: 300 to 3000 Hz, ±3 db.
- Amplified AGC, fast attack, no pumping, controlled decay.
- S-Meter circuit functions automatically in receive mode.
- Automatic Noise Limiter, with panel on-off switch.
- CW Sidetone circuit for monitoring CW Keying.

POWER SUPPLY REQUIREMENTS:

- For 117 volts, 50-60 Hz: Swan model 117-XC, includes speaker.
- For 117-230 volts, 50-60 Hz: Swan model 230-XC, includes speaker.
- For 12-14 volts DC: Swan model 14-117. (Also operates on 117 volts AC.)
- For 12-14 volts DC: Swan model 14-230. (Also operates on 117-230 volts AC.)

SHARP AS A LASER

THE SWAN MODEL SS-16 QUARTZ FILTER NETWORK

Now available to provide super selectivity fo[r] your Swan Transceiver. Easily installed in models 240, 260, 270B, 350, 350C, 400, 500, and 500CX.

- Unprecedented rejection of adjacent channel QRM.
- 2.7 kHz bandwidth at 6 db down.
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with instructions. Specify transceiver model.

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Deluxe *Cygnet* 270B

SSB TRANSCEIVER
5 BANDS—260 WATTS
WITH BUILT-IN AC POWER SUPPLY AND LOUDSPEAKER

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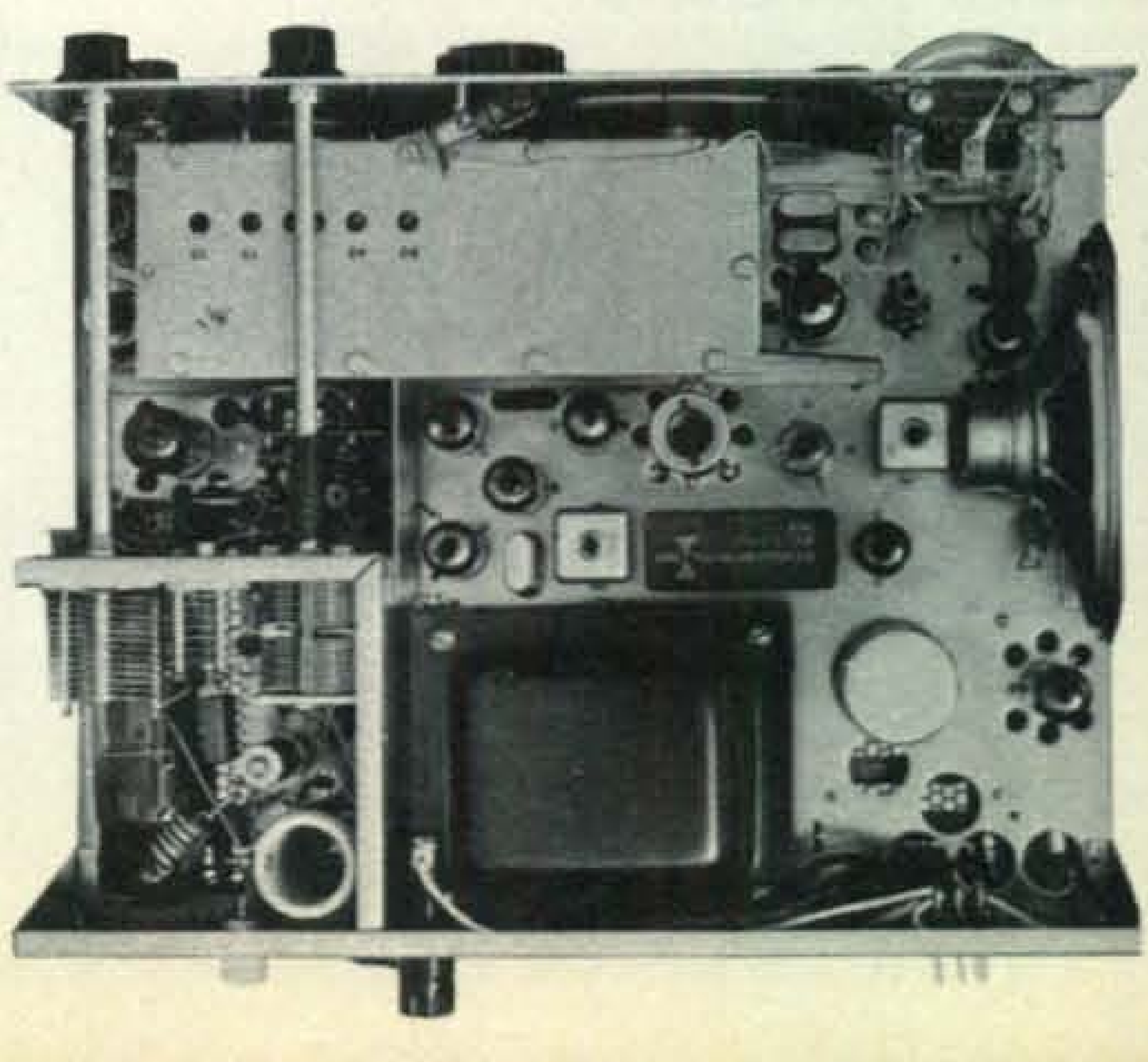
The Swan Deluxe Cygnet is the most versatile and portable transceiver on the market, and certainly the best possible value. **$399**

14A DC

Model 14A DC Converter
Shown in rear view above $29

REAR VIEW



TOP VIEW

Swan quality at import prices!

Portable...Versatile

Cygnet 270B SPECIFICATIONS

- Power Input: 260 watts P.E.P. SSB and 180 watts CW
- Frequency Range: 3.5-4.0 mHz, 7.0-7.3 mHz, 14.0-14.35 mHz, 21.0-21.45 mHz, 28.0-29.7 mHz
- C.F. Networks: Crystal Lattice Filter. Same as used in the Swan 500 CX 2.7 kc with 1.7 to 1 shape factor. Ultimate rejection exceeds 100 db
- Unwanted sideband suppressed 50 db
- Carrier suppressed 60 db. 3rd order distortion down approx. 30 db
- Audio Response: flat within 3 db from 300 to 3000 cycles in both transmit and receive modes
- Pi Antenna coupler for 50 to 75 ohm coaxial cable
- Grid Block CW keying with off-set transmit frequency
- Solid state VFO circuit temperature and voltage stabilized
- Receiver sensitivity better than ½ microvolt at 50 ohms for 10 db S + N/N ratio
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- Voltage Input: 117 volts 50-60 Hz. Available on special order for 208-220-240 volts.
- For 12-14 volt DC operation, a plug-in converter, model 14-A, is available. This unit is only 1½x3x4 in., and plugs onto the back of the 270B in place of the AC power connector.
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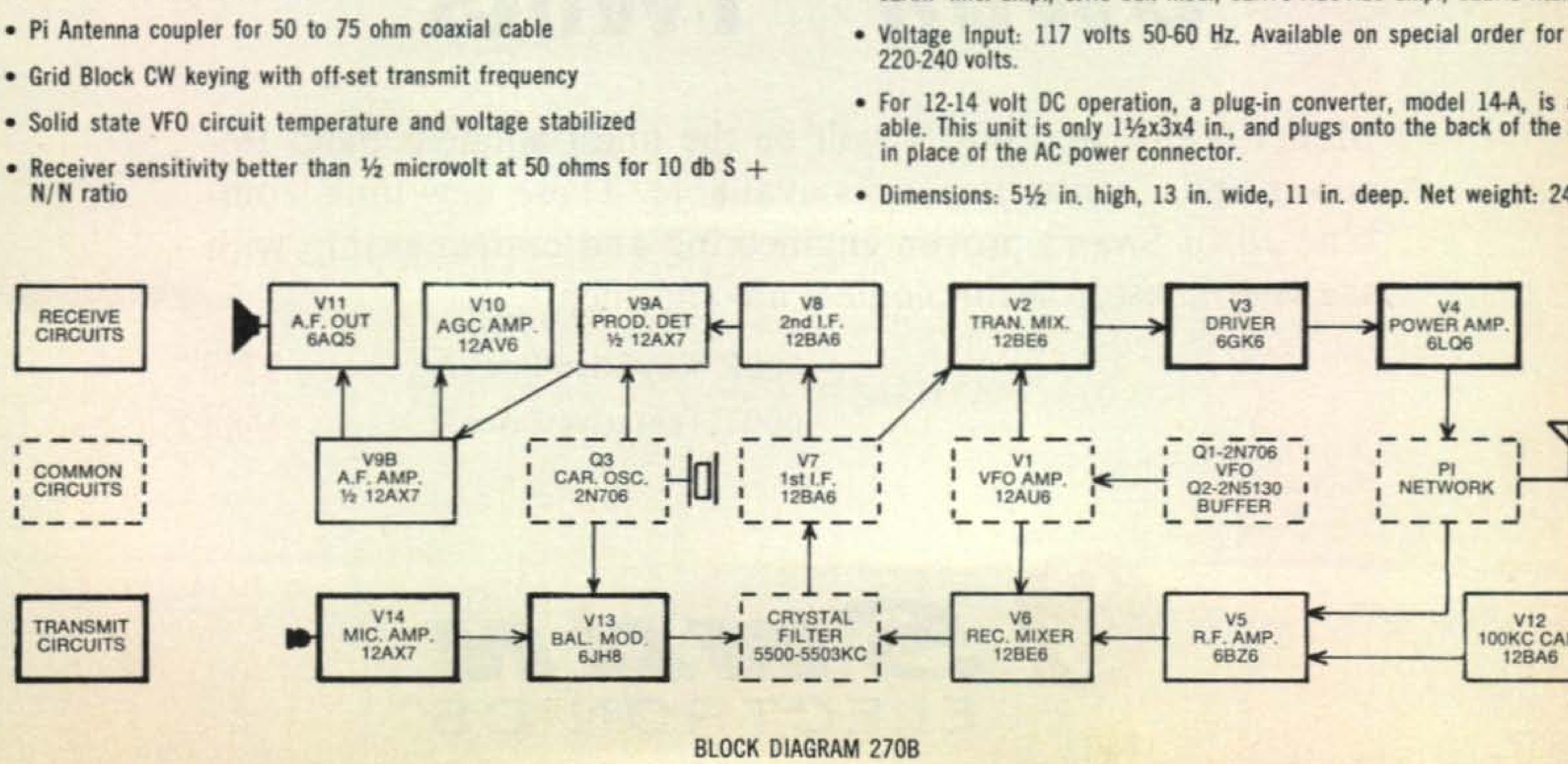

BLOCK DIAGRAM 270B

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VHF FM TRANSCEIVER FOR 2 METERS

NO COMPROMISE 2 METER PERFORMANCE.

The all new Swan FM-2X has been a long time in the making, but we wanted to offer you the finest in performance and quality at a price all can afford. The Swan FM-2X features all solid state construction (no final tubes to waste battery power), and comes complete with microphone, AC power supply and mobile mounting bracket. The FM-2X is being built to our specifications by a highly respected Japanese manufacturer of commercial communications equipment. Needless to say, the FM-2X is backed by the famous Swan service policy.

$229

SPECIFICATIONS:

General

- **Frequency Coverage:** 144-148 MHz
- **Number of Channels:** 12 Channels, 2 supplied.
  Channel 2: Receive 146.94 MHz Transmit 146.93 MHz
  Channel 1: Simplex 146.94 MHz
- **Modulation:** Frequency Modulation
- **Transmitter Control:** Push to talk.
- **Power Source:** AC: 117 volts 50/60 Hz
  DC: 13.5 Volts ±10%

Dimensions:

- **Weight:** 8¼ lbs.
- **Standard Accessories:** Dynamic Microphone, Antenna, Connector Plug, AC/DC Cord.

Transmitter

- **FULLY SOLID STATE, NO TUBES.**
- **RF Output Power:** 10 watts minimum.
- **Frequency Deviation:** 15 KHz maximum.
- **Frequency Stability:** ±.001% or less.
- **Spurious Radiation:** Greater than −60 db below Carrier.
- **Frequency Multiplication:** 12

Receiver

- **Receiver Circuit:** Crystal-controlled Double Conversion Superheterodyne.
- **Intermediate Frequencies:** 1st 10.7 MHz, 2nd 455 kHz.
- **Input Impedance:** 50 to 75 Ohms.
- **Sensitivity:** 0.5μV for 20 db quieting. 1 x .5μV for 12 db SINAD.
- **Intermodulation:** Greater than 60 db.
- **Audio Output:** 2 watts to internal speaker.

VHF 150 2 METER FM AMPLIFIER

Here in one complete package is a 150 watt self-contained amplifier. Use for home station, or with the addition of the Swan 14A DC converter, the unit may be used in mobile operation to greatly extend the range of direct communications

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3 **Please ship me the following Swan Equipment.**

QUANTITY	MODEL #	DESCRIPTION	PRICE EACH	TOTAL
			TOTAL AMOUNT OF ORDER	
			5% SALES TAX Calif. Residents	
			TOTAL	

4A **Check how you want order shipped.**

☐ SURFACE FREIGHT, BEST WAY
(Swan pays shipping charges, except on C.O.D.)

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(Customer pays charges)

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All prices and specifications subject to change without notice.

A Single Boom G4ZU Beam

BY ARTHUR S. GILLESPIE, JR.,* W4VON

ABOUT a decade and a half ago Captain G.A. Bird, G4ZU, published several articles[1] describing an efficient, easily constructed triband minibeam that involved no traps or loading coils. This antenna was extremely popular – particularly with the European hams who were more inclined to build their own gear. The antenna was marketed commerically as the "Panda Minibeam." At W4VON we have experimented with several versions of the G4ZU beam for nearly a dozen years. In this present article we summarize published G4ZU beam technology and describe a mechanically rugged single-boom version of the antenna.

Electrical Principle

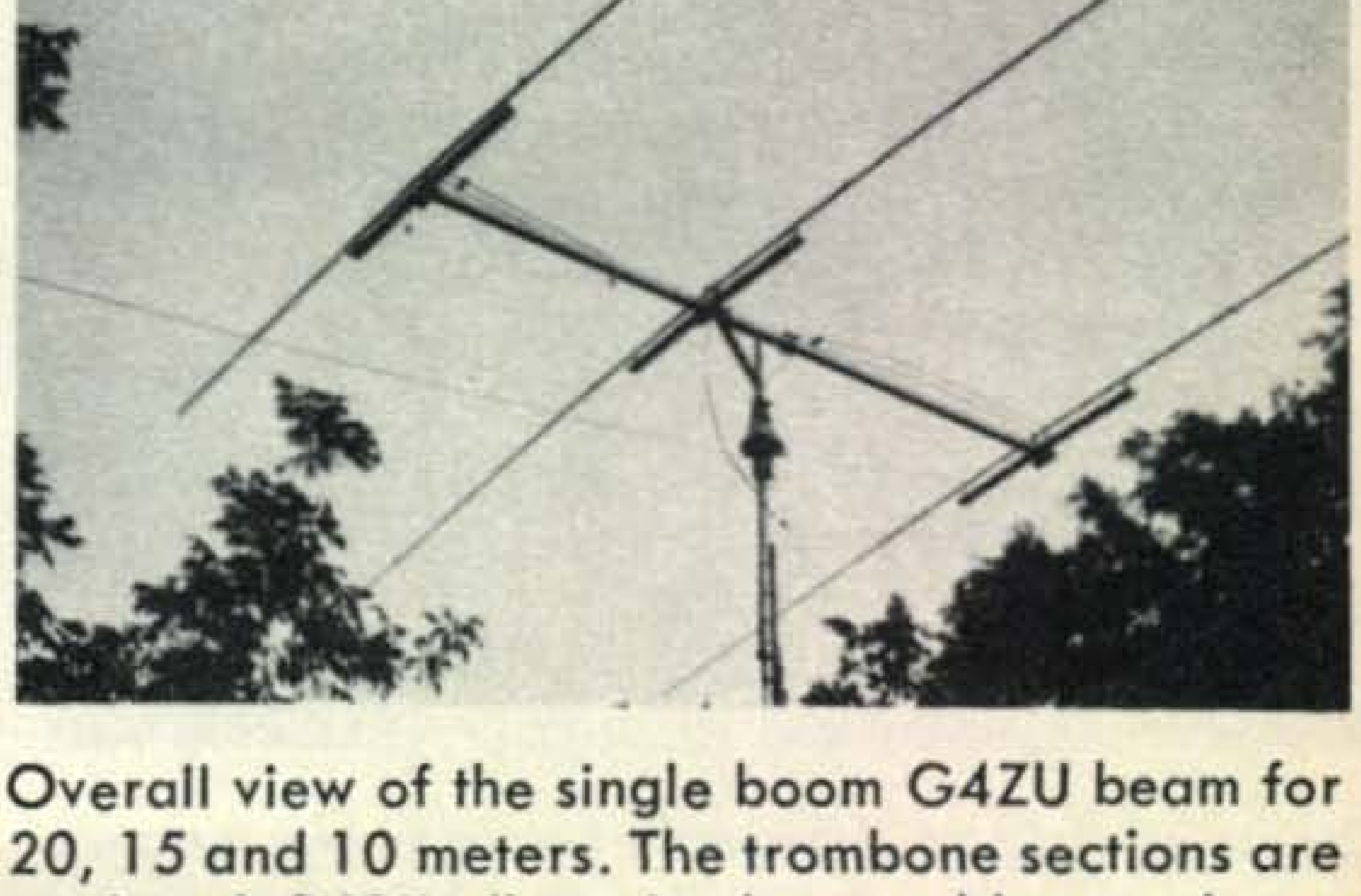
The G4ZU beam is in effect a three element beam on 15 meters, a short 2 element beam on 20 meters and something approximately equivalent to a five element beam on ten meters. The antenna employs an ingeneous combination of shorting stubs and "trombone tuning elements" to permit the director and reflector each to resonate on two separate bands. The earliest versions of the G4ZU beam employed coil loading and stub shorting components to accomplish this. The driven element is a center fed resonant antenna that is made resonant on the three bands by proper choice of open line feeders and "transmatch" components. In the present design the two boom trombone system is replaced by a single boom plus separate "trombone" sections made from lengths of 3/8" diameter aluminum tubing connected together by metal sliders.

Consider first the director. This element consists of a split dipole of an electrical half wavelength for ten meters. A stub cut from 5'6" of 72 ohm twin lead is connected across the dipole split and serves as an electrical short at 10 meters. On other frequencies this stub acts as a small capacitance across the split in the dipole. This same director is made to resonate simultaneously as a shorted 15 meter element by adjustment of the trombone section. The 15 meter resonating director element consists of the two dipole halves plus the trombone section. The 10 meter shorting stub on 15 meters merely acts as a small capacitance that is included in the overall 15 meter resonance.

Similiarly, the reflector is resonant on 15 meters as a half wave element closed by the 15 meter quarter wave stub and as a shortened 20 meter element consisting of the two dipole half elements plus the 20 meter trombone.

The driven element is a resonant antenna which incorporates the lengths of the driven element, the feed line and the capacitive and inductive components of a transmatch as a part of the resonating circuit. A great deal has been written about the matching network and more will follow here. Since it is a resonant antenna, the driven element may, in principle, be of any length. By making the element 24 feet long, or 3/4 wavelength on 10 meters the radiating element becomes a collinear array on this band. This provides additional 10 meter gain equivalent to that expected from an additional one or two elements.

In the original G4ZU beams the two



Overall view of the single boom G4ZU beam for 20, 15 and 10 meters. The trombone sections are made of 3/8" dia. aluminum tubing and are visible above the 2" square boom.

*618 Hillcrest Ave., Gastonia, N.C. 28952.

[1]Articles by G4ZU have appeared in: *RSGB Bulletin,* Feb. '56; *Amateur Radio* (Wireless Institute of Australia), Sept. '56; *Break-In,* New Zealand Amateur Radio Transmitting Society, Aug. '56; *Malayan Amateur Radio Magazine,* March, Apr., May, June, Sept., Oct. '56; *RSGB Bulletin,* Dec. '56; *CQ,* March '57, p. 20; *CQ,* July '58, p. 52; *CQ,* Aug. '58, p. 28.

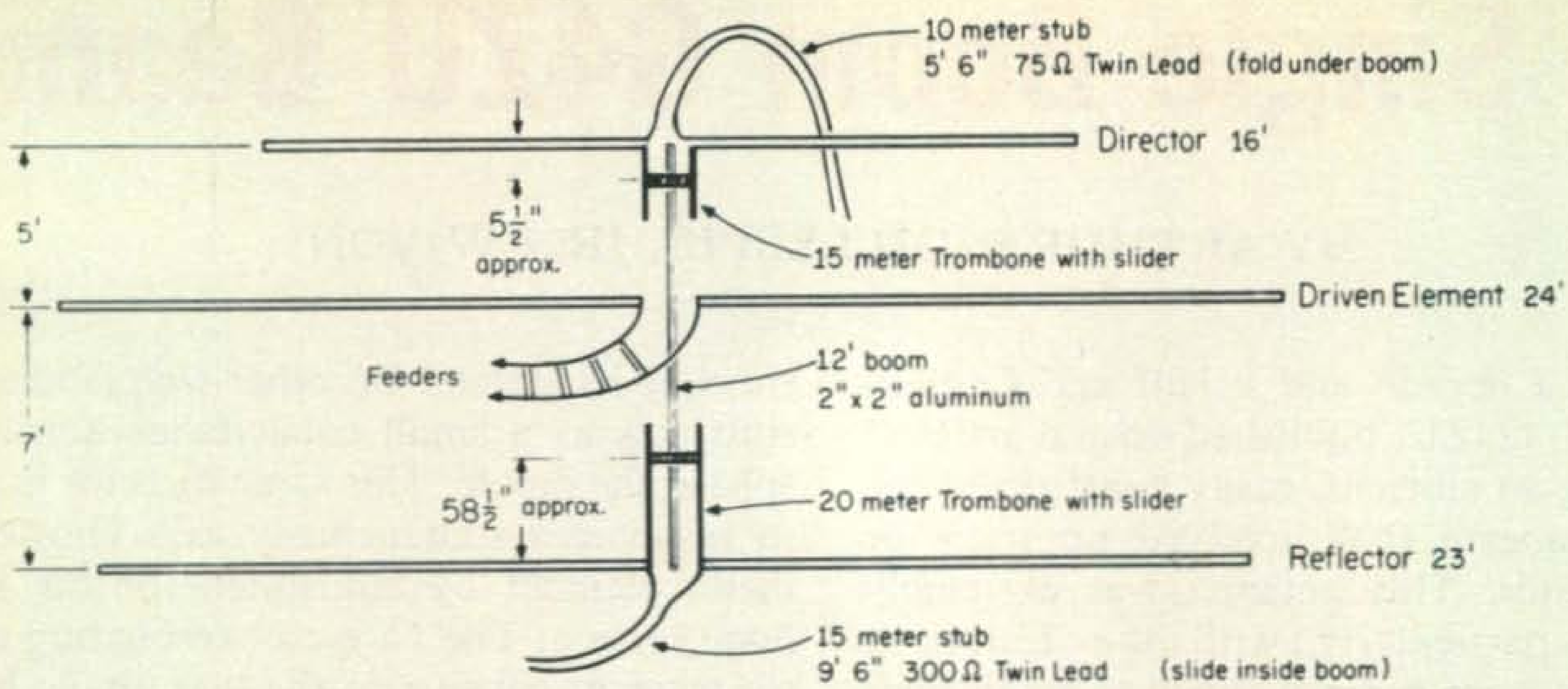


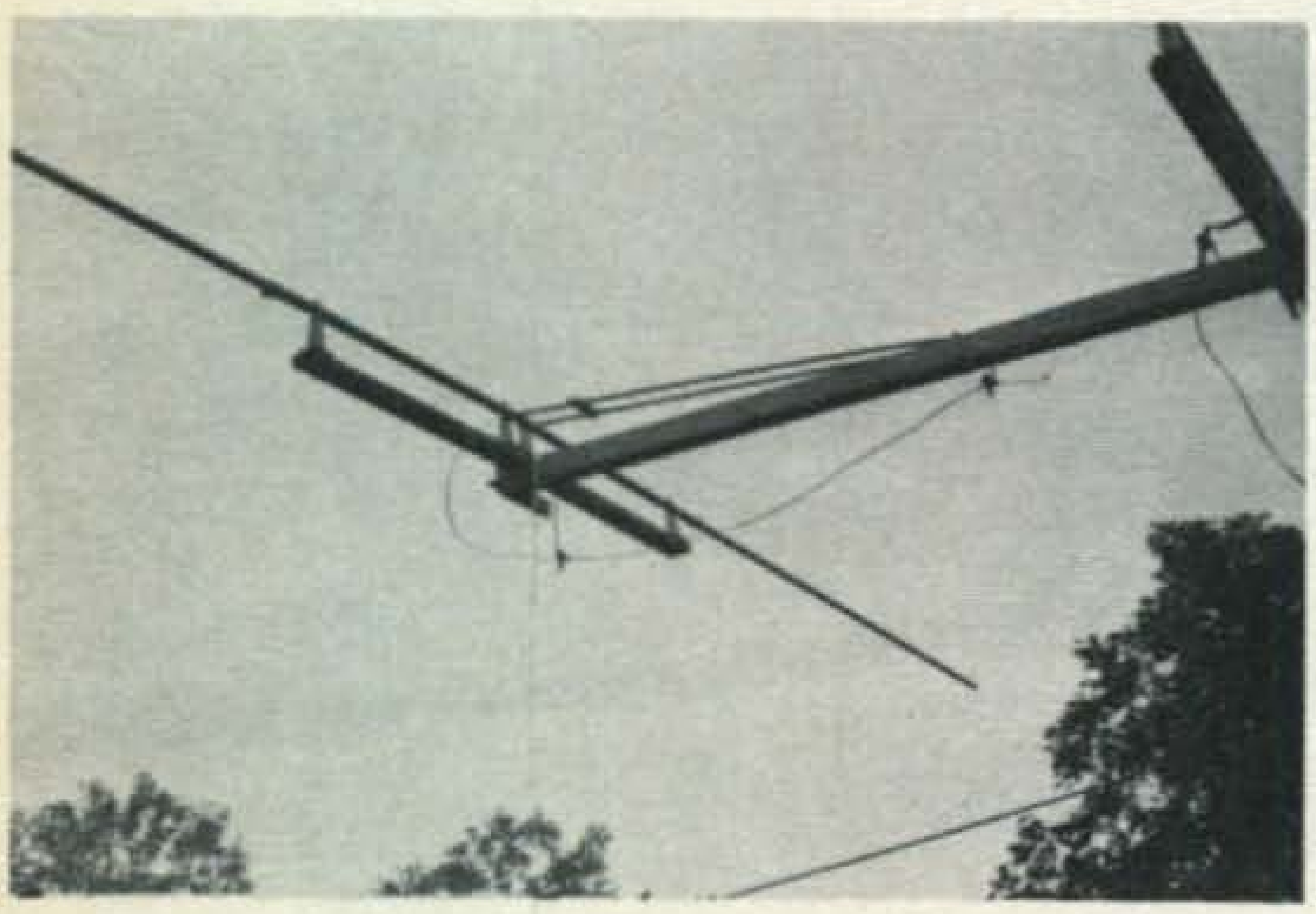
Fig. 1—The single boom G4ZU Beam for 10, 15 and 20 meters. The 10-meter stub is bent back and under the boom and supported on twin-lead stand-offs. The 15-meter stub is pushed inside the boom as described in the text.

quarter-wave shorting stubs were neatly stuffed into the two booms. Corks were used to center them in the metal tubing.

Single Boom Construction

The antenna design is shown in fig. 1. A 2" × 2" square boom was used. A round boom with appropriate fittings should be equally serviceable. The longer (15 meter) shorting stub is tucked into the boom using corks or sponge rubber balls to keep it away from the metal walls. The 10 meter stub is looped over the front of the beam and supported under it by means of TV twin line stand-off insulators.

The beam elements are constructed from 6061 aluminum alloy tubing. The center sections are made from 1" diameter, .035" wall tubing and the tips are made from 7/8" diameter .035 wall tubing. These sizes slide together nicely. Radiator hose clamps are used to tighten the elements after adjustment.


Close-up view of the single boom G4ZU beam's director showing details of the 15-meter trombone and 10-meter stub.

The elements are supported on standoff insulators mounted on dried, knotless pine wood supports. The wood sections are painted before assembly.

The trombone elements consist of lengths of 3/8" diameter aluminum tubing with a sliding member consisting of two strips of hard drawn aluminum and bolted in the center. The lower ends of the trombones are grounded to the booms.

All hardware should be made of stainless steel or heavily cadmium plated steel. Non-plated steel hardware rusts very rapidly and brass hardware in contact with the aluminum sets up galvanic cell action that causes the aluminum to corrode excessively.

Adjustments

First, the stubs should be cut and their quarter wave resonances checked before the beam is assembled. This may be done by temporarily shorting one end of the stub in such a manner as to form a single turn loop. Application of a grid dip meter should show a dip at 30.5 mc for the director and 20.5 mc for the reflector stub. After the reflector stub is inserted into the boom its resonance should be rechecked.

Trombone adjustments should be made with the antenna as high as possible off of the ground. Preferably they should be made with the antenna in final position. Alternatively, the antenna may be mounted on a 10 foot post or stepladder and adjustments made before elevation to final position is made.

The trombone resonances are adjusted by the insertion of the grid dip meter directly into the trombone while sliding adjustments are made.

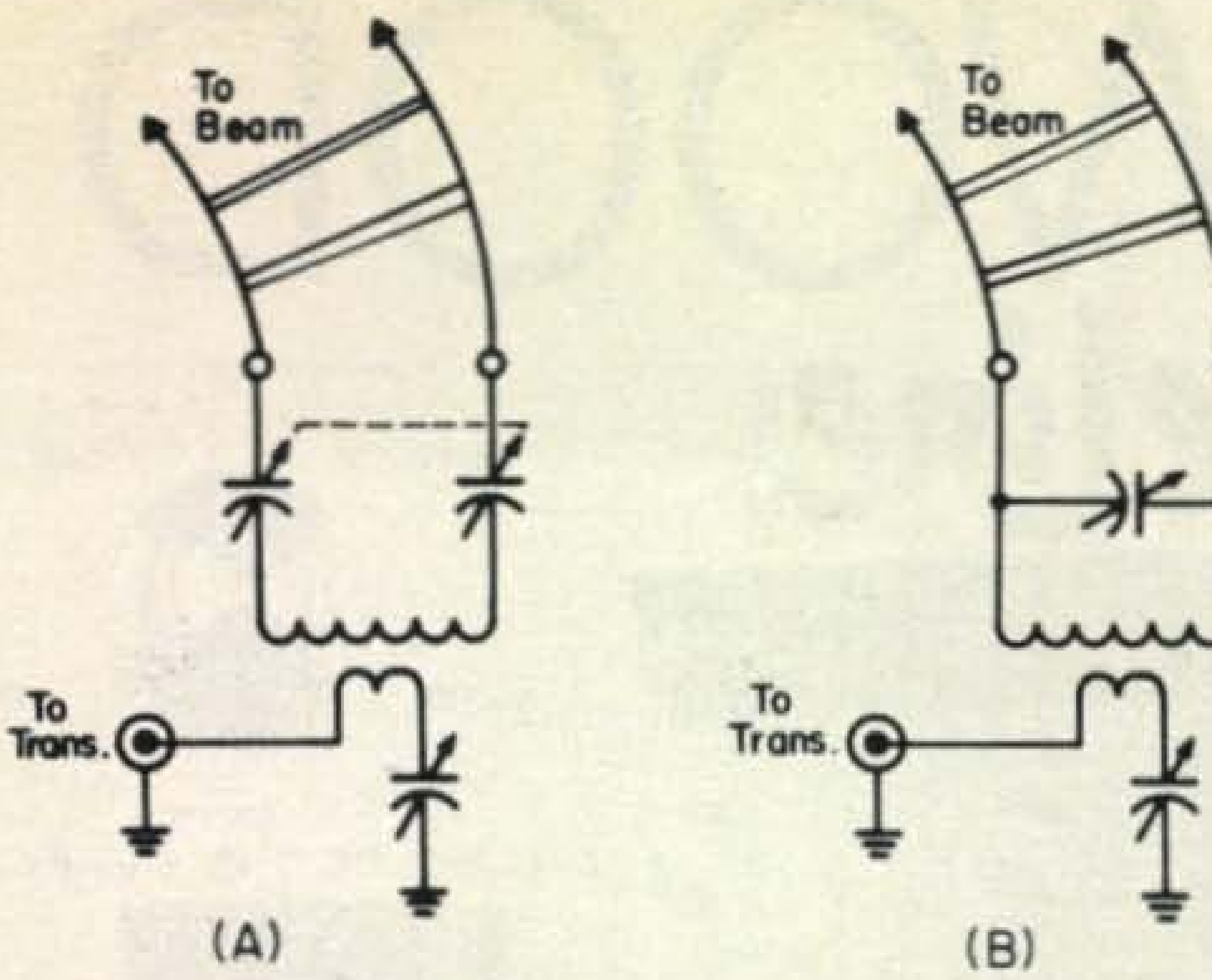


Fig. 2—Matching devices for feeding the G4ZU beam from a transmitter with coaxial output. (A) Series tuning. (B) Parallel tuning.

The director trombone should be set at 21.55 mc and the reflector at 13.4 mc. Grid dip meter calibration should be verified by tuning in the signal on a good communications receiver.

The purist will perhaps want to apply power (through an appropriate matching device) and make fine adjustments while observing a field strength meter situated several wavelengths in front of the beam. The advantage gained by this is probably not worth the extra effort.

Matching

Since this antenna is driven as a center fed resonant antenna, some type of matching device is required. The simplest and perhaps the most efficient system employs a suitable length of open wire feedline with an antenna tuner having capabilities for series or parallel tuning. Certain combinations of band frequency, feedline length, and transmatch components will require series tuning while other combinations will require parallel tuning. 450 ohm TV open wire line serves admirable for the feeders even at high powers. 300 ohm transmitting twin lead will serve as a good second choice. This matching system is shown in fig. 2A and 2B.

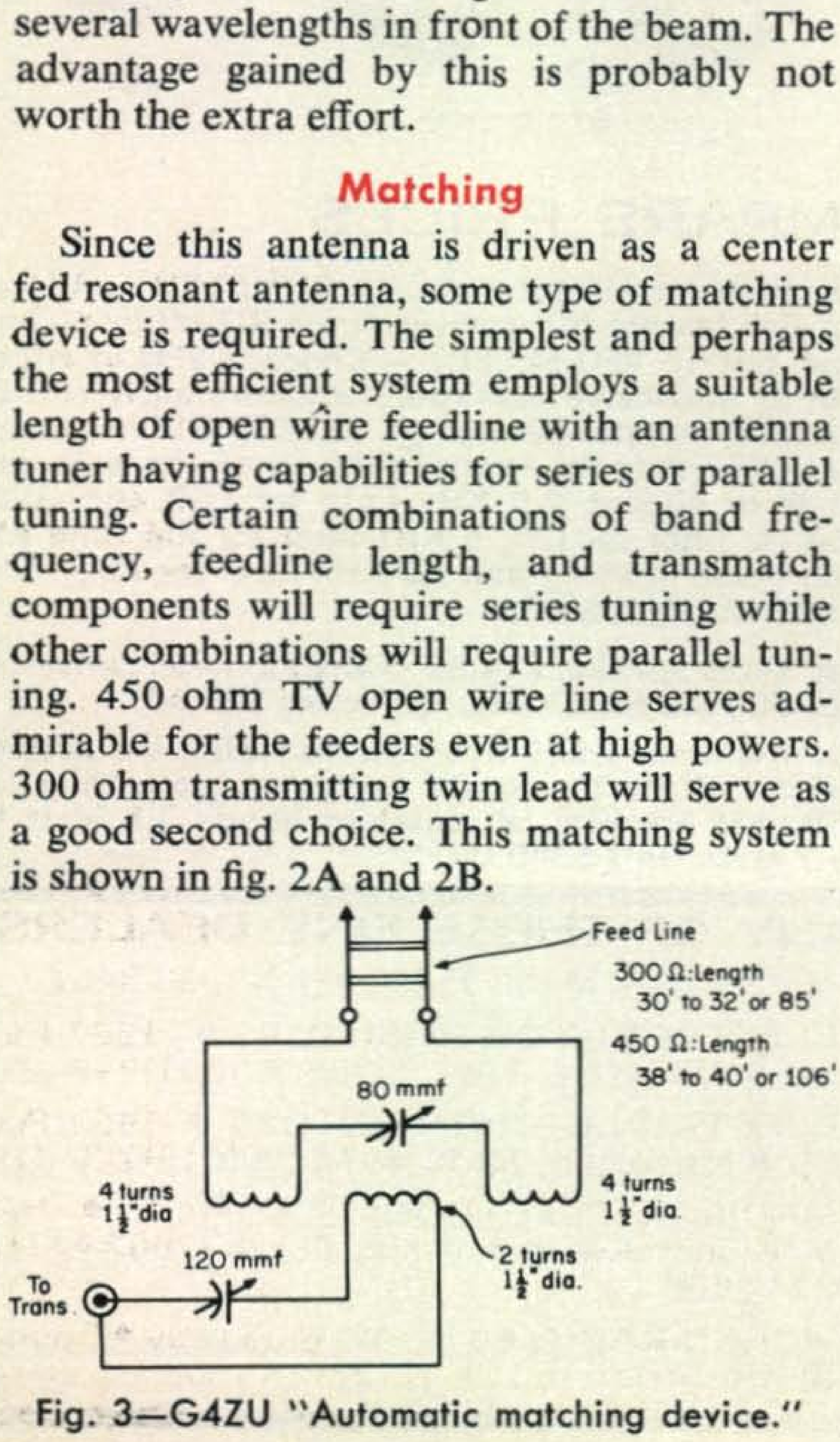


Fig. 3—G4ZU "Automatic matching device."

