CQ

December 1969

75¢

A Decade Later

CQ Reviews The Collins S-Line

AUSTRALIS-OSCAR V

Launch Due This Month

The Radio Amateur's Journal

The New Heathkit®
2-kW Linear
Is Here

(at last)

New Heathkit® SB-220 . . . $349.95*

It's not just a rumor anymore . . . the SB-220 is here, with a price and performance worth the wait.

The New Heathkit SB-220 uses a pair of conservatively rated Eimac 3-500Z's to provide up to 2000 watts PEP input on SSB, and 1000 watts on CW *and RTTY*. Requires only 100 watts PEP drive. Pretuned broad band pi input coils are used for maximum efficiency and low distortion on the 80-10 meter amateur bands.

Built-In Solid State Power Supply can be wired for operation from 120 or 240 VAC. Circuit breakers provide added protection and eliminate having to keep a supply of fuses on hand. Operating bias is Zener diode regulated to reduce idling plate current for cooler operation and longer life.

Double Shielding For Maximum TVI Protection. The new "220" is the only final on the market that's double shielded to reduce stray radiation. The heavy gauge chassis is partitioned for extra strength and isolation of components. When you put this kind of power on the air, you'd better be sure. With the SB-220, you are.

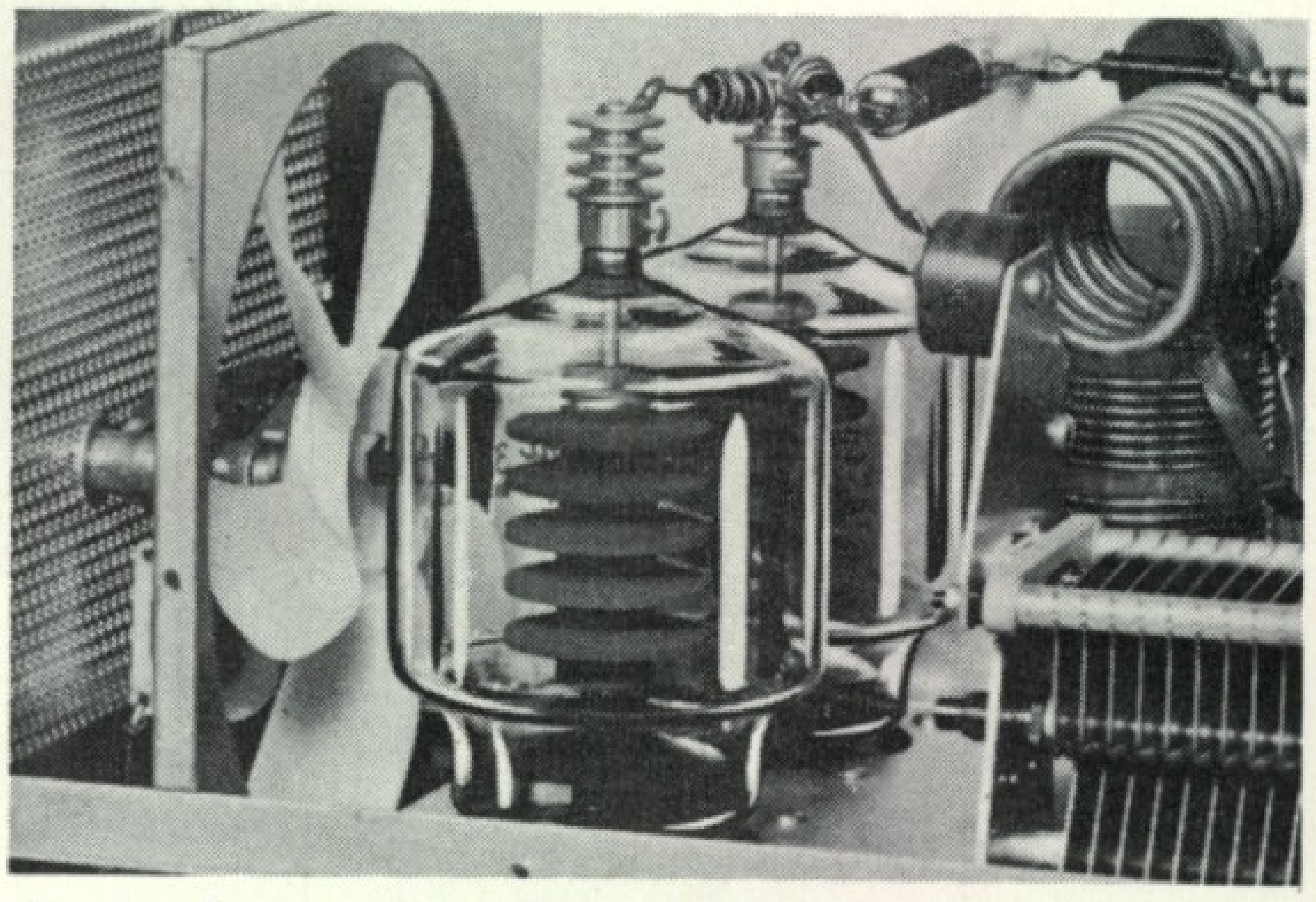
Really Cool Running. The layout of the SB-220 is designed for fast, high volume air flow, and a quiet fan in the PA compartment does the job. The "220" actually runs cooler than most exciters.

Other Features include ALC output for prevention of overdriving . . . safety interlock on the cover . . . easy 15 hour assembly and sharp Heathkit SB-Series styling.