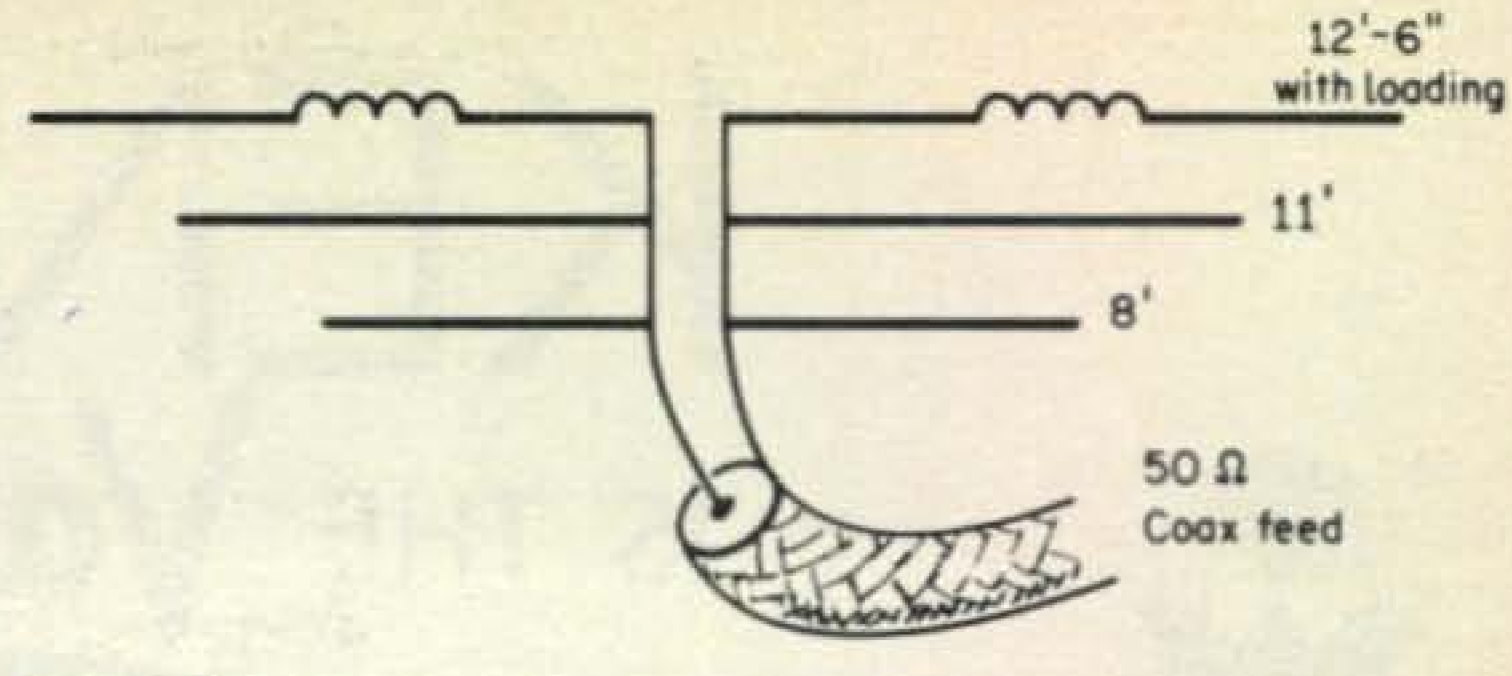


Fig. 4—As an alternative to feeding with open wire line, the G4ZU beam may be constructed with a parallel dipole driven element and fed with coax. A coaxial line balun should be used to ensure semetrical operation of each dipole half. To keep the 20 m. dipole small, series inductance loading is employed.

Captain Bird, G4ZU, included an "automatic transmatch" system in his original antenna development. This device included a fixed length of feedline and a proper choice of inductive and capacitive components in an easily constructed antenna tuner that could be adjusted so as to effect a resonant condition on all three bands. Once adjusted, the tuner required no further adjustment when going from band to band. This was admittedly a compromise system but a thoroughly practical one that has been used with wide success. If desired, this tuner may be located at the bottom of the tower and a random length of coax run into the station. This system is shown in fig. 3. In any of these tuner systems an s.w.r. bridge is placed in the coaxial line between the antenna tuner and transmitter, power applied and the tuner adjusted for maximum forward and minimum reflected power.

A still more interesting matching device was developed by Arthur Blave, ON4BX[2] in which no antenna tuner is employed. He determined theoretically and experimentally that if a feedline consisting of approximately 43 feet of open wire line is attached to the antenna, the end of this matching section will show an almost purely resistive component with an impedance of approximately 20-40 ohms depending on frequency. 50 ohm coax may be connected directly to the open line with good results.

For those who will not use open wire feeders at any cost, a system of parallel dipoles was suggested by G4ZU.[3]

Loading coils will be required on 20 meters to keep the driven element in practical

[*Continued on page 100*]

[2]"Feeder Matching System for the G4ZU Beam," Blave, ON4BX, *QST*, June 1959, p. 18.

[3]"More About the Minibeam," Bird, G4ZU, part II, *CQ*, Aug. 1958, p. 28.

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CQ Reviews: The Heathkit SB-303 Solid-State Receiver

BY WILFRED M. SCHERER,* W2AEF

IN these days of increasing use of solid-state circuitry it is not surprising to find one of the new products in the Heathkit amateur-equipment line to be an all solid-state receiver of advanced design: the SB-303 Amateur Band Receiver. It is the counterpart to the popular SB-300/301 vacuum-tube jobs, offering the added advantages gained by the use performance with reliable operation and long life, instant operation, low power consumption, high stability, elimination of high-heat generation with minimal component deterioration, etc.

Like its predecessors mentioned above, the SB-303 provides complete coverage of the 3.5-28 mc amateur bands with an identical linear tuning rate for each. Calibration is in 1 kc steps, furnishing an accurate frequency readout, a usual necessity these days. The receiver may be used for s.s.b. (l.s.b. or u.s.b.) and RTTY with a 2.1 kc filter, for c.w. with a 400 c.p.s. filter optional accessory) and for a.m. with a 3.75 kc filter (also optional). Preselector tuning of the front end is provided. A.g.c., which has a wide dynamic range, may be disabled or employed with fast or slow time constants. A crystal calibrator furnishes signals at 100 or 25 kc intervals. The antenna input may be panel switched to accessory jacks for use with two different external v.h.f. converters. For converter use, power is applied at the same time to an accessory socket for solid-state converters.

*Technical Director, *CQ*.

Besides the usual r.f. and a.f. gain controls, there also is an r.f.-input attenuator for minimizing adverse effects under severe signal-input conditions. A transistorized regulated power supply is incorporated and operation of the set may be from a 120 or 240 v.a.c. source.

Oscillator outputs make it possible to simultaneously control the frequency of a separate transmitter using the same conversion scheme such as the Heath SB-400/401, thus providing transceiver-type operation. A special feature for transceive work is that complete circuitry is incorporated at the receiver v.f.o. (LMO) for shifting the transmitter frequency as needed for transmission in the RTTY or FSK mode with future Heathkit equipment or other gear designed for such work.

Excellent design, operating and performance features, however, are not the only assets of the SB-303. Its unique type of construction not only makes assembly easy using modular printed-circuit boards, but they also are set up to make servicing easy through the use of "extender" boards that allow the individual boards to be slid out of the chassis

The Heath SB-303 Solid-State Receiver.

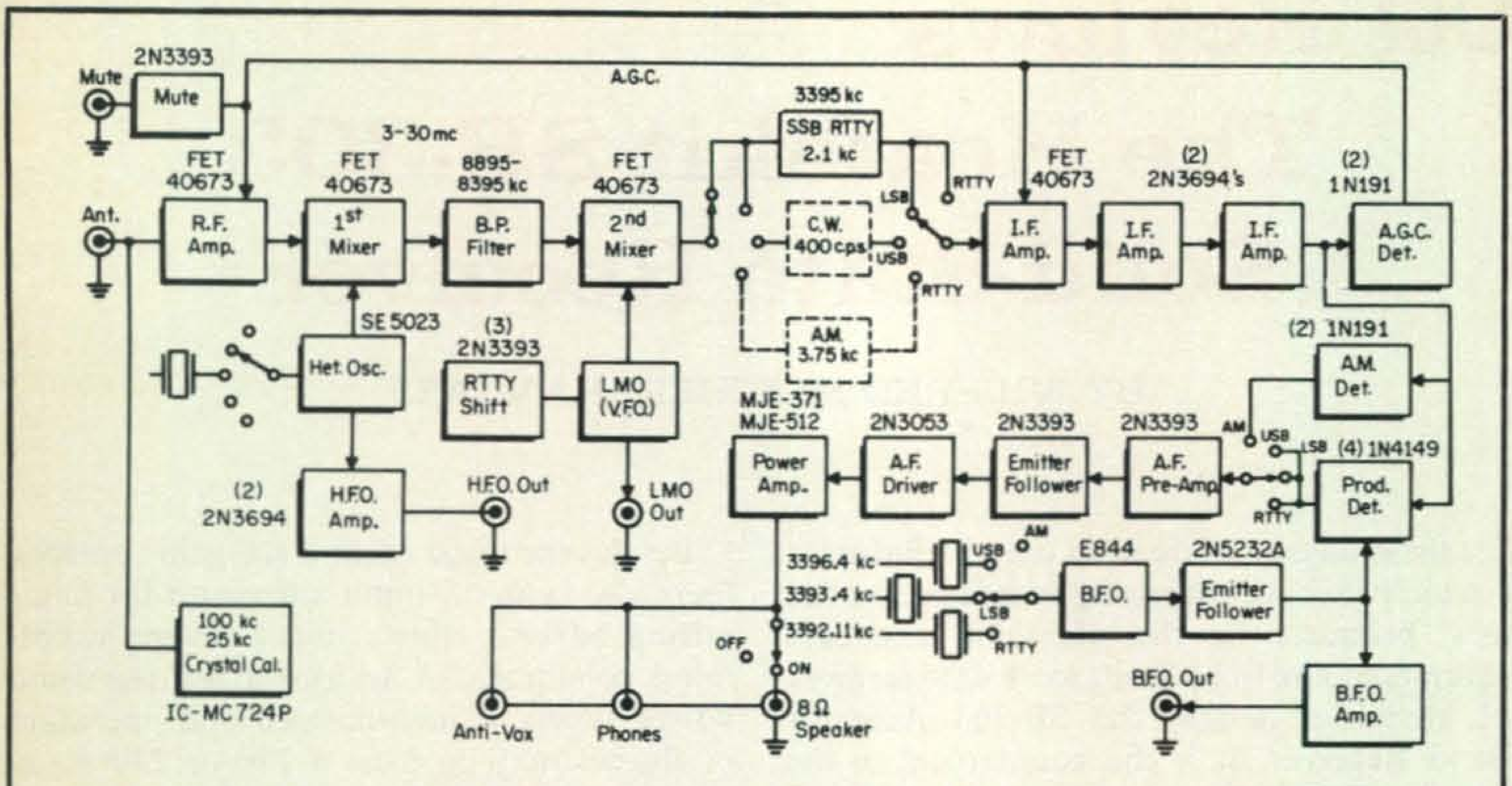


Fig. 1—Block diagram for the SB-303. Heterodyning-crystal frequencies are 8895 kc plus the frequency at the low end of the related range. Other details are in text.

while remaining operational for in-service checking. More on this later.

Technical Details

The success of the SB-303 is largely due to the employment of four dual-gate MOSFET's which provide performance superior to bipolar transistors and often better than that of vacuum tubes. In addition, there are 24 silicon transistors, an integrated circuit, and 13 diodes.

Referring to fig. 1, the time-proven dual-conversion scheme and basic lineup, used in the other SB-series of gear employs a crystal-controlled local oscillator at the first mixer for conversion to a 8895-8395 kc 1st i.f. and a linear master oscillator (LMO or v.f.o.) for the 2nd conversion to 3395 kc where the desired selectivity is obtained by crystal lattice filters switched in for the desired bandpass.

An RCA 40673 dual-gate MOSFET is used in the r.f. stage, 1st and 2nd mixers and the 1st i.f. High-Q slug-tuned inductors are used at the input and output of the r.f. stage with tuning handled by a ganged variable capacitor. Low-impedance (50-ohm) primaries are used at the individual input inductors for the 3.5-14 mc bands. On 21 and 28 mc the antenna is tapped at the low-impedance point on the related inductors.

An 8895 kc series-tuned trap across the 7 mc input minimizes external-signal feedthrough in the 1st i.f. range. The r.f.-input attenuator is a 600-ohm potentiometer. A.g.c. is fed to gate 2 of the r.f. stage and the input signal to gate 1 through a resistor/inductor parasitic suppressor. Output from the MOSFET drain is capacitively-coupled to gate 1 of the mixer, while the heterodyning oscillator goes to gate 2. Output from the mixer drain goes through a 8895-8395 kc bandpass filter to gate 1 of the 2nd mixer. This filter rejects the sum frequencies produced in the mixer, allowing only the difference frequencies in the desired range to pass. The LMO (v.f.o.) feeds gate 2.

A tapped tuned circuit at the output from the mixer drain provides a 2000-ohm impedance match to the 3395 kc filters that follow. Each filter is selected automatically as needed to give a 2.1 kc bandpass for RTTY, l.s.b. or u.s.b.; a 400 c.p.s. bandpass for c.w. and a 3.75 kc width for a.m. As already mentioned, however, the set is supplied with only the 2.1 kc filter. The others are optional accessories.

The signal applied to the 1st i.f. goes to gate 1 of the MOSFET with a.g.c. applied to gate 2. Bipolar transistors are used for the 2nd and 3rd i.f. using a grounded-emitter configuration. A.g.c. is not required at these stages due to the wide a.g.c. range of the MOSFET's.

The product detector is comprised of four diodes in a shunt ring-type demodulator. The a.m. envelope detector consists of two diodes in a voltage-doubling setup. A similar arrangement is engaged for the a.g.c. detector with a somewhat conventional setup provid-

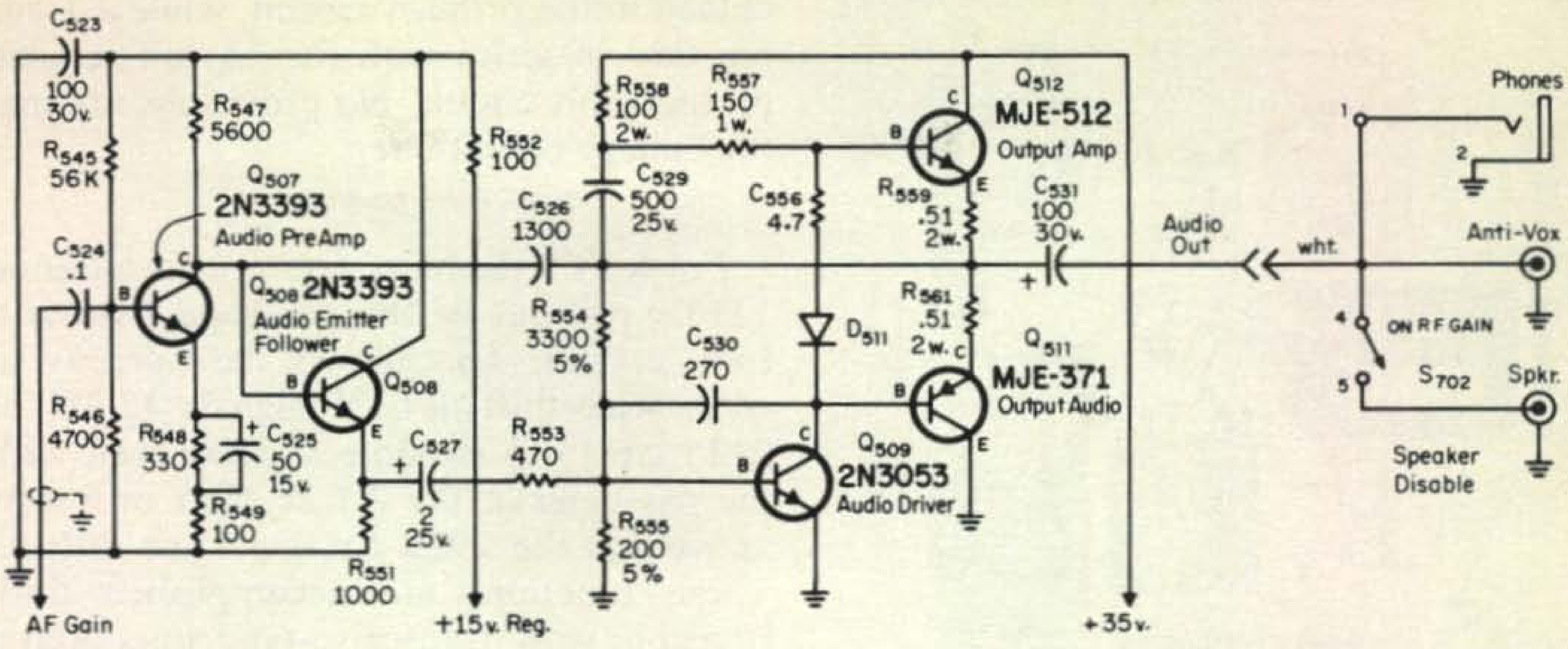


Fig. 2—Circuit for a.f. amplifier used in the SB-303. Q_{511}-Q_{512} comprise a push-pull complimentary output amplifier. R_{554} and C_{526} provide negative feedback to the base of Q_{509} and Q_{508} respectively. C_{529} is the bootstrap capacitor described in the text. D_{511} is installed on the same heat sink with Q_{511}-Q_{512}. The voltage drop across the diode then varies with the heat-sink temperature, thus compensating for changes in the operating point of Q_{511}-Q_{512}.

ing fast attack and a choice of fast- or slow-release times. The latter is obtained by a capacitor-resistor combination. A steering diode also is included in the a.g.c. line, to ensure a fast attack.

Muting is accomplished through a voltage drop at the collector of a muting transistor when the mute line is opened, causing an increase in collector current. This results in a negative voltage applied to the a.g.c. line, cutting off the r.f. and i.f. MOSFET's. At the same time the voltage on the mute line is positive and is applied to the base of the 3rd i.f. transistor. This causes the transistor to saturate to the point where there is no gain.

The a.f. chain consists of bipolar transistors. The output stage employs an NPN and a PNP type in a complimentary circuit with output obtained directly from the common return for the emitters. Negative feedback is applied to the base of the driver and emitter follower. Distortion is further minimized by an additional "bootstrap" capacitor providing a measure of feedback that regulates the supply voltage at high a.f. levels.

The S-meter setup utilizes two transistors with the change in source voltage of one of the a.g.c.-controlled MOSFET's applied to the base of one transistor, that of the other controlled MOSFET to the base of the other transistor. The collectors are connected in parallel with the meter connected in the circuit for reflecting the changes in the collector currents. Controls are provided for setting the meter zero and the maximum deflection. With readings above half-scale a diode, shunted across the meter, comes into play to provide linear db readings at the upper portion.

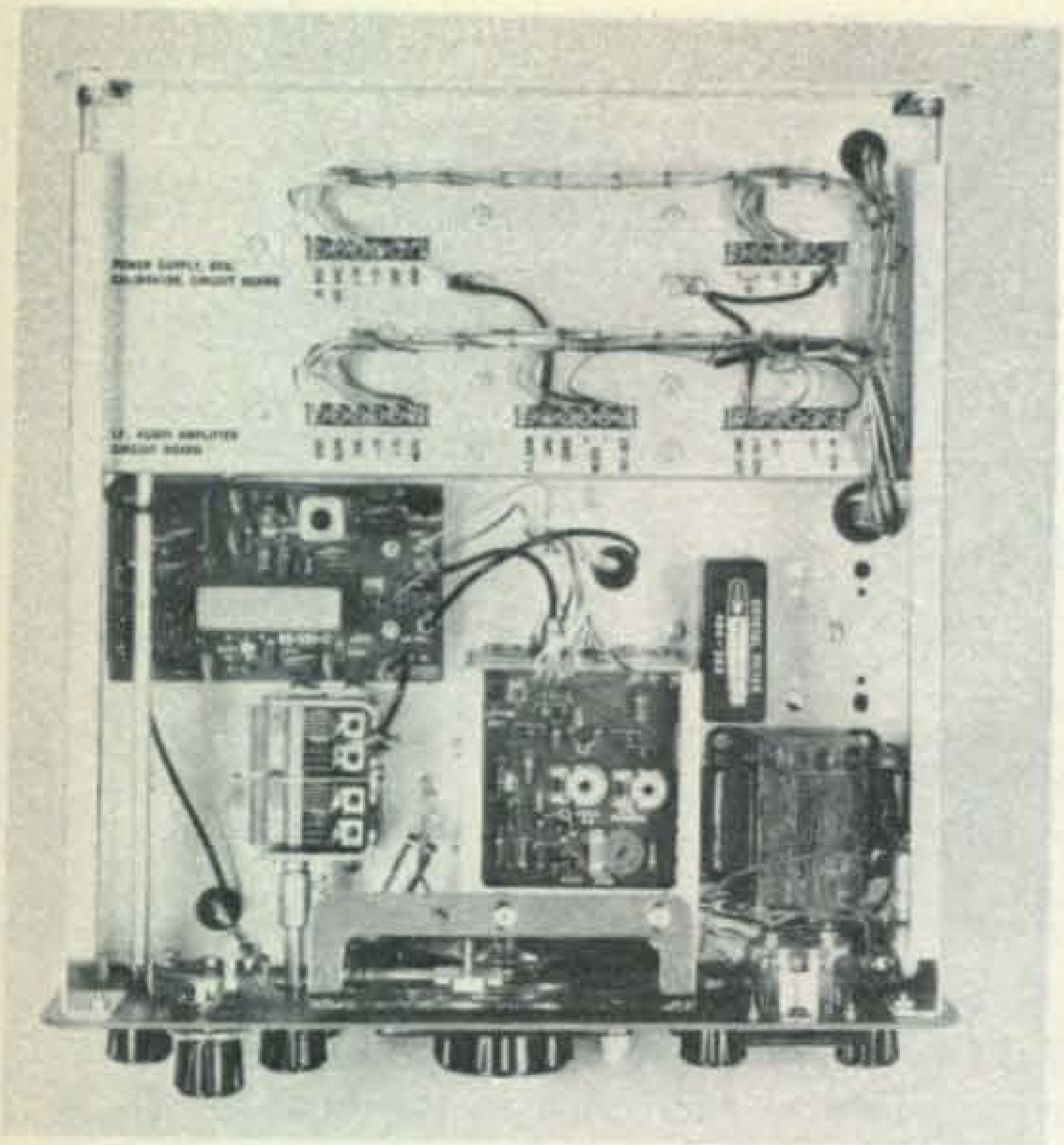
Oscillators

The heterodyning oscillator (HFO) functions as a tuned-collector, tuned-base oscillator with the base circuit controlled by the crystal. A handy feature here is the inclusion of an r.f. detector for use during alignment. This makes it possible to use a d.c. meter instead of an r.f. probe. The oscillator is capacity-coupled to gate 2 of the 1st mixer.

There also is an h.f.o. amplifier using two cascaded emitter-follower stages that present a high impedance to an output jack for transceive operation with the Heathkit SB-400/401 transmitter.

The v.f.o. is supplied completely assembled and is linearly aligned in a sealed package containing a capacity-tuned silicon-transistor oscillator and a transistor bandpass amplifier. In order to avoid retuning when sidebands are changed, a diode switch connects or disconnects a compensating inductor as needed for the particular sideband. A separate adjustment for this inductor is provided for obtaining exact compensation. Output from the v.f.o. is available at a rear jack.

The b.f.o. operates in an untuned Pierce-type circuit. U.s.b. and l.s.b. crystals are switched from one side of the filter response to the other as needed for each case. This mode switch simultaneously compensates the frequency of the v.f.o. as explained above.



Top view of the SB-303. The RTTY-shift board is on top of the LMO at right foreground. The 2.1 kc filter is at its right with space left for the two optional filters. The harness at the rear is connected to terminals of the pins for the two large rear boards. The mixer board is at left center.

The oscillator signal is fed to the product detector from an emitter follower which also drives an amplifier to provide a good b.f.o. signal at an output connector for transceive work.

Crystal Calibrator

The calibrator is an integrated circuit which starts off with an astable multivibrator locked by a 100 kc crystal. The output from this section of the IC goes to an amplifier for increasing the level of the signals at the 100 kc intervals injected at the antenna input. Another section of the IC is connected as a monostable multivibrator that divides the 100 kc signals by four to produce signals at 25 kc intervals through a separate amplifier. The function switch selects either type signal by turning the 100 kc section on and the 25 kc one on or off.

Power Supply

The power supply employs two separate full-wave rectifier setups across the secondary winding of the power transformer. One rectifier supplies +35 volts, the other −10 volts regulated by a zener diode. A regulated potential of +15 volts is derived from the 35-volt line through a transistor series regulator and is used for all stages except the a.f. output which requires 35 volts. Dual primary windings permit operation from a 120 or 240 v.a.c. source. A 0.7 a. circuit breaker is included in the primary circuit, while a 1-ampere fuse in series with the 15-volt regulator protects this circuit. No provisions are made for battery operation.

RTTY

For RTTY the b.f.o. crystal is an additional 1490 c.p.s. out of the passband than is the l.s.b. crystal. This allows the narrow- and wide wide-shift RTTY signals (2805 and 2125 c.p.s.) to straddle and fall well within the passband of the 2.1 kc filter on receive, as well as the 2925 c.p.s. narrow-shift c.w. These functions are accomplished during transmit with transceive-type operation by three different transistors. When the base circuit of any one of these is keyed, the collector voltage decreases. This appears at the FSK terminal of the v.f.o. through which the oscillator frequency is shifted by a variable-capacitance by an amount depending on the setting for which the wide- narrow- or c.w.-shift controls have been set for the related transistor.

Construction

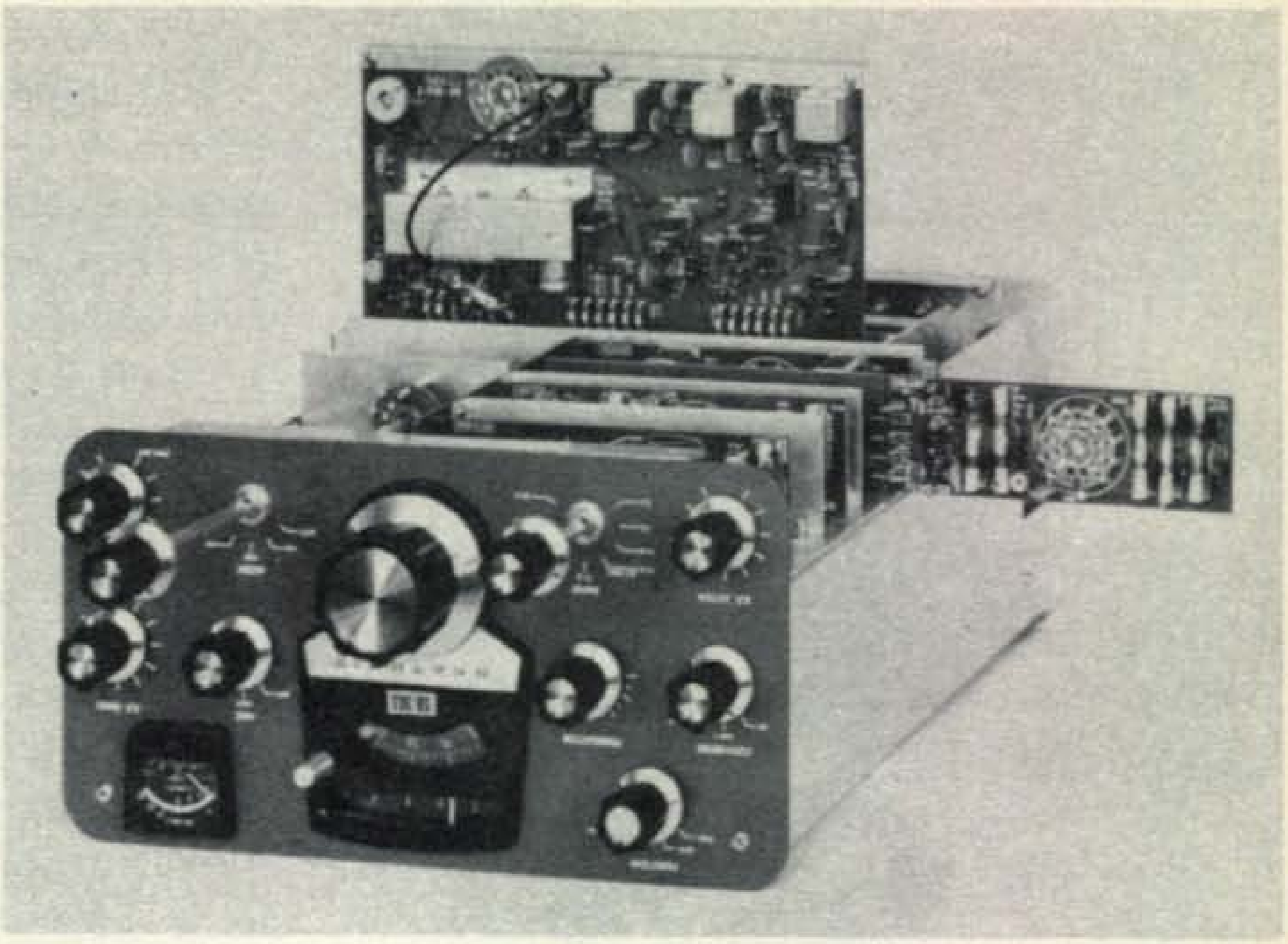
The novel manner in which the SB-303 is put together can best be seen from the accompanying photos; however, special notes of interest are as follows:

A modular setup is employed using plug-in printed-circuit boards for various individual sections Four of these are called "switchboards". One contains the antenna-input circuits, another the r.f. amplifier and its output circuit, another has the heterodyning oscillator, while the forth is for the heterodyning crystals. As shown in the photos, these are installed vertically below the chassis along one side where they slide into supporting tracks with power connections engaging pin-type connectors at the inner edge of each board. A long bandswitch shaft passes through the movable section of the switch wafer on each board.

When the switch shaft is removed, any one of the switchboards may be slid out and attached to an "extender" board installed in its place. This bridges each power connection to the switchboard, thus allowing in-service checks of voltage and resistance on the related switchboard, the various components and circuit points of which are now readily accessible. The particular board, however, is not operational from an r.f. standpoint.

Also vertically mounted below the chassis and at the rear are two large boards, one with

One of the r.f. switchboards on the SB-303 shown at the right attached to an extender board for facilitating servicing. At the top is the i.f./b.f.o. board similarly installed on its extender board.[4] The shafts for the mode switch and bandswitch are pulled out to free the boards. See text for details.



the i.f. and a.f. section, the other with the power supply and b.f.o. These also slide on tracks and engage power-connecting pins. A large extender board also is provided here to facilitate servicing of these boards which then remain fully operational in all respects.[1]

The two mixers are installed on a board at the top of the chassis. This board, too, could be lifted up for service checking of voltages and resistance by removing its mounting nuts, inasmuch as the wire power leads have sufficient slack; however, a small clip lead would be required for a connection between the ground foil on the board and the chassis.

Coax cables equipped with phono plugs are used for the r.f. connections between the various boards, thus making it easily possible to localize trouble to a specifie section by applying test signals at the related jacks.

Power connections for the two large boards are made at the harness connections for the circuit-board pin terminals at the top of the chassis. These points are identified at the terminals. The terminals for the switchboard power pins also are easily accessible and identified at the rear of the board that supports the releated pins for switchboards.

The rear panel has an octal accessory socket for use with v.h.f. converters or RTTY, the circuit-breaker reset button, a 3-pin a.c. connector into which a 3-wire detachable a.c. line cord may be plugged a phone jack, plus phono jacks for the following: H.F. ANT.; VHF ANT. 1; VHF ANT. 2; HFO OUT; LMO OUT; BFO OUT; MUTE; ANTI-VOX; C.W. SHIFT; 4 SPARES; SPEAKER (8Ω). The latter can be disengaged when the r.f.-gain control knob is pulled out.

The dial mechanism, which covers a 500 kc incremental range with 1 kc calibrations on the vernier dial, is the same as that used in the other Heath SB Line, as is the styling. The size of the set is the same, except for about a 3-inch narrower width (6⅝" × 12¼" × 13" —H.W.D.) and it weight 15¾ lbs.

Assembly

Due to the type of construction, assembly is easily completed with about 30 hours required to do the job, including initial tests and alignment. Instructions should be carefully carried out if later trouble shooting is to be avoided. In this respect, make certain that the two a.f.-output transistors are installed at the proper position on the heat sink (page 39, detail 8-9A); otherwise their polarity will be reversed with possible damage resulting. These items are supplied in the same package and look the same, but each has a different identifying number on it.

The phono plugs for the cables fit so tightly on the jacks, that considerable force is needed to get them started on the jacks, thus being a potential cause of damage to the boards. If needed to avoid this, we suggest that the wings of the ground shell for each plug be slightly spread to provide an easy start at the jacks.

Performance

Measurements on our SB-303 produced the following results (figures in parenthesis are Heathkit's ratings where given; series of five

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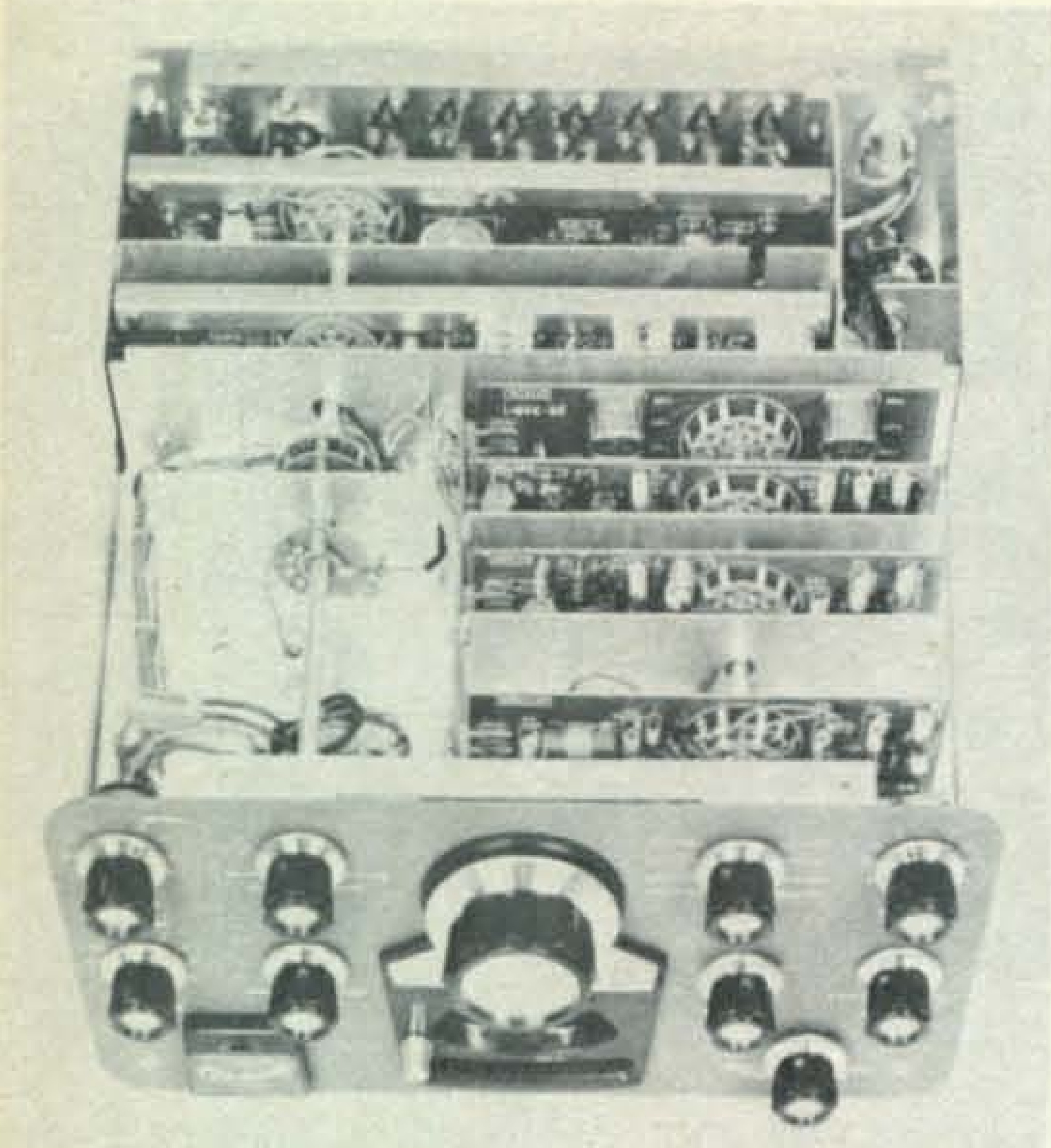
[1]When the power-supply/b.f.o. board is to be installed on the extender, the block with the center set of pins must be slipped off the extender to prevent the pins from interfering with the 50-ohm, 5-watt resistor on the circuit board.



Bottom view of the SB-303. The four r.f. switch-boards are at the right. The i.f./a.f. and power-supply/b.f.o. boards are at the rear. The long shaft at the left is for the mode switch.

figures are for 3.5, 7, 14, 21 and 28 mc bands respectively): SENSITIVITY—0.14 μv (0.25) or less for 10 db S+N/N with s.s.b., c.w. and RTTY on all bands; OVERALL GAIN—1 μv (1.5) r.f. input for 0.5 watts a.f. output; BAND-TO-BAND GAIN— −1, +9, 0, −2, −3 (zero is the reference at 14 mc); IMAGE REJECTION (60 db min.)—100, 100, 68, 65, 67 db; I.F. SIGNAL REJECTION AT 8595 KC (50 db min.) −84, 68, 75, 76, 74 db, at 3395 kc (55 db Min.)—96 db on 3.5 mc, 100 db on other bands; INTERNAL TWEETS (less than 1 μv equivalent)—within rating and found only at 3735, 15375 and 21200 kc; CROSS-OVER BIRDIES—50 db down; UNWANTED SIDEBAND SUPPRESSION—60 db at 1 kc; A.G.C. CHARACTERISTIC (dynamic range of at least 150 db)—A.F. output change on all bands averaged 7 db with 100 db r.f. input change (1-100,000 μv)[2], 5 db with 80 db r.f. input change (10-100,000 μv), Slow-release time of approx. 1 sec. from S-9 signal; A.G.C. THRESHOLD—approx. 0.35 μv all bands, except 7 mc 0.1 μv; S-METER—S-9 reading with r.f. input of 18, 10, 13, 20, 25 μv, 1 μv signal reads average of S-3, except S-5 on 7 mc; BLOCKING (at greater than 3 v. input)—none at 100,000 μv[3]; R.F. INTERMODULATION—(This characteristic is indicative of the other potential signal-handling abilities and is the one most commonly experienced with receivers. It is often mistaken for cross modulation)—3rd-Order I.M.—5 db better than the SB-300/301 vacuum-tube jobs[4], but not as good as the receiver in the HW-100 which is one of the best we've measured in this respect.

CALIBRATION LINEARITY (within 400 c.p.s. with calibration at nearest 100 or 25 kc point)—within 200 c.p.s. when calibrated at nearest 25 kc point, within 0.5 kc at any point and within 200 c.p.s. at the 100 kc points when calibrated at either end of range; Frequency stability (less than 100 c.p.s. drift per hour after 10-minute warmup)—10-minute warmup drift of 30 c.p.s., drift after 1st hour from warmup 100 c.p.s., drift after next hour 100 c.p.s.; then 35 c.p.s. or less per hour thereafter (averaged of several runs), with ±10% line-voltage variation (less than 100 c.p.s. change)—of ±2 c.p.s., stability solid as a rock under mechanical vibration.

Operationally the SB-303 handles very well with exceptionally pleasant and clean a.f. quality on s.s.b. signals. A maximum output of 4 watts may be obtained within 10% distortion. The nice quality is enhanced by the fine action of the slow a.g.c.

Without the optional filters, c.w. must be received using the s.s.b. mode. The RTTY position also may be engaged, in which case the selectivity will appear greater with peaking at 1.5-2.5 kc. A.m. signals may be copied by tuning to zero beat with the carrier.[5]

[*Continued on page 94*]

[2]Rejection and unwanted-sideband figures are inherent properties of the receiver. With the a.g.c. on, these effects may appear poorer at the a.f. output in relation to desired signals due to a.g.c. action on the latter. Where needed, they can be minimized by bringing the r.f. gain or r.f. attenuator into play.

[3]Limitation imposed by maximum available r.f. output from signal generator used.

[4]Where such effects are determined present, they may be avoided or minimized by adjusting the r.f. attenuator accordingly. For example: a 10 db improvement in I.M. may be obtained by increasing the r.f.-input attenuation for a sensitivity of only 1 μv or so which is adequate for most applications. Intelligent use of the attenuator or r.f. gain also may be helpful in reducing desensitization or a.g.c. pumping of a desired signal by an undesired adjacent-channel signal.

[5]Where only the 2.1 kc filter is installed, a.m. signals could be received in the normal manner using this filter and the a.m. envelope detector by connecting terminals 4 and 5 to terminal 3 of mode-switch section MS-2R and by removing the ground connection from terminal 11. This section of the switch normally grounds the output of the unused filters to prevent responses outside of the desired passband; hence the need for lifting the ground connection when only the 2.1 kc filter is installed and connected as above.

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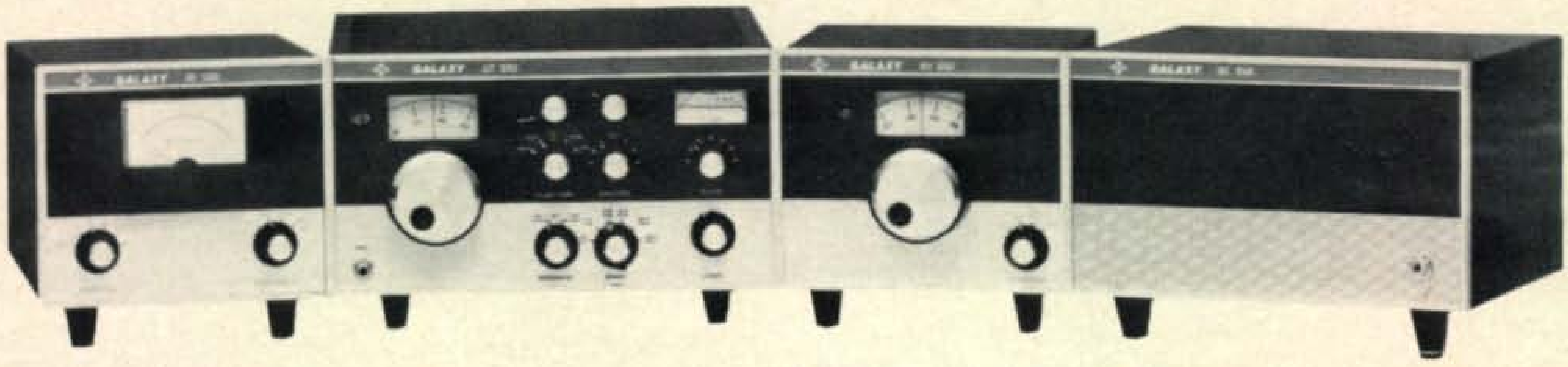

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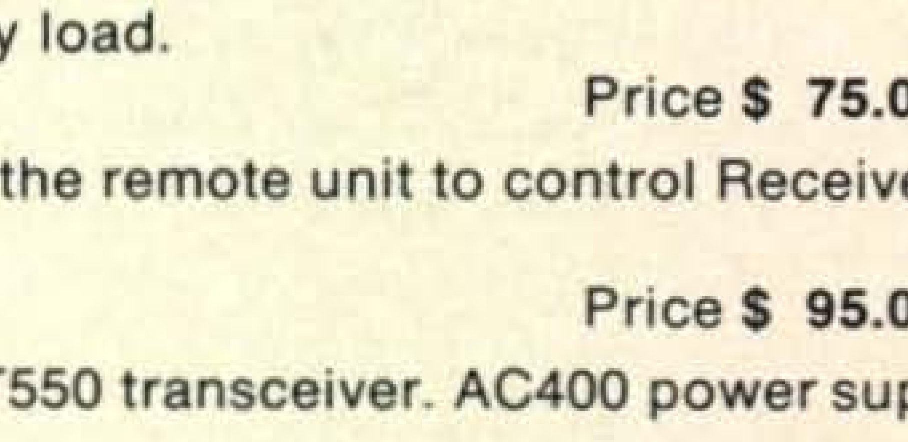

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F.M.

BY GLEN E. ZOOK,* K9STH/5

I am happy to report that this column appears to be meeting the expectations of the *CQ* Editors and the approval of the f.m. minded amateur. Although the number of letters received to date is not overwhelming, the sampling has been entirely favorable. This, of course, gives the columnist a swelled head, but that is a livable situation. There still remains the matter of news items and photographs. The boys down in Florida are doing their best, as are the boys up in Wichita, to keep up the column. There will be more on these areas in the News portion of the column. How about hearing from the f.m.'ers on the West Coast, Mid-West, and Canada. I know that there is f.m. activity there.

The influx of ready made f.m. equipment is bringing many old-timers out of the woodwork, as well as converts from other modes. Many of the retreads say that they have not had so much fun since their first phone contacts back on 160 meters. Lets keep it that way. Help out the newcomer, Don't make fun of him if he calls CQ the first time around or if he insists on giving S meter readings to everyone on the repeater. This is a carry-over from the d.c. bands which seems to be instilled in everyone. A brief run-down on the local f.m. procedures should be sufficient. Also, a suggestion that the newcomer join the local f.m. society might also be in order. Most newcomers are quite willing to support the repeaters by financial contributions, equipment contributions, or, in some cases, physical labor. Many old-timers have a vast knowledge which can be channeled into constructive things for the repeater. The same thing holds true for many new-comers to the amateur fold. The average amateur today is well educated and, if properly motivated, a potential contributor to the local v.h.f. f.m. repeater. Well, so much for my monthly tirade.

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Technical Talk

The last two months' Technical Talks have dealed primarily with the establishment of a new repeater. The February column contained information on building the basic repeater. The March column added the control links to keep the F.C.C. happy. This month's Technical Talk contains suggestions to keep the F.C.C. even happier. Present F.C.C. regulations call for both identification and logging by the repeater. An attempt is underway to change the entire repeater licensing structure by both the F.C.C. and the amateur population (Docket No. 18803; F.C.C. 70-206). However, at the time of this writing the rules are still the same as always. Thus, provision must be made to both identify and log the repeater.

Since the methods and equipment which can be used to satisfy the F.C.C. requirements are quite varied the suggestions herein will be of the "block diagram" type. The simplest method of complying with the logging requirements is the tape recorder. Even the simplest tape recorder can be pressed into service for logging, since hi-fi is not required. In fact, the slower the tape speed, the better, because this allows a reel of tape to be used for several weeks. The tape must be retained for one year after the last logging. Then it can be erased and reused.

The logging requirement also includes a

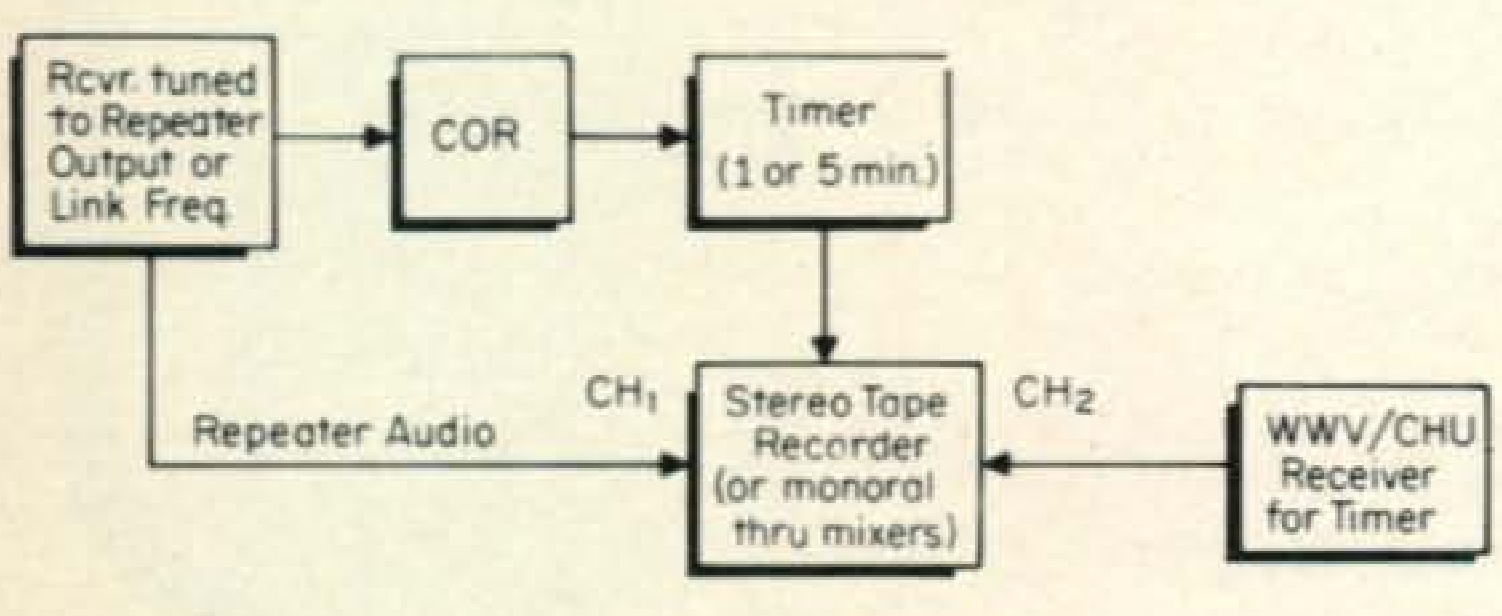

Fig. 1—Block diagram of time standard logging.

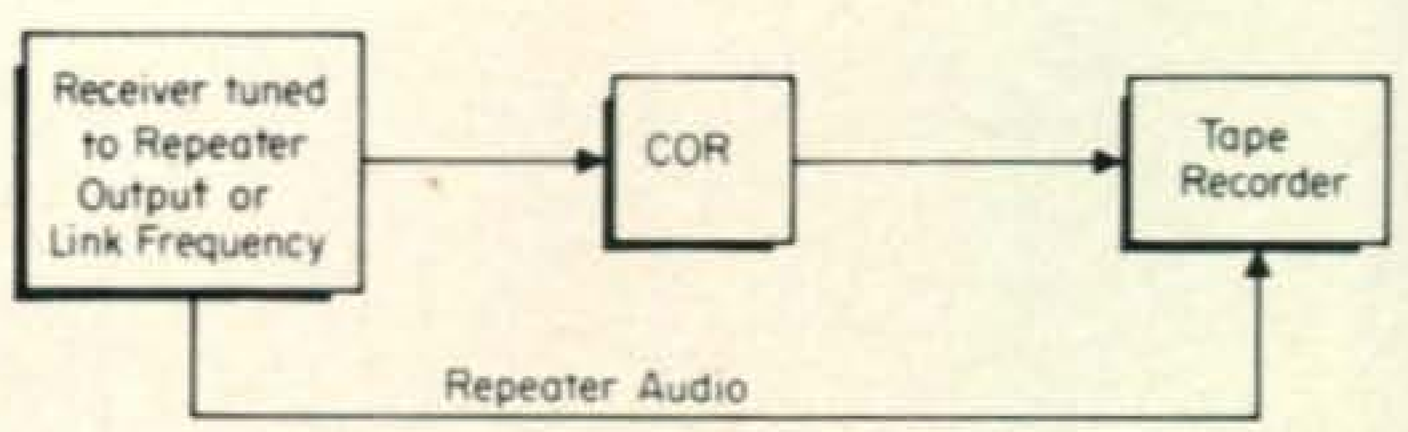

Fig. 2—Logging system for operator announcement of time.

time element. Repeaters such as the .34/.94 Ft. Worth repeater use a voice time announcement along with the regular repeater identification. This is fine, but is beyond the technical scope of many beginning repeaters. A second method of time recording is to use a stereo tape recorder with an input from WWV or CHU on one channel and the audio from the repeater on the other channel. The only drawback to this method is that the recorder must run for at least 5 minutes (in the case of WWV) or for 1 minute (in the case of CHU) to insure a time "hack" from the voice announcement. A third method is for stations using the repeater to announce the time at the beginning and end of each QSO. This method works in many cases. The block and logic diagrams for the second and third methods appear as figures 1 and 2.

The identification of the repeater can be accomplished in either of two ways: The use of a recorded voice announcement or the use of an m.c.w. (modulated code) signal such as produced by a code wheel. In either case it is best to make the announcement every three minutes in which the repeater is in use. Provision also should be made to insure that the repeater does not identify after it has not been used for a period of time. The identification signal should be audible during normal voice transmissions, but should be at a lower level to insure no disruption of the QSO on the repeater. In the case of narrowband systems, an identification level of between 2 and 3 kc deviation should be quite sufficient. In either case the block diagram and logic are identical. Only the means of producing the identifying signal differs. The diagram appears as figure 3.

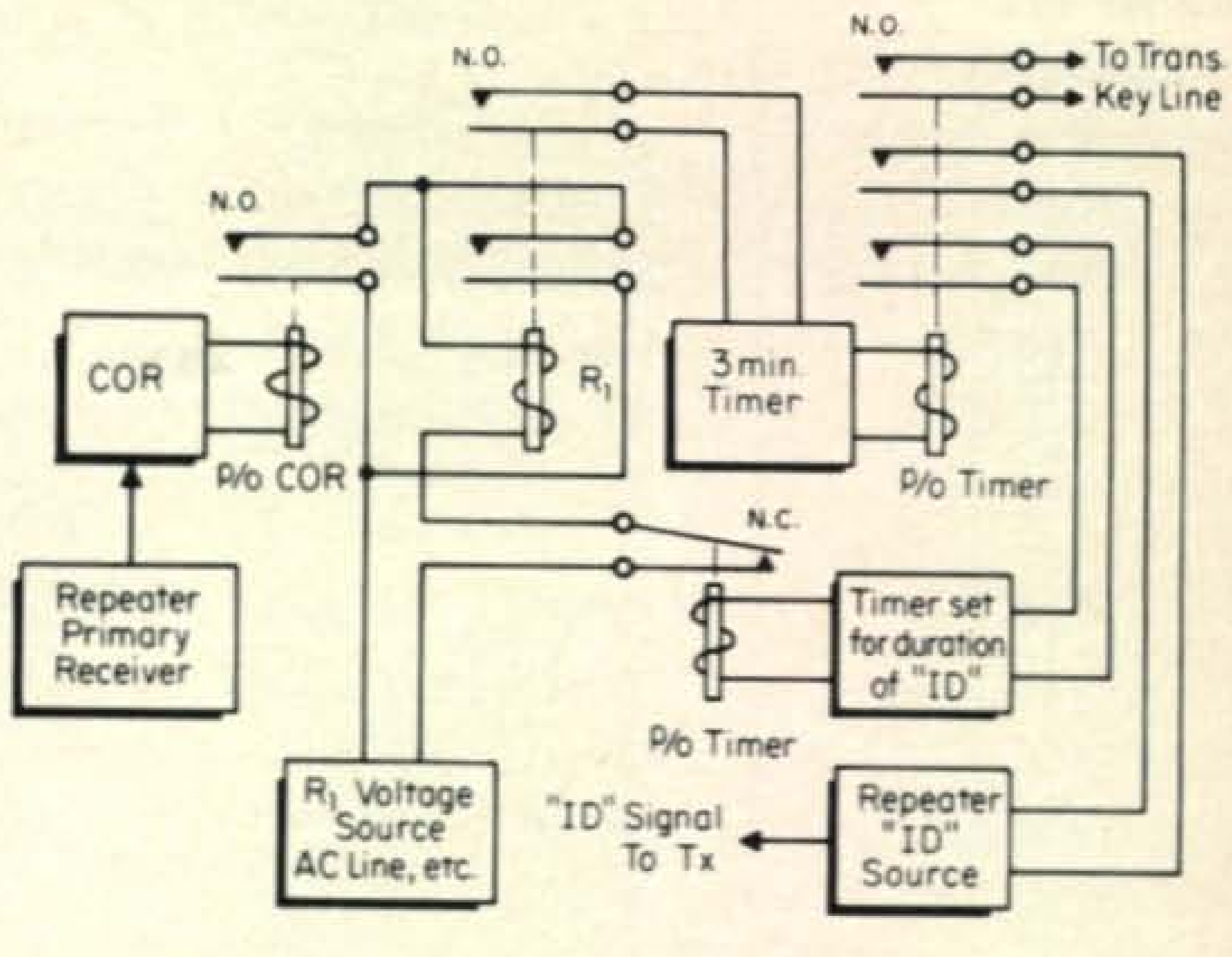

Fig. 3—Repeater identification system. COR activities R_1. R_1 remains energized, thus activating a 3 minute timer. At the end of 3 minutes the timer keys the repeater primary transmitter (if not already keyed by an input signal). Also, a second timer set for the length of the identification signal is activated along with the identification signal source. After the identification is complete, the normally closed contacts on the identification duration relay timer open and reset the system. If a signal is present on input, the identification system is immediately reactivated. If no signal is present, the identification system remains silent until another input signal.

After the repeater has been provided with logging and identification the F.C.C. should remain happy (you did license it, didn't you?!!). One thing to remember is that the repeater is responsible for the actions of the operators using it, as well as the operators themselves. The problem with Novice power levels is no longer with us, but the frequency restrictions on the Technician License are. By this I mean that even though the Technician is operating on an input frequency within his band (e.g. 146.34 mc) if the repeater output is above or below the Technician's band (e.g. 147.3 mc) the repeater can be cited with a violation of F.C.C. regulations. Also, the Technician operating on the input can be cited. The reasoning behind this is that the repeater is a remotely controlled base station. Such a station (and any station, for that matter is limited by F.C.C. regulations to restrictions of the lowest class of license held by either the operator or licensee. For example, if an Extra Class amateur were to operate a Novice station he is restricted to 75 watts crystal controlled in the Novice frequency spectrum. On the other hand, if the Novice were to operate the Extra Class station, he is still restricted to 75 watts crystal controlled in the spectrum allotted to the holders on Novice class licenses. The same holds true for all other classes of licenses and the possible combinations thereof. When Novices were allowed phone privileges on two meters many used the f.m. repeaters. However, if the input to the final of the repeater exceeded 75 watts (or, if for some reason, not crystal controlled) the repeater would be guilty of a violation of F.C.C. regulations, because the Novice was not permitted to run over 75 watts input. If you don't believe me, then ask some of the boys down in Houston, Texas. They have had the most experience that I know of in dealing with F.C.C. regulations and their interpretations.

Up to now I have been dealing primarily

Operating Channel Frequency = Fc	$\frac{Fc-12}{5}$	$\frac{Fc+12}{5}$	$\frac{Fc-8}{5}$	$\frac{Fc+8}{5}$	$\frac{Fc-5.5}{5}$	$\frac{Fc+5.5}{5}$	$\frac{Fc-2.9}{5}$	$\frac{Fc+2.9}{5}$
147.300	27.060	31.860	27.860	31.060	28.360	30.560	28.880	30.040
146.940	26.988	31.788	27.788	30.988	28.288	30.488	28.808	29.968
146.880	26.976	31.776	27.766	30.976	28.276	30.476	28.796	29.956
146.820	26.964	31.764	27.754	30.964	28.264	30.464	28.784	29.944
146.760	26.952	31.752	27.742	30.952	28.252	30.452	28.772	29.932
146.700	26.940	31.740	27.730	30.940	28.240	30.440	28.760	29.920
146.640	26.928	71.728	27.718	30.928	28.228	30.428	28.748	29.908
146.580	26.916	31.716	27.706	30.916	28.216	30.416	28.736	29.896
146.520	26.904	31.704	27.694	30.904	28.204	30.404	28.724	29.884
146.460	26.892	31.692	27.682	30.892	28.192	30.392	28.712	29.872
146.400	26.880	31.680	27.670	30.880	28.180	30.380	28.700	29.860
146.340	26.868	31.668	27.658	30.868	28.168	30.368	28.688	29.848
146.280	26.856	31.656	27.646	30.856	28.156	30.356	28.676	29.836
146.220	26.844	31.644	27.634	30.844	28.144	30.344	28.664	29.824
146.160	26.832	31.632	27.622	30.832	28.132	30.332	28.652	29.812
146.100	26.820	31.620	27.610	30.820	28.120	30.320	28.640	29.800
146.040	26.808	31.608	27.598	30.808	28.108	30.308	28.628	29.788
145.980	26.796	31.596	27.586	30.796	28.096	30.296	28.616	29.776
145.920	26.784	31.584	27.574	30.784	28.084	30.284	28.604	29.764
145.860	26.772	31.572	27.562	30.772	28.072	30.272	28.592	29.752

Fig. 4—The crystal frequency for many crystal formulas used in receiving.

with the newcomer to amateur f.m. Its about time to put in something for the more experienced FM'er. Well, it has come to my attention that many f.m.'ers do not know how to move the plated crystals used in most f.m. gear. When the techniques are known, it is possible to move such a crystal about 1% up or down in frequency. Next month's Technical Talk will give the details. As an appetizer figures 4 and 5 are included in this column. These figures give the crystal frequencies for many crystal formulas used in both transmitting and receiving setups. Of course the operating parameters such as capacity, current, ets. are involved to make the crystal operate on its frequency as marked on the holder. More on this next month.

News

Hooray!! News from outside the Texas area!!! Bev Cavender, W4CKB, with the help of many, is publishing a booklet entitled *Florida FM Directory*. This little directory lists all known f.m.'ers in Florida as of the time of publishing. There are 554 calls from 108 cities and towns around the state. The *Florida FM Directory* is available free of charge from Bev Cavender & Associates, P.O. Box 1083, Lake Placid, Florida 33852. If you are active on f.m. in Florida, drop Bev a line giving your call, address, and bands operated. I know that he will appreciate hearing from f.m.'ers in Florida.

John Perry, WB4GGW, President of the Brevard Repeater Association, Palm Bay, Florida, also came forth with information on the Florida f.m. scene. According to John, all major repeaters in Florida operate on 146.-340 mc input with 146.760 mc output (we here in the South Central US like to pair 146.160 mc with 146.760 mc) as do many East Coast and Mid-West repeaters. The primary exception to the .34/.76 rule is the Lake Worth repeater operating on 146.280 mc input and 146.880 mc output. As a precaution in case of mandatory tone control requirements by the F.C.C., and in case of extreme overlap of repeaters, the South Eastern Repeater Association, of which John is spokesman, is initiating a simple method of tone control. If needed, each repeater will choose a touch-tone number or digit for control. The number or digit selected will be made known to all to allow free usage of the repeaters.

Fc–.455	Fc+.455	Fc–8.7	Fc+8.7	Fc–5.25	Fc+5.25	Fc–10.7	Fc+10.7	Fc–11.7	Fc+11.7
5	5	12	12	4	4	3	3	9	9
29.369	29.551	11.550	13.000	35.5125	38.1375	45.5333	52.6666	15.0666	17.6666
29.297	29.479	11.520	12.970	35.4225	38.0475	45.4133	52.5466	15.0266	17.6266
29.285	29.467	11.515	12.965	35.4075	38.0325	45.3933	52.5266	15.0200	17.6200
29.273	29.455	11.510	12.960	35.3925	38.0175	45.3733	52.5066	15.0133	17.6133
29.261	29.443	11.505	12.955	35.3775	38.0025	45.3533	52.4866	15.0067	17.6067
29.249	29.431	11.500	12.950	35.3625	37.9875	45.3333	52.4666	15.0000	17.6000
29.237	29.419	11.495	12.945	35.3475	37.9725	45.3133	52.4466	14.9933	17.5933
29.225	29.407	11.490	12.940	35.3325	37.9575	45.2933	52.4266	14.9867	17.5867
29.213	29.395	11.485	12.935	35.3175	37.9425	45.2733	52.4066	14.9800	17.5800
29.201	29.383	11.480	12.930	35.3025	37.9275	45.2533	52.3866	14.9733	17.5733
29.189	29.371	11.475	12.925	35.2875	37.9125	45.2333	52.3666	14.9667	17.5667
29.177	29.359	11.470	12.920	35.2725	37.8975	45.2133	52.3466	14.9600	17.5600
29.165	29.347	11.465	12.915	35.2575	37.8825	45.1933	52.3266	14.9533	17.5533
29.153	29.335	11.460	12.910	35.2425	37.8675	45.1733	52.3066	14.9467	17.5467
29.141	29.323	11.455	12.905	35.2275	37.8525	45.1533	52.2866	14.9400	17.5400
29.129	29.311	11.450	12.900	35.2125	37.8375	45.1333	52.2666	14.9333	17.5333
29.117	29.299	11.445	12.895	35.1975	37.8225	45.1133	52.2466	14.9267	17.5267
29.105	29.287	11.440	12.890	35.1825	37.8075	45.0933	52.2266	14.9200	17.5200
29.093	29.275	11.435	12.885	35.1675	37.7925	45.0733	52.2066	14.9133	17.5133
29.081	29.263	11.430	12.880	35.1525	37.7775	45.0533	52.1866	14.9067	17.5067

Heading into the Mid-West we find the Wichita, Kansas crew. Larry Waggoner, WAØQPM, fills us in on the details in Wichita. Presently there are two open repeaters in operation. WØDKU repeater has an input of 146.340 mc and an output of 146.940 mc. WØIPB repeater has an input of 146.220 mc and an output of 146.820 mc. In addition, using control from 2 meter frequencies the WØIPB repeater will operate with 52.525 mc input and 146.820 mc output and 146.220 mc input and 52.525 mc output. As a note of information, the Dallas WA5-VKV repeater is making preparation for a similar hookup. Larry requested information on problems associated with intermod from four or more amateur repeaters operating on the two meter band. In this area (Dallas-Ft. Worth) there are seven repeaters operating with only 30 kc (narrowband) channel spacing. To date the only major intermod known to the author was the result of a design deffiency in a receiver used on one repeater. What the receiver usually received was not actual intermod but was so wide that it actually received several other channels. After modification of the system the intermod has been eliminated. Occasionally intermod occurs from commercial equipment, but this is not the fault of any of the amateur repeaters. In the near future there will be nine repeaters operating in the Dallas-Ft. Worth area along with several simplex channels. All channel spacing is 30 kc and no intermod problems are expected. If any reader has had an intermod problem and has solved it, I will be very happy to give the information to other groups via the column.

Announcement

The second Southeastern FM Convention will be held in conjunction with the Orlando (Florida) Hamfest, 22-23 May 1971. Further information and details are available from the Brevard Repeater Association, Inc., P.O. Box 82, Palm Bay, Florida 32901. I did not attend last year, but the materials from the meetings were quite informative in themselves. Also, those who did attend who filled in this columnist were very impressed with both the handling of the meetings and the items accomplished. Many big names in f.m. were present last year and are expected this year. I think that I have persuaded the XYL to let me go, so lets see everyone at Orlando.

Q & A

Q. Can I use my existing two meter receiving setup to get my feet wet in f.m.? If so, what modifications must I make?

A. Almost every two meter receiving systems will receive f.m. The only exception to this is the super-regen receivers such as the Heath Twoer, which will not demodulate narrowband f.m. The a.m. receiver may be used by the slope detection method. This requires the tuning to one side of the f.m. signal. This places the signal on the slope of the i.f. response. This, in turn, results in the detection of the f.m. signal. The s.s.b. receiver using a product detector may also be used. The trick is to zero-beat the signal as you would do a conventional a.m. signal. This also places the signal on the slope, but the product detector is doing most of the work. A third method of using the normal two meter station receiver is the addition of an outboard discriminator circuit. The Collins 75A2 and 75A3 have internal provision for a n.b.f.m. (narrowband f.m.) adaptor. Other receivers have an i.f. output jack. Still others may be modified to add such a feature. The i.f. signal in all cases is sampled, detected by the discriminator, and fed into an audio amplifier (such as the existing receiver audio circuitry).

Q. I have some equipment which will operate in the ten meter band. Is it worthwhile to put this equipment on 29.6 mc?

A. The term worthwhile is quite relative. The f.m. operation on the ten meter band is growing. 29.600 mc is the equivalent of 52.-525 mc or 146.940 mc as a calling and emergency frequency. Many stations operate in the last 200 kc of the ten meter band using f.m. I presently do not operate 29.600, but am readying equipment for such use. When the band is open, many DX contacts can be made on 29.6 mc. I have tuned around this frequency with my 75A2 and have heard much activity. The activity is sufficient for me to prepare equipment. As far as saying that operation on ten meter f.m. is worthwhile: It is for me.

Finale

Again the FM COLUMN must close for another month. The "audience participation" is on the increase, but is still not enough. Keep the letters coming in. Also, please send photographs. I know that everyone is getting tired of my photos and drawings. Besides, I want everyone to recognize me at Orlando by my "swelled head." ■

Operating Channel Frequency = Fc	Fc/8	Fc/12	Fc/16	Fc/18	Fc/24	Fc/36	Fc/48
147.300	18.4125	12.2750	9.20625	8.18333	6.1375	4.0916	3.06875
146.940	18.3675	12.2450	9.18375	8.16333	6.1225	4.0816	3.06125
146.880	18.3600	12.2400	9.18000	8.16000	6.1200	4.0800	3.06000
146.820	18.3525	12.2350	9.17625	8.15666	6.1175	4.0783	3.05875
146.760	18.3450	12.2300	9.17250	8.15333	6.1150	4.0766	3.05750
146.700	18.3375	12.2250	9.16875	8.15000	6.1125	4.0750	3.05625
146.640	18.3300	12.2200	9.16500	8.14666	6.1100	4.0733	3.05500
146.580	18.3225	12.2150	9.16125	8.14333	6.1075	4.0716	3.05375
146.520	18.3150	12.2100	9.15750	8.14000	6.1050	4.0700	3.05250
146.460	18.3075	12.2050	9.15375	8.13666	6.1025	4.0683	3.05125
146.400	18.3000	12.2000	9.15000	8.13333	6.1000	4.0666	3.05000
146.340	18.2925	12.1950	9.14625	8.13000	6.0975	4.0650	3.04875
146.280	18.2850	12.1900	9.14250	8.12666	6.0950	4.0633	3.04750
146.220	18.2775	12.1850	9.13875	8.12333	6.0925	4.0616	3.04625
146.160	18.2700	12.1800	9.13500	8.12000	6.0900	4.0600	3.04500
146.100	18.2625	12.1750	9.13125	8.11666	6.0875	4.0583	3.04375
146.040	18.2550	12.1700	9.12750	8.11333	6.0850	4.0566	3.04250
145.980	18.2475	12.1650	9.12375	8.11000	6.0825	4.0550	3.04125
145.920	18.2400	12.1600	9.12000	8.10666	6.0800	4.0533	3.04000
145.860	18.2325	12.1550	9.11625	8.10333	6.0775	4.0516	3.03875

Fig. 5—Crystal frequencies for many crystal formulas used in transmitting.

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Digital Proportional Radio Control

BY HOWARD G. McEntee,* W2SI

Amateur radio is more than just 20 m. s.s.b. DXing, as thousands of radio controlled model enthusiasts will attest. R/C gets downright sophisticated, too, which is why this article was written. The multi-channel R/C system described below employs digital techniques to provide fine control of up to five independent model control functions.

BEFORE reading the following description of modern digital radio control equipment, it might benefit those interested in this area of R/C to review the general R/C articles in past issues of *CQ*,[1] to understand some of the background of this field. Digital equipment has displaced all other forms of multi-control in R/C, for it offers many advantages. The name comes from the fact that some parts of the system operate similarly to digital computer circuitry—they are either turned-on fully, or turned-off completely. There is no in-between state. However, the *input* to the transmitter is analog—it varies smoothly both sides of neutral. And the *output* we want from the servos is also analog —it must follow the system input exactly. The input, of course, comes from the operators hand on one or more control sticks; the output drives the model (plane, boat, car or other) controls as commanded. Thus our system converts analog input to digital pulses, transmits the pulses by radio to a receiving system which interprets the pulses and controls servo motors, converting the pulses back to analog action.

Digital Advantages

Digital systems have displaced most others because they can accommodate most any desired number of controls (systems from one to eight controls have been marketed), all of which operate entirely independently—there is no interaction. Digital systems offer full servo power, even for very minute control movements. They also offer ease of factory tuneup, though high quality scopes must be utilized to check pulse shape and spacing. Their main disadvantage is rather serious sensitivity to inteference; this can come not only from other transmitters on the same frequency, but from pieces of metal in the model rattling together. Servo motor brush noise is also a real problem. Continued development has helped reduce this interference problem, but it is far from licked. It will be seen from the pulse sketch, fig. 1 that the predominently on r.f. transmitter signal is turned off for each pulse. If one or more of these off periods is filled with interference, control malfunction naturally results.

The Transmitter Encoder

Our description of circuit operation will be based upon the popular Heathkit system, which is representative of the field in general

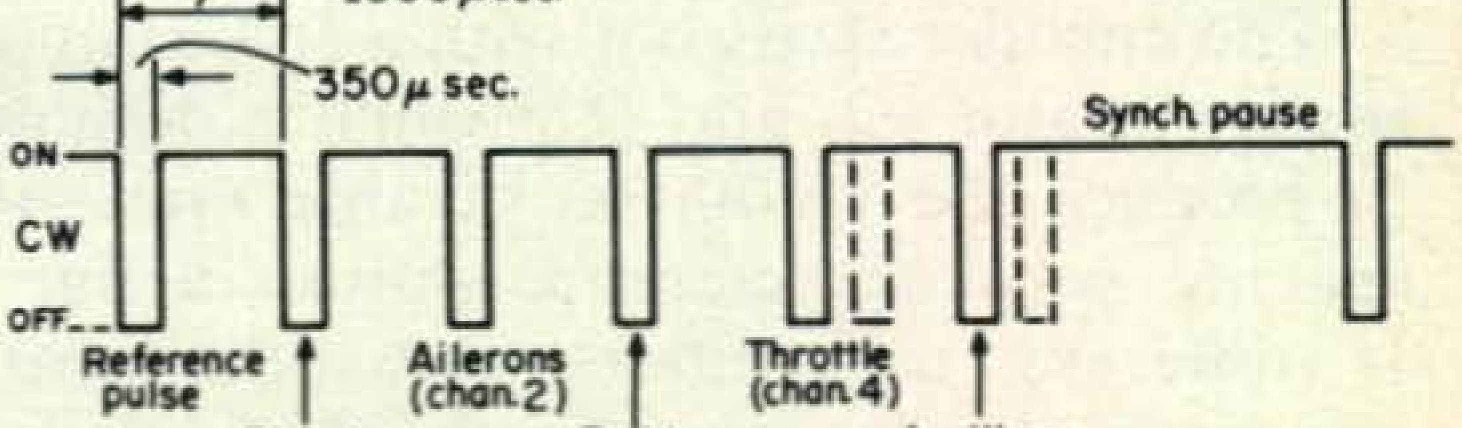

Fig. 1—Pulse presentation of the Heathkit 5-control digital system. The reference pulse never moves. The control pulses move to the right or left from the neutral position shown. When any control pulse is moved, all pulses to the right of it move the same distance. Note that the Channel 4 pulse has been moved to the right (dotted line). Channel 5 pulse has also moved right an equal amount, but actually Channel 5 has not changed its spacing from Channel 4, so, in effect, it has not moved. Any pulse can be linked to any servo.

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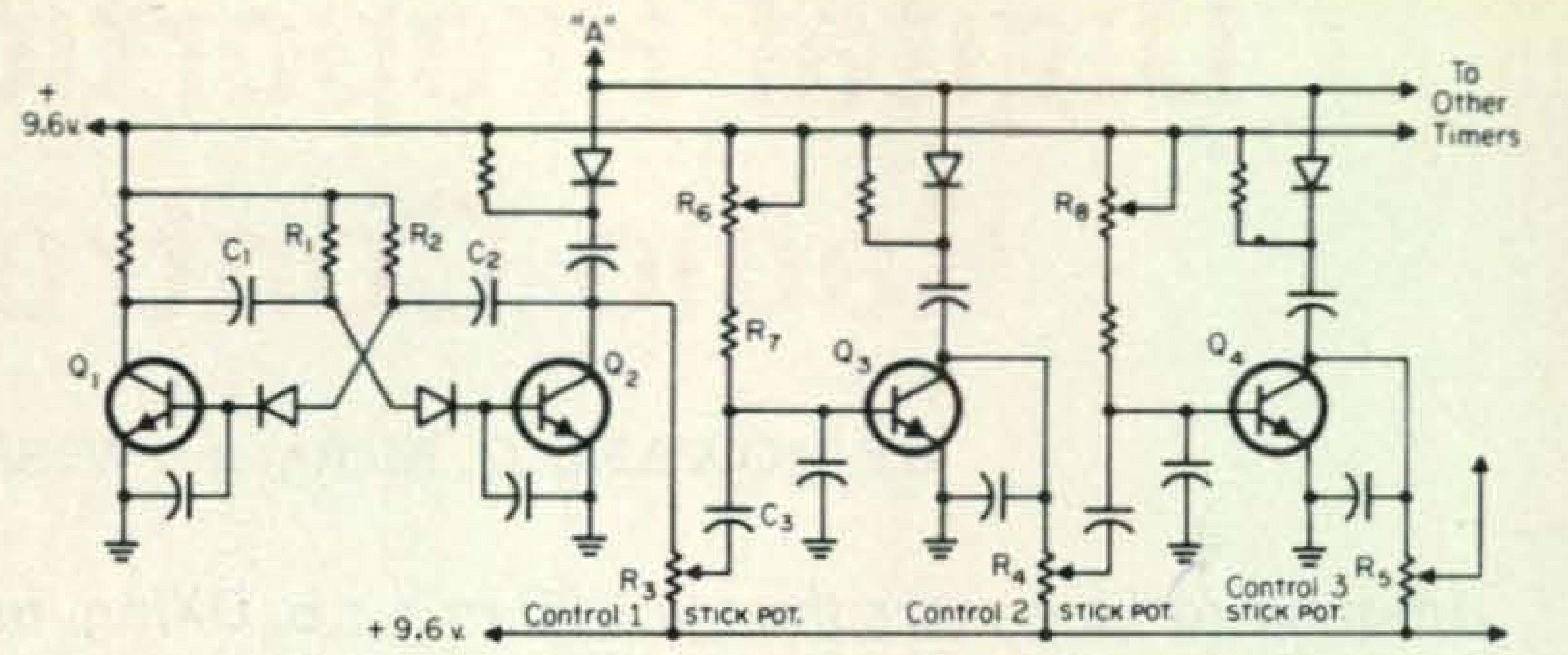
[1]McEntee, H., "Model Control By Radio," *CQ*, June '70, p. 16; July/Aug., p. 41.