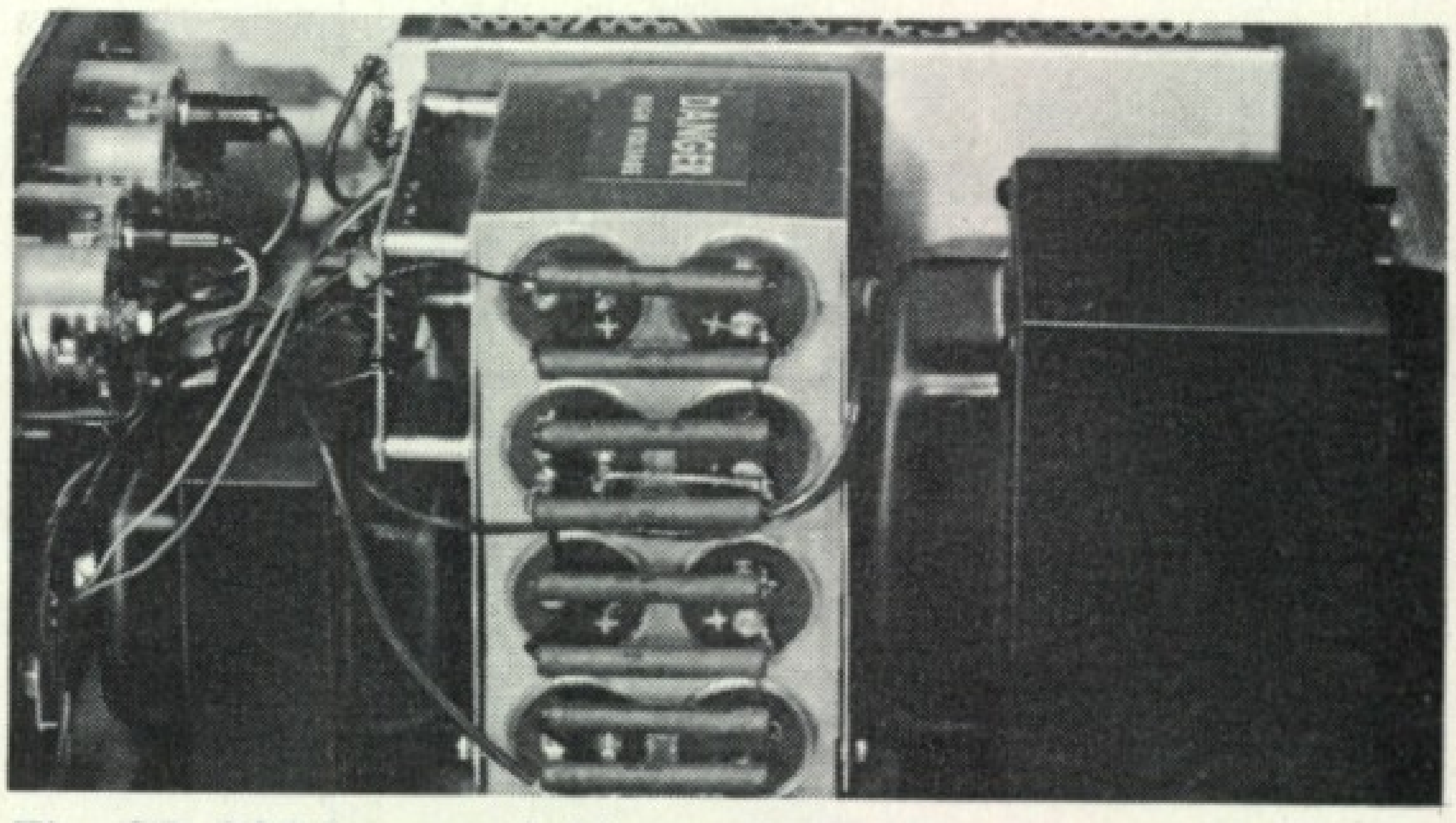
Tired Of Stumbling Barefoot Through The QRM? Put on big shoes . . . the new Heathkit SB-220. Another hot one from the Hams At Heath.