Fig. 2—Transmitter encoder circuitry. A five-control system will have five transistor circuits similar to those of Q_3 and Q_4; there will be five control pots (R_3, R_4, etc.) and five "range" pots (R_6, R_8, etc.). Heathkit GD-19 system.



(Heathkit R/C circuits closely follow those of Kraft, one of the largest equipment makers in the R/C field; Heathkit uses much Kraft circuitry under license, and many Kraft parts as well). In fig. 2 we see a portion of the transmitter encoder, where the pulse train is produced for the transmitter, the position of individual pulses in the pulse train being governed by the transmitter control stick position (the sticks may be coupled to from one to three variable resistors). Some transmitters today have two separate sticks, each driving two pots. Others have a single stick that handles three pots—one each for up-down and for sideways stick motion, the third by turning a knob on the end of the stick. Any other control pots are handled by small auxiliary levers placed at various spots on the transmitter case front, sides, top or even back. In practically all transmitters those pots handled by the stick or sticks also have trim capability; this usually allows about 10% servo movement each side of neutral, independent of stick position, and is handled mechanically, (usually by rotating the entire pot body), not electronically.

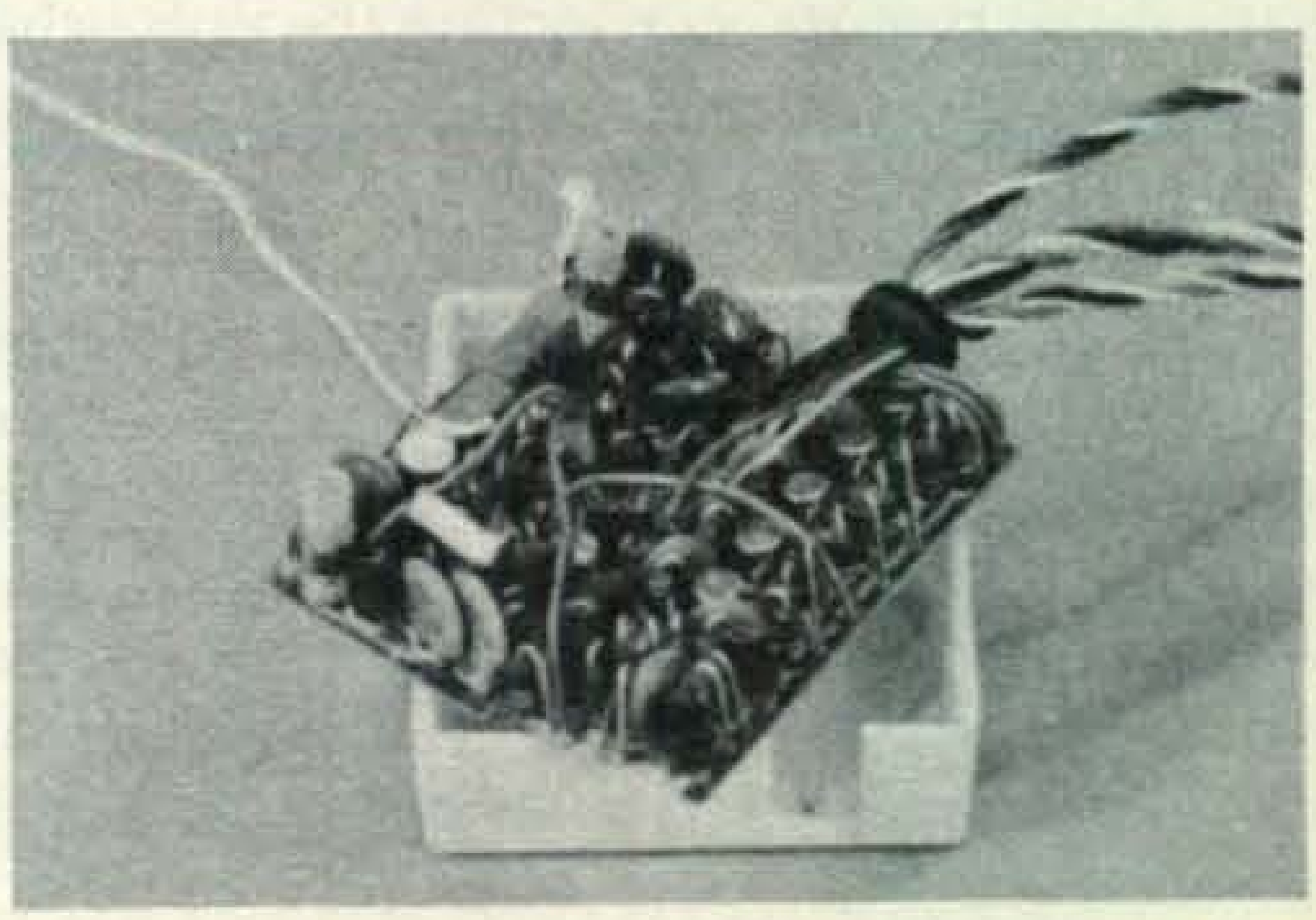
The encoder starts out with a free-running multi-vibrator (Q_1 and Q_2) which is designed to produce the 16,000 μs "frame rate"—the spacing between reference pulses in fig. 1. If different transmitters and other components are to be interchangeable (if the r.f. operating frequencies are the same) this frame rate must be approximately the same for each transmitter, accomplished by using close tolerance units for the timing components of the multi-vibrator, C_1 and C_2, R_1 and R_2.

The multi-vibrator produces a starting pulse for each frame, fed out at point "A"; the pulse also goes through R_3 to the base of Q_3. R_3, R_4 and R_5 are pots hooked to the control sticks. Q_3 and Q_4 are monostable timers, part of a string of five in the Heathkit 5-control transmitter (GD-19 system).

As such reference pulse comes from Q_2 it starts a train of pulses from the monostable timer chain. Q_3 is normally biased ON through trimmer pot R_6 (R_6, R_8 and similar pots for all monostable timers set the range of servo movement, that is, how far each servo runs each side of neutral toward the ends of movement).

Each negative frame-starting pulse from Q_2 turns Q_3 OFF. The time constant of R_3, C_3, R_6 and R_7 determines how long Q_3 will stay non-conducting; the amplitude of the pulse picked off R_3 is also a determining factor here. When Q_3 again starts to conduct, a negative-going pulse from its collector is passed along to Q_4 through R_4, and the sequence is continued down the chain.

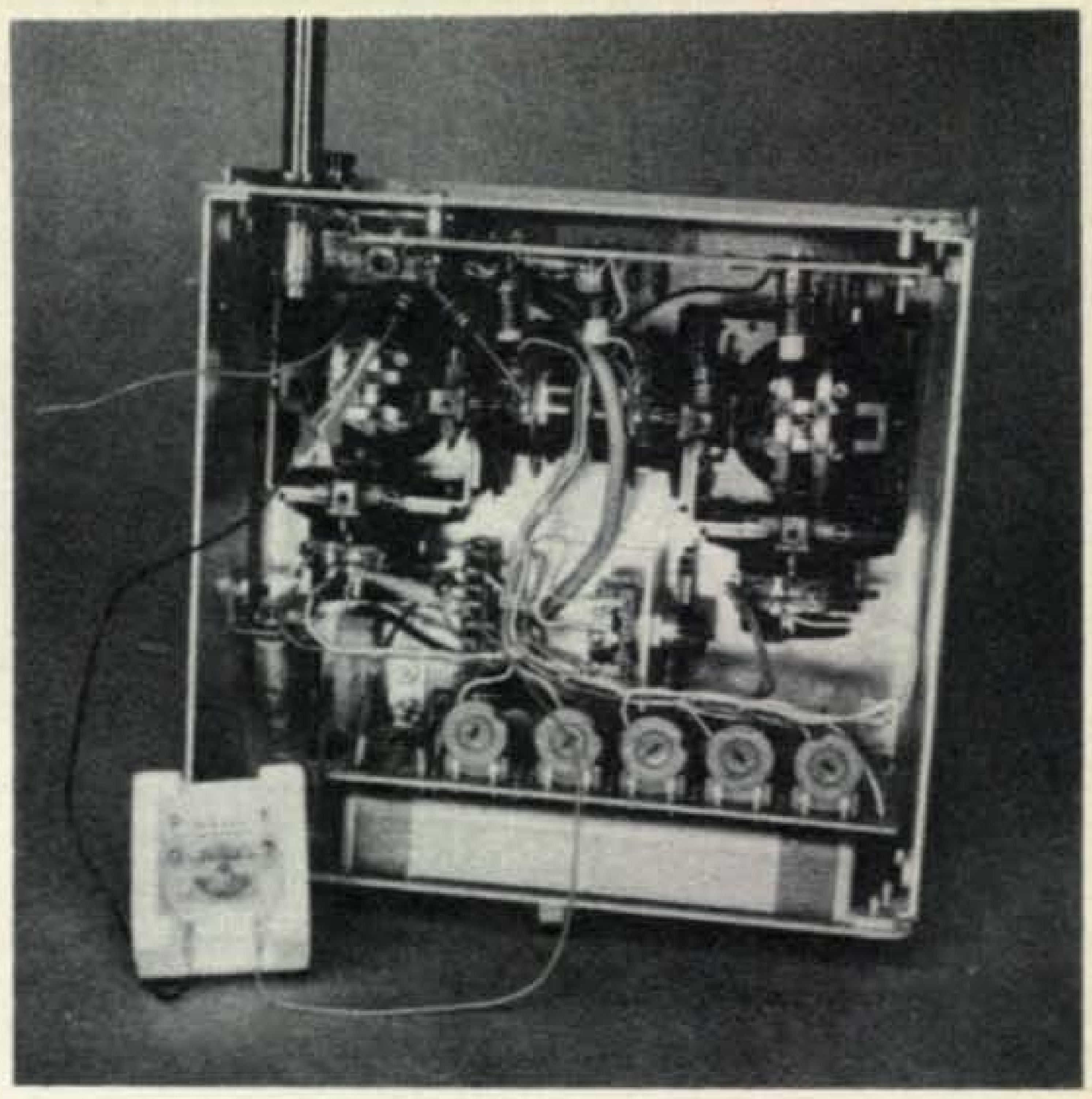
If all the control pots are in neutral (center position of associated stick movement) the spacing between adjacent pulses will be equal. The servos at the other end of the system are adjusted to center with such equal-pulse spacing. When one pulse early in the string is advanced or retarded (by shift of a control pot) all following pulses are advanced or retarded the same amount,



This Heathkit receiver is built on two P.C. boards which go side by side in flat plastic case. Superhet board on left here, decoder at right.

but the spacing *between* these following pulses remains equal, so their servos do not move.

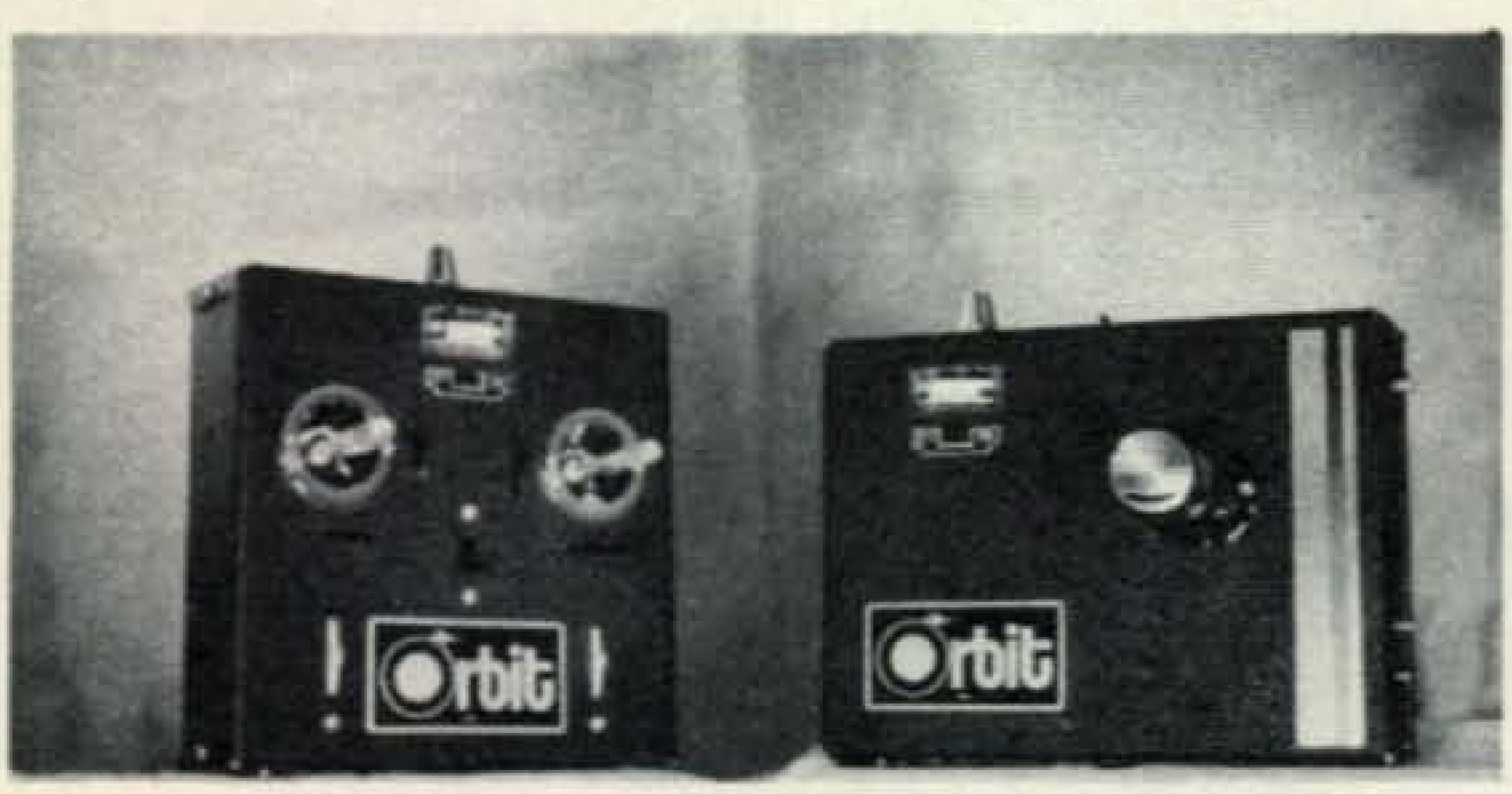
Control pulses from multi-vibrator Q_1-Q_2 and from all the monostable timers pass through point "A" to a monostable multivibrator which shapes each pulse to 350 μs width. These shaped pulses then go to a modulator transistor which cuts off the transmitter's oscillator supply voltage for this time interval every pulse. The r.f. circuitry is quite conventional so is not included here. Heathkit transmitters for 27 and 50 mc utilize only two r.f. transistors; those for the 72 mc R/C spots have an added buffer stage (on 72, the modulator pulses cut the buffer off, while the oscillator runs constantly). Battery power to the output amplifier is not interrupted, no matter what the frequency. Heath transmitters run about 500 mw input to the final amplifier. Power varies roughly from 200-800 mw among the various makes of R/C transmitters on the market. Most all transmitters utilize some sort of antenna loading, either internal or external (usually center-loading, in latter case).



Heathkit transmitter being tuned up. The r.f. strip (top of case) comes tuned, ready for use, but pots and encoder must be adjusted. The five trimmers in the lower board are R_6, R_8, etc. Transmitter meter is utilized in this kit system for all transmitter and receiver checking, shown here is its plastic foam packing wired in for one specific test. Flat package under lower board is nickle-clad battery pack.

Digital Receiver

All digital R/C receivers today have crystal-controlled superhet r.f. circuitry, again fairly conventional, so we won't go into great detail. The Heathkit receivers have a double-tuned r.f. stage (some R/C receivers have just double-tuned input with no amplifier transistor, others have a single-tuned circuit at the input driving the mixer directly), an autodyne converter and a unique i.f. setup with three ceramic filters in series, followed by two direct-coupled i.f. amplifiers. Most



Two Orbit transmitters show typical 2-stick and single-stick control configurations. Two-sticker has two controls on each stick; single stick job at right has three controls on stick. Auxiliary controls of single-stick unit are on sides, top of box. Transmitter at left has all trim and aux. control knobs on case front.

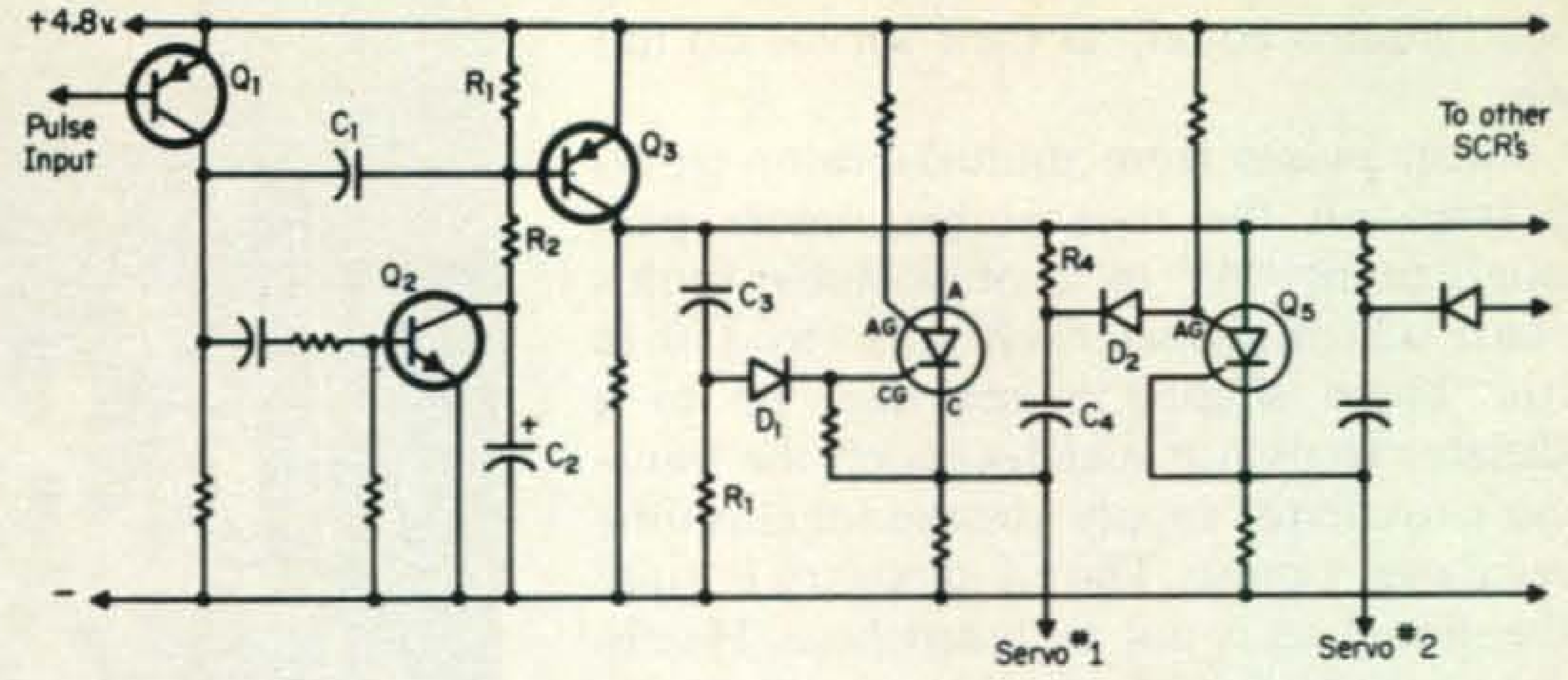
R/C receivers utilize standard sub-miniature i.f. cans and i.f. transistor circuitry. Again, Heath utilizes a.g.c. on the r.f. and i.f. stage; others may have it only on the i.f.'s—or none at all. There is, of course, a rather tremendous range of input signals to the receiver. Before a model is released, the transmitter antenna may be only a couple of feet from the receiver antenna, but in flight they could be separated by as much as half a mile! Yet modelers expect normal control action at both extremes! It's a tribute to equipment designers that they usually have it.

From a transistor power detector, the signal goes through a two-stage pulse amplifier to a sync transistor and a driver transistor. This receiver has all the r.f. circuitry on one circuit board, all the pulse circuitry on another; both are mounted side-by-side in a flat case. Some makers mount one board over the other, some put everything on a single board.

The Decoder

Several specific circuit tricks are used in the receiver to reduce adverse effects from both strong and weak interference. All this is taken care of on the receiver p.c. board. We pick up the action in fig. 3.

Fig. 3—Receiver decoder. The Heath 5-control system has five silicon controlled diode circuits, three more identical to that of Q_5. Each diverts a specific pulse in the pulse train from the transmitter, to a specific servo.



Q_3 is a switch to turn on and off the anode current supply to a series of five SCR's, each powering a separate servo. The object is to turn on each SCR (servo) in sequence for a period of time corresponding to the control settings at the transmitter.

Q_1 is the second pulse amplifier in our typical pulse-propo receiver. Remember that the normal, no-pulse condition is "signal on." Pulses are the momentary absence of signal. Referring to fig. 1 and fig. 3, let us pick up the sequence of operations with the "Synch Pause" at the end of the pulse frame.

The long synch pause from Q_1 turns off Q_2, allowing C_2 to charge through R_1 and R_2. Voltage drop across R_2 as C_2 charges turns on Q_3 which applies anode voltage to all five SCRs, Q_4-Q_8. No SCRs can conduct yet, until triggered by an appropriate gating signal.

The first pulse in the pulse frame from Q_1, the "Reference Pulse," turns on Q_2 and at the same time is applied to Q_3 turning it off momentarily. With Q_2 turned on, C_2 begins to discharge.

When the pulse ends, Q_3 is again turned on by the re-charging of C_2, and anode voltage is once again applied to Q_4. Simultaneously, Q_4 is triggered on by the anode voltage coupled to the cathode gate of Q_4 through C_3 and D_1. The first servo is thus actuated.

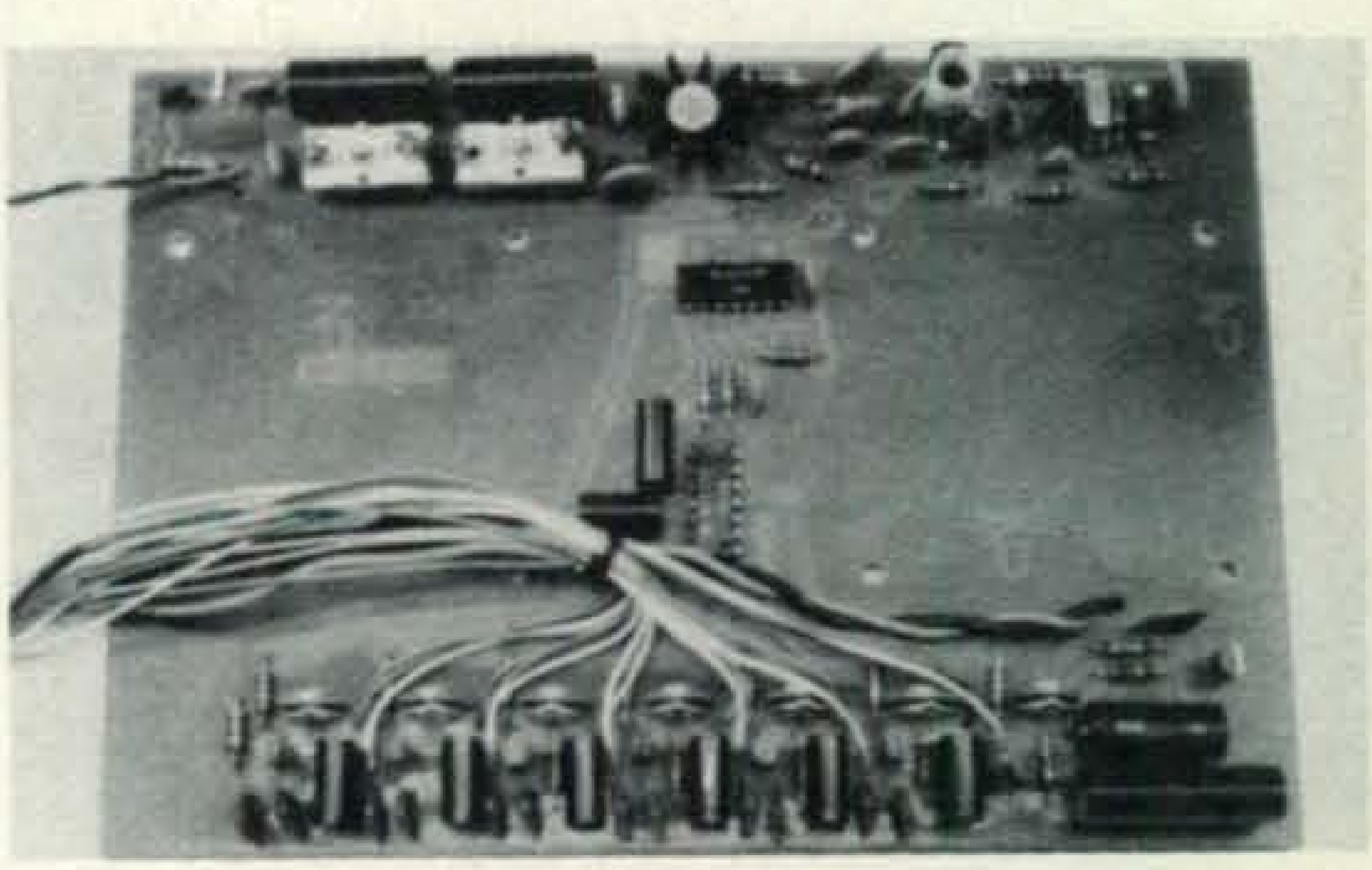
The next pulse, "Channel 1" again momentarily cuts off the SCR string anode voltage. As Q_4 is turned off a pulse is sent to the anode gate of Q_5 through C_4 and D_2. The time constant of C_4-R_4 is selected so that the pulse arrives at the anode gate as the anode voltage is re-applied by Q_3, thus turning on Q_5 and its associated servo.

The process continues with each succeeding channel pulse, each servo staying activated until the succeeding pulse turns off it's SCR (and all other SCR's) triggering the next one on. The synch pause at the end of the pulseframe recharges C_2 and the process begins again. The time each SCR is on depends on the time between channel pulses as determined by the transmitter controls. The interpretation of the pulse intervals is handled by the servos themselves.

It is interesting to note that some receiver makers prefer to use direct-coupled pairs of common silicon transistors in place of each SCR; Heath does so in their much lower-cost three-control GD-57 system. The transistor pairs are considerably lower in cost than a single SCR and it has also been claimed that they are more uniform and reliable. Circuitry using them looks very much like that we show in fig. 3 however.

Servo Operation

Since we are covering the operation of the Heath system, we will continue with their servos. These are unique in the field today, in that they utilize a variable capacitor for the element that is mechanically geared



Typical transmitter p.c. board of type holding practically all transmitter circuitry. This one from 7-channel Classic system by Royal Electronics. The r.f. section is along the top edge of the board, the encoder at the bottom. Note two flatpack I.C.'s at center of board containing some of encoder and other transmitter circuitry.

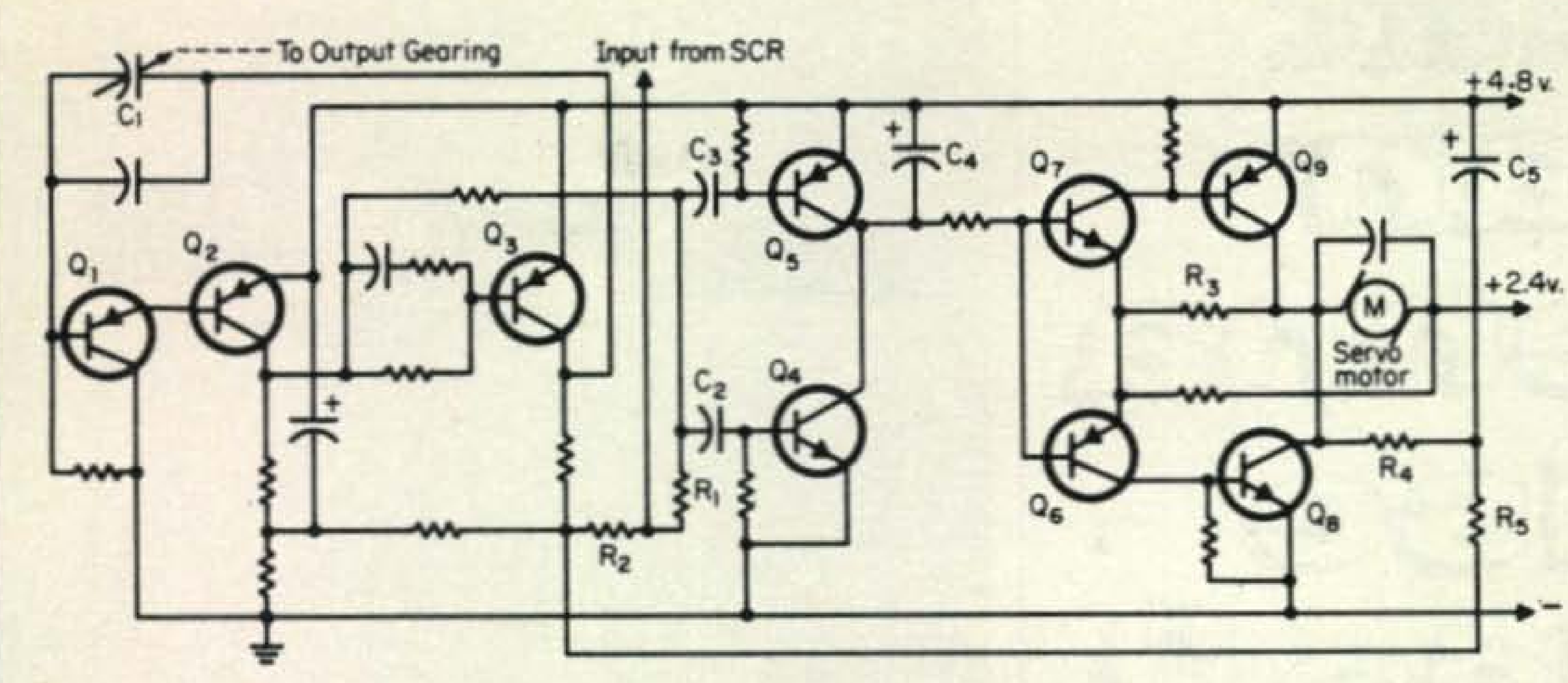


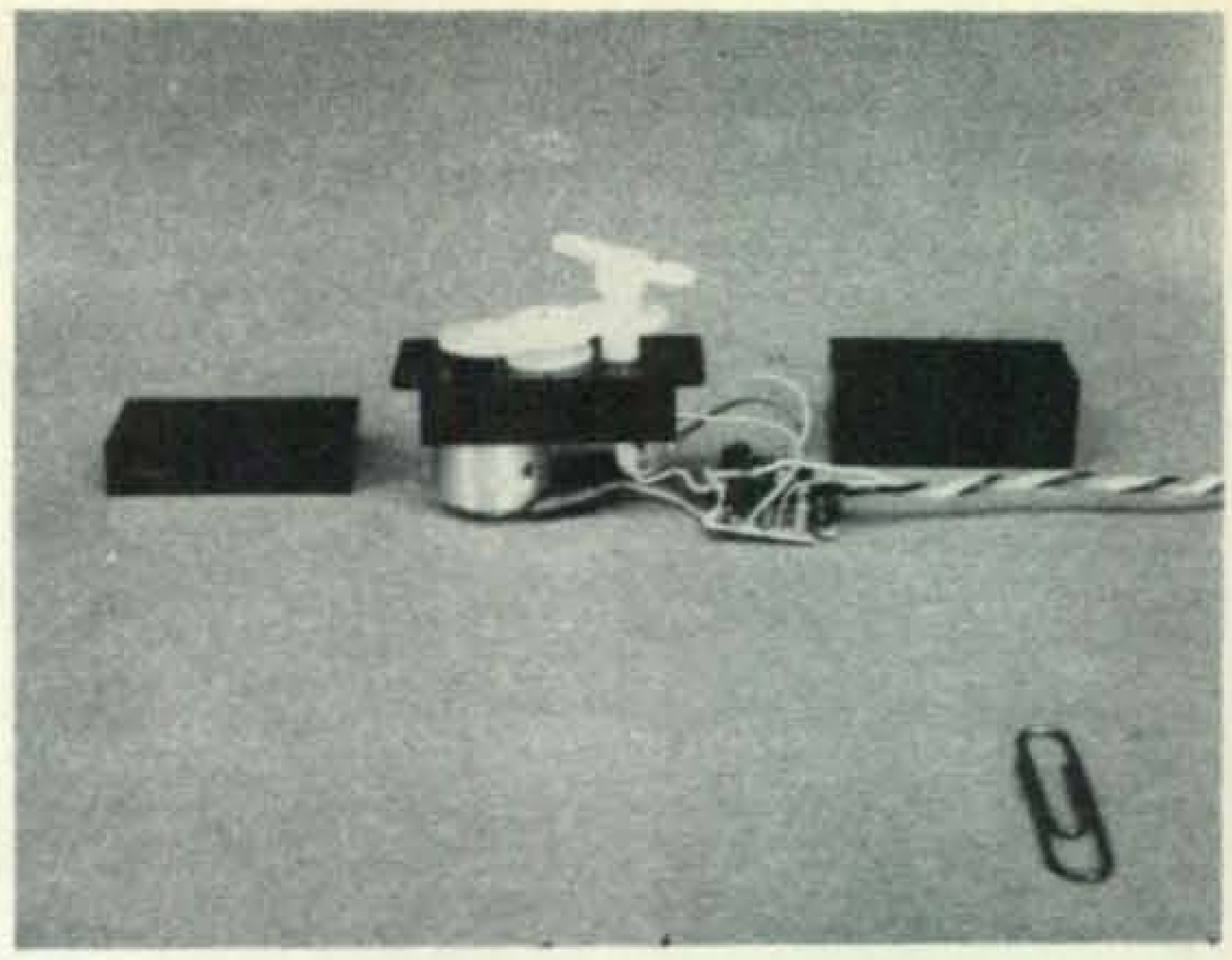
Fig. 4—Servo amplifier circuitry. C_1 is a 2-gang variable capacitor, each section has a trimmer. These trimmers are used to center the servos during tuneup. However, course centering adjustments are made first at the transmitter pots, then C_1 is used for fine adjustment.

to servo output; all other servo makers today utilize variable resistors. The capacitor arrangement was developed by Kraft at a time when variable resistors were by far the most troublesome servo element. They quickly "got dirty," and erratic servo action was the result; it was so bad in some cases that modelers had to clean the moving contacts in their servo pots every dozen or two flights! The variable-capacitor servo, since it had no wiping contacts on a resistor sector, was much superior. One other manufacturer developed a variable-inductance servo; this worked by moving a ferrite core in and out of an long inductor–and had no moving electrical contacts at all. Meanwhile, however, servo makers discovered what are termed "hard ceramic" variable resistors, which have proven to give long trouble-free life. Kraft dropped the capacitor in favor of these–but Heath has retained them for several years, claiming very satisfactory results. These capacitors are the tiny two-gang units that you see in pocket transistor radios; rather than air gaps between plates, the plates are spaced apart by thin interleaved sheets of tough plastic. As a backup to the rubbing contact for the moving plates, the Heath servos have an added very flexible pigtail wire. In our servo circuit, C_1 represents a two-gang capacitor (each section having a trimmer) with sections paralleled, and it "tunes" the monostable (one shot) multivibrator consisting of Q_1, Q_2, Q_3. Positive pulses from the decoder enter the circuit at the junction of R_1 and R_2, and are fed to the collector of Q_3 and the base of Q_1 through C_1. The normal condition of the circuit has Q_1, Q_2 conducting, while Q_3 is cutoff. The incoming pulse reverses these conditions for a timed period (depending upon the setting of C_1), after which all three return to the normal condition. With the servo centered, the three transistors reverse conduction for 1,500 μs.

The negative pulse from Q_2 collector is coupled to Q_4 and Q_5 bases via C_2 and C_3. The input pulse from the receiver also goes to Q_4 and Q_5 via the same capacitors. If the positive input pulse from the decoder is the same length (time period) as the negative pulse from the one-shot, they cancel and there is no voltage applied to C_2 and C_3. An input pulse differing in length from the one shot pulse will put either a positive or negative voltage on the bases of Q_4 and Q_5.

With no input voltage, Q_4 and Q_5 do not conduct, and C_4 is charged to approximately half battery voltage. If there is a positive difference between input and one-shot pulses, Q_4 will conduct. These pulses occur only once every 16,000 μs and can be very narrow. However, such brief pulses in the conduction of Q_4 will cause C_4 to charge more fully than normal. With the normal resting voltage charge on C_4, neither Q_6 nor Q_7 conduct, and hence neither do Q_8 nor Q_9. If, due to conduction of either Q_4 or Q_5 for even a very slight time, C_4 voltage varies from its normal resting value, the driver (Q_6 or Q_7) and an

Heathkit servo ready for assembly. Motor at right (gearing goes above portion of case shown). There are three main case sections, all of nylon. Square unit at left is C_1; its shaft projects through large hole seen toward left end of case section. Amplifier p.c. board is in center.



Tiny World Engines servo has I.C. on circuit board. Tiny board measures 3/4 × 13/16", carries 32 electronic components plus round I.C.! 3-section case bolts together.

output transistor (Q_8 or Q_9) will conduct until the voltage of C_4 resumes its restnig value. Since this takes far longer than the relatively brief pulse that may have changed its charge, Q_4, Q_5 and C_4 with their associated circuit components are termed a "pulse stretcher". If it were not for this circuit, brief pulses might not even start the motor armature moving due to inertia.

The actual motor driving circuit – Q_6 through Q_9–is quite orthodox, but with a couple of useful additions. Since the servo must, of course, be driven either direction, we need this dual-section amplifier. This is the only part of the circuitry in the model that requires a battery center tap. Resistor R_3 provides a little feedback to increase amplifier stability. R_4, R_5 and C_5 form another feedback network that prevents servo overshoot; they cause the servo to come to an almost instant stop when the movement of the transmitter stick ceases, or when the stick is allowed to snap back to center.

Servos such as this get the name of "feedback servos," however, due to the mechanical linkage of a circuit element to the servo output gearing, (capacitor C_1 in this case, or a variable resistor in other makes of servos, connected to vary the period of the input oscillator). They are also called "closed loop" servos.

Other System Features

In common with most others, the Heathkit transmitter includes a panel meter. On this one the meter indicates r.f. output; on some

[*Continued on page 101*]

Semiconductor Protective Devices

BY JOHN J. SCHULTZ,* W2EEY

As a follow-up to the author's previous article on current-overload protective devices,[1] this article discusses how simple and inexpensive protection can be provided for sensitive transistor and integrated circuit units which require extremely fast-acting overload protection.

THE author's article on the use of fuses and circuit breakers apparently clarified many reader's conceptions as to how these devices should be used.[1] However, it also raised questions in many reader's minds as to how more adequate over-voltage or over-current protection could be provided for transistor or integrated circuit components where extremely fast protective action is required for these sensitive components. This article therefore, is intended to discuss the considerations involved in using semi-conductor devices to protect other semi-conductor devices. The foregoing statement may sound like a contradiction in terms, but actually the only device which can generally react fast enough to protect a semi-conductor device—especially integrated circuits—is another semi-conductor device.

The Several Aspects of Circuit Protection

The use of various semi-conductor devices to protect expensive components does not mean that convention protective devices—such as fuses and circuit breakers—can be eliminated. Rather, the two types of protective devices should be used to complement each other. For example, extremely short periods of over-voltage or over-current can destroy many integrated circuits. The duration of such transients need only be microseconds in many cases, as more than one novice experimenter with low-power, high-gain integrated circuits has learned. On the other hand, it is the slower but steady temperature buildup that occurs during sustained over-voltage or over-current conditions that destroys such items as power supply components, transformers, power transistor devices, etc. The latter devices or circuits can be adequately protected by fuses or circuit-breakers, but sensitive semi-conductor devices require a form of extremely fast-acting protection.

Fast-Acting Protective Devices

Before one writes off the fuse completely as being unsuitable for sensitive transistor circuit protection, it should at least be mentioned that manufacturers are developing specialized fuses for such applications. For instance, Beckman Instruments 817 high-speed fuses operate in one millisecond on light overloads and as fast as 50 microseconds on drastic overloads. However, like all fuses they are "one-time" protective devices and

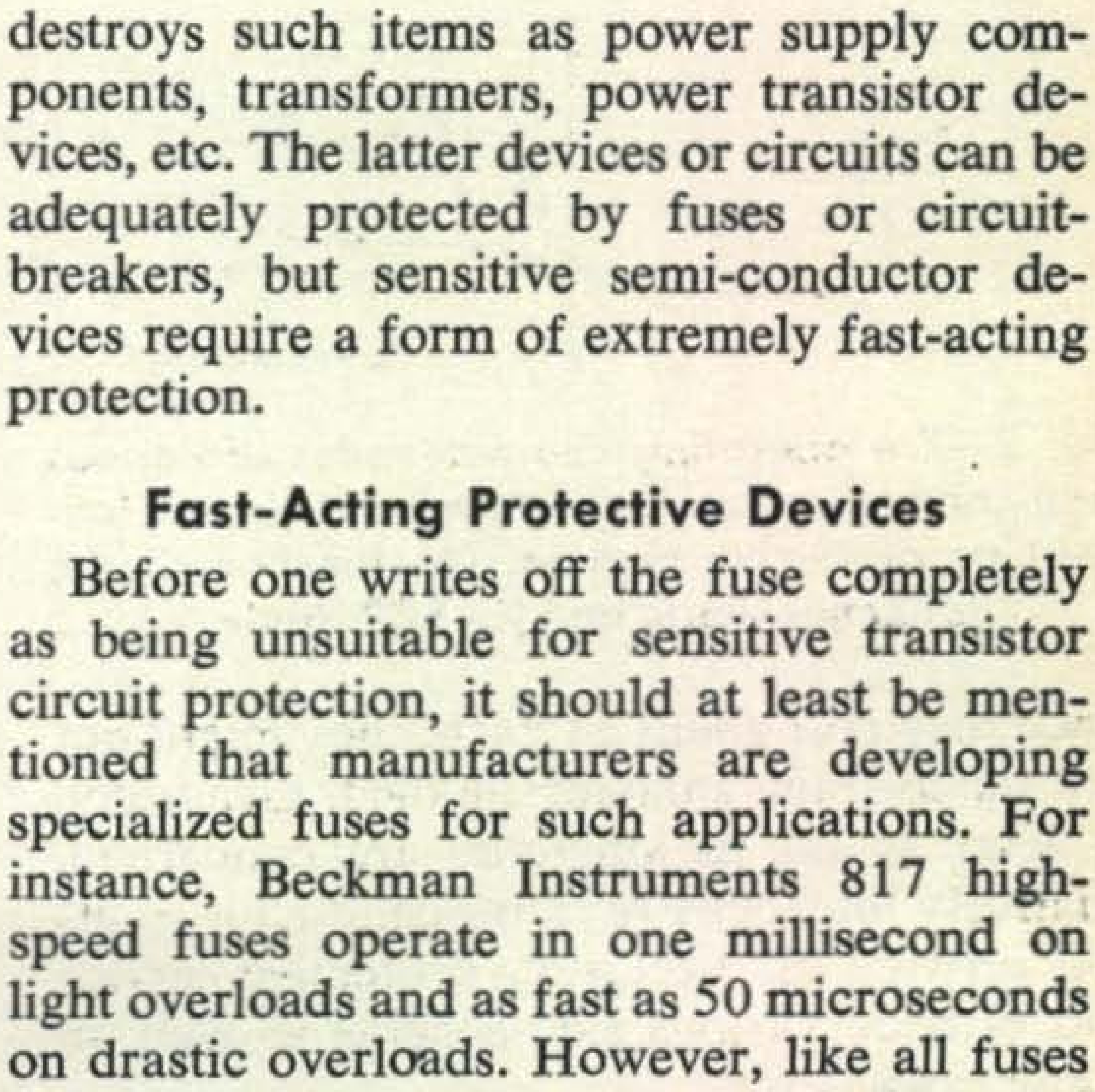


Fig. 1—Various semi-conductor devices used for circuit protection. (A) Small signal diodes, (B) Zener diode and (C) SCR diode.

*1829 Cornelia Street, Brooklyn, N.Y.

1"The Use and Abuse of Current Overload Protection Devices," *CQ*, October, 1968.

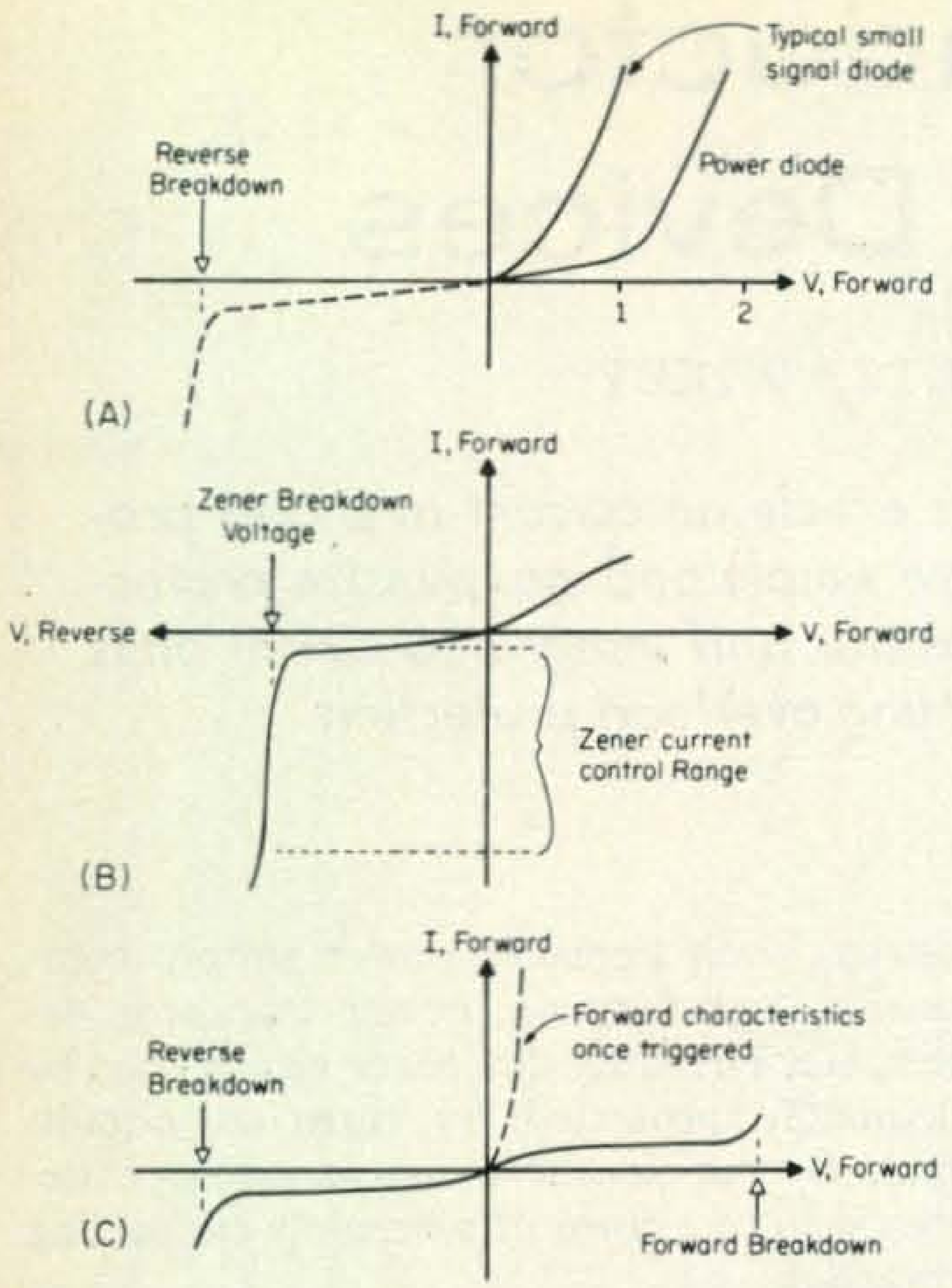


Fig. 2—The operating characteristics of various semi-conductor devices determine their employment as protective devices. (A) Junction diode, (B) Zener diode and (C) SCR diode.

since they cost about $1 each, they might not suit the average amateurs budget. Generally, at least as far as amateurs are concerned, relatively inexpensive semi-conductor units will provide the necessary protective service and provide various side-benefits as well, in many cases.

Simple diodes are often used as protective devices, such as shown in fig. 1(A) for protection of the r.f. amplifier stage in a transceiver or receiver. The diodes suppress the transients that might be produced by transmitter switching, nearby transmitter keying, etc. which could destroy one of the junctions in the transistor. Such diodes do not effect normal r.f. amplifier stage operation since a certain potential barrier exists in the diode which must first be overcome before the diode effectively shorts the input circuit. This is illustrated in fig. 2(A). The diode does not really start to conduct when biased in the forward direction until this potential barrier is exceeded. For a junction type power diode, the potential barrier can be one volt or more. For many small signal diodes, the potential barrier is in the millivolt range and effective diode shunting action will take place before an input level is reached which could be considered destructive. Since the input transients are usually very brief, the dissipation rating of the diodes is usually unimportant. What is important, however, is the response time of the protective diodes since they have to act faster than the current carriers in the transistor junction. For this reason, high speed computer switching diodes, such as the 1N695, 1N914, HE9010, etc. are preferred over such general purpose diodes as the 1N34, 1N54, etc.

The zener diode is not usually thought of as a protective device, but rather as a voltage regulating device. Actually, it can perform both functions simultaneously in many applications. Figure 1(B) shows a zener diode used in the supply lead to an IC amplifier. If the zener diode were used solely for voltage regulation purposes, the diode rating and series resistor value would be chosen on the basis of the lowest expected supply voltage, etc. However, if the zener diode is regarded mainly as a protective device, its rating and that of the series resistor can be chosen on a different basis. For example, if the IC required 10 volts at 20 ma for normal operation and a 12 volt (nominal) supply source were used, the series resistor's value used with the zener diode would be based upon the relative current demands of the IC and the minimum current demand of the zener diode used in order to effect a voltage limiting action when the supply voltage exceeds 12 volts. When the supply voltage falls below 12 volts, no voltage regulation action takes place since the IC would not be endangered.

Perhaps some practical values would make the application clearer.

If the IC load just described (10 volts at 20 ma) were placed on a 12 volt source, a series resistor and 10 volt 10 watt zener diode might be used—wired as shown in fig. 1(B). The zener diode being a 10 volt 10 watt unit can handle 1000 ma under full dissipation conditions. If only a 100 ma sustaining current (sufficient for some regulation) were allotted for the zener diode, the total demand on the 12 volt source would be 120 ma. The series resistor must effect a voltage drop of 2 volts at 120 ma or have a value of 16 ohms. Now if a really *drastic* increase in the source voltage were to occur—say to 32 volts from 12 volts, the zener diode would still try to maintain the IC load voltage at 10 volts. This would require a current flow through the 16 ohm resistor of about 1¼ amperes. If such a current could be supplied by the 12 volt source, about 1000 ma would flow through the zener and only 20-25 ma through the IC. The latter unit would still be protected. In practice, of course. it would be very unusual that the 12 volt source which supplied 120 ma under normal operating conditions could supply 1¼ amperes under an over-voltage condition. Nonetheless, the IC unit would have been protected by the zener diode unit until the excess current flow had caused the fuse or circuit breaker in the power supply to open. Considering that zener diodes of the necessary type are available for $1 or less and their use provides a degree of voltage regulation as well as over-voltage protection, they should be seriously considered as a protective device to be used in the power supply lead to any IC.

Figure 2(B) illustrates the characteristic of the zener diode which makes it useful both as a regulating and protective device. Biased in its forward region, the zener diode acts somewhat like a normal junction diode. Biased in its reverse region, it presents a high impedance until its zener breakdown voltage is reached–after which it provides a sharply decreasing impedance over a wide current range.

The action of the zener diode in providing over-voltage protection is essentially instantaneous. The SCR, or silicon controlled rectifier, is a somewhat similar device which can be used to provide a 1/2-2 microsecond reaction to current overloads in sensitive circuits. The characteristic of the SCR is illustrated in fig. 2(C). It provides a high-impedance condition between its anode and cathode for either polarity of applied voltage until *either* the breakdown voltage of the diode is exceeded (either polarity) or the SCR is triggered. Once the SCR is triggered, its characteristic is very similar to that of a zener diode. SCR's can be obtained in a variety of triggering options, but usually a positive voltage on the gate terminal is required in order to trigger it into conduction.

The circuit of fig. 1(C), for instance, shows an SCR used as a circuit protective device. A resistor is placed in the positive lead in order to produce a voltage proportional to an over-current condition. Very little voltage is required since many SCR's–such as the popular 3N58 unit–require only a gate current voltage of .5 to .8 volt at 50 to 100 μamp. in

[*Continued on page 90*]

DX

BY JOHN A. ATTAWAY,* K4IIF

The S.S.B. DX Award Program

100 Countries

665........K8HZU

This is probably the last report from the old S.S.B. DX Award Program. Next month we will have the first winners from the new CQ C.W. DX Award and CQ S.S.B. DX Award programs. Application blanks and complete rules for the new awards may be obtained from the Award Manager, P.O. Box 1271, Covina, Cal. 91722. The rules may also be found on pg. 58 of the January issue.

Yours truly hasn't been on the other end of the DX pileups enough lately. Except for four days at 4U1ITU last summer its been almost two years since K4IIF was passing out reports contest style from a rare one. This can gradually lead to loss of the perspective necessary to write a well-balanced DX column.

Hopefully this situation will be corrected by the time you read this, as we plan to be on from a medium rare location during the *CQ* WPX S.S.B. Contest the last weekend in March. We recently received a license to operate as VP5JA from the Turks and Caicos Islands, and plans for the contest are being firmly up. If we don't make it for that particular event you can count on us for sure sometime in the weeks ahead. VP5 is a rare prefix since Jamaica dropped it for 6Y5, and I'm sure that a lot of you can use the country for the new *CQ* S.S.B. DX Award, particularly the low band and 10 meter endorsements. Later we hope to go back for some QRPp c.w. operation and some 160 meter contacts as well.

*P.O. Box 205, Winter Haven, Fl. 33880.

Here is Joe Arcure, Jr., W3HNK, latest winner of the Scott's QSL Manager of the Month Award. Joe has been a QSL Manager for 10 years. His list of stations includes JA6BEE, YV5CEY, 4X4RD, 4X4UH, PZ1CF, EP2KB, EP2DX, 9C9DX, 5A3TX, 5A5TR, PAØCOE, PAØHVM, UM8FM, UA3FF, LX1BW, GW3DJZ, SMØBUT, ZS3R, ZS3CJ, VK9BS, CR6LF, CR6KT, ZE4JS, 3Z9PT, SP9PT, KV4EY, VP2VY, EL2BI, CN8BG, KR6HR, CT1MZ, CT1UA, CT1UE, CT1TZ, OX5AP, OY9LV and XP1AA. He also operated at PJ8AR during the 1970 CQ Worldwide S.S.B. Contest so he knows what it's like at the other end as well.

De Extra

At it's December, 1970 meeting the Northern California DX Club adopted a proposal that steps be taken to determine the feasibility of organizing a Council of DX Clubs for the exchange of information, and for mutual effort on problems which may affect DX activities.

This proposed Council would probably

The WAZ Program

S.S.B. WAZ

831........W7RI	836........CT1UA
832........VE6GN	837........DL3OH
833........W6JKJ	838........DJ9ZB
834........YU2NFJ	839........DL9DE
835........JA1ALX	840........K6AQV

C.W.—Phone WAZ

3064........OK1ASJ	3074........DJ2MG
3065........W2UWD	3075........DJ9LJ
3066........WØCDC	3076........DJ7YM
3067........EI5F	3077........DL2GV
3068........YU2NFJ	3078........DL3BA
3069........SP3DOI	3079........HA3GF
3070........WA6TAX	3080........DL1GN
3071........JA1FI	3081........I1CBU
3072........YU1NIG	3082........GM3ITN
3073........DJ1IK	3083........K4KSB

Phone WAZ

449........KP4WD	451........CR7GJ
450........WA6TAX	

Complete WAZ rules are shown on pgs. 64-66 of the June, 1970 issue. Application blanks and reprints of the rules may be obtained by sending a self-addressed, stamped envelope to DX Editor, P.O. Box 205, Winter Haven, FL 3-3880.

work well as a "mail-type" organization. Costs should be minimal. Possibly it would stimulate the formation of additional DX clubs throughout the country, as well as providing a channel for inter-club communications.

Any DX club within the United States which might be interested should drop a line to Hugh Cassidy, publisher of the West Coast DX Bulletin and immediate past president of the Northern California DX Club. Hugh's address is 77 Coleman Drive, San Rafael, California 94901. Delivery is assured as Hugh is also the postmaster.

De Extra heartily endorses this effort. More unity on the part of the major DX organizations can't help but be beneficial to DX activities.

160 Meter News

A resounding first!! On Jan. 3, 1971 at 2157 GMT, Isaji Shima JA3AA, operating on 1909 kc made contact with DL3KRA on 1827 kc. This was the first 160 meter QSO ever reported between Japan and Europe. JA3AA was 579 while DL3KRA was 559. Heartiest congratulations to these intrepid 160 DXers. Another new world is conquered.

The trans-pacific DX path between North America and Japan produced some noteworthy contacts. JA3AA worked WA7ILC, K6DDO, and K6CEO/6 in early January, while JA2CLI made it with a dozen W and VE 6's and 7's during one opening in December. JA2CLI and JA7AO also heard W4EX and W5RTQ.

Rare Stations for the CQ C.W. and S.S.B. DX Awards

Canary Islands—Several stations are active as shown by the following reports: EA8CL, 28560, 1700 GMT on a Saturday; EA8HJ, 14332, 1330 GMT on a Sunday; and EA8FJ, 7020, 0718 GMT on a Saturday.

Ceylon—4S7EC is a good catch on 40 meters. He has been worked on 7012 at 0747 GMT on a Saturday.

Chagos—VQ9SM uses both modes, 14030 for c.w. and 14232 for s.s.b. Preferred operating times are 0200 and 1400 GMT. His gear was furnished by the Southern California DX Club.

Comoro Islands — FH8CG is active daily around 28500 kc at 1200-1500 GMT. If 10 is dead try 21200 at 1500 GMT.

Egypt—SU1MA, Ibrahim, is frequently in the Arabic DX Net on 14200 Fridays at 0600

Antonio, EA8GK, has been licensed about 2 years and is very active on 10, 15 and 20 meter s.s.b. He has a beam and puts in good signals. QSL to K6GAK. *(Photo via K6GAK)*.

The WPX Program

S.S.B. WPX

574........KC6WS
575........WA2DHF
576........PY1BQK
577........DJ5LA

C.W. WPX

1075........WA1CYT

Mixed WPX

264........DA1QP
265........WA6HRS
266........W4DQD

Phone WPX

203........K6SSN

WPNX

26........WN4OJR

VPX

29........OK1-15835 (Mixed)
30........OK1-15835 (C.W.)
31........JA1-8993
32........WDX9JFT

WPX Endorsements

S.S.B.: I1AMU–700, K2JFE–350, DJ5LA–350, W9GHO–350, DA1QP–300, W2EHB –300, and K8BGZ–250.

C.W.: YU1SF–600, K4RDU–500, K8NQP–400, and W9HE–350.

Phone: DK2BL–450.

Mixed: WA6HRS–600, K1LWI–600, 4X4-FU–450, and DA1QP–450.

80 Meters: OK1-15835.

20 Meters: OK1-15835.

Europe: W4WSF, OK1-15835, DK2BL, and WA1CYT.

Oceania: WA6HRS.

Complete rules for WPX, WPNX, and VPX are shown on pages 66-67 of the June, 1970 issue. Application blanks and reprints of the rules may be obtained by sending a self-addressed, stamped envelope to Award Manager, P.O. Box 1271, Covina, Cal. 91722, or to the DX Editor.

WPX HONOR ROLL

The WPX Honor Roll is based on confirmed current prefixes which are submitted by separate application in strict conformance with the CQ Master Prefix List. Scores are based on the current prefix total regardless of an operator's all-time prefix count.

MIXED

W4OPM	Joe Hiller	1050
W9WHM	John Leary	811
W8LY	Michael Bakos	785
K1SHN	Chuck Banta	746
KØBLT	Frank Cahoy	733
W3PVZ	Joseph Olnick	730
W8ROC	Frederick Riecks	729
G3DO	D.A.G. Edwards	721
WØAUB	Bill Bergmann	719
VE3GCO	Garry Hammond	713
W4IC	George Mack	707
WA5LOB	James Edwards	699
I1SF	Serafino Franchi	690
W4BQY	G. B. Fisher	662
CT1LN	Paulo J. S. Coelho Vieira	652
WA6EPQ	Larry Brockman	650
YU1AG	Djura Borosic	614
W8KSR	Jon Hodgin	609
W4CRW	Robert C. Sommer	604
W8GMK	John Marhefka	592
WAØCPX	Edward C. Gray	550

SSB

W4OPM	Joe Hiller	925
W4NJF	Gay Milius	857
DL90H	Karl Muller	741
DL1MD	Heribert Rechl	700
HP1JC	Juan G. Chen	698
WA5LOB	James D. Edwards	692
K2POA	Arthur Johnson	683
I1AMU	Alfonso Porretta	657
F2MO	Michel Dort	632
K1SHN	Chuck Banta	626
G3DO	D.A.G. Edwards	622
W3DJZ	Arden B. Hopple	620
W4IC	George A. Mack	609
I1KDB	Giampaolo Nucciotti	599
W6YMV	Paul E. Friebertshauser	553

CW

W4OPM	Joe Hiller	900
W8KPL	William Simpson	816
W8LY	Michael Bakos	786
W2AIW	Charles Rogers	776
DL1QT	Helmut Baumert	764
VK3AHQ	Henry Denver	753
W2HO	W. Vollkommer	720
ON4QX	Bob Berge	682
W9FD	W. W. Johler	680
WB2FMK	Robert Rasche	628
G2GM	F. D. Cawley	627
K1SHN	Chuck Banta	611
VE4OX	D. E. McVittie	600
I1SF	Serafino Franchi	571
YU1AG	Djura Borosic	569
W8GMK	John Marhefka	562
OK2QX	Ing. Jiri Pecek	556
K1LWI	Wendell Boyden	550

PHONE

W9WHM	John Leary	813
G3DO	D.A.G. Edwards	708
W3DJZ	Arden B. Hopple	654
CX2CN	Samuel C. Barreiro	624
CT1LN	Paulo J. S. Chelho Vieira	619
I1SF	Serafino Franchi	568

Note: The Honor Roll requirement will be increased to 600 prefixes effective next month.

GMT. SU1IM frequents the low end of 14 mc c.w. One report shows him at 14006 at 0306 GMT on a Wednesday.

Gabon Republic – TR8JM was worked on 28500 at 2100 GMT on a Thursday. QSL to DK2NV.

Galapagos Islands–HC8WW is Rolf Weidmer who has a hotel on Floreana Island. He uses a Swan Cygnet and has been heard on s.s.b. from 0200-0315 GMT. Listen around 14210.

Gough Island – ZD9BR is on s.s.b. Try 14200-210 at 0600 GMT. QSL to ZS2RM.

Mariana Islands – KG6SV, 14300 at 0900 GMT, and KG6SL, 1430 at 0700 GMT are on Saipan.

Marion Island–ZS2MI transmits on 14194 and listens on 14200-205. Try at 0430 GMT and again at 1900 GMT.

Oman – MP4MBB is reported to be very active on 20 meters. 14235 at 1230 GMT is a good frequency and time.

Portuguese Guinea–CR3KD has a regular sked with his QSL Manager, Mary Ann, WA-3HUP, on 14300 at 1900 GMT on Thursdays. She can arrange a contact for you.

Rwanda – 9X5AA was heard on 14210 at 0500 GMT. His name is Leo.

Sikkim–AC3PT has been reported on 14290-295 kc around 1300-1330 GMT. The operator's name is Namu.

Sudan – Sid, ST2SA, can sometimes be worked around 14200 s.s.b. on Fridays at 0600 GMT. This is the Arabic DX Net. Also check 14240-250 after 1400 GMT for Middle Eastern stations.

Syria – Rasheed, YK1AA, can occasionally bee worked on Fridays between 0700 and 0900 GMT. QSL to P.O. Box 35, Damascus.

Togo–Albert, 5U4AH, was heard on 28600 at 1645 GMT.

Voltaic Republic–XT2AA, whose handle is Jack, can be found on Fridays at 14218 kc s.s.b. around 2200 GMT. QSL to K3RLY.

Yemen–4W1KZ is another good 40 meter catch. He was reported on 7020 c.w. at 0715 GMT on a Saturday.

New and Rare Prefixes

DF—This was a special German prefix used early this year. Among the stations reported were DF1AFZ and DFØIT.

FYØ—FYØZO on 20 meter s.s.b. is a rare one for WPX.

HG1—HG prefixes are assigned to v.h.f. (28 mc and higher) stations in Hungary. HG1ZA was heard on 28021 kc at 1440 GMT.

HM—HM1EU, 14220 kc at 0150 GMT and HM5BF, 14030 kc at 1220 GMT are Korean stations.

PZ6—PZ6AA puts this rare prefix on the air. Some frequencies and times reported are 14270 kc at 0130 GMT and 28590 kc at 1425 GMT.

TG4—TG4FY heard on 14201 at 0450 GMT is a good prefix catch.

3Y3—3Y3CC is reported to be a Norwegian station in the antarctic. QSL to LA3CC.

Some of the rare prefixes which frequently appear in contests are: 4M4 and 4M5—Venezuela, 4B1 — Mexico, CW4 and CW8 — Uruguay, ZW3, ZY3, ZZ3, and many, many others—Brazil, and 3V3—Tunisia.

New DX Committeemen

We are pleased to announce the appointment of two new members of the *CQ* DX Awards Advisory Committee. Bob Rosier, K4OCE, of Greensboro, N.C. will represent the North Carolina DX Association. This club is rapidly becoming one of the foremost DX clubs in the country and certainly merits a Committeeman.

Bob Vallio, W6RGG, has been picked to replace Dave Baker, W6WX, who has resigned as Committeeman from the Northern California DX Club. We hate to lose Dave as he has been one of our most active members, but we are certain that Bob will do an equally capable job.

Effective April 1, 1971, both K4OCE and W6RGG can check your QSL's for credit toward WAZ and the *CQ* C.W. and S.S.B. DX Awards.

QSL Information

The following volunteer their services as QSL Manager for DX stations: Fred Fleck, W9MWO, 5008 Jarlath Ave., Skokie, Ill. 60076.

AP2KS—Via WB9BWU.
CN8HD—To W2GHK.
CT2BB—c/o WA3NRV.
CT3AS—Via G2MI.
EA8GK—c/o K6GAK.
EA8GZ—To VE7BWG.
F6AEV—c/o WB2QXX, 106 South Cornwall Ave., Ventnor City, N.J. 08406.
FB8WW—Via F5QE.
FG7TG—Not c/o W5OB.
FK8AH—To W2CTN.
FL8HM—c/o W9FN.
FM7WN—Via K2KGB.
FPØCA—To K2OJD.
HC8AA—Box 281, Quito, Ecuador.
HS4ABL—c/o K4TZU.
KG4EE and KG4EQ—To W4PKS.
K3QOS/KB6—Via INDXA, Box 125, Simpsonville, Md. 21150.
ITC4USX—c/o K2BPP.
KP6AL—To INDXA, Box 125, Simpsonville, Md. 21150.
KR6AY—Via KØVXU.
KW6AA—c/o WB6YCT.
LX1BW—To W3HNK.
MP4MBB—Via G3LQP.
OY3MH—P.O. Box 72, Klaksvik, Faeroe Islands, Europe.
OY9LV—To W3HNK.
PJ8NN—c/o K9GCE/4, 6636 11th Ave. No., St. Petersburg, Fla. 33710.
PJØDX—Via K3NPV.
ST2SA—To INDXA, Box 125, Simpsonville, Md. 21150.
TJ1AW—c/o K4ZCP.
TR8JM—Via DK2NU.
UA9VH/JT1—To W3HNK, P.O. Box 14, Norwood, Pa. 19074.
UAØKIP—c/o UW3FD.
VP2EE—Via W9ZRX.
VP2VP—To VE3ACD.
VP5CS—Via ZD8 Bureau. (Business-sized s.a.s.e. please).
VQ9TF—P.O. Box 4, Mahe, Seychelles.
VQ9W—P.O. Box 234, Mahe, Seychelles.
ZB2BY—Via GW3DIX.
ZD8CS—Via ZD8 Bureau (Business-sized s.a.s.e. please).
ZD9BM—c/o GB2SM.
ZE1BT—To WA1IRY.
ZM4OL/A—Via ZM2GX.
ZS2MI—To ZS6LW.
ZS1MH—Via WA1LDA, 55 Amble Rd., Chelmsford, Mass. 01824.
Z56YK—WB2JYM.
3B8CZ—c/o VQ8AD.
3Y3CC—Via LA3CC.
4S7AB—To W2CTN.
5H3LV—c/o VE3ODX.
5H3MV—Via VE7SE.
7P8AB—To W2LGV.
7P8AZ—c/o VE2JH.
7Q7AA—Via W2CTN.
7X7AJ and 7X7AL—To WA2HSX.
7Z3AB—c/o W5NOP.
9E3USA—Via VE3IG.
9J2WS—To W4LS.
9U5CR—c/o WA8BTS.
9X5AA—Via W1YRC.
9X5WJ—To W1MIJ.

73, John, K4IIF

PLEASE USE YOUR ZIP CODE NUMBER ON ALL CORRESPONDENCE

Q AND A

BY WILFRED M. SCHERER,*
W2AEF

MARS Operation With SB-101

QUESTION: The Heath SB-101 has a provision for MARS operation with a crystal socket for crystal-controlled operation. The manual states that the frequency of operation must be within 25 kc of the band edge due to the bandpass filter characteristics. I should like to know how this circuit can be modified to allow operation on the 3245 kc MARS net which is 255 kc out of the 80-meter band.

ANSWER: The bandpass filters in the SB-101 are the 8895-8395 kc and the 3395 kc ones. Their characteristics should have no effect on the shift to 3245 kc operation of the unit if the proper heterodyning crystal is used.

Using a 12095 kc heterodyning crystal, the transceiver will tune 3200-3700 kc and the 1st i.f. would be 8895-8395 kc which is the bandpass on the 1st filter. What does have to be considered is the range of the crystal-oscillator inductor used for the 3.5 mc band. This may require readjusting the inductor slug or adding some capacitance across the inductor to get down to the crystal frequency.

Another consideration is the tuning range of the r.f. circuits used for the receiver front-end, the driver and the p.a. tank. These might require similar treatment. No doubt this situation is what is implied in the instructions as far as the limited bandpass goes.

Need A Spring?

When work is conducted on mechanical devices used in electronic gear, small springs are often found defective, become lost or broken. Where such is the case, springs may be fashioned from those found in ball-point pens. To have a supply of such springs handy for emergencies, save those which may be retrieved when replacement pen cartridges are installed. This will avoid the need for stealing a spring from a still-functioning pen. They may be used as comparison or expansion springs.

6146B's with SB-101

QUESTION: I'd like to install 6146B's in my SB-101, but have heard of rumors that the B-model of the tube was hard to neutralize. I have also heard some hams on the air, which I have been unable to "break," talking about modifying their SB-101's for use with the 6146B's. I gather from their conversation that they changed a resistor and/or capacitor in the final section to change the biasing slightly, etc.

Since switching to 6146B's, with no circuit changes, I find I get good performance out of the SB-101, but I do appear to have a bit more of a TVI problem. Have you any recommended circuit changes?

ANSWER: Unless operating voltages are changed, there is nothing to be gained in thet way of output by the use of 6146B's in the SB-101. However, they do have a bit higher plate-dissipation rating than do the 6146's which is a little easier on the tubes when used with existing operating potentials. More power output requires an increase in screen and bias voltages. The latter makes the tubes harder to drive. Slight differences in the internal characteristics of the 6146's over the 6146's may require a change in neutralization and the parasitic suppressors. We have no specific data on circuit changes.

Perhaps one of our readers, such as those you heard discussing the situation on the air, may be able to shed some light on any modifications. How about it fella's?

Plate-Voltage Control with Regenerative Detector

QUESTION: Can you think of any reason why a regeneration control should not be used in the negative plate lead of the old-time regenerative detector circuit instead of in the positive plate lead as the books show? Oscillator circuits have seemed a little more prone to parasitic oscillations when regenerative lead, but this may be just a coincidence. I can't see why there should be any difference.

ANSWER: There should not be any difference in respect to the above locations for the control; provided r.f. isolation is furnished between the plate return and the B-plus lead. With the control in the negative lead, stability

[*Continued on page 101*]

*Technical Director, *CQ*.

Propagation

BY GEORGE JACOBS,* W3ASK

THERE is now evidence that the present sunspot cycle has started to decline again. The Swiss Federal Solar Observatory at Zurich reports a mean sunspot number of 76.6 for December, 1970. This is the lowest monthly level of solar activity reported since September, 1967. Based upon December's level of solar activity, the latest smoothed sunspot number is 105, centered on June, 1970. A smoothed sunspot number of 84 is forecast for April, 1971.

During April, 15 meters is expected to be the optimum DX band from shortly after sunrise through the late afternoon and early evening hours. Exceptionally good openings, with strong signal levels, are forecast to most areas of the world during this time span. On some paths, mainly to southern and tropical areas, the band should also remain open well into the hours of darkness.

DX conditions are expected to be optimum on the 20 meter band during the hours of darkness and the sunrise period. With increased hours of daylight, 20 meters is expected to remain open to one area of the world or another, practically around-the-clock. DX conditions should peak during the sunrise period, and again during the late afternoon hours, when excellent openings are forecast to most areas of the world. Exceptionally high signal levels are expected on many openings during the hours of darkness.

A noticeable decline is forecast in the number of 10 meter openings that can be expected during April on DX paths, but this is normal for this time of year. A few good openings are still likely to occur, however, during the daylight hours, especially on paths to southern or tropical areas.

With shorter hours of darkness, there will be a decline in DX openings on the 40, 80 and 160 meter bands during April. Good DX propagation conditions, however, are expected on 40 meters to many parts of the world, during the hours of darkness and the sunrise and sunset periods. Some fairly good 80 meter DX openings should also be possible during the hours of darkness and the sunrise period, and there is also a chance for an occasional DX opening on 160 meters during this same time period. A seasonal increase in thunderstorm activity in the northern hemi-

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

LAST MINUTE FORECAST

April, 1971

	Rating & Forecast Quality			
Days	(4)	(3)	(2)	(1)
Above Normal: 4, 7, 12-13, 15, 18, 25, 27.			B-C	C
Normal: 3, 6, 8, 10-11, 14, 16, 19, 24, 26, 30.	A-B	B-C	C-D	D-E
Below Normal: 1-2, 5, 9, 17, 20-21, 23, 29.	C	D	D	E
Disturbed: 22.	D	E	E	E

HOW TO USE THESE CHARTS

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

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

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

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

3—With the forecast rating noted above, start with the numbers in parenthese 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 meaning: (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 and considerable fading and noise; E—poor opening, or none at all.

4—This month's DX Propogation Charts are based upon a transmitter power of 250 watts c.w.; 1 kw p.e.p. 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 0 areas, and the Western USA Chart in the 6 and 7 areas. The Charts are valid from April 15, 1971 through June 15, 1971 and are prepared from basic propagagation data published monthly by the Institute For Telecommunication Sciences of the U.S. Dept. of Commerce, Boulder, Colorado.

sphere will mean higher static levels on these bands.

DX propagation forecasts for each of the amateur bands from 10 through 160 meters for the period April 15 through June 15, 1970 appear in the *DX Charts* on the following pages. For predictions of short-skip openings between distances of 50 and 2400 miles, refer to the *Short-Skip Charts,* which appeared in last month's column.

V.h.f. Ionospheric Openings

April is expected to be a good month for v.h.f. ionospheric openings, with seasonal increases in sporadic-E propagation, an improvement in trans-equatorial scatter and a major meteor shower.

A seasonal increase in sporadic-E propagation usually begins during April and continues through the spring and summer months. This should result in a noticeable increase in the number of short-skip openings between distances of approximately 750 and 1300 miles on the 10 and 6 meter bands, with an occasional two-hop opening up to a distance of about 2400 miles. During periods of intense sporadic-E ionization, openings on 2 meters may also be possible over distances between approximately 1200 to 1400 miles. While sporadic-E propagation may occur at any time of the day or night, there is a tendency for it to peak between 8 A.M. and Noon and again between 5 and 8 P.M., local standard time.