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

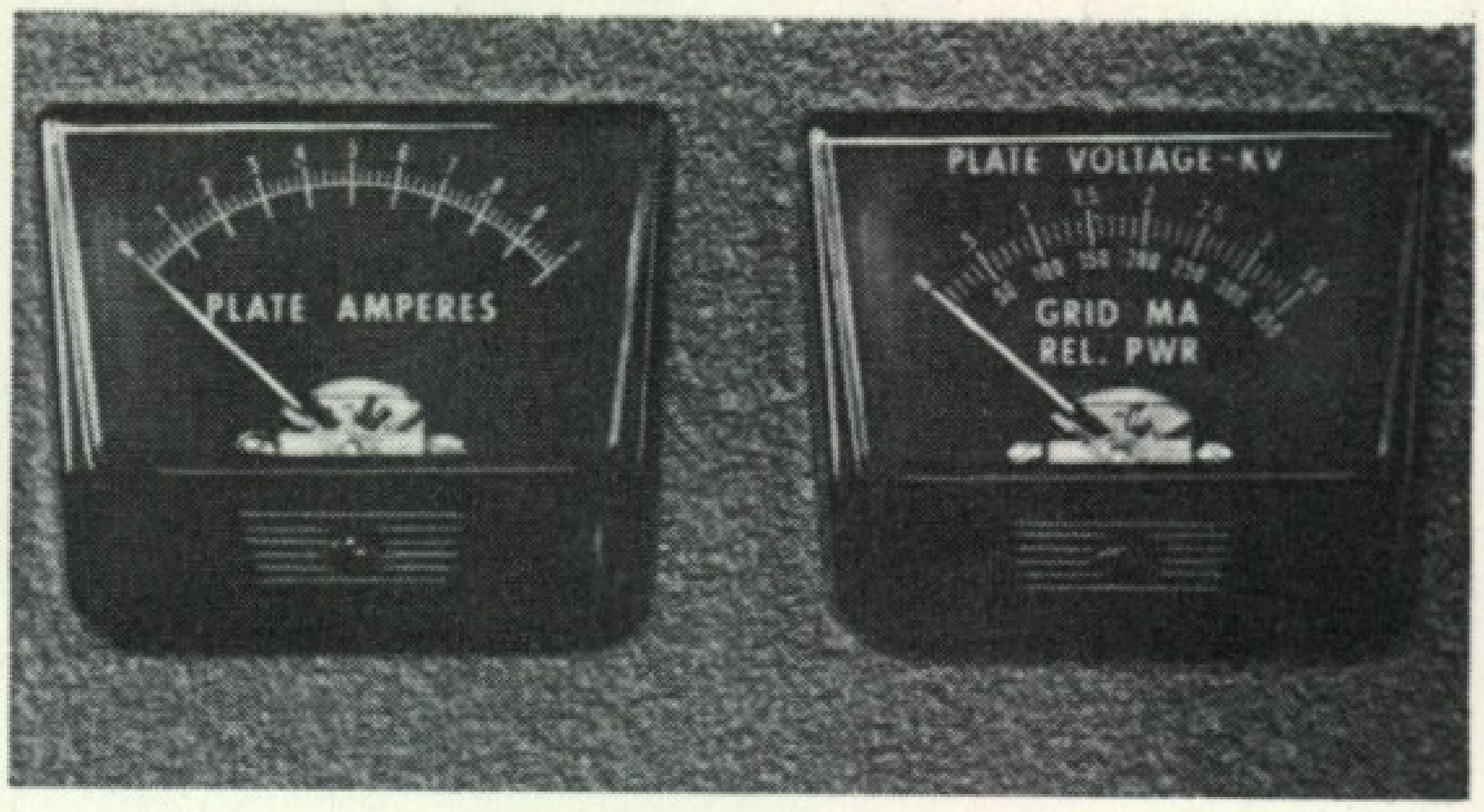
SB-220 SPECIFICATIONS — Band coverage: 80, 40, 20, 15 and 10 meter amateur bands. **Driving power required:** 100 watts. **Maximum power input:** SSB: 2000 watts P.E.P. CW: 1000 watts. RTTY: 1000 watts. **Duty cycle:** SSB: Continuous voice modulation. CW: Continuous (maximum key-down 10 minutes). RTTY: 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:** 14 7/8" W x 8 1/4" H x 14 1/2" D. **Net weight:** 48 lbs.



A pair of rugged, dependable Eimac 3-500Z's in the final mean unbeatable performance. Zener diode regulated operating bias reduces idling Ip and the large fan means cool running, long life.



The SB-220 has a reliable, well-designed power supply . . . the plate power transformer is at right, a 25 ufd capacitor bank in the center gives excellent dynamic regulation and the filament and bias circuitry and transformer is on the left.



Complete monitoring facilities for fast, easy tune up. The left meter gives continuous monitoring of Ip . . . the right one can be switched to read Relative Power, Ep and Ig.

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Seasons Greetings

from the Old Man himself.

WØFQY KØAXS

Mosley Electronics Inc.

See page 104 for New Reader Service

CQ

DECEMBER, 1969 VOL. 25, No. 12

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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When QRM Gets Tough Choose The Only Microphone With Backbone!

ELECTRO-VOICE MODEL 676 DYNAMIC CARDIOID

The backbone of the Electro-Voice Model 676 is no mere ecoration. It's visible proof of e most exciting idea in directional icrophones—Continuously ariable-D (CV-D)™.

Iere's how it works. We attach a ery special tapered tube to the ack of the microphone element. his tube automatically varies in ffective length with frequency. 's a long tube for lows—a short ube for highs. All this with no noving parts! The tube is always ptimum length to most effectively ancel sound arriving from he back of the microphone, egardless of frequency.

This ingenious solution* is ears ahead of the common ixed-path design found in most ardioid microphones. It means ou pick up less noise and oom reverberation, ensuring a risp signal and optimum vox erformance. It also is less ensitive to wind and shock—ideal for field days! There is almost no "proximity effect"... no boosted bass when you must operate extra close.

Long life and peak-free response are guaranteed by the exclusive E-V Acoustalloy® diaphragm. And the 676 has unusually high output for a microphone so small. Of course you get both 150-ohm and Hi-Z outputs, plus high efficiency dust, pop, and magnetic filters—indeed, all of the hallmarks of Electro-Voice design that have made E-V a leader for years.

But that's not all. The 676 has an exclusive bass control switch built in. Choose flat response (from 40 to 15,000 cps) or tilt off bass 5 or 10 db at 100 cps to eliminate power-robbing lows that reduce efficiency and lower intelligibility. You'll be amazed at the reports of improved audio you'll get when you switch to the E-V676.

Visit your E-V distributor to see this remarkable new microphone today. And when difficult QRM must be faced squarely, stand up and fight back with the microphone with a backbone (and CV-D)—the new Electro-Voice Model 676 dynamic cardioid!

Model 676 Satin Chrome or TV grey, $89.00 list; in Gold, $94.50 list. Shown on Model 420 Desk Stand, $21.00 list. Model 674 identical except stud-mounted with On-Off switch, $89.00 list. (Less normal trade discounts.)