Lyrids, a major meteor shower is expected to take place between April 21-23, peaking during the late afternoon hours of April 22. During the peak of the shower, an average of 15 good sized meteors are expected to enter the earth's atmosphere every hour, considerably increasing chances for v.h.f. meteor scatter-type openings.

A seasonal increase in trans-equatorial (TE) openings is expected during April. TE openings are most likely to occur between 8 and 11 P.M., local time at the path mid-point, on long north-south paths which cross the geomagnetic equator at approximately a right angle. TE openings to South America favor locations in the southern third of the USA, with progressively less frequent openings in the central and northern sectors.

Some fairly good v.h.f. auroral-type ionospheric openings are expected during April, especially during periods when the ionosphere is disturbed for h.f. signals. Check the "Last Minute Forecast" at the beginning of this column for those days during which h.f. conditions are exected to be disturbed or below normal. Auroral-type v.h.f. openings are most likely to occur during these same periods.

April 15–June 15, 1971

Time Zone: EST (24-Hour Time)

EASTERN USA TO:

	10 Meters	15 Meters	20 Meters	40/80 Meters
Western & Central Europe & North Africa	11-16 (1)	08-10 (1) 10-14 (2) 14-16 (3) 16-18 (2) 18-20 (1)	08-12 (2) 12-15 (3) 15-19 (4) 19-21 (3) 21-00 (2) 00-04 (1) 04-05 (2) 05-08 (3)	18-20 (1) 20-21 (2) 21-23 (3) 23-01 (2) 01-03 (1) 20-22 (1)* 22-23 (2)* 23-01 (1)*
Northern Europe & European USSR	*Nil*	09-11 (1) 11-15 (2) 15-17 (1)	05-08 (2) 08-12 (1) 12-14 (2) 14-16 (3) 16-18 (2) 18-20 (1) 20-23 (2) 23-05 (1)	18-19 (1) 19-23 (2) 23-01 (1) 19-23 (1)*
Eastern Mediterranean & Middle East	*Nil*	09-12 (1) 12-15 (2) 15-17 (3) 17-18 (1)	11-13 (1) 13-15 (2) 15-19 (3) 19-21 (2) 21-23 (3) 23-01 (2) 01-05 (1) 05-07 (2) 07-09 (1)	19-21 (1) 21-23 (2) 23-00 (1) 21-23 (1)*
West & Central Africa Africa	10-13 (1) 13-17 (2) 17-18 (1)	06-07 (1) 07-09 (2) 09-12 (1) 12-13 (2) 13-14 (3) 14-17 (4) 17-19 (3) 19-21 (2) 21-22 (1)	07-13 (1) 13-15 (2) 15-17 (3) 17-21 (4) 21-00 (3) 00-02 (2) 02-05 (1) 05-07 (2)	18-20 (1) 20-22 (2) 22-01 (3) 01-02 (2) 02-03 (1) 21-02 (1)*
East Africa	13-17 (1)	07-10 (1) 10-13 (2) 13-17 (3) 17-18 (2) 18-19 (1)	04-05 (1) 05-07 (2) 07-08 (1) 13-15 (1) 15-17 (2) 17-21 (3) 21-23 (2) 23-01 (1)	19-20 (1) 20-23 (2) 23-01 (1) 20-22 (1)*
South Africa	09-10 (1) 10-12 (2) 12-13 (1)	00-01 (1) 01-02 (2) 02-03 (1) 07-09 (1) 09-11 (2) 11-13 (3) 13-14 (2) 14-16 (1)	12-14 (1) 14-16 (2) 16-17 (1) 23-00 (1) 00-03 (3) 03-05 (2) 05-07 (1)	19-20 (1) 20-23 (2) 23-01 (1) 21-00 (1)*
Central & South Asia	*Nil*	08-10 (1) 18-20 (1)	05-06 (1) 06-08 (2) 08-10 (1) 17-19 (1) 19-21 (2) 21-23 (1)	18-20 (1)
Southeast Asia	*Nil*	07-10 (1) 17-18 (1) 18-20 (2) 20-22 (1)	05-06 (1) 06-08 (2) 08-10 (1) 16-17 (1) 17-19 (2) 19-21 (1)	*Nil*
Far East	17-19 (1)	08-10 (1) 16-17 (1) 17-19 (2) 19-21 (1)	03-05 (1) 05-06 (2) 06-08 (3) 08-09 (2) 09-10 (1) 17-19 (1)	05-07 (1)*

	10 Meters	15 Meters	20 Meters	40/80 Meters
South Pacific & New Zealand	14-16 (1) 16-19 (2) 19-20 (1)	07-08 (1) 08-10 (2) 10-15 (1) 15-18 (2) 18-21 (3) 21-23 (2) 23-00 (1)	09-11 (2) 11-20 (1) 20-21 (2) 21-22 (3) 22-00 (4) 00-04 (3) 04-07 (2) 07-09 (3)	00-02 (1) 02-02 (2) 02-04 (3) 04-06 (2) 06-07 (1) 02-06 (1)*
Australasia	17-20 (1)	08-10 (1) 16-18 (1) 18-21 (2) 21-23 (1)	14-15 (1) 15-17 (2) 17-22 (1) 22-00 (2) 00-02 (3) 02-06 (2) 06-08 (3) 08-09 (2) 09-10 (1)	03-04 (1) 04-06 (2) 06-07 (1) 04-06 (1)*
Northern & Central South America	10-11 (1) 11-13 (2) 13-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	06-07 (1) 07-08 (2) 08-12 (3) 12-18 (4) 18-20 (3) 20-21 (2) 21-22 (1)	03-05 (2) 05-09 (4) 09-11 (3) 11-15 (2) 15-17 (3) 17-23 (4) 23-02 (3) 02-03 (2)	18-19 (1) 19-20 (2) 20-04 (3) 04-06 (2) 06-07 (1) 20-01 (1)* 01-03 (2)* 03-05 (1)*
Brazil, Argentina, Chile & Uruguay	09-11 (1) 11-14 (2) 14-16 (3) 16-17 (4) 17-18 (3) 18-19 (2) 19-20 (1)	06-07 (1) 07-10 (2) 10-14 (1) 14-15 (2) 15-16 (3) 16-19 (4) 19-20 (3) 20-21 (2) 21-22 (1)	15-16 (1) 16-17 (2) 17-18 (3) 18-22 (4) 22-00 (3) 00-02 (2) 02-05 (1) 05-07 (2) 07-09 (1)	20-21 (1) 21-03 (2) 03-06 (1)* 23-04 (1)*
McMurdo Sound, Antarctica	15-17 (1)	08-10 (1) 13-15 (1) 15-18 (2) 18-20 (1)	16-18 (1) 18-20 (2) 20-01 (3) 01-06 (2) 06-08 (1)	19-00 (1) 00-04 (2) 04-05 (1)

Time Zone: CST & MST (24-Hour Time)

CENTRAL USA TO:

	10 Meters	15 Meters	20 Meters	40/80 Meters
Western & Central Europe & North Africa	11-15 (1)	09-13 (1) 13-17 (2) 17-18 (1)	05-07 (1) 07-09 (2) 09-12 (1) 12-14 (2) 14-16 (3) 16-18 (4) 18-20 (3) 20-22 (2) 22-01 (1)	19-20 (1) 20-22 (2) 22-01 (1) 21-22 (1)* 22-23 (2)* 23-00 (1)*
Northern Europe & European USSR	*Nil*	09-11 (1) 11-13 (2) 13-15 (1) 21-00 (1)	05-06 (1) 06-08 (2) 08-14 (1) 14-18 (2) 20-23 (2) 18-20 (1) 23-02 (1)	18-20 (1) 20-22 (2) 22-00 (1) 20-22 (1)*
Eastern Mediterranean & Middle East	*Nil*	10-14 (1) 14-16 (2) 16-18 (1)	06-08 (1) 12-14 (1) 14-18 (2) 18-21 (3) 21-00 (2) 00-02 (1)	19-23 (1)
West & Central Africa	10-12 (1) 12-16 (2) 6-17 (1)	07-10 (1) 10-13 (2) 13-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	05-07 (2) 07-09 (1) 12-14 (1) 14-16 (2) 16-17 (3) 17-19 (4) 19-22 (3) 22-00 (2) 00-05 (1)	19-20 (1) 20-22 (2) 22-00 (1) 20-22 (1)*
South Africa	11-13 (1)	09-11 (1) 11-13 (2) 13-15 (1) 23-01 (1)	14-16 (1) 16-19 (2) 19-22 (1) 22-02 (2) 02-04 (1) 04-07 (2) 07-08 (1)	19-21 (1) 21-23 (2) 23-00 (1)
East Africa	15-17 (1)	10-12 (1) 12-14 (2) 14-17 (3) 17-18 (2) 18-20 (1)	12-15 (1) 15-16 (2) 16-22 (3) 22-00 (2) 00-04 (1)	20-23 (1)

	10 Meters	15 Meters	20 Meters	40/80 Meters
Central & South Asia	*Nil*	15-18 (1) 18-20 (2) 20-21 (1) 08-10 (1)	04-06 (1) 06-09 (2) 09-11 (1) 17-19 (1) 19-22 (2) 22-00 (1)	06-08 (1)
Southeast Asia	*Nil*	09-12 (1) 12-16 (2) 16-18 (1) 18-20 (2) 20-22 (1)	22-02 (1) 02-06 (2) 06-08 (3) 08-09 (2) 09-12 (1)	06-08 (1)
Far East	*Nil*	07-09 (1) 12-14 (1) 14-18 (2) 18-20 (3) 20-22 (2) 22-00 (1)	22-00 (1) 00-02 (2) 02-04 (1) 04-06 (2) 06-09 (3) 09-10 (2) 10-12 (1)	02-03 (1) 03-05 (2) 05-07 (1) 03-05 (1)*
South Pacific & New Zealand	12-14 (1) 14-17 (2) 17-19 (3) 19-20 (2) 20-22 (1)	06-08 (1) 11-13 (1) 13-17 (2) 17-19 (3) 19-21 (4) 21-22 (3) 22-00 (2) 00-01 (1)	16-18 (1) 18-20 (2) 20-22 (3) 22-01 (4) 01-06 (3) 06-08 (2) 08-10 (1)	00-02 (1) 02-03 (2) 03-05 (3) 05-06 (2) 06-07 (1) 01-02 (1)* 02-05 (2) 05-06 (1)*
Australasia	15-17 (1) 17-20 (2) 20-21 (1)	07-08 (1) 08-09 (2) 09-10 (1) 15-18 (1) 18-20 (2) 20-22 (3) 22-00 (2) 00-01 (1)	08-11 (2) 11-13 (1) 13-15 (2) 15-20 (1) 20-22 (2) 22-00 (3) 00-04 (4) 04-08 (3)	01-03 (1) 03-05 (2) 05-07 (1) 04-06 (1)*
Northern & Central South America	10-12 (1) 12-14 (2) 14-15 (3) 15-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-09 (2) 09-14 (3) 14-18 (4) 18-20 (3) 20-21 (2) 21-22 (1)	02-05 (2) 05-07 (3) 07-09 (4) 09-11 (3) 11-15 (2) 15-18 (3) 18-22 (4) 22-02 (3)	18-20 (1) 20-30 (3) 03-04 (2) 04-06 (1) 20-22 (1)* 22-01 (2)* 01-05 (1)*
Brazil, Argentina, Chile & Uruguay	09-11 (1) 11-13 (2) 13-15 (3) 15-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-10 (2) 10-13 (1) 13-15 (2) 15-16 (3) 16-18 (4) 18-19 (3) 19-21 (2) 21-22 (1)	12-15 (1) 15-17 (2) 17-19 (3) 19-22 (4) 22-00 (3) 00-02 (2) 02-04 (1) 04-06 (2) 06-08 (1)	20-22 (1) 22-00 (2) 00-02 (1) 02-04 (2) 04-06 (1) 00-04 (1)*
McMurdo Sound, Antarctica	17-20 (1)	16-18 (1) 18-21 (2) 21-00 (1)	15-17 (1) 17-18 (2) 18-20 (3) 20-00 (4) 00-04 (3) 04-06 (2) 06-07 (1)	21-23 (1) 23-01 (2) 01-06 (1)

Time Zone: PST (24-Hour Time)

WESTERN USA TO:

	10 Meters	15 Meters	20 Meters	40/80 Meters
Western Europe & North Africa	*Nil*	09-11 (1) 11-15 (2) 15-17 (1)	05-07 (1) 07-09 (2) 09-12 (1) 12-15 (2) 15-17 (3) 17-19 (2) 19-21 (1) 21-23 (2) 23-00 (1)	19-20 (1) 20-22 (2) 22-23 (1) 20-22 (1)*
Central & Northern Europe & European USSR	*Nil*	08-09 (1) 09-11 (2) 11-14 (1) 21-23 (1)	06-07 (1) 07-09 (2) 09-10 (1) 14-15 (1) 15-17 (2) 17-20 (1) 20-00 (2) 00-02 (1)	19-22 (1)
Eastern Mediterranean & Middle East	*Nil*	10-14 (1) 18-20 (1)	04-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-18 (1) 18-23 (2) 23-01 (1)	19-22 (1)

West & Central Africa	12-15 (1)	08-10 (1) 10-13 (2) 13-16 (3) 16-17 (2) 17-19 (1)	05-07 (1) 10-14 (1) 14-17 (2) 17-20 (3) 20-23 (2) 23-02 (1)	20-00 (1)
East	*Nil*	12-14 (1) 14-17 (2) 17-20 (1)	10-14 (1) 14-17 (2) 17-19 (3) 19-20 (2) 20-22 (1)	18-20 (1)
South Africa	08-10 (1)	06-08 (1) 08-11 (2) 11-12 (1) 21-23 (1)	05-07 (1) 13-14 (1) 14-16 (2) 16-17 (1) 21-22 (1) 22-00 (2) 00-02 (1)	18-19 (1) 19-21 (2) 21-22 (1)
Central & South Asia	*Nil*	07-09 (1) 09-11 (2) 11-12 (1) 15-16 (1) 16-18 (2) 18-20 (1)	02-04 (2) 04-06 (1) 06-08 (3) 08-09 (2) 09-12 (1) 17-19 (1) 19-21 (2) 21-22 (1)	04-07 (1)
Southeast Asia	13-15 (1) 20-22 (1)	07-09 (1) 09-11 (3) 11-12 (2) 12-15 (1) 15-19 (2) 19-21 (1)	22-01 (1) 01-02 (2) 02-03 (3) 03-06 (2) 06-08 (3) 08-10 (2) 10-12 (1)	02-06 (1)
Far East	13-15 (1) 15-17 (2) 17-18 (1)	08-09 (1) 09-11 (2) 11-13 (1) 13-15 (2) 15-20 (3) 20-22 (2) 22-23 (1)	18-21 (1) 21-22 (3) 22-23 (3) 23-01 (4) 01-02 (3) 02-03 (2) 03-05 (1) 05-06 (2) 06-09 (3) 09-11 (2) 11-12 (1)	00-02 (1) 02-05 (2) 05-07 (1) 02-05 (1)*

South Pacific & New Zealand	11-12 (1) 12-13 (2) 13-17 (3) 17-19 (4) 19-20 (3) 20-21 (2) 21-22 (1)	09-11 (1) 11-13 (2) 13-15 (1) 15-18 (2) 18-19 (3) 19-21 (4) 21-22 (3) 22-23 (2) 23-00 (1)	05-08 (1) 08-11 (2) 11-16 (1) 16-18 (2) 18-19 (3) 19-23 (4) 23-00 (3) 00-05 (2)	20-22 (1) 22-00 (2) 00-05 (3) 05-06 (2) 06-08 (1) 00-02 (1)* 02-05 (2)* 05-06 (1)*
Australasia	12-14 (1) 14-16 (2) 16-18 (3) 18-20 (2) 20-21 (1)	11-13 (1) 13-18 (2) 18-20 (3) 20-22 (4) 22-00 (3) 00-01 (2) 01-02 (1)	18-20 (1) 20-22 (2) 22-00 (3) 00-03 (4) 03-07 (3) 07-09 (2) 09-10 (1)	00-01 (1) 01-02 (2) 02-05 (3) 05-06 (2) 01-02 (1)* 02-04 (2)* 04-05 (1)*
Northern & Southern South America	09-11 (1) 11-13 (2) 13-15 (3) 15-16 (2) 16-17 (1)	06-08 (1) 08-10 (2) 10-14 (3) 14-17 (4) 17-19 (3) 19-21 (2) 21-23 (1)	15-17 (3) 17-21 (4) 21-01 (3) 01-04 (2) 04-07 (3) 07-15 (2)	18-19 (1) 19-20 (2) 20-01 (3) 01-03 (2) 03-05 (1) 20-00 (1)* 00-02 (2)* 02-04 (1)*
Brazil, Argentina, Chile & Uruguay	08-11 (1) 11-13 (2) 13-14 (3) 14-16 (4) 16-18 (3) 18-19 (2) 19-20 (1)	06-07 (1) 07-09 (2) 09-13 (1) 13-15 (2) 15-16 (3) 16-18 (4) 18-19 (3) 19-21 (2)	12-14 (1) 14-16 (2) 16-18 (3) 18-22 (4) 22-00 (3) 00-03 (1) 03-06 (2) 06-07 (1) 21-23 (1)	18-19 (1) 19-02 (2) 02-03 (1) 19-02 (1)*
McMurdo Sound, Antarctica	18-20 (1)	14-17 (1) 17-20 (2) 20-23 (1)	15-17 (1) 17-19 (2) 19-21 (3) 21-00 (4) 00-02 (3) 02-03 (2) 03-05 (1)	20-21 (1) 21-22 (2) 23-04 (1) 04-06 (2) 06-07 (1)

*Predicted times of 80 meter openings. Openings on 160 meters are also likely to occur during those times when 80 meter openings are shown with a forecast rating of (2), or higher.

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

Mar.	14	WAB HF Phone Contest
Mar.	**27-28**	**CQ WW WPX SSB Contest**
Mar.	28	WAB HF C.W. Contest
Mar.	27-28	New Mexico QSO Party
Apr.	4	WAB LF Phone Contest
Apr.	2-5	Old, Old Timers QSO Party
Apr.	3-4	Florida QSO Party
Apr.	3-4	SP DX C.W. Contest
Apr.	3-5	Connecticut QSO Party
Apr.	11	WAB LF C.W. Contest
Apr.	3-11	IARC Propagation Phone
Apr.	10-11	Novice QSO Party
Apr.	24-25	PACC DX Contest
Apr.	24-25	WAE RTTY Contest
Apr.	24-25	ONE Land QSO Party
May	1-2	OZ-CCA DX Contest
May	1-3	Georgia QSO Party
May	8-9	USSR C.W. DX Contest
May	15-16	Bermuda Phone Contest
May	17-18	World Telecomm. Contest
May	21-23	YL ISSBers QSO Party
June	4-7	CHC/FHC/HTH QSO Party
June	20	WAB VHF Phone Contest
June	19-20	Bermuda C.W. Contest

Worked All Britain Contest

The "WAB" contests are 12 hours affairs from 0900 to 2100 GMT on the dates listed in the Events list above.

The following rules are for over-seas stations other than the British Isles. Contacts made during the contest period may also be used for the WAB awards.

Bands: l.f.–1.8, 3.5, 7 mc. h.f.–14, 21, 28 mc. v.h.f.–All above 30 mc.

Exchange:–RS/RST and QSO number. UK will also give county and WAB area number.

Scoring: Each contact 5 points, the same station may be worked on different bands for QSO points but not a multiplier.

The multiplier is determined by the different UK WAB areas worked. Final score, total QSO points times the WAB multiplier.

Awards: Certificates to leading stations in each country and VE, VK and W/K call areas. There are also awards for s.w.l's logging stations working the contest. Serial nr. must be shown.

Logs must be received within 50 days and go to: WAB Contest Manager, Norman Booth, G2DSF, 49 Baggrave Street, Leicester, England.

Awards applications and information about WAB awards go to: John Morris, G3ABG, 24 Walhouse Street, Cannock, Staffs., England.

*14 Sherwood Road, Stamford, Conn. 06905.

New Mexico QSO Party

Three Periods: (GMT)
2200 Sat. Mar. 27 to 0100 Sun. Mar. 28
0200 to 0600 Sunday, March 28
1700 to 2200 Sunday, March 28

This announcement should have appeared in last month's CALENDAR but was not received in time. The Radio Clubs of New Mexico are the sponsors this year.

Exchange: QSO nr., RS/RST and QTH; county for N. Mex. and state or country for others.

Scoring: 1 point for QSOs on 40, 20 and 15; 2 points on 80 and 10; 3 points other bands. Multiplier is sum of states and countries for New Mex. (KH6, KL7 and USA not countries) Others use New Mex. counties. (max. of 32) New Mex. may work in-state for multiplier only.

Frequencies: C. W. – 3565, 7065, 14065, 21065, 28065. Phone–3900, 7250, 4275, 21350, 28600.

Awards: Certificates to highest scoring station in each state and country, and top New Mexico scorers. (min. of 5 QSOs)

A check sheet of contacts is required for stations making over 25 QSOs. Include a s.a.s.e. for copy of results.

Logs go to: Los Alamos A.R.C., P.O. Box 787, Los Alamos, New Mexico 87544 before May 1st.

Old, Old Timers QSO Party

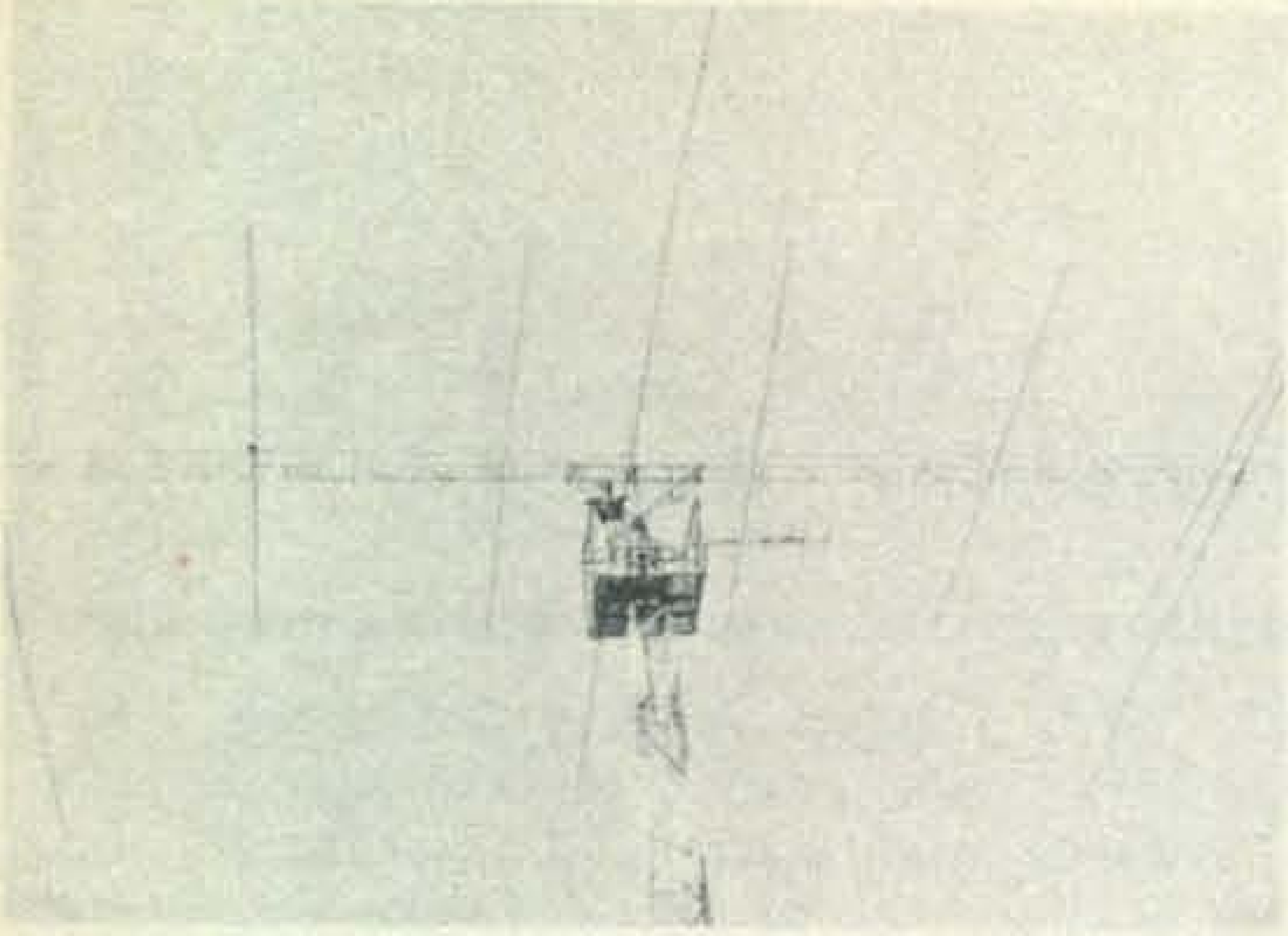
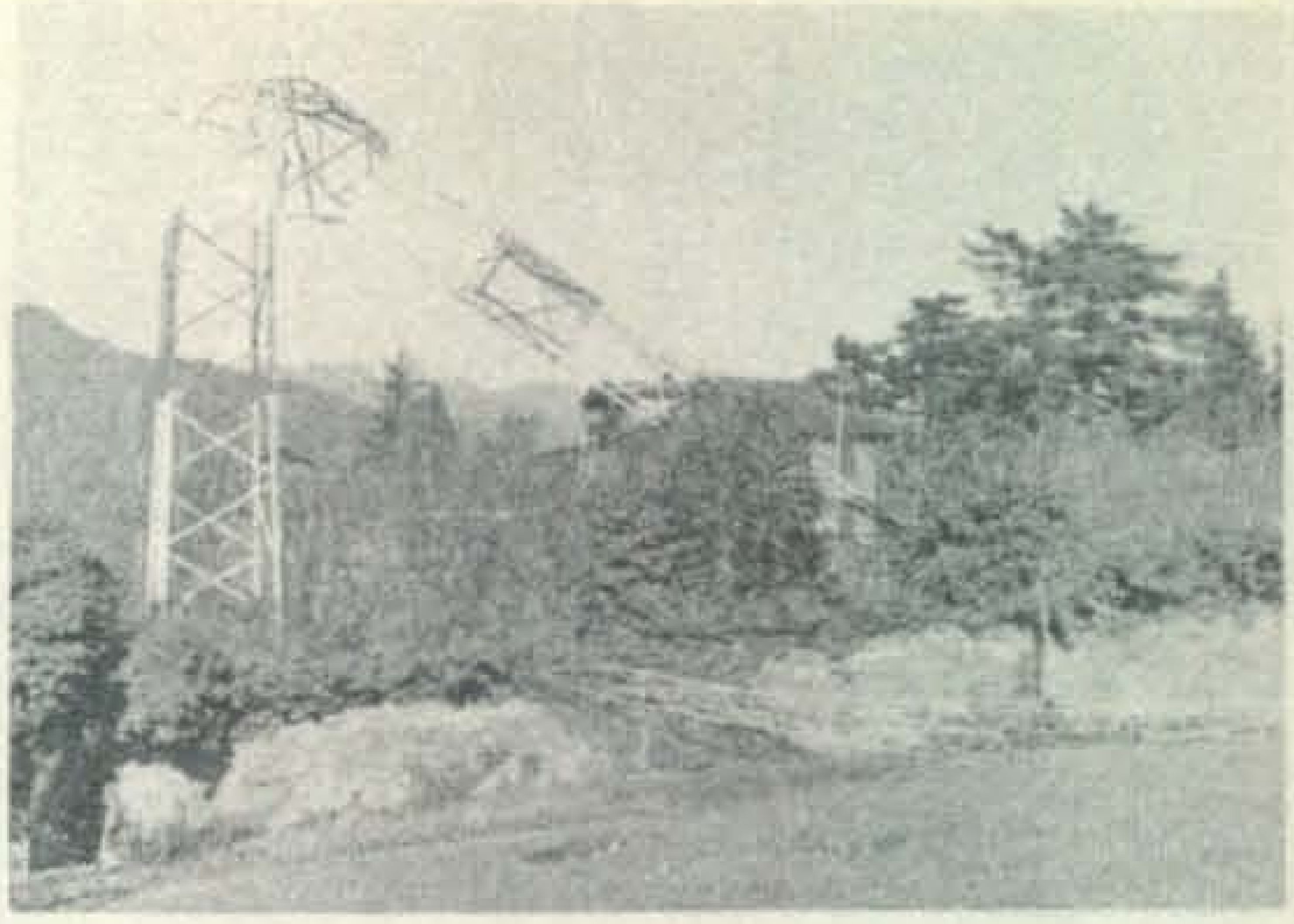
Starts: 2300 GMT Friday, April 2
Ends: 2300 GMT Monday, April 5

This one is for members of the Old, Old Timers Club only. Details were published in *Spark Gap Times* of the OOTC.

Exchange: QSO nr., RS/RST, state, province or country, name and OOTC number.

Scoring: One point per QSO between stations in the US or Canada, 5 points if its with a DX station. A multiplier of 1 for each state, province and country worked.

Frequencies: 3520, 3530, 3820, 3830, 7020, 7030, 7240, 7260, 14279, 14290, 21021, 21030, 21270, 21280.

So you think you had troubles. These are the "before and after" photos of IIBAF's antenna system. The completed job after 2 years of construction, 100 ft. tower, 66 ft. boom with 6 el on 20 and 3 el on 40. Two days before the Phone Contest a 100 m.p.h. northeaster created the devestation in the "after" photo. Mino was going to chuck amateur radio and go back to fishing, but thought better of it and hastily put up some dipoles and joined the fray. That's dedication.

Awards: Certificates to top scorers in each state, province and country.

Logs go to: Graham McConomey, W6BUK, Space 45, 36770 Florida Ave., Hemet, Calif. 92343.

Florida QSO Party

Three Periods: (GMT)
1500 to 2000 Saturday, April 3
0000 to 0500 Sunday, April 4
1400 to 2359 Sunday, April 4

Florida Skip, the amateur radio publication for Florida announces its 7th annual party.

Phone and c.w. are separate contests, the same station may be worked on each band for QSO points. Florida stations may work in-state stations but for QSO points only.

Exchange: RS/RST and county for Florida; and RS/RST, state, province or country for others.

Scoring: 1 point per QSO. Fla. stations use states, (49) provinces (10) and DX countries (12) for their multiplier. (max. mult. of 71. No more than 12 DX countries may be used.) Other use Fla. counties for multiplier. (max. of 67)

Frequencies: C.W.–1807, 3571, 7071, 14071, 21071, 28071. Phone–1817, 3971, 7271, 14317, 21371, 28571.

Awards: Certificates both phone and c.w. to the top scorers in each state, province and DX country. And in each Fla. county, both single and multi-operator. There are also 4 Trophies as follows: Top single operator c.w., phone and multi-operator station in Florida. And top single operator out of state station.

A summary sheet is requested with each log showing the scoring and other pertinent information, and also the customary signed declaration that all rules and regulation have been observed.

Mailing deadline is April 30th to: *Florida Skip* Contest Chairman K4FMA, P. O. Box 501, Miami Springs, Fla. 33166. Include a 6¢ stamp for issue with results.

Connecticut QSO Party

Starts: 2300 GMT Saturday, April 3
Ends: 0400 GMT Monday, April 5

The Candlewood ARA announces its 8th annual QSO party. Each station may be worked on each band for QSO points but not multiplier.

Exchange: QSO nr., RS/RST and QTH; county for Conn., ARRL section or country for others.

Scoring: One point per QSO. Conn. stations multiply total by ARRL sections and countries worked. Others use Conn. counties for their multiplier. (max. of 8)

Frequencies: 3540, 3925, 7040, 7275, 14040, 14300, 21050, 21300, 28040, 28880. Novices try 3740, 7175, 21125.

Awards: Certificates to high scorer in each ARRL section and country. Also two highest scorers in each Conn. county. Novice certificates will also be awarded.

Mailing deadline is May 20th to: Conn. QSO Party, c/o Tom O'Hara, W1DDJ, 7 West Wooster Street, Danbury, Conn. 06810.

Novice QSO Party

Starts: 0001 GMT Saturday, April 10
Ends: 2400 GMT Sunday, April 11

The International Novice CHC Chapter #11 is sponsoring this one. Novices may work anyone but only novice stations may be worked by others. The same station may be worked on each Novice band for QSO points.

Exchange: QSO nr., RST, county and state. DX stations give city.

Scoring: One point per QSO. Total QSOs multiplied by total states, DX countries and continents worked for final score.

Frequencies: 3710, 7160 and 21140. (plus or minus 10)

Awards: Certificates to highest scoring station both Novice and non-novice in each state, DX country and continent. There are separate catagories for novice, higher classes, B/P, s.w.l. and mobile stations.

Mailing deadline May 30th to: International Novice CHC Chapter #11, c/o T.A. Winkel, WB9AHJ, 607 East Street, Madison, Ind. 47250.

PACC DX Contest

Starts: 1200 GMT Saturday, April 24
Ends: 1800 GMT Sunday, April 25

Its the world working the PA∅'s in this one, 1.8 thru 28 mc on both c.w. and phone. Submit separate logs for each mode.

Exchange: RS/RST plus a progressive QSO number starting with 001. PA/PE/PI stations will also include their province. (579001/GR)

There are 11 provinces: DR, FR, GD, GR, LB, NB, NH, OV, UT, ZH, ZL.

Scoring: Each QSO counts 3 points. The same station may be worked one each band for QSO and multiplier credit. The multiplier is the sum of provinces worked on each band.

Final score, total QSO points multiplied by the sum of provinces from all bands.

Awards: Certificates to the top scorers in each country and each call district in W/K, VE/VO, CE. JA, PY, VK, ZL, ZS.

Logs: Date/time in GMT, station worked, serial number sent/received, multiplier column for each band, (fill only when its a new multiplier) and QSO points.

Include a summary sheet showing the scoring and other pertinent information, and your name and address in BLOCK LETTERS. Also include a signed declaration that all rules and regulations have been observed.

Contest contacts may be applied for the PACC 100 Award.

Mailing deadline is June 1st to: PACC Contest Manager, L.V.D. Nadort, PA∅LOU, Bospolderstraat 15, Nieuwerkerk, A.D. Ysel, The Netherlands.

WAE RTTY Contest

Starts: 0000 GMT Saturday, April 24
Ends: 2400 GMT Sunday, April 25

This is the 3rd annual RTTY contest sponsored by the DARC. Only 36 hours out of the 48 are permitted for single operator stations. The 12 hours of non-operating may be taken in one but not more than 3 periods anytime in the contest.

Both single and multi-operator stations permitted on all bands, 3.5 thru 28 mc.

Exchange: QSO nr. and RST report.

Points: Contacts within one's own continent 1 point, outside one's continent 3 points, however non-Europeans get 5 points for each EU contact. Like other WAE contests the QTC feature is also used. Each QTC exchange is worth 1 point. (See July 69/70 CALENDAR for details and WAE country list)

Multiplier: The multiplier is determined by number of countries worked on each band. The WAE and ARRL country lists are the standards. In addition Europeans will use call areas in the following countries as a multiplier: JA, PY, VE/VO, VK, W/K, ZL, ZS, UA9, UA∅.

Scoring: Total QSO points, plus QTC points, multiplied by sum total countries from all bands.

Awards: Will be made to stations using up to 200 watts, and over 200 watts in each country and call areas mentioned above. Continental leaders will also be honored.

Mailing deadline is June 10th to: WAEDC Contest Committee, D-8950 Kaufbeuren, P.O.B. 262, Germany.

One Land QSO Party

Starts: 0001 GMT Saturday, April 24
Ends: 2400 GMT Sunday, April 25

The New England Chapter #32 of the CHC International sponsors this annual affair.

The same station may be worked on each band and mode and again if in a different county.

Exchange: QSO nr., RS/RST and QTH; county and state for N.E. stations; county/state or country for others.

Scoring: For N.E.–Total QSOs × states × countries × continents. Others–Total QSOs × N.E. states × N.E. counties.

Frequencies: C. W. – 3575, 7060, 14075, 21090, 28090. Phone–3943, 7260, 14340, 21360, 28620.

Awards: Trophies to Top New England station, North America outside N. E. and DX station. Also 1st, 2nd and 3rd place certificates in each state, country and N.E. county. There are awards for Novices and s.w.l.

Mailing deadline is May 30th to N.E. Chapter #32, George Levensalor, W1DPJ, 399 Buck Street, Bangor, Maine 04401.

Editor's Notes

Rules for the IARC Propagation Phone Contest and the SP DX Contest will be found in the February and March CALENDAR respectively. Space does not permit to repeat this information in this month's column.

We were again saddened to hear of the passing of another friend and avid DXer and contester, Al Stobbe, W2WZ. Because of failing health Al's activities in QCWA circles and DXing had tapered off the past few years but he always managed to send us at least his "check log," even in the last Phone contest. May he "rest in peace."

73 for now, Frank, W1WY

CQ BOOK SHOP

Ham's Interpreter
This valuable book is imported from Germany and written by DL1CU. It contains a collection of phrases and expressions designed to assist those amateurs who wish to enlarge their knowledge of various languages for use on amateur radio. It is a must for every DX'er. $1.50

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A treasury of vital and "hard-to-get" information, this book is loaded with valuable equipment schematics, adjustment procedures, etc. A boon to beginner and pro. A special section on getting started, written by Byron Kretzman, W2JTP, a well-known authority in the field. $3.95

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Ken Grayson has loaded this book with schematics for currently popular pieces of conversion gear, making it invaluable to amateurs as a guide to surplus gear. $2.50

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103 - Simple Transistor Projects
The aim of this book is to familiarize the beginner and advanced experimenter with the handy source of reference circuits. $2.95

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THE awards PROGRAM

BY ED HOPPER,* W2GT

Special Honor Roll
All 3079 Counties!

#49—Henry A. Freiberger, W5ULN
12-15-70.
#50—Alfred L. Pulling, K1WQU
12-25-70.

USA-CA HONOR ROLL

3000	2000	500
K1VTM 63	WAØJRZ 123	WAØJRZ 834
K8ODY 64	WAØKGD 124	K7RDH/
WAØJRZ 65	1500	DL4PS 835
WA5OCG 66	WAØJRZ 154	W5ILR/
WAØKGD 67	WA5ALB 155	TF2WKP 836
2500	WAØKGD 156	WA6TAX 837
WAØJRZ 97	1000	WA2HWD 838
WAØKGD 98	WAØJRZ 225	KØARS 839
	WAØKGD 226	

THE April, "Story of The Month" is:

K. D. Wilson, W7GKN

Affectionately know as "KD", W7GKN (ex-OH6BWV, W3GT, W6DIX) was born in Fayette, Missouri on May 12, 1900. After finishing High School, the family moved to Benton County, Arkansas.

He tried fruit farming but lost money due to a freeze each year. That plus the big railroad strike of 1921 made him plenty disgusted with conditions, so he hit the road and shortly joined the Air Corps. and went to the Islands.