ELECTRO-VOICE, INC., Dept 1192G
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this CW and SSB Cyclone system is unmatched by any other on or off the market. just look at the score of features built-into the transceiver alone:

• RIT • AALC • Notch Filter • CW Filter • CW Sidetone • Grid Block Keying • Front Panel Bias Adjust • 1 kHz Readout • Noise Blanker • Switched full metering • Upper/Lower SSB • Phone Patch Output • Xmit and Receiver Antenna Connectors • 6 Pole Xtal Lattice Filte • Semi-Automatic Break-In CW • MOX • VO • PTT • 100 kHz Xtal Calibrator • Adjustable P Network

Accessories include:

PS-500A-AC Power Supply, HA-20 VFO, HA-1 Keyer. see and buy the "the spoilers" today a your local Hallicrafters distributor. go ahead an spoil yourself!

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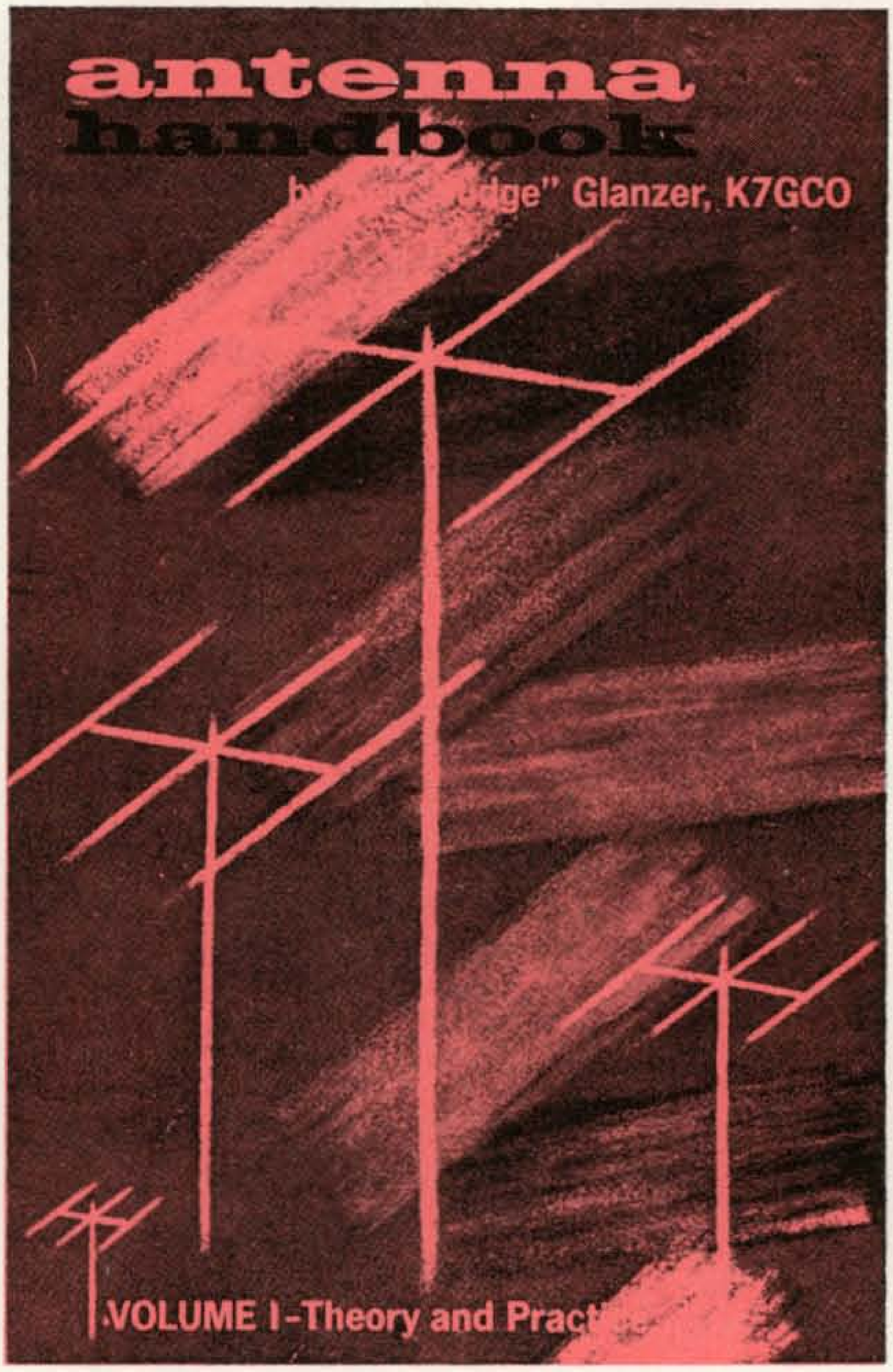
Something Really New!

The result of 15 years of exhaustive research—of trying to find the best antenna for every possible situation. Not a re-hash of old material, but a completely new and exciting book describing techniques and concepts as never before seen in the antenna field.

So big and complete that it takes *three* volumes to tell the whole story. Now, after six years of preparation, the *CQ* Technical library is proud to present Volume I of this soon-to-be-classic trilogy. Volumes II and III will follow in quick succession.



Here's just a sample of what Volume I covers: Transmission line theory, Attenuation, Impedance, Standing waves, resonant and non-resonant lines, stub matching, single and parallel coaxial lines, radiation fundamentals, current distribution, induction field, radiated field, gain, reciprocity, radiation resistance, dipoles, tripoles, depth of electrical ground, relative ground conductivity from s.w.r., reactive variations, free space **3 dimensional** patterns of long wires of all practical lengths, effect of center and end feed on antennas, tilted antennas, terminated long wires and vee beams, matching, devices, what happens to all that reflected power, which end of feed is more important to match, how to use open wire feed on beams, gamma matches, T-matches, feeding T-match with dual coax, transforming balanced 100 ohm coax lines to 200 or 50 ohms, capacitive match for balanced transmission lines, inductive (hair-pin) match, quarter wave and short bazookas for balanced feed, broad band baluns and effect on feedpoint current, effect of surrounding objects and power lines on feedpoint current, folded dipole matching for beams, feeding stacked beams individually or together.