The next 30 years saw great advances in communications from spark to diodes, tubes and transistors.

KD was a flying operator from 1922 to 1941, then advanced to supervisory and inspection work on all types of air and ground communications.

He became an amateur in 1925 as OH6-BWV, as W3GT in 1927, and W6DIX in 1931 in California and retired in 1958.

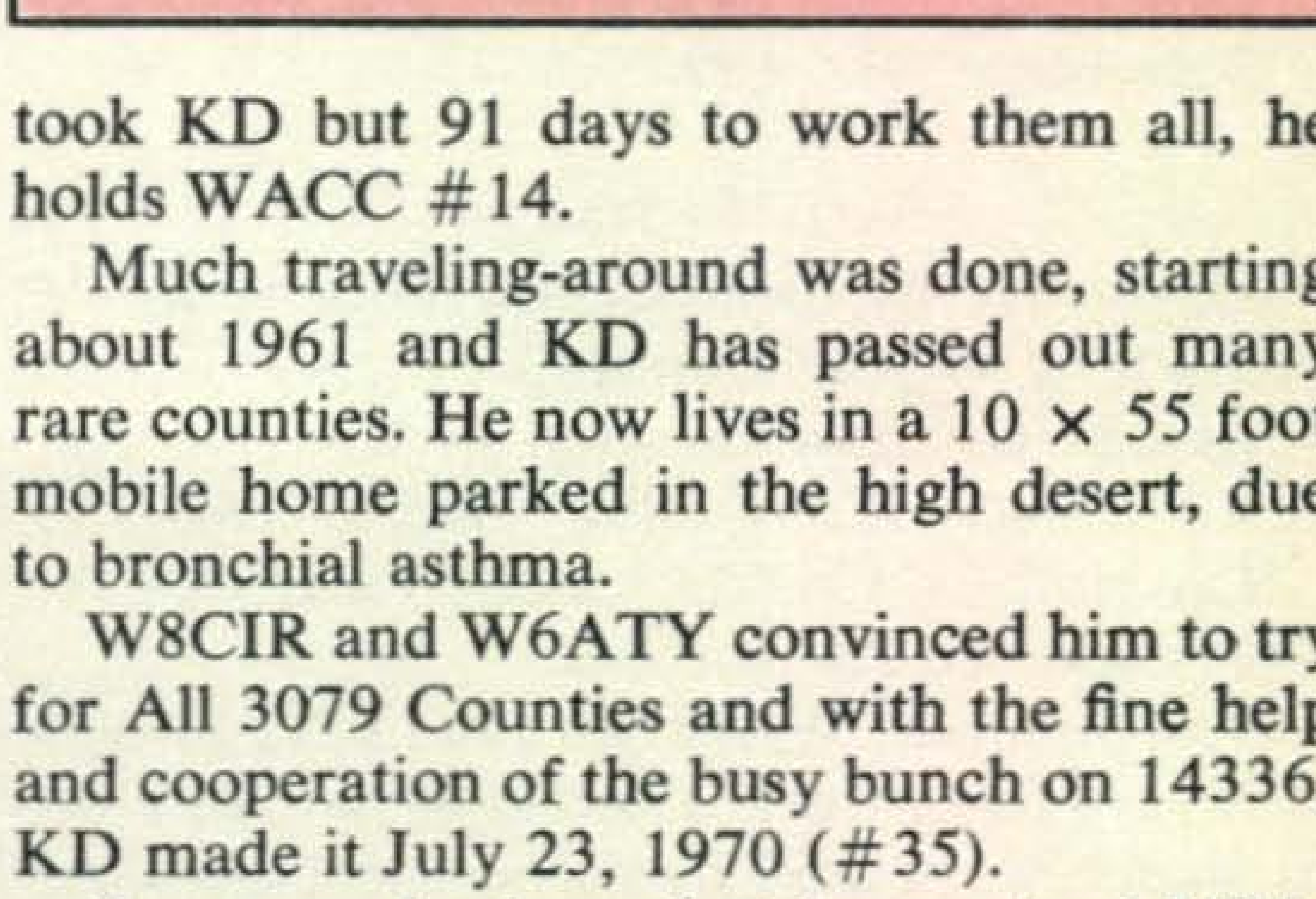
His interest in County Hunting started in 1957 when a friend bet he could not work All California Counties in one year.

This was a tough one due to the lack of activity in many counties and all QSLs had to bear the post mark of the county. Well it took KD but 91 days to work them all, he holds WACC #14.

Much traveling-around was done, starting about 1961 and KD has passed out many rare counties. He now lives in a 10 × 55 foot mobile home parked in the high desert, due to bronchial asthma.

W8CIR and W6ATY convinced him to try for All 3079 Counties and with the fine help and cooperation of the busy bunch on 14336, KD made it July 23, 1970 (#35).

Our records show that he received USA-CA-500-AWARD #180 in February 1963; 1000 #101 and 1500 #51 in June 1966. USA-CA-2000-#35 in May 1967; 2500 #24 in March 1968 and USA-CA-3000-#31 in November 1969.



Mr. & Mrs. W7GKN.

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

Worked Toledo Ohio Award

Oh yes, the call, W7GKN was received in 1970 but most of us still think of him as W6DIX, Hi.

KD is always happy to help NCS and to give out Nevada Counties. He is most grateful for all the kind cooperation and help he has received and if, sometimes, he sounds a bit gruff, remember it takes a long time to forget Military NCS, NCO/IC work.

Any of the County Hunters needing some of those rare Nevada Counties, drop him a card at Box 89, Wadsworth, Nevada 89442. Upon receipt of 5 or more for a rare county, he will make the trip.

There were fotos of KD and Mobile Home in December 1965 *CQ*.

Awards Issued

As you see by the Special Honor Roll, we are up to #50 All Counties!

Mixed 3000 awards went to Ron Nevers, K1VTM and "Moby Dick" Brege, K8ODY.

Roy Hall, WA5OCG acquired a USA-CA-3000 endorsed All 2×SSB.

Don Schmidt, WAØJRZ must have turned off his rig for a week or more to catch-up on his paper work and qualified for USA-CA-500, 1000, and 1500 endorsed All 14 mc SSB Mobiles; USA-CA-2000 All 14 mc SSB; USA-CA-2500 All SSB; and USA-CA-3000 endorsed All Phone.

Mike Nickolaus, WAØKGD also gave me some work by applying for USA-CA-1000 through USA-CA-3000.

John Dyer, WA5ALB sent for USA-CA-1500 and at the same time brought his endorsement for his USA-CA-500 to now include, Mixed; All 7 mc 2 × SSB; and All 14 mc 2×SSB.

Minneapolis Radio Club Award

Mixed USA-CA-500 awards were issued to John McLeland, WA6TAX; and Jim Willingham, KØARS (How is that for having *ham* in his name and *a*mateur *r*adio *s*tation in his call).

Ron Miller, WA2HWD received a USA-CA-500 award endorsed All 14 mc A3A.

Eldred Daigre, W5ILR/TK2WKP applied for USA-CA-500 endorsed All 2 × SSB.

Bob Hatter, K7RDH/DL4PS was issued a USA-CA-500 award endorsed All Phone.

Awards

Worked Toledo Ohio: Sponsored by the Toledo Radio Club, this certificate is issued free for working 15 stations in the greater Toledo area which includes: Berkey, Bono, Harbor View, Holland, Maumee, Monclova, Neapolis, Sylvania, Toledo, Waterville and Whitehouse. Receipt of QSLs is not essential, *full* log data is the only information needed. Send this data to: Robert Gensler, W8UPH, 318 Decatur St., Toledo, Ohio 43609.

Minneapolis Radio Club Award: Issued for confirmed two-way contacts with five (5) members in good standing of the MRC. Submit full log data to MRC Award, Minneapolis Radio Club, Inc., P.O. Box 742, Minneapolis, Minnesota 55440. There are no limitations on time, mode, nor frequency and there is no charge for the award, but QSLs must be sent to the stations worked.

TA-10 Diploma: Issued for working 10 of the following TA stations: TAØA; TA1-AM, AV, CEM, DS, HY, IB, KT, MGP, MT, NC, NF, OR, QR, RF, RT, SK, TS, VG, VY, WR. TA2s-AC, AE, BK, CD, EA, EM, FM, FK, QR, SC. TA3s-AR, AY, OZ, RK. If a station is worked on different bands, you can count them as separate stations. Send full log data certified by two other licensed amateurs and 10 IRCs to: TRAC, P.O. Box 699, Karakoy, Istanbul, Turkey.

Istanbul Award: Each year from 1800 GMT 29th May until 1800 GMT 31st May, all Istanbul amateurs will use a special call sign with the prefix TCØ, celebrating the Day of conquest of Istanbul. You must work 5 of the following Istanbul stations: TCØ-A, AE, AM, AV, DS, EA, HY, IB, KT, MT, NC, NF, OR, QR, SC, TS, VG, WR. or s.s.b. may be used but duplicating a QSO on c.w. and s.s.b. will not count as different QSOs, but working a station on different bands does count as

[*Continued on page 88*]

SURPLUS sidelights

BY GORDON ELIOT WHITE*

A little over two years ago I described the AN/ARC-65, an air-borne high-frequency 200 watt transceiver used in the B-36 bomber and subsequent Air Force aircraft. In the ensuing months I heard quite a bit from readers who had set to work on the ARC-65 and its amplitude-modulated brother, the AN/ARC-21. Letters came in from Mexico, Italy, and several stateside addresses.

Most of those who worked on the ARC-65 and ARC-21 sets needed parts-plugs, of course, and the complex control head. There are two "heads," one a "remote" unit, the other the "master," and the "master" is necessary to use the set unless one wants to manufacture a fairly complex control system.

I have received descriptions of two conversion efforts on the 21/65 sets, of which that by John Hutchings, of Los Angeles, will be dealt with this month.

John, who is a most sophisticated s.w.l. is an engineer at NCR. He writes that the conversion of the ARC-65 was an education, likely to keep one out of the bars for several weekends. He echoed my caution that it is to be attempted *only* by experienced amateurs or experimenters.

Since John is not licensed as an amateur, he discarded the transmitter section, and mounted a power supply in its place in the transceiver frame. In order to use the transmitter, the same interconnections could be made with an externally-located power supply, and a few additions such as a transmitting antenna made. The original 4×250F power tubes are vastly underrated, and with additional cooling, and a hike in the B plus voltage, could give a half kilowatt... or more. Remember, they were used in a sealed set, at high altitude. The manufacturer rates them at 250 watts apiece with 2,000 volts B plus. I have no idea how far they can be safely pushed in amateur use.

The "F" suffix, by the way, indicates 28 volt filaments. The "B" version of the 4×250 is available for 6.3 volt filament use at 2.1 amps.

Power requirements, also conservatively overestimated, are as follows:

Receiver B plus....140 volts at 240 ma, d.c.
Transmitter
B plus...............450 volts at 190 ma, d.c.
1,000 volts at 450 ma, d.c.
Bias...................... −24 volts, 2 ma, d.c.
Filaments and
tuning motor....24-28 volts, 8.5 A., d.c.
Power Amplifier
Filaments.........24-28 volts, 3.5 A. d.c.

In receive-only mode, only 140 volts receiver B plus and filament and tuning motor power is required. A rather low-rated isolation transformer, with a bridge rectifier will provide adequate B plus power, and a small 24 volt transformer and diode rectifier will handle the 2 ma bias supply.

The 28 volt requirements may be met by a suitably-rated transformer and a single 25 amp/50 p.i.v. diode rectifier filtered across a high-capacity computer capacitor. Your

The RT-400/ARC-65 transmitter-receiver unit. This pressurized container holds most of the transceive system, allowing it to operate without arc-over at altitudes up to 70,000 feet. The ARC-21 set is virtually identical, but is an a.m. unit. The ARC-65 is a single sideband set.

*5716 N. King's Hgwy., Alexandria, Vir. 22303.

supply should put out 28 to 30 volts in normal operation, in order that during tuning, the drain of the motors will not reduce the voltage too far with this simple power supply.

For amateurs who want to use the transmitter, we recommend one of the surplus commercial 24 volt d.c. supplies. These rack-mount units are available with up to 30 amp capacities in the stores, with meters, regulators, etc.

Some of the 24 volt circuits are designated as a.c. or d.c., and some of the 28 volt, 400 cycle aircraft buss power was used there, in order to reduce d.c. drain. You can either tie these all to 24 volts d.c., or isolate them and power the a.c./d.c. circuits from 24 volts, 60 c.p.s. a.c. The blower motor is d.c., and must be disconnected from a.c. lines in that case. It had a bridge rectifier enabling it to use the original 400 c.p.s. main power.

To design the power supply, refer to the manual, p. 59, fig. 7-5, the dynamotor assembly schematic. The negative 40 volt bias is not used.

It is necessary to have a copy of the manual —Technical Order 12R2-2ARC-65-2, as the schematics are extensive—far too voluminous to reproduce here. The photo of the main chassis shows its peculiar bomb shape. This is an ungainly item, which can be mounted somewhere out of sight, with only the remote control placed near the operating area in the shack.

Specifications on the AN/ARC-65 include a range of 2-23.9995 mc in 500 c.p.s. steps. (this was incorrectly indicated as 500 kc steps in the original article, and the correction published later may have been missed by some readers) The range is divided onto 44,000 available channels.

Receiver sensitivity is better than 1 microvolt for a 10 db signal plus noise to noise ratio. The set is double conversion, and tuning is via permeability-tuned circuits. A mechanical filter is provided for selectivity.

Stability is rated at less than 22 c.p.s. plus or minus deviation.

The original ARC-65 article, (*CQ*, February, 1969, p. 87) carried block diagrams of the ARC-21 and ARC-65 sets, and a diagram of the motor tuning arrangement. Due to the limits of space we will not reprint them here. Fig. 1 is a schematic of the C-415-A/ARC-21 tuning head (used with both ARC-21 and ARC-65 sets). It might be possible, in a pinch, to construct a tuning control—if one were exceedingly ambitious.

Unless s.s.b. operation is of major importance, the ARC-21 set is rather more easily used, especially for s.w.l. use. The ARC-65 is upper sideband only—the mechanical filter is upper sideband with no l.s.b. availability. The ARC-65 also lacks the "fine tuning" that the ARC-21 offered in the c.w. tune BFO CONTROL. Without delta-frequency control, you are limited to the precise selected channels.

As to specific conversion items: first familiarize yourself with the set, *noting the positions of the sub-miniature coax cable and connections.*

Inspection of the set is an education in itself. You might check for dirt, loose parts, lack of lubrication, etc., but *DO NOT MOVE* any of the tuning mechanism until you *thoroughly* understand what the units are supposed to do. This set becomes virtually a lost cause, once gotten out of synchronism.

The tuning slugs move at two speeds, coarse tuning and fine tuning, driven by an ingenious gear-clutch mechanism. Remove the modules, being certain how they should be replaced. It is possible to discard the top bell cover, and wire directly to the transceiver chassis, or retain it, using the original-equipment plugs. All connections to the power supply and controls pass through the main terminal box under the top cap. Note that every out-going line is filtered for r.f. interference.

Conversion

1.—Relay assembly RE-315: remove diode CR-201 (anode to pin 2, K-204) and jumper pin 2, K-204 directly to plus 28 volts d.c. and any convenient point. If only d.c. is used to supply the filaments, simply jumper out the diode. The diode was originally used as a protective device to cycle-down the unit if the 400 c.p.s. power was lost. Ground 60 c.p.s. a.c. power will load down and not operate the relay. The relay source thus *must* come from *28 v. d.c.*

2—Timer motor B-1201: *on receive-only conversions only*—jumper the red wire to the controlled plus 28 v.d.c. (E-1101). This requires running a special wire through the chassis.

3.—In the transceive unit find the TAKE CONTROL relay K-1102 under the top cap near the main junction box. Tie terminal #1 to a permanent ground.

4.—Main junction box: ground terminal 21, Z-1106. This grounds one side of the audio output, and terminal 19 Z-1104 becomes a

600 ohm audio point, with the other side of the audio circuit being ground.

5.—Control box C-451A: completely rewire as follows:

(A)—Remove ratchet motor B-1302 and switch S-1303.

(B)—Remove and discard both sockets J-1301 and J-1302.

(C)—c.w. TUNE pot R-1311 is not used, and may be discarded. It was part of the b.f.o. reactance tuning circuit in the ARC-21, but is not used in the ARC-65, so unless you can figure some way to use it to give delta-frequency tuning, it can be discarded. We have not been able to figure a way, so used its hole.

(D)—Discard control switch S-1305. Replace with a s.p.s.t. switch, rotary or toggle, as MASTER POWER switch.

(E) – Remove the power Hi-Lo switch, S-1306.

(F)—Mount a normally open single pole push button switch in the c.w.-TUNE hole, as the START TUNING CYCLE switch.

(G)—Mount an audio jack in the HI-LO switch hole. Tie the "hot" terminal to pin 10, S-1304 rear.

(H)—Wire terminals in the box as follows:

Terminal	Function	To
1	bridge supply	common wire of all bridge resistors
2	bridge units	tie to respective divider
3	bridge tens	tie to respective divider
4	bridge hundreds	tie to respective divider

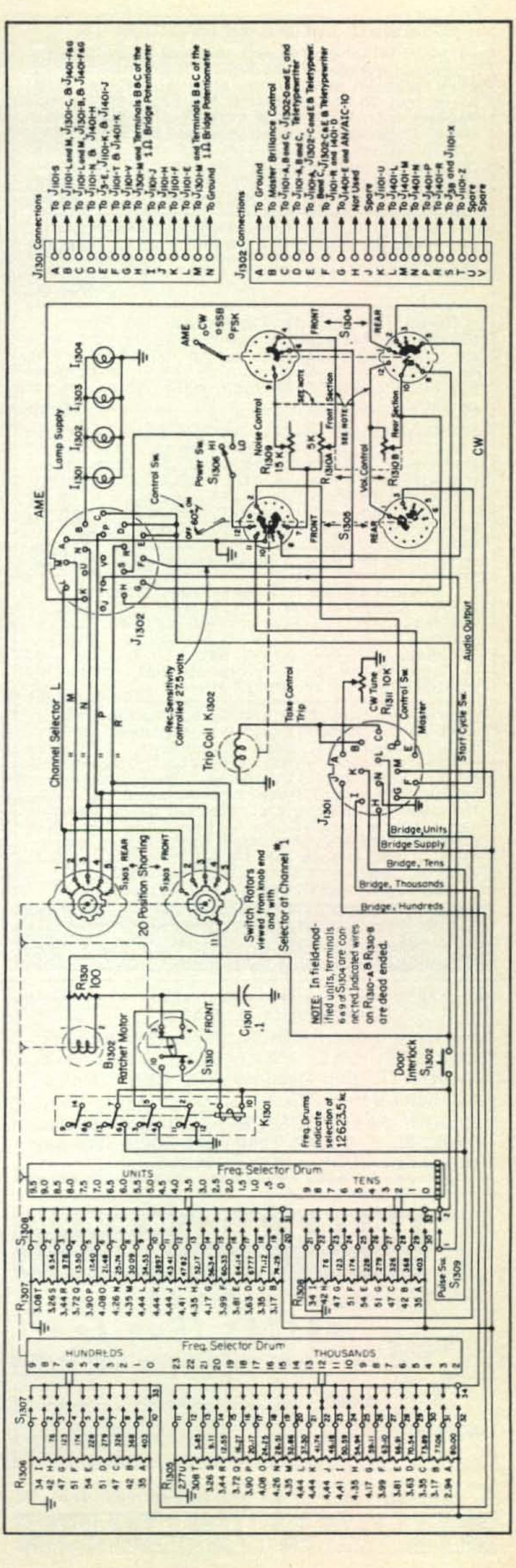


Fig. 1—Diagram of the AN/ARC-21 and AN/ARC-65 control box, the heart of the conversion of these units to convenient ground use. This is the "master" control. There is a "remote" unit that will operate through the "master" for a limited number of the 44,000 frequencies available in the set.

5	bridge thousands	tie to respective divider
6	controlled 28 v.d.c.	tie to one side of panel lights and one side of the newly installed pushbutton (step (F))
7	start cycle	tie to other side of push button (F)
8	AME	tie to pin 1, S-1304, rear
9	CW	tie to pin 2, S-1304, rear
10	Master on-off	tie to one side of master on-off switch (D)
11	receiver sensitivity	tie to pin 6, S-1304, front
12	audio output	tie to pin 12, S-1304 rear
13	ground	
14	master on-off	tie to other side of on-off switch (D)

(I)–Make up a 14-wire cable long enough to reach from your operating position to the transceiver unit, which may be remotely mounted.

6.–Terminate the cable either to the plug, J-1101, or the main junction box as follows: (control box numbers refer to section 5(H) terminal list above)

Control box	J-1101	Junction box
1	D	Z-1102–5
2	E	Z-1102–3
3	F	Z-1104–2
4	H	Z-1104–3
5	J	Z-1102–4
6	A,B,C	E-1101
7	Z	Z-1105–2
8	U	Z-1104–8
9	V	Z-1104–9
10	K	to power supply
11	R	Z-1105–4
12	T	Z-1104–7
13	ground	
14	vacant pin	to power supply

7.–A master power relay should be provided on the power supply, to be controlled from the master power switch (D) using wires #10 and #14.

8.–Controlled 28 v.d.c. at 10 amps is provided to pins U, V or W of J-1102 or directly to terminal E-1101.

9.–Tie E-1101 to Z-1102–10 and Z-1102

–8. Use heavy wire as this will carry the main 28 volt power to all tube filaments and the blower.

10.–Tie plus 140 v.d.c. to pin A of J-1102 or directly to Z-1106–4.

11.–Tie –24 volts d.c. (bias) to pin P, J-1102 or directly to Z-1106–8.

This completes the receive-only conversion. For transceive operation, continue with steps 12-15:

12.–Tie 450 v. d.c. plus to pin B, J-1102 or directly to Z-1103–3.

13.–Tie plus 1000 v. d.c. to pin H, J-1102 or directly to Z-1103–4.

14.–Z-1104–6 (J-1101–a) is the mike keying relay connection. K-301 in relay assembly RE-313 is the keying relay. Shorting the line to ground keys the transmitter.

15.–Z-1104–12 (J-1101–b) is the mike audio input.

This completes the changes.

In operating the set, timer motor B-1201 starts cycling when power is applied. The motor has contacts that operate at 30 seconds after power is applied to the tube filaments, the other at 42 seconds, by which time tuning should be complete. If tuning is not complete, automatic down-cycle is instituted–a safety feature. With the present wiring, all power must be removed to recycle. Alternatively the motor could be removed and a switch installed. Thirty seconds seems rather a short tube warmup for transmit operation.

The discarded box door interlock S-1302 and pulse switch S-1309 causes a complete tuning cycle to start. This is accomplished in the conversion with the push-button START-CYCLE switch (F).

To change frequencies, set up the drum selector and push the button (F).

The slow (12 second) tuning probably will be exasperating to you. It was to us.

The ARC-21 and ARC-65 sets are complex, sophisticated units. Hopefully yours will come right up on WWV when you first dial 10000.0 and push that START CYCLE button. Ours was quite a thrill when it did.

I had an even more complex set, the Collins AN/ARC-58, a kw transceive set covering the same frequencies, and it was something of a thrill when a friendly sergeant at Andrews Air Base plugged it into the B-52 test bench and tuned up WWV and it blasted in at zero-beat. Unfortunately I was never able to find the control head for the set. (*CQ* Feb. 1966 p. 98). ■

USA-CA *[from page 82]*

separate. In addition to the award, all QSOs will be confirmed by special QSL cards. Logs must be sent in by 15 of July to: TRAC, P.O. Box 699, Karakoy, Istanbul, Turkey.

Notes

Many thanks to Fred Woodley, VE3-9301 (USA-CA-3000-#36) for his fine coverage of the USA-CA Program in his column in the Canadian Electronics Magazine, *Electron.*

During the week 3-9 September, KFØNEB, operated by the Lincoln Amateur Radio Club (Lancaster County) of Lincoln, Nebraska made over 8600 QSOs. This included DXCC (124 Countries) and WAS as well as handling over 800 messages mostly Military). The operation was from the State Fair and QSLs may be obtained by sending s.a.s.e. to WØYOY.

Lou Braun, K8IQB is trying very hard to re-establish a County Hunter Net on about 7285 to take advantage of the different skip, and promises to be active there most days starting at 7 or 8 A.M. (1200 or 1300Z). This would hopefully take some of the QRM from 14336.

Letters continue to arrive regarding changes of names, boundries, and number of Counties. As far as I can confirm from all sources, including the latest (1970) POD 26, there have been but 3 changes since January 1, 1963. On that date the County of Princess Anne was taken into the City of Virginia Beach. The City of South Norfolk and the County of Norfolk merged to compromise the City of Chesapeake (So, Virginia lost 2 Counties). Thus, as of January 1, 1963 there have been but 3077 U.S. Counties, but fear not, if you work them all, you can qualify for a 3079 Plaque.

On September 4, 1969, the County of Ormsby (Nevada) was taken into Carson City, *but* the new POD 26 does *NOT* list Carson City as an Independent City, so for the purposes of USA-CA, I will count QSO's with Ormsby or Carson City as *ONE,* thus keeping the Counties at 3077. (This data, as furnished by Jack Carpenter, K8MNG, was in March 1970 *CQ).*

No, there has been no changes in the names nor number of Counties of New Jersey.

Sorry that I've had little time for hamming so you beter write to tell me–How was your month? 73, Ed., W2GT.

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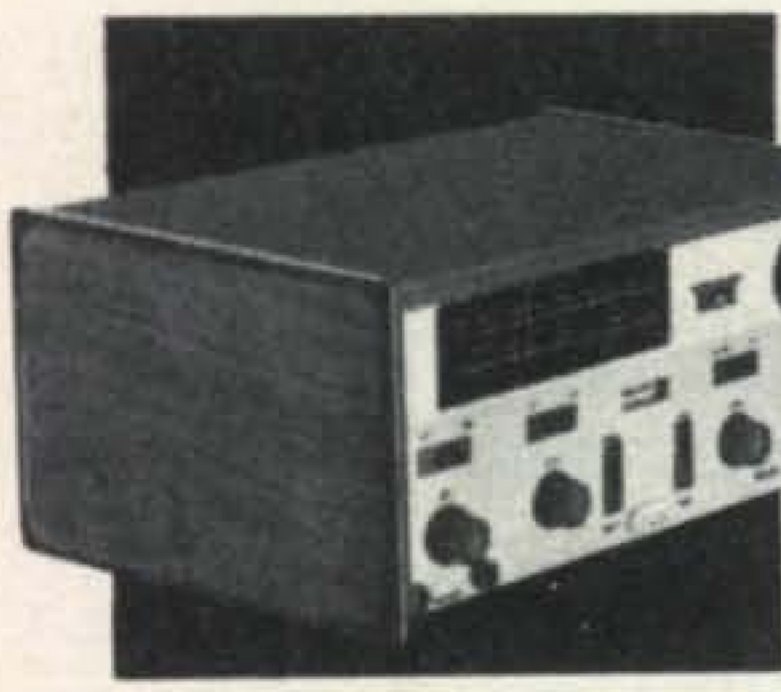

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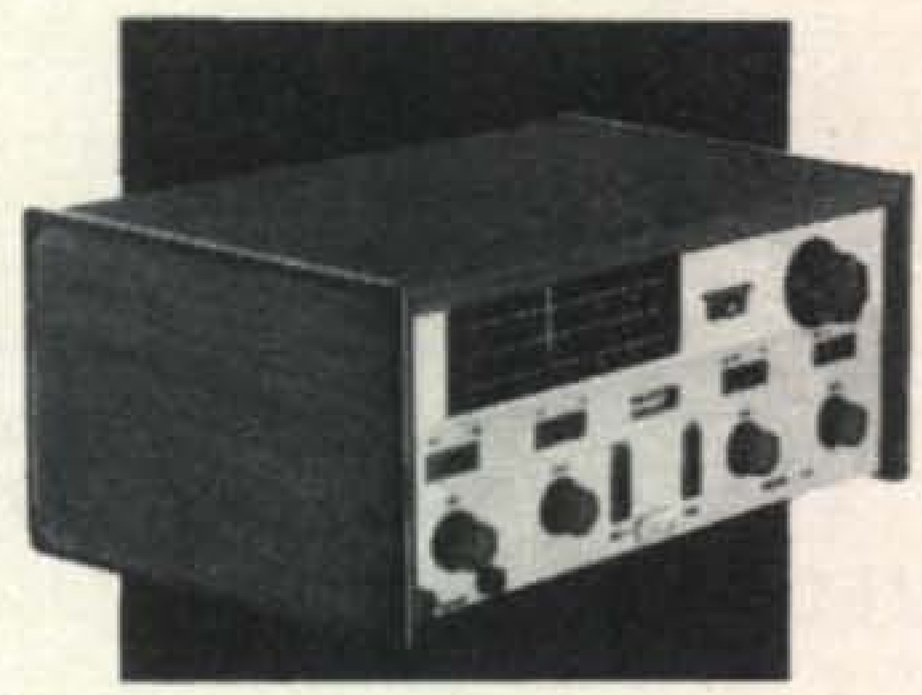

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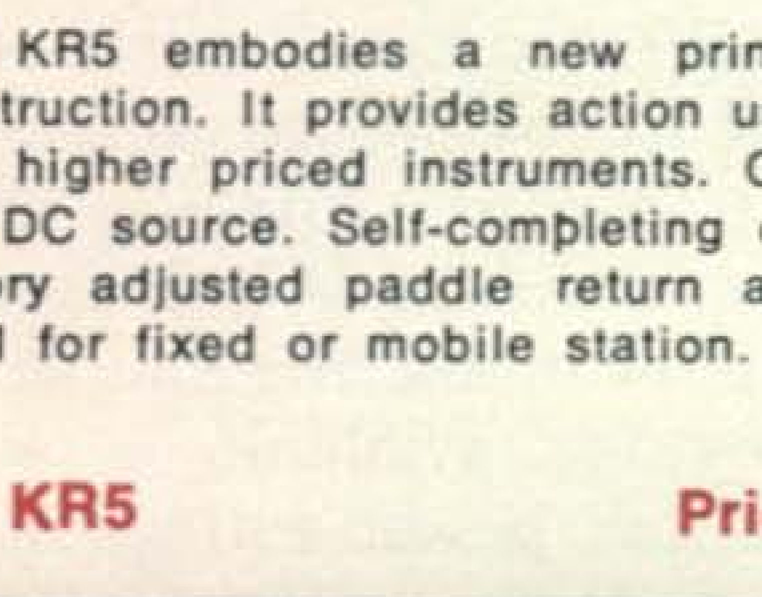

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New Products [*from page 14*]

area in which the headset is to be used. The audio room loop (RL-2) is a kit to equip a classroom up to 30 × 40 feet; it includes instructions, 150 feet of cable, mounting equipment and color coded wiring for simplified installation. Normal battery life for the headset is over 1000 hours. This is an ideal setup for teaching code, theory and any other group project where ajoining work is going on. It can change a club-room to a classroom and back again in a short time. The CH-2 is priced at $24.50 and the RL-2 at $24.00. For complete details and suggested applications write to: Mr. Dan Metzdorf, The Murdock Corp., 158 Carter St. Chelsea, Mass. 02150 or circle 82 on the Reader Service coupon.

Protective Devices [*from page 67*]

order to trigger the SCR. The high value resistor in the SCR gate lead serves only to protect the gate terminal from excessive current flow.

As long as the current through the ground return resistor is such that the voltage produced across it is not sufficient to trigger the SCR, the anode-cathode terminals of the SCR act as essentially an open switch. Once, however, the SCR is triggered, the anode-cathode terminals essentially act as a short-circuit. The anode terminal might be wired to directly short out the positive supply lead to a semiconductor circuit under protection or to place a shunting resistor across it in order to divert an excessive current flow. One problem with the SCR, however, is that once it is triggered, the gate terminal loses control of the unit. The only way the SCR can be returned to a non-conducting state is to interrupt the current flow between its anode and cathode terminals. In fig. 1(C) a push-button switch is used to reset the SCR once it has been triggered.

One can find many complicated protective circuits using SCR's and their "offshoots." It would be almost impossible to describe all the specialized transistor switching devices which have been developed. However, for most amateur applications, the simple SCR will suffice. They are available in a wide range of voltage and power ratings at very reasonable prices. Perhaps the only SCR "offshoot" that should be mentioned without confusing the situation is the Triac. Basically, it is a double SCR. Either polarity of voltage can be used between its anode and cathode terminals and it can be triggered by a gate voltage of either polarity. Once triggered, it must be returned to a non-conducting state in the same manner as a regular SCR. Its gate

requirements for triggering are slightly greater than those of a plain SCR. For instance, the RCA 40525 to 40527 triacs which can handle up to 400 volts at 2.5 amperes when conducting, require a gate voltage of 1-2 volts at 1-3 ma in order to trigger.

Summary

This article has presented some of the simple ways in which semi-conductor devices might be used as protective devices. Certainly for someone who is just starting to experiment with such devices as IC's, the inclusion of such a protective device in a power supply, in order to augment conventional fuse protection, will prove very economical in the long run. The protective devices can be set to proper operating conditions by simulating overload conditions with test resistors. Elaborate protective circuits can be devised by combining the features of devices such as zener diodes, SCR's, Triacs, etc. Various ideas along these lines may present themselves to the reader once he understands the basic function of each unit.

Finally, one should also remember that the protective devices themselves are semi-conductors and can also be ruined by mis-application. Generally, the greatest problem with such devices (aside from small signal diodes) is heat dissipation. Calculate the dissipation involved and follow the manufacturer's recommendation for proper heat-sinking where necessary. In most cases where a high-wattage zener or SCR is used only for protective purposes and "backed up" by fuse protection, it will generally be found that an elaborate heat-sink is not necessary. ■

Camper Mobile *[from page 29]*

is a hose clamp. Inevitably, one day I drove into the carport with the antenna extended. The little brass bushing at the antenna base split. "Temporarily" I repaired it with a small size screw-type hose clamp. I may even fix it permanently some day.

Mounting the Transceiver

After I had acquired an SB-33 transceiver for the express purpose of going mobile in my truck-camper, I came up against a sad fact. Although the truck's cab was very roomy, there was really no good place to mount the rig. Mounting it under the dash over the transmission hump was out: it would interfere with the floor-mounted gear shift lever. I even considered suspending it from

New FM for '71 Standard's SR-C826M

professional quality, solid state, two-way radio, designed and sold exclusively for amateur use in the United States and Canada.

Standard Communications Corp., the world's largest manufacturer of marine V.H.F. equipment, has just developed a new industrial quality, high performance 2-meter unit. This rugged, compact transceiver is available only in the U.S. and Canada thru an authorized Standard dealer. The "826" is so compact that it makes mobile installation practical in almost any vehicle or aircraft, it becomes fully portable with the addition of Standard's battery pack.

GENERAL

Freq. Range — 143 to 149 MHz, 2 MHz spread

Supply voltage — 11 to 16 VDC. Negative Ground 13.8VDC nominal

Current Consumption — .15 amp receive standby. 2.4 amp transmit

Number of channels — 12- Supplied with 4 channels

1) 146.94 Simplex
2) 146.34/94
3) 146.76 Simplex
4) 146.34/76

Microphone — Dynamic

Dimensions — 6⅞"w x 2½"h x 9⅞"d

Weight — 4½ lbs. max.

Frequency stability—.001% (−10 to +60°C)

TRANSMITTER

RF power output — .8 or 10 watts

Output impedance — 50 ohms nominal

Deviation — Internally adjustable to ±10 kHz min. factory set to ±7 kHz

Spurious and harmonic attenuation — 50dB below the carrier power level

Type of modulator — Phase

RECEIVER

Sensitivity — .4 or less microvolts for 20 dB quieting

Squelch sensitivity — Threshold — .2 microvolts or less

2 MOSFET RF Amplifiers
1 MOSFET Mixer

Deviation acceptance — Up to ±15 kHz deviation

Spurious and image attenuation — 65 dB below the desired signal threshold sensitivity

Adjacent channel selectivity (30 kHz channels) — 60 dB attenuation of adjacent channel

Type of receiver — Dual conversion superheterodyne

Audio output — 5 watts For external speaker

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the roof, but this was merely an invitation to bruised heads. After much experimentation, using a cardboard box cut to the same size as the rig, I finally concluded that the best place was on the seat, alongside the driver. This would be satisfactory, since I seldom have more than one passenger riding with me. The rig should be on a small platform, and should be easily removable to become part of the home station when not on a trip.

I made up a small framework of 1″ × 2″ wood strips, designed to hold the rig horizontally on the seat. The controls are at a convenient height. Some rubber weatherstrip was cemented on too, and the rig merely sits there, being held in place by its feet, which project downward inside the framework. Air can circulate up through the holes in the bottom of the rig, and the space underneath is handy for storing microphone, logbook, and pencils. The framework has a solid bottom. The rig even has its own seat belt: a nylon strap equipped with a snap hook, which passes behind the seat and is fastened to the floor of the cab.

The 12 v.d.c. power supply is permanently mounted in the engine compartment, and wired to the auxiliary battery. Power and control for the transceiver come from the power supply to a connector on the dash. An antenna connector is also on the dash. An inexpensive imported v.s.w.r. meter, mounted under the dash, is an invaluable aid in tuning up.

Putting the rig in the truck for a trip is a simple matter of fastening the seatbelt and plugging in two cables.

So that's the story. I have received a lot of enjoyment from this installation, even though it took quite a bit of work. Perhaps you can use some of the ideas. ■

CQ Reviews SB-303 [*from page 48*]

The Heathkit SB-303 is priced at $319.95 (kit) supplied with 2.1 kc filter only. The 400 c.p.s. and 3.75 kc filters are $21.95 and $20.95 each respectively. These are products of the Heath Company, Benton Harbor, Michigan 49022. Heath has quite a few Electronic Centers in various locations. Where such are within reasonable travel distance, it might be well to make a visit there to look over not only the SB-303, but also Heath's other fine products in the amateur, hi-fi, test-gear, TV line, etc. *—W2AEF*

Tips and Tidbits [*from page 24*]

There will be minor lobes (as there are also with horizontal polarization) but directivity can be established if needed.

Again as stated before, the normal rating of f.m. transmitters is in watts out, not watts in as usually stated on the lower frequencies. Of course the FCC still requires logging of power input, but the measure of the equipment is in power output. The reasoning behind this is quite simple. As the frequency increases, the efficiency (power output divided by power input) for the output stage decreases. Efficiencies of over 65% are quite common for the lower frequencies. However, on 144 mc the efficiency of most equipment begins to drop off. Efficiencies of less than 50% are quite common. Thus a rating of 25 watts input may mean only 10 watts output on 144 mc but may mean 20 watts output on 3.8 mc. Most of the equipment now being manufactured for amateur f.m. use has a power output of 10 watts. Units manufactured originally for commercial service range up to 250 watts output (at about 600 watts input).