Watch for the announcement of volumes II and III.

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OUR READERS SAY

Reason For Being

Editor, *CQ:*

Since the advent of incentive licensing last November, I have kept my amateur operation to a minimum. Instead of running my 100 watts in the crowded phone and c.w. segments of 80, 40 and 20 meters, I have concentrated my activity in the MARS frequencies. I was against the proposal when the League first tried to shove it down the throats of the General and Conditional class amateurs. I was against this proposal for several reasons.

In the first place, incentive licensing was a blow to the General and Conditional class (the average license class) amateur who was not professionally connected with communications or the electronics industry. Second, it has made an absolute mess of the 75 meter phone band. This action has caused many nets to shift higher into the General class portion of the phone band. This is because any state or regional net must be located where a majority of the participants can operate. Those who are located in the larger cities will remember how much Novices contributed to the 2 meter band. There was a time when I could pass traffic or get phone patch on the 75 meter phone band with relative ease. However, present conditions have deteriorated so that we now have extremely difficult conditions on the high end of the band and relative inactivity (except for the creeping foreign carriers) on the lower end of the band.

However, the most serious result of incentive licensing was that it split amateur radio into differing and sometimes warring factions. This has resulted in a caste system on some of the bands. For example, I have noticed that even above 3850 kc in some QSO's the Advanced class is no longer welcome. This bickering and disunity, unless something happens, may speed the down-fall of amateur radio because without unity we will have no representation in Washington. How much do you think that we have now?

What puzzled me was the hypocrisy of the League during this period. They complained, as many advocates of incentive licensing did, that it was just terrible that many of us average hams either bought a complete station or built rigs from a kit. The irony is that you can still find advertisements from Collins, Drake, Swan, Heath, etc., in their monthly publication.

I feel that the ultimate justification of amateur radio will not rest with making everyone electronic wizards or A-1 operators. The ultimate justification will rest with public service and its contribution to society. I am referring to traffic and phone patch nets and not the garbage nets

A friend of ours dropped by the other day to talk to us about this rooftop problem.

About the only one down on our antennas these days is your friend and ours. But, what can we do? It seems you dig our antennas so much we can't stop making them. So, keep on buying them. And we'll see if we can't get the old guy to start using the front door.

Season's Greetings from Hy-Gain

Hy-Gain Electronics Corporation
P. O. Box 868-FL, Lincoln, Nebraska 68501

The Strongest Signal Under the Sun

that abound on 20 meters. In net operation we are providing a service to the public by handling traffic and by training operators. This is one reason why MARS is justified by the military. Public service can also come in the forms of experimentation, civil defense and emergency operations.

As I see the problem, we can either bring unity back to the radio fraternity and obtain representation in Washington or we can sit back and watch amateur radio fade into a thing of the past. With this in mind, I suggest that we eliminate the incentive licensing and return to normal operation. I do not suggest the formation of a new League but a policy change in the old one. It is evident that the majority of amateurs do not support incentive licensing (evident by the fact that there are few Extra class licensees and a downward curve in the number of new licensees), and I believe that the sooner this mess is repealed, the better we will be.

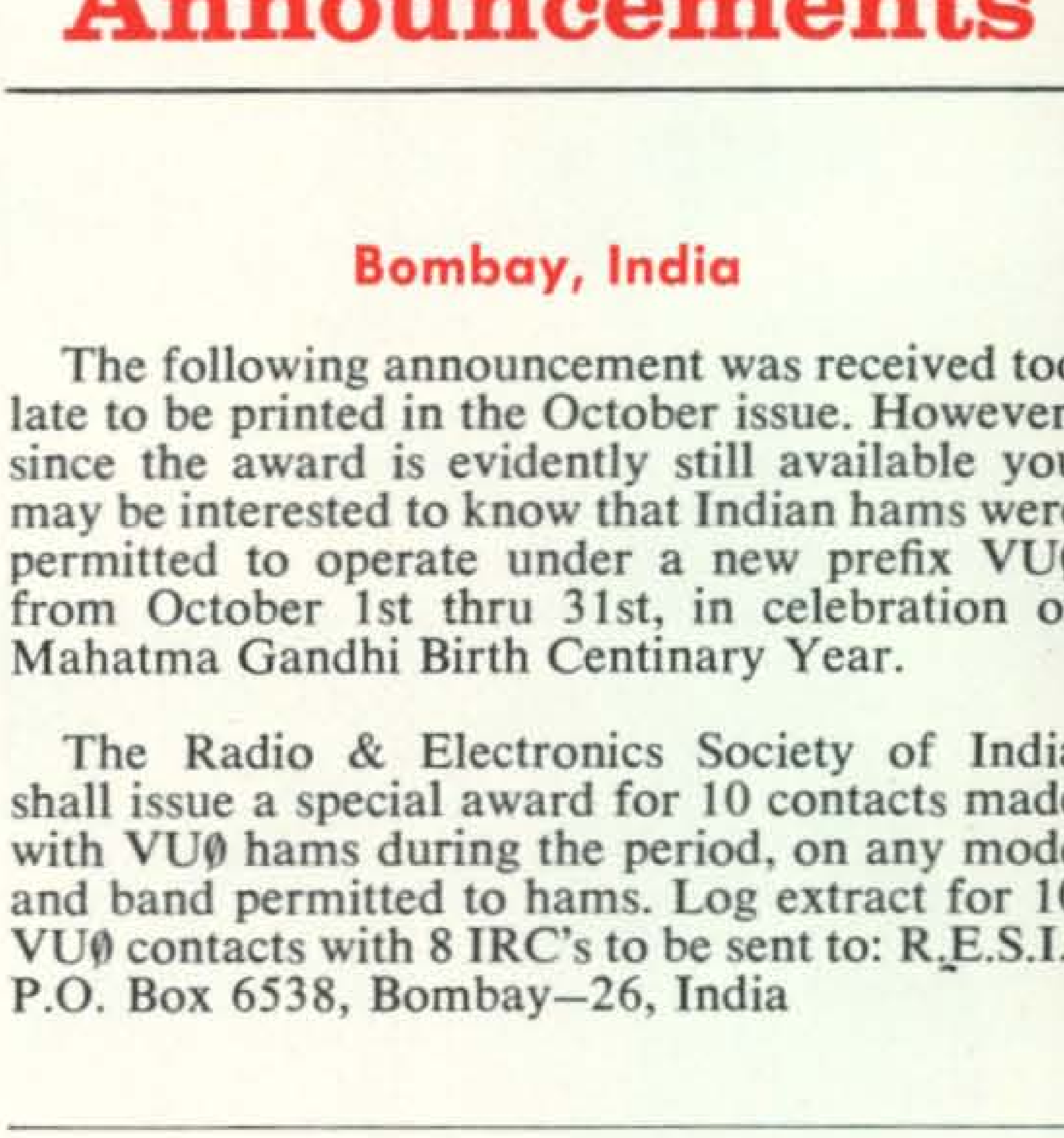
Gregory L. Winters, K4PVA
Elizabethton, Tenn.