The measurement of receiver performance is the 20 db quieting check. This standard has been agreed upon by the manufacturers of commercial f.m. equipment and has been carried over into the amateur f.m. operations. The check is quite simple to make. An a.c. voltmeter such as used in the everyday vom or v.t.v.m. is placed across the speaker terminals of the receiver. The volume control is adjusted for a relative average reading on noise only (*e.g.* 1.25 volts). A signal on the desired frequency is then applied through a calibrated attenuator from a signal generator until the reading on the voltmeter drops to one-tenth (0.1) of the original reading (*e.g.* 0.125 volts). At this point there is usually a slight amount of noise still on the signal, but any signal of this intensity is quite copyable. Typical levels for six meter operation is 0.35 microvolts, for two meters is 0.5 microvolts, and for 432 mc 1.0 microvolts of signal for 20 db of quieting. By the way, if measurement of the a.c. signal is made with a high quality of db meter, the results will not agree with the industry standard. Although not truly accurate, the industry standard using the cheap type of a.c. voltmeter is accepted. It is analogous to using furlongs per fortnight. If everyone agrees as to the method a standard is established.

Most s.s.b. operators are familiar with the fact that conventional a.m. is about 6 kc wide because of both sidebands and that s.s.b. is only about 3 kc wide because of the supression of one of these sidebands. Also, everyone with a Technician class or higher was required to answer questions dealing with percentage of modulation on his license exam. Well, f.m. is measured in related, but different terms. F.m. is measured by what is called deviation. This is the width of the signal on each side from the original carrier frequency. Present commercial, and most amateur, standards call for a maximum width of 10 kc. This is 5 kc on each side, usually referred to as ±5 kc (narrowband). Old commercial standards called for a 30 kc bandwidth or ±15 kc deviation. Some areas still use this for amateur use, but with the ever increasing activity on amateur f.m. the trend is to narrowband or ±5 kc deviation. When receivers designed for wideband (±15 kc) operation are used for narrowband work there is a loss of signal-to-noise ratio and of audio output This can be remedied by sharpening up the bandpass of the receiver and making a few small changes in the audio circuitry to add what is called "audio recovery." In some areas amateurs have compromised on what is sometimes called "Belly band" which is using deviation of approximately 7.5 kc. This is usually satisfactory compromise between audio recovery for wideband receivers and the tendency of narrowband receivers to chop on highs.

Conclusion

A final item which will become useful to the new f.m. operator is the slang and technical terms of f.m. Since these are quite lengthy, they have been included in a separate article which will be published next month in *CQ*. Again I hope that I have encouraged non-f.m. operators and not discouraged them. There are, unfortunately, in every area a very small group of operators who will make fun of the newcomer, especially if he doesn't know the ropes. These types of people are found in every phase of amateur radio. Don't let them get you down. Just follow the tips given herein and they will not be able to justify any criticisms of the newcomer. And, we hope, fade into the sunset out of sheer boredom. Come on up, v.h.f. f.m. is useful, public service minded, and of prime importance, just plain fun. ■

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SELL: Heath SB-301 receiver, $230 or best offer; Eico 720 transmitter, $45. Both FOB Logan. WANT; Heath Twoer or similar in good condition. Jeff, WA7MBL, Box 64, Logan, Utah. 84321.

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SALE: One-Drake 2-C, RX, $170.00/ One Drake 2NT, TX, $90/ One Heath HG-10, VFO With P.S., $25/ One Instructograph Code Machine, $35/ One Heath SWR Bridge, $9/ One HQ129-X, RX, $50/ One Vibroplex Original, $20/ One Viking Adventurer, $20. Contact: WA8VEY, 143 Seminary St., Beren, Ohio. 44017.

FOR SALE: Hammarlund HQ110A, receiver $150., Globe HG303 Multiband Transmitter $40. Albert Mazurek, 4115 Oakridge Drive, Charleston, S. C. 29405.

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WANTED: T4X/R4A. Sell Wagner Xfmr 3600-0-3600 v 1 amp, 110-220 primary $25 fob, Rev. Paul Bittner, 814 4th St S, Virginia, Minn. 55792.

WANTED: Dial Plate for SX-111, junk SX-101A. WB8EEJ, 125 Gardner St., Caro, Mich. 48723.

SELL: Hallicrafter SX-140 6-80M Rcvr, $60; BC-342-N 1.5-18 Mhz Rcvr, $35. WB8GEH/4, 4401 7th Ave., N., St. Petersburg, Fla. 33713.

SALE: Gonset G66 G77 Twins pkged for suitcase-A.C. sply. C.W. only, $100 or make offer. W2CVW, 13 Robert Cir., S. Amboy, N. J. 08879.

SALE: Knight T-60 transmitter (factory wired- a rare one), $50. 6 mtr converters, techcraft CC-50, Ameco CB6, $27.50 each; Transcon 10 mtr, trans, VFO & conv. $50. All fob. R. Wendel, 160-20 Grand Central Pkwy., Jamaica, L. I., N. Y. 11432.

VHF GEAR: WRL 6-2 VFO (mint) $25 ppd U.S. Ameco CN type 6-mtr (7MHz IF) ppd U. S., $25. 6-mter crystals 6 for $5. Stamp for list. W6DOR-, 4100 Worthington Dr., N. Highlands, Calif. 95660.

FOR SALE: NRI Radio-TV course, 6 vols. w/VT. VM; $75.00; Sams Photo Facts, 420 pcs. from Nos. 1-620, $150. Eico 944 Yoke & fly tstr, $22.50. All FOB. R. Wendel, 160-20 Grand Central Parkway, Jamaica, L. I., N. Y. 11432.

FOR SALE: S-40B/Q-Mult, DX-20, DX-40/VF-1, VHF gear, misc. WA3OKJ, 132 Ponderosa Dr., Beaver Falls, Pa. 15010.

BRASSPOUNDERS: If you were ever a CW operator in the military, gov't, or commercial, join the Society of Wireless Pioneers. $5 per year brings you historical pictures, Directory and ham list info. Write: P. O. Box 530, Santa Rosa, Calif. 95402.

FOR SALE: 40' Rohn Tower, 2 El Fiberglass Tri-Band Quad, Tandberg 64X Tape Deck, Triplet Tube Tester, RCA Sr Voltohmist, Hickock VOM. J. Williams, 1404 Iverson St., Oxon Hill, Md. 20021.

FOR SALE: SR-150 and pwr sply, Ham-M, TA-33, TD-2, W-4 Wattmeter. WA9WPO, Larry D. Alwardt, RR 1, Strasburg, Illinois. 62465.

SALE OR SWAP: HW32/HP-13, $125; Heath AG-9A Audio Generator, $25; TS-175/U, 85-1000 MC with book, $65; Need SB-200. W2NUE, 205 Hollywood Avenue, Crestwood, N. Y. 10707.

SB-401 xmtr with crystal pack (SB-301 not needed). College expenses. Best offer. $250 or over. WB8-CYW, 734 Lincoln Ave., Grand Rapids, Mi. 49504.

HAM RADIO needs good publicity. Send me news items, clippings, all returned. WA1GFJ, 160 Elm St., North Haven, Ct. 06473.

WANTED: TS-174 Freq. Meter with Cal. Book. Excellent condition required. Quote price wanted. Curt Foltz, 234 So. Richmond, Carson City, Nevada. 89701.

IMPORTANT: Rochester location for the W. N. Y. Hamfest and V. H. F. Conference on May 15th has been changed. Send for map and program. Write WNY Hamfest, Box 1388, Rochester, N. Y. 14603.

WANTED: 7211 UHF Tubes— SBE LInear for SBE 34 — Speaker — Magnetic or cone circa 1920-1925. G. Vilardi, WA2VTR, 14 Oakwood Terr., Spring Valley, N. Y. 10977.

WANTED REAL BUY IN TRANSCEIVER OR S-LINE and Linear plus accessories. WA4LXX, 251 Collier Ave., Nashville, Tenn. 37211.

TELETYPE SALE. Model 12 KSR excellent, $50; Model 14 KSR 3/8" tape printer & KB excellent, $50; Model 26 KSR w/table $65. All crated FOB, K1VTW, Box 103, Sherborn, Mass. 01770.

FOR SALE: Unique Wire Tuner for random and long wires. Excellent condx. Will ship. $45, WB-2IWH, 213 Dayton Ave., Clifton, N. J. 07011.

FOR SALE: Collins 75S-3B Receiver. Will take 75S-1 in trade. Wanted: Collins 70K-2 PTO. Mike Ludkiewicz, 143 Richmond, Ludlow, Mass. 01056.

F.M. 50/W TRANSCEIVER 150 m.c. w/control, $40., G.E. prog-line 450 m.c. T-powered transceiver, $50. W. Davis, 4434 Josie Ave., Lakewood, Calif. 90713.

FOR SALE: Swan 500-C, 117X-C, Knight SWR bridge, digital clock, EV619 mike, B&W coax switch, Dow Key coax relay, Mosley TA-33 Jr., and rotor, and much more. D. Rubin, WA3JRA, 3919 Bancroft Rd., Balto., Md. 21215.

WANTED: Old Battery-operated radios or crystal sets of the early 1920's. Need not be in working condition. State price wanted first letter. David McKenzie, 1200 W. Euclid, Indianola, Iowa. 50125.

NCL-2000, $340; SB-200, Spare final, $190; EICO 753, 751, $140; TR-3, $300; 5-EL CL-20 (pick-up) $195; LA-1 Arrestor, $10; New: EV-674, $35; BN-86, $12; Drake 4-B Line, mint, xtals. R. Nevers, 23 Sunrise, Saybrook, Ct. 06475.

SELL: Elmac AF67 (160 thru 10) transmitter, $65; PMR-GA Receiver, $60; Eico 70 stereo amp, $65; ATR 12V. to 110V. Inverter (250W.), $65; Fisher Scintillation Counter, $200; Home brew 2KW amplifier, $100; power supply, $65 (2500V. @ 500 ma). E. H. Simmons, Jr., W3QHN, 400 Highland Rd., Pottstown, Penna. (215) 326-1123.

TCS 14 tx & rx, vfo/xtal, 50 cw/am. Cables, pwr supply included, improved keying and am circuits, $70. 150 lbs., U ship. K7JYE, Box 18, Oakridge, Oregon. 97463.

SALE: TH4 BEAM, Gonset II & VFO, meters, microphones. What do you need? Best prices. W2ASI, 15 Kensington Oval, New Rochelle, N. Y. 10805. (914) NE3-7077.

INSTRUCTION MANUALS available for cost of postage and envelope. (one of each). Heath 0-3 o-5, 0-7, 0-8 scope and HW-16 Xcvr. LERC Amateur Radio Club, 2814 Empire Ave., Burbank, Ca. 91504.

MECHANICAL FILTERS: 455 Khz. 2.1 Khz, $18.95. 300 Hz $22.95. J. A. Fredricks, 314 S. 13th Avenue, Yakima, Washington. 98902.

WANT: 6022 tube. Write: Paul J. Skinner, W9QXR, Galesburg Research Hosp., Galesburg, Ill. 61401.

KWM-2, AC & DC PS, TD-1 "TAPE DIPOLE", 14 AVQ, etc., Aug. 70 O'Haul. $775.00. WA6GZZ (916) 331-2185.

SWAN 250, 117XC, calibrator, and vox, $250. R. V. Blaney, 127 Westlawn Dr., RR 4, Decatur, Indiana. 46733.

FOR SALE: G-28 10M Comm., $125; GPPI PH Patch, $30; 3-30 Mobile Conv., $15; DX40, $50; Heath 10'er, $50. WB9FHQ, B. Cook, RT 1, Box 132A, Warrenville, Ill. 60555.

1895 thru 1923 wireless gear and tubes wanted for cash. W9LGH, 610 Monroe Ave., River Forest, Illinois. 60305.

LICENSING COURSES: The LERC Amateur Radio Club regularly conducts Ham Courses which are open to all Los Angeles Area people. Write to: 2814 Empire Ave., Burbank, Calif. 91504.

BARGAINS: SX-100, $115; HQ-110AC(VHF), $145.00; BC-779 Super Pro with P.S. and speaker, $55; Heath twoer, $40; Lafayette HA-460, $105; Much more available. Send stamp for list. J. R. Shank, 21 Terrace Ln., Elizabethtown, Pa. 17022.

FOR SALE: Astatic GD104 High impedance microphone with grip to talk stand. Excellent condition. $24. 9 Pensdale Ct., Stony Brook, N. Y. 11790.

HEATH DX-40 w/xtals, $25; VF-1 VFO, $7; Gonset G-66B Rcvr, $25. All w/manuals. C. Moore, 3329 March Ln., Garland, Tex. 75040.

SELL: HQ-170 AW Clock exc. cond just factory realigned. $185. Heath DX60B, vy gd cond. Little use. $50. WANT: Trap vertical state price & cond, can be any type, 1, 3, 5, band. WN2NPW, 90 Midwood Avenue, Allendale, N. J. 07401.

DO YOU HAVE A SPARE OR UNWANTED COPY OF "CQ", October, 1945, to replace mine with missing pages? A. Herridge, G3IDG, 96 George St., Basingstoke, Hants, England.

MAGAZINES WANTED: Care to donate a batch of Ham Magazines to a club that runs a service helping hams fill in their libraries? If so, pls ship them to LERC, 2814 Empire Ave., Burbank, Ca. 91504.

FOR SALE OR TRADE. TA36, $85. 14AVS, $15. Wilcock Gay Antique Rcvr. Prefer local deal. Milo, Rt. 2, Salem, Ohio. 44460.

WATERS Model 361 "Codax" Automatic Keyer, $30 ppd; Collins 2.0 kc Mech. Filter F455 N20, $25 ppd. K7CPW, 2115 Wolfe Pl. W., Seattle, Wa. 98199.

WANTED: Coils, E and F for my HRO 60. Please state price. Harrison, P. O. Box 234, Bloomsbury, N. J. 08804.

BARGAINS IN SURPLUS COMPONENTS. Panel meters, A-B Pots., Coax Fittings, Rotary Inductors. Lists SASE. Ken Maas, Burlington, Wis. 53105.

FOR SALE: Drake TR-4, AC-4, mike, extra set of matched finals, $450; SX-100, $90. Wright, P. O. Bx 12061, Res. Triangle Pk., N. C. 27709.

SELL: QST Magazines, 38 years solid to date. Fine condition. $50. W6PNO, 2700 Neilson Way, Santa Monica, Calif. 90405.

FOR SALE: Drake 2B Rcvr with 2-AC calibrator & instruction book. Mint condition. $175. B. Nastoff, 320 W. 56th Place, Gary, In. 46410.

WANT: Millen 90905 5" Rack Mount Scope also needed HRO or HRO-5 receiver. J. Feasel, W8-HPL, 9401 Clark State Rd., Pataskala, Oh. 43062.

WANTED: Binders for QST, CQ, 73. Also want keyer, paddle, and cassette tape recorder. Tom Dornback, K9MKX, 19W167 21st Pl., Lombard, Il. 60148.

2 MTR FM--AS NEW VARITRONICS HT-2 2-CH. Handie-Talkie, w/.94-.94, .34-.76 xtals, NI-CADS, Charger, Flexible antenna. 6 mos. old, works perfectly. $200. K9KDI, Box 552, Arlington Hts., Il. 60006.

SELL: NCX-500, AC-500 Excellent. $365. H. Taubin, W2GCW, 192-15A 69th Avenue, Flushing, New York. 11365. (212) 454-2775.

HAVE 20 UNUSED 807W TUBES. One or all, $2 each PPD. U.S.A. WB6ZWS, 5113 Arvada, Torrance, California. 90503.

SURPLUS —Xfmrs, relays, meters, etc. Must clean out. Stamp for list. W2VR, 2 Wood Haven Pl., E. Northport, N. Y. 11731.

SELL OR TRADE: Eldico novice transmitter, noise limiters, Oscilloscope Voltage Calibrator, more. Write: WB2PUH, Frank Simon, 26 Joanne Ct., Albany, N. Y. 12209.

THE SPRING AUCTION of the ROCKAWAY AMATEUR RADIO CLUB will take place Friday evening April 23, 1970 at 8:00 P. M. at the American Irish Hall, Beach Channel Drive at Beach 81st. St., Rockaway Beach, N. Y. Doors open at 6:00 P. M. to accept items for the sale. One dollar donation accepted at the door, refreshments included. For more info write to Auction Chairman: Al Smith, WA2TAQ, P. O. Box 341, Lynbrook, N. Y. 11563.

SSB STATION: HT-46, TX, SX146 RX with cal and AM, CW filters. Ant. Rel., Dyn. Mic. All in good condx. Price: $380. K3FOD, 925 Coleridge, Balto., Maryland. 21229.

WANT: "Radio" Magazine, dated July, 1935 to complete 7-year run. A. Herridge, G3IDG, 96 George St., Basingstoke, Hants, England.

WANTED: B&K T.V. Analyst & other B&K Test Equip. By Student. Reasonable. J. Wegner, Jr., POB 262. Glendale. Calif. 91209.

FOR SALE: Collins Station 75S-3B, 32S-3, 516F-2, 312B-4; also Swan 500 with A.C. and D.C. Supply, 40 ft. Rohn Tower, 20' Rabs Tower, Ham "M" Rotor, TH-6 Antenna, TB-3 Antenna. All excell. condition. Best offer. Henry Samplin, P.O. Box 147, Rockaway Park, N. Y. 11694.

MODEL 15 TELETYPE WANTED. Give lowest price and condition. K1VTW, P. O. Box 103, Sherborn, Massachusetts. 01770.

3rd ANNUAL LAND OF LINCOLN CB JAMBOREE, June 12 and 13, 1971, in Decatur, Illinois, at Macon County Fairgrounds. Contact: Mrs. Sue Hannon, Chairman, 3402 Orchard Dr., Decatur, Illinois. 62521. Phone: (217) 428-5914.

SALE: ARRL Handbooks, 1938-42-43-44-46-47-49-52-53-57- $3 each, FOB. Radio and Engineers 8th 1941 and llth 1947 Handbooks, $8 each FOB. Douglas, 2254 Pepper Dr., Concord, Calif. 94520.

HELP! NEED MANUAL OR SCHEMATIC for RME DB-22A Preselector. WA4TOJ, 2957 Gaffney Rd., Richmond, Va. 23234.

G. E. PROGRESS LINE, 2 meter F.M., Hand carry transceiver, 2 ch. 1 watt out,, built in Nicad pack and charger. On .94/.94 excellent. $125. or trade for Gonset G-50 or Sim. 6 meter Xcvr. WA8QBJ, Clinton, Ohio. 44216.

NEW SSTV MONITOR, $295; FM MOTOROLA, Hi-pwr (660W) amplifier 2 meters, $75; 6-2-432-1296 converters cheap, UHF & Test Gear SASE, W4API, Box 4095, Arlington, Va. 22204.

SELL: Galaxy GT-550, AC-400 P.S., VOX with manuals. $450. Will ship. Siefert, 4295 Waybourn Rd., Columbus, Ohio. 43220.

WANTED: Old battery-operated radios of the early 1910's. Need not be in working condition. State model and price. McKenzie, 1200 West Euclid, Indianola, Iowa. 50125.

FOR SALE: Colorual PMK-1, Heath Color Canoe, 8 x 10. Durst M300 with Schneider Componon & Iscrit Lenses. Tim-O-Lite, Color Filters, Trays & all you need for mailing color prints. Ed Schofield, 301 N. 3rd St., Lantana, Florida. 33460.

FOR SALE: Morrow shielded BC rcvr- can be used as variable I.F. W2CVW, 13 Robert Cir., S. Amboy, N. J. 08879. $5.00.

WANTED: Two (2) Courier B-30 radios or a Johnson 600. Lester Engineering Co., 501 West Broadway, Mayfield, Ky. 42066. Ph: 247-1808.

CANADIANS: Complete amateur equipment service by fully-equipped lic'd technician, kits wired-serviced. B. Fransen, VE6TW, 227 Cottonwood, Sherwood Pk., Alta.

LINEAR BUILDERS: 30 AMP FILAMENT CHOKES for GG Linears. Perfect for pair 4-250A's, 4-400A's, 3-400Z's, 3-500Z's, 813's, or single 4-1000A, 3-1000Z, etc. $5 each PPD, USA. V. R. Murrell, K4-HHA, 712C Rich Rd., Newport, Tenn. 37821.

WANTED BY STUDENT: B & K TV Analyst, model 1076 or 77 and B & K equip. J. Wegner, Jr., POB 262, Glendale, Calif. 91209.

VHF: Send stamped envelope for list of 6-meter crystals. Ameco type CN 6-meter converter (7 MHz IF) $25. Globe (WRL) 6-2 VFO, $25. All postpaid U. S. W7BYF/6, 4100 Worthington Dr., No. Highlands, California. 95660.

SELL: Drake 2-NT Novice Xmtr. Mint. Break-in, Sidetone. 75-100 watts. Best offer over $80 takes it. Will ship. WB6PBJ, 2531 Sarandi Grande Dr., Hacienda Hts., California. 91745.

WANTED: 2BP1 scope tube. State condition and price. W6DOU, 3154 Stony Point Rd., Santa Rosa, Calif. 95401.

JOHNSON VALIANT I, just reconx — $135; Hammarlund HO-170AC/VHF w/spkr and immunizer, excellent — $275. WB9DWG, R. O. Lust, Box 314, Whitewater, Wis. 53190.

WANTED: Heath equipment HP-13 supply, HS-24 spkr, GH-12A mike. WB6ZWS, 5113 Arvada, Torrance, California. 90503.

SELL OR SWAP FOR TELESCOPE: BC-348, ARC-5's, PCA-200 Panadaptor, SR-75 Transceiver. T. Gosman, 143 Roxton Rd., Plainview, N. Y. 11803.

NEMS-CLARKE 1304 RX. Let me buy or copy and return schematic and/or T-M. M. Brame, Rt. 4, Logan, Ohio. 43138.

SB300 with SSB, CW & AM Filters, matching speaker. HKE new, $185. W6TRU, 5226 Vickie Dr., San Diego, Calif. (714) 488-8673.

JOHNSON 124 — $200; Johnson 323, $180. New, in factory sealed carton. Write: Shelton, 103 Public Square, Berryville, Ark. 72616.

FOR SALE: Heath HW-100, HP13A, HP23, $300 or best offer. Shipped to you, prepaid. S. F. Carter, 6675 E. 19th St., Indpls., Ind. 46219.

SELL: California Kilowatt, pr. of 4-1000A's. Professional construction. $700.00. Details SASE. WB2YRU, A. Povol, 3538 Centerview Ave., Wantagh, N. Y. 11793.

KT38B and Mobile transceiver wanted. JLD, W3-FBT, 904 Haws Avenue, Norristown, Pa. 19401.

TRADE: For CW Xmtr w/VFO. RCA Carfone, Heath Sixer or 2 4-65A w/sockets. WA2FFZ, 186 West Avenue, Pitman, N. J. 08071.

F. M. UNITS: Six meter High power G. E. Progress lines; factory 40-54 MHz w/pair 6146's; No conversion necessary. Supplied w/control head & cables, $100 each. Also have Lo-band Motorola T-S1 $100 and Hi-Band GE TPL $300. R. P. Stein, 2966 Carrizo, Dallas, Texas. 75229. (214) 357-4425.

WABASH CO. AMATEUR RADIO CLUB'S THIRD ANNUAL HAMFEST, Sunday May 23. Rain or shine! Door prizes, major prizes and much more. $1 donation for admission. For information, write Bob Mitting, 663 Spring, Wabash, Indiana. 46992.

WANTED: Good used AC power supply for Heath HW-23 HP-23. Box 8352, Savannah, Georgia. 31402.

G4ZU Beam [*from page 41*]

dimensional perspective with the overall antenna. This system of matching is shown in fig. 4.

Performance

Performance over a number of years has been excellent. We have not had the facility for installing a dipole at the same height for comparative gain figures. In general, the antenna performs equally well with a good 3-element single-band yagi beam on 15 and considerably better than a 3-element beam on 10 meters. The 20-meter performance is the compromise expected from a 2-element shortened beam. It radiates very well and shows considerable gain and directivity over a 20-meter dipole.

Worries of radiation by feedlines are quickly dispelled by the excellent directivity obtained in receiving. Front-to-back ratios and front to end ratios vary somewhat depending on actual director and reflector settings, however, it is probably fair to say that these ratios are nearly equivalent to those for equivalent trap beams fed with coax cable.

Enlarged Two Band Beam

In addition to the standard three band minibeam, several years ago we designed and built a two-band 20/15 meter beam of this type. This beam was used with considerable success for several months but had to be taken down when the author moved into a home without room for a full 20 meter beam. This beam employed a 20 foot boom, a 33.5 foot split driven element and a single connected 35.2 foot reflector. The director was a 21.0 foot split element shorted by a 9'1" 300 ohm 15-meter stub and a 20 meter trombone resonant at 13.5 mc. Spacing were approximately 12 feet for reflector and 8 feet for director. Matching was done with 450 ohm open wire line and a good transmatch. The beam worked extremely well on 20 meters. 15-meter operation appeared satisfactory, however time and band conditions did not permit extensive testing before the antenna was dismantled.

The G4ZU beams are somewhat complicated in theory but are easily constructed and they perform very well indeed. They may be constructed at a fraction of the cost of equivalent commercially produced trap beams. A poor man's version could be made by constructing the beam from elements made by taping copper wires to bamboo poles. ■

Digital Propo [*from page 62*]

transmitters it simply shows battery voltage. Since most all digital propo outfits utilize nickel-cad batteries at both ends of the system, a suitable charger is required. Most makers put the charger right in the transmitter (impossible to leave behind if you are operating away from home—and remember the charging cables!). Other makers furnish a separate charger; most of these include an isolation transformer. Unfortunately most chargers built into transmitters don't have this valuable safety feature. Generally the batteries for transmitter and receiver run down at about the same rate, and they are usually charged in series.

It can be seen that if one cell in the usual four-cell receiver and servo battery goes dead, servo action will be seriously "unbalanced" —so much so that the model may become unmanageable and crash. This has happened all too often. In such cases the receiver, decoder and most of the servo circuits may still function—though perhaps at lower efficiency —but the servo amplifiers will be very unsymmetrical. Several makers have therefore utilized a so-called "bridge amplifier" for the motor, such that no battery center tap is required. Here, even if one (perhaps even two) cells go dead, the servo motor will still retain its center position with no signal, and will still operate properly, though more slowly and with considerably reduced power. Such circuitry is more complex, and thus used only in the highest cost systems.

Integrated circuits are coming more and more into use in R/C equipment. So far they have been utilized mainly in encoder and decoder circuitry. Their reduced size (in the small round configurations) have brought them into servo circuitry too. One manufacturer early in 1970 introduced a servo with *all* circuit components except the feedback pot and the drive motor in a single I.C. Even though applied to a very small servo, this unit was so tiny that considerable plastic filler had to be used to keep it from rattling around in the space formerly occupied by a jam-packed conventional P.C. servo amplifier.

Digital equipment is getting smaller and smaller (some users fear this trend is leading to less reliability due to use of tiny parts, very high P.C. board density, the need for top grade workmanship on the tiny amplifiers)—servos especially. Transmitters probably won't get much smaller—they wouldn't be comfortable to hold. Receivers probably will though. And batteries will doubtless get lighter. Several equipment makers are now using the recently announced nickel-cad cells of reduced weight. Most nickel-cads in both transmitters and plane installations utilize cells of either 450 or 500 maH; both button and cylindrical cells have seen wide use, but the former seem to be less and less popular. The new "fast charge" nickel-cads have reached the R/C field too. Now if we could only eliminate that "noise-sensitivity" that still plagues digital systems...! ■

Q & A [*from page 72*]

should be had with an r.f. choke or bypass at the plate return to the positive side of the supply source. Otherwise, the B-plus lead and power source becomes part of the oscillator circuit. When the control is located in the B-plus leg, its resistance can function as a choke, thus providing the required location.

73, Bill, W2AEF

READER SERVICE

To obtain literature from advertisers, simply check the box to the name of each advertiser listed below whose product or service is of interest to you. We'll pass your name on and you'll get literature from the advertiser in short order.

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- ☐ World Radio Laboratories
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NEW PRODUCTS

80 81 82 83 84 85 86 88

CQ Reader Service
14 Vanderventer Ave.
Port Washington, N. Y. 11050

Name............................Call..............

Street Address..................................

City..................State..........Zip.........

Advertiser's Index

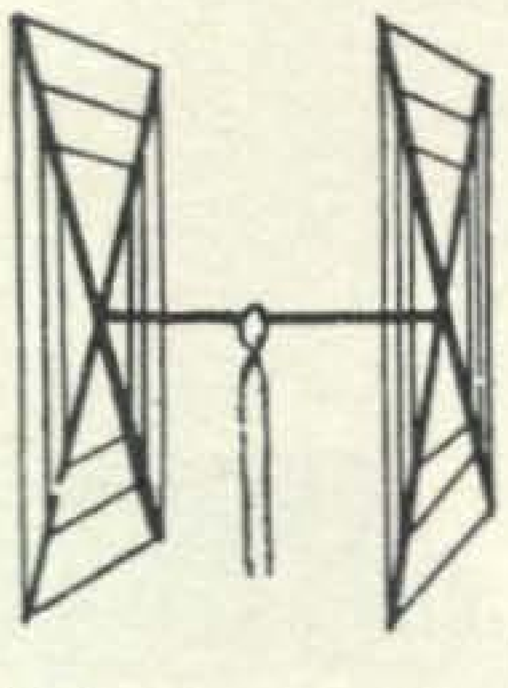
AHA! YOU THOUGHT GOTHAM

made run-of-the-mill ordinary antennas. No, no, no. Our materials are the best, and our design superior. WA1JFG won the New England Round-Up championship with our 3-element 15meter beam by a margin of 5,982 points!

QUADS

Worked 42 countries in two weeks with my Gotham Quad and only 75 watts...
W3

CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount; uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!



10/15/20 CUBICAL QUAD SPECIFICATIONS

Antenna Designation: 10/15/20 Quad
Number of Elements: Two. A full wavelength driven element and reflector for each band.
Freq. Covered: 14-14.4 Mc. 21-21.45 Mc. 28-29.7 Mc.
Shipping Weight: 28 lbs. Net Weight: 25 lbs.
Dimensions: About 16′ square.
Power Rating: 5 KW.
Operation Mode: All
SWR: 1.05:1 at resonance
Gain: 8.1 db. over isotropic
F/B Ratio: A minimum of 17 db. F/B
Boom: 10′ long x 1¼″ O.D.; 18 gauge steel; double plated; gold color
Beam Mount: Square aluminum alloy plate incorporating four steel U-bolt assemblies. Will easily support 100 lbs. Universal polarization.

Radiating Elements: Steel wire, tempered and plated, .064″ diameter.

X Frameworks: Each framework consists of two 12′ sections of 1″ OD aluminum 'hi-strength' (Revere) tubing, with telescoping ⅞″ tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings

Feedline (not furnished); 52 ohm coaxial cable

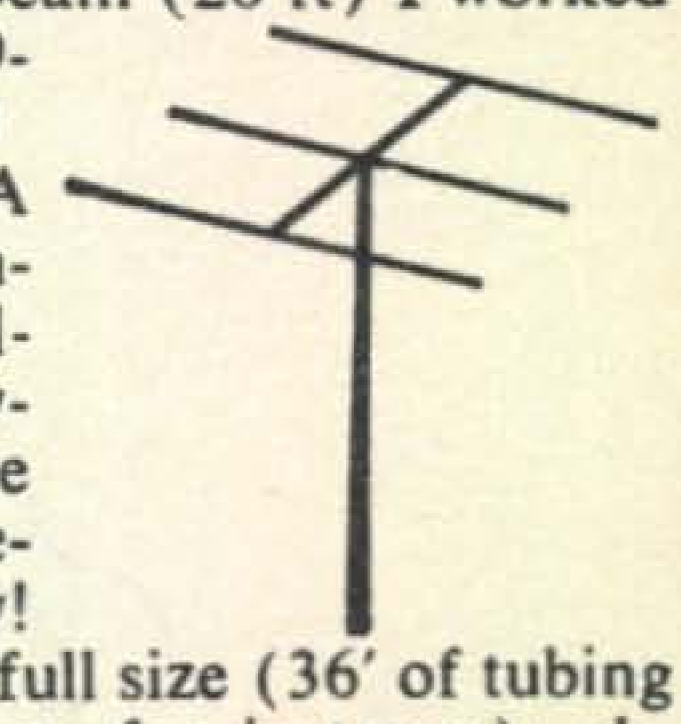
Now check these startling prices—note that they are *much lower* than even the bamboo-type:

10-15-20 CUBICAL QUAD	$37.00
10-15 CUBICAL QUAD	32.00
15-20 CUBICAL QUAD	34.00
TWENTY METER CUBICAL QUAD	27.00
FIFTEEN METER CUBICAL QUAD	26.00
TEN METER CUBICAL QUAD	25.00

(all use single coax feedline)

BEAMS

The first morning I put up my 3 element Gotham beam (20 ft) I worked YO4CT, ON5LW, SP9-ADQ, and 4U1ITU THAT ANTENNA WORKS! WN4DYN Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history!



Each beam is brand new; full size (36′ of tubing for *each* 20 meter element, for instance); absolutely complete including a boom and all hardware; uses a single 52 or 72 ohm coaxial feedline; the SWR is 1:1; easily handles 5 KW; ⅞″ and 1″ alumnium alloy tubing is employed for maximum strength and low wind loading; all beams are adjustable to any frequency in the band.

2 EL 20	$21	4 EL 10	20
3 EL 20	27	7 EL 10	34*
4 EL 20	34*	4 EL 6	20
2 EL 15	17	8 EL 6	30*
3 EL 15	21	12 EL 2	27*
4 EL 15	27*	***20' Boom**	
5 EL 15	30*		

ALL-BAND VERTICALS

"All band vertical!" asked one skeptic. "Twenty meters is murder these days. Let's see you make a contact on twenty meter phone with low power!" So K4KXR switched to twenty, using a V80 antenna and 35 watts AM. Here is a small portion of the stations he worked: VE3FAZ, TI2FGS, W5KYJ, W1WOZ, W2-ODH, WA3DJT, WB2FCB, W2YHH, VE3-FOB, WA8CZE, K1SYB, K2RDJ, K1MVV, K8HGY, K3UTL, W8QJC, WA2LVE, YS1-MAM, WA8ATS, K2PGS, W2QJP, W4JWJ, K2PSK, WA8CGA, WB2KWY, W2IWJ, VE3-KT. Moral: It's the antenna that counts!
FLASH! Switched to 15 c.w. and worked KZ5-IKN, KZ5OWN, HC1LC, PY5ASN, FG7XT, XE2I, KP4AQL, SM5BGK, G2AOB, YV5-CLK. OZ4H. and over a thousand other stations!

V40 vertical for 40, 20, 15, 10, 6 meters	$14.95
V80 vertical for 80, 75, 40, 20, 15, 10, 6 meters	$16.95
V160 vertical for 160, 80, 75, 40, 20, 15, 10, 6 meters	$18.95

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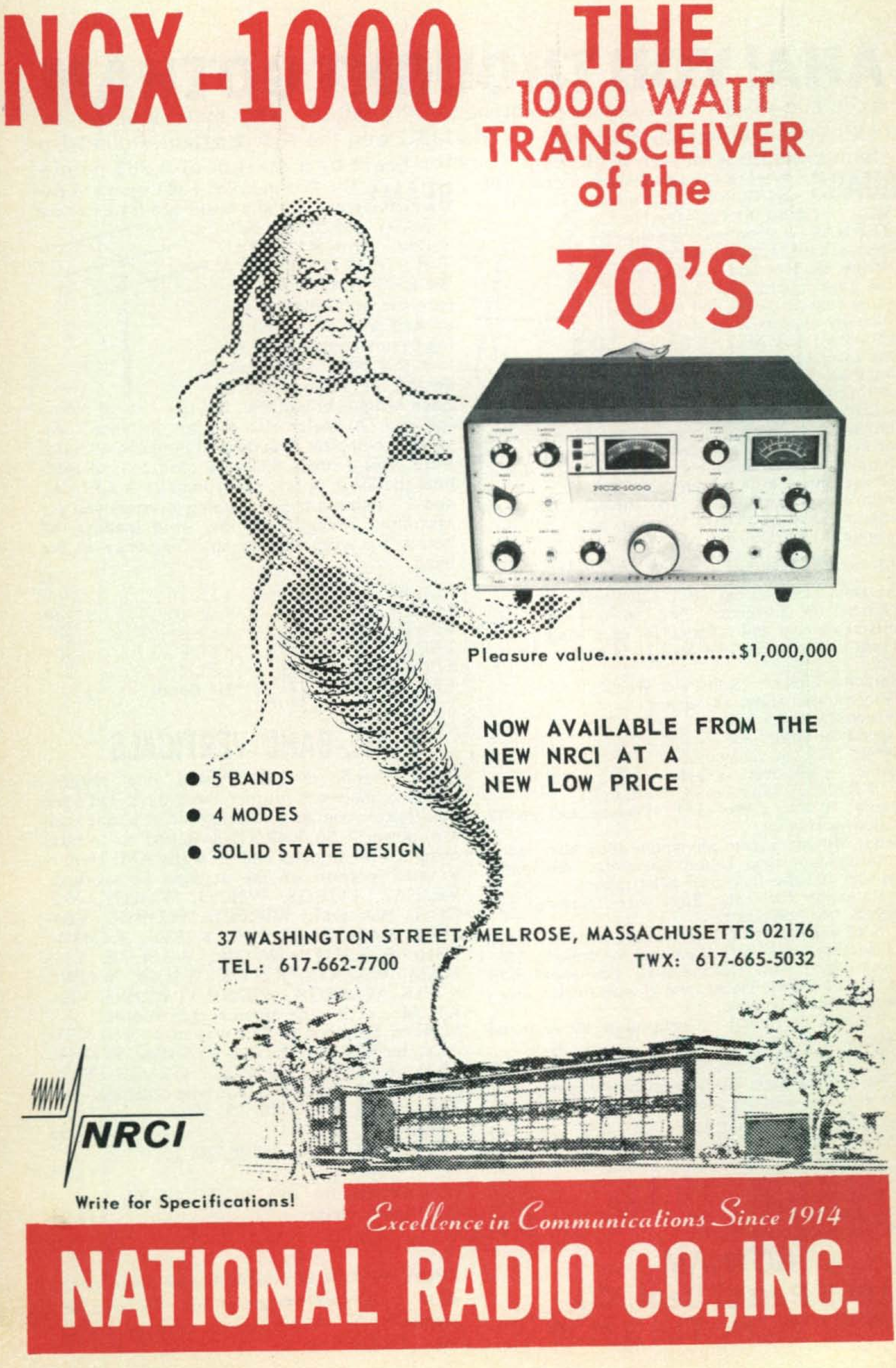
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