Announcements

Bombay, India

The following announcement was received too late to be printed in the October issue. However, since the award is evidently still available you may be interested to know that Indian hams were permitted to operate under a new prefix VUØ from October 1st thru 31st, in celebration of Mahatma Gandhi Birth Centinary Year.

The Radio & Electronics Society of India shall issue a special award for 10 contacts made with VUØ hams during the period, on any mode and band permitted to hams. Log extract for 10 VUØ contacts with 8 IRC's to be sent to: R.E.S.I., P.O. Box 6538, Bombay–26, India



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Catch Him. . .

. . .If You Can

HOW DO YOU FIND OUT . . .
if a product is all it's cracked up to be?

EVEN DETAILED SPECIFICATIONS CAN'T DESCRIBE . . .

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- the *natural feel* of operator-oriented controls . . .
- the *pleasure* of operating a rig that seems to have been designed *just for you* . . .

ONLY THE MAN WHO OWNS ONE . . .
can give you *the straight story*. Like Joe Pontek. He's technically trained . . . active in traffic and DXing . . . SSB and CW . . . club and ARRL affairs . . . the kind of guy who makes amateur radio go. Joe's lucky too . . . Last summer in Louisville he walked off with the KENvention grand prize . . . and became one of the first hams to own a production CX7. Judging by all we've heard of K8HKM since, he must be trying to wear it out. When he gives up . . .

IN A YEAR OR SO, MAYBE . . .
we'll catch him for a testimonial. MEANWHILE, if *you* run across K8HKM, ask Joe how he likes the instant bandswitching, razor-sharp selectivity, velvet-smooth tuning with 100 Hz readout, hard-punching SSB, full break-in CW . . . in short,

THE *FEEL* OF THE CX7 . . .

SIGNAL/ONE has an exceptional career opportunity for a competent, aggressive, product design engineer with 5-10 years' experience in state-of-the-art HF/SSB receivers and transceivers. BSEE is essential. MSEE and leadership experience desirable. Send resume including background and salary history to General Manager. *SIGNAL/ONE is an equal opportunity employer.*

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SCRATCHI

Feenix, Ariz.

Deer Hon. Ed:

With strings of colored lites festooning the streets, misteltoe and holly hanging on lite poles, and Hon. Sandy Claws taking children on his lap and talking to them in every department store, I beginning to get the good old Xmas feeling.

So, natchyourally, I thinking of riting my annual letter to jolly old Saint Nick, to tell him what to leeving by the Xmas tree for Scratchi come Dec. 25. At first it quite a dilemma. I meen, what can an amchoor ask for that he not alreddy having avaleable, or can getting easy.

Then I seeing news artickle in electronics publicayshun about a new STAR compooter that some goverment agency is bilding. The STAR stands for—now get this, Hon. Ed.—Self Testing and Repairing!! Hackensake!! if that not enuf to boggle the imaginayshun I not knowing what will

Now I know what I wanting for Xmas—a Self Testing and Repairing Xmitter. Boy, that would be the Hon. Living End. Just think—having an xmitter that fixing itself. Even while you sleeping, it sitting quietly there, taking its own electronic pulse, and fixing itself whenever the need arises.

Then I got to thinking, how can it possibly doing that? Maybe like this. First, there needing to be a kind of compooter attached to the xmitter, to do the thinking. Then there needs to be a testing unit.

So, like then every cupple minutes when xmitter not being otherwise used, compooter telling testing unit to test away. So, it sending testing signals thru the various circuits in the xmitter. As these signals are going on, reedings are made by voltmeters, milliammeters, etc., and results of these reedings are being reported to the compooter.

All that not sounding too hard to do, is it, Hon. Ed? But now comes the hard part. When

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where excitement begins

Power Mite PM-1

the $49.95 quality transceiver

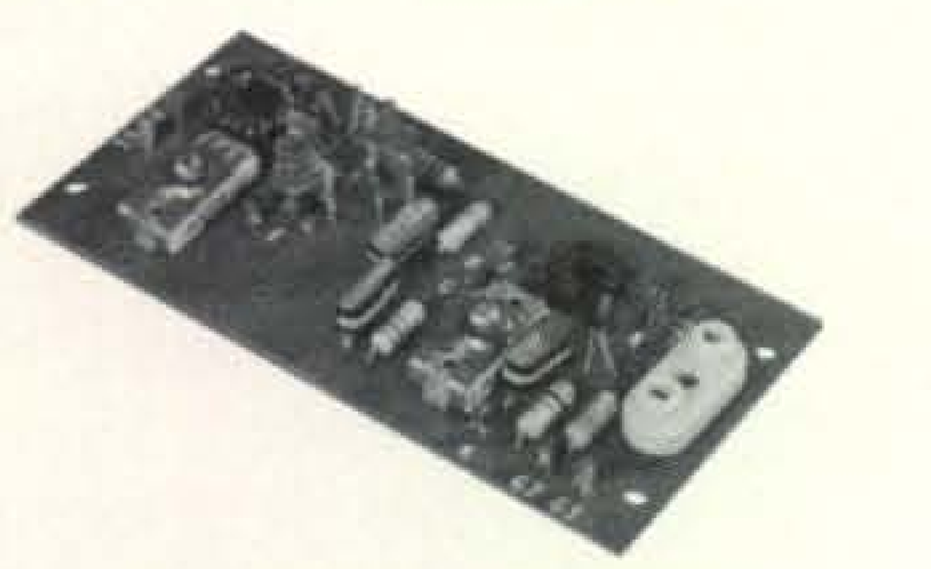
The wonderful world of CW is yours for a fraction of what you'd expect to pay! Precision Ten-Tec craftsmanship is comparable to that of the highest priced transceivers. Transceive operation on 80 and 40 meters, crystal operation on 80, 40 and 15 meters. 15 meter receiving converter available. Mounting and necessary switching is included in the PM-1.

Check these other features: 12-volt lantern battery power, front-panel band switching with flywheel tuning on slide-rule dial. 200-2500 Hz shaped audio, metered power amplifier stage, silicon transistors with integrated circuit. 2 KHz receiving band width, 2 watts input to final stage, 100 cycles drift with no warm-up.

Designed for the critical operation of the novice or veteran interested in QRP or portable. 4" H × 6" D × 10" W.

MODULES

Basic PM-1 circuit modules, tuning dial, instructions for bread board mounting and interconnecting. Completely wired $29.95



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compooter figyouring out that something needs fixing, how it being done?

One way being to have all circuitry on printed circuit boards. When one board are bad, mechanical arm are swinging over to board, plucking it out, dropping it in waste-backet, then swinging over to spare parts stock, picking out replacement board, swinging back and plugging it in. Samelike method can be used for toobs, coils and other parts.

I visualizing QSO something like this. In middle of nice ragchew, warning lite on panel liteing up, and voice from compooter coming on air at same time, telling amchoor I working to standing by for cupple minutes. Winking red lite on panel meening "repares are being made."

As mechanical arm taking care of things, internal testing circuits trying out new part what just being plugged in. If everything being okey-dokey, compooter voice saying over air "thank you for your payshunts, the xmitter are operayshunal again." Reds lites go out and everything hunky-dunky and you back in ragchew again.

So, you thinking I going to asking Hon. Sandy Claws for a STAR xmitter? Not on your chinny-chin-chin. It can't be reely automatic. I meen, what happens when mechanical arm going into spare parts box and not finding spare toob, or printed circuit board? Hah.

Certainly STAR xmitter not automatically sending out order to local radio store for parts it needing. And, even if it did, how would the spare parts getting put in parts slots. Hon. Mailman not doing it.

Even if you solving that problem, how you solving problem of paying for spare parts?! Not on my allowance, you not solving problem.

Besides, supposing by some Hon. Miracle the spare parts are showing up free. And, by some magic, supposing the spare parts get put in the spare parts slots, you still not home free. No indeedy. With my luck, my antenna would short out, or fall down, or the a-c power would cut off at the wrong moment.

No, I being safer to asking Hon. Sandy Claws to bringing me cupple dozen hankercheeves in assorted colors and sizes, and eleventeen loud and unwearable ties.

Why not face facts–it going to be what I getting anyway.

Have a Hon. Jolly Holly.

Respectively yours,
Hashafisti Scratchi

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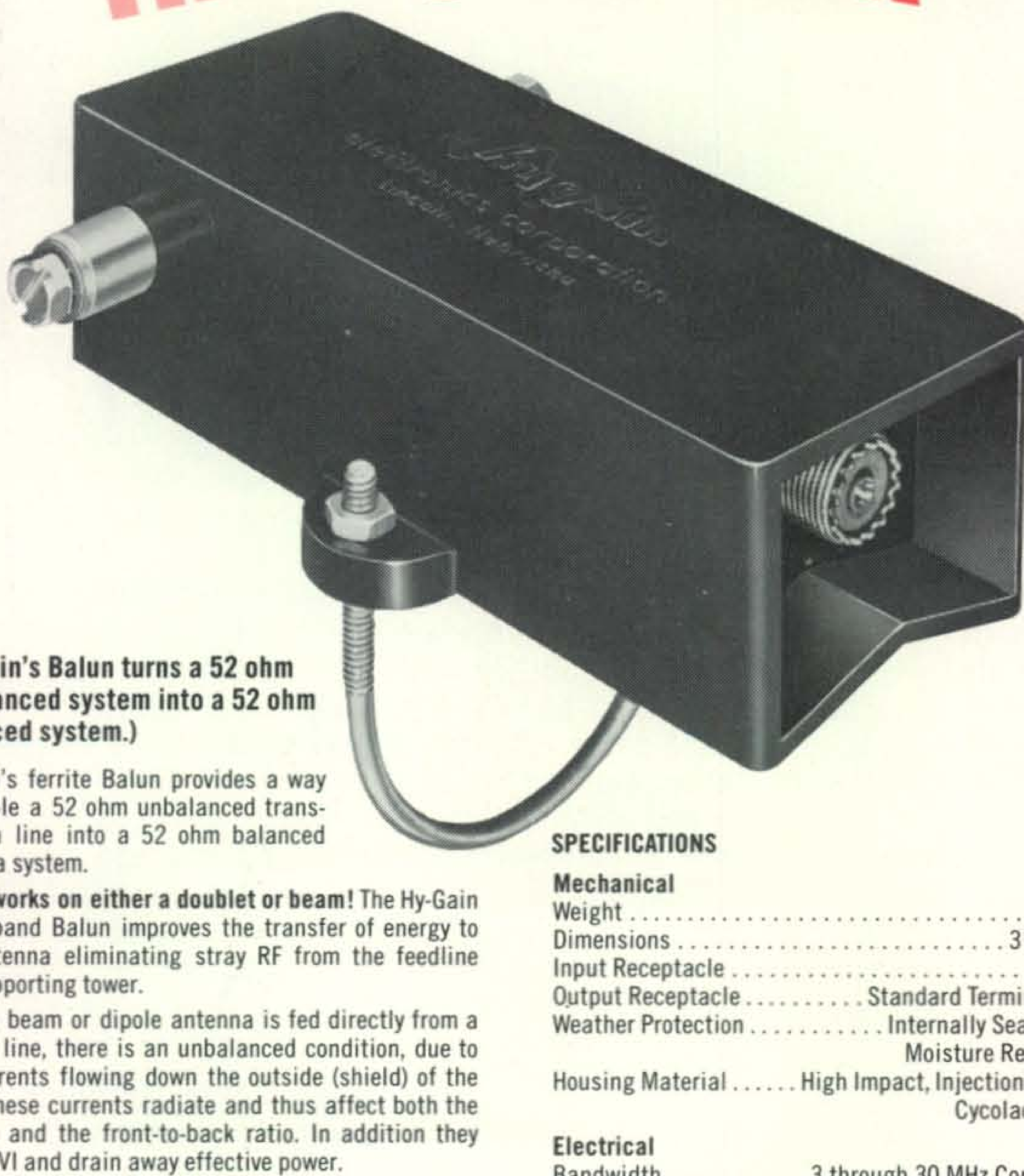
THE EQUALIZER



(Hy-Gain's Balun turns a 52 ohm unbalanced system into a 52 ohm balanced system.)

Hy-Gain's ferrite Balun provides a way to couple a 52 ohm unbalanced transmission line into a 52 ohm balanced antenna system.

And it works on either a doublet or beam! The Hy-Gain broad band Balun improves the transfer of energy to the antenna eliminating stray RF from the feedline and supporting tower.

When a beam or dipole antenna is fed directly from a coaxial line, there is an unbalanced condition, due to the currents flowing down the outside (shield) of the coax. These currents radiate and thus affect both the pattern and the front-to-back ratio. In addition they cause TVI and drain away effective power.

The electrical principal of operation is similar to that of a 1:1 transformer. It is frequency independent, mechanically superior, and will operate over all ham bands. Hardware is furnished to mount on the beam boom or to be used as center insulator in a doublet.

Get the Hy-Gain Balun at the best distributor under the sun (he carries all Hy-Gain products).

The Balun from Hy-Gain

FOR THE STRONGEST SIGNAL UNDER THE SUN!

SPECIFICATIONS

Mechanical

Weight	1 lb.
Dimensions	3¼ x 6¼"
Input Receptacle	SO-239
Output Receptacle	Standard Terminal Lugs
Weather Protection	Internally Sealed with Moisture Relief Hole
Housing Material	High Impact, Injection Molded, Cycolac Plastic

Electrical

Bandwidth	3 through 30 MHz Continuous
VSWR	1:1 (when terminated with a balanced 52 ohm load)
Power Rating	1 KW DC-AM
Impedance Transformation Ratio	1:1 at 52 ohms
Input Connector	SO-239
Insertion Loss	Negligible
Feed-through Loss	Negligible

Order number 242

Hy-Gain Electronics Corporation
P. O. Box 868-FL, Lincoln, Nebraska 68501

MODEL 508 VFO—SWAN 500C TRANSCEIVER—117XC POWER SUPPLY—MARK II LINEAR

For several years Swan Electronics has been specializing in value engineering of single sideband transceivers to give radio amateurs the best possible equipment at the lowest possible price. We're pleased to say that we have thousands of satisfied customers all over the world, many who have purchased their third or fourth Swan as we continue the evolutionary improvement of our product. (Trade-in value of a used Swan is well above average.) We would like to say that the station illustrated above is a typical Swan station, but that would be misleading. Actually, the average Swan owner finds the quarter kilowatt or half kilowatt transceiver very adequate for his operating needs. What the picture illustrates is some of the Swan accessories that will add more versatility and greater operating pleasure to your Swan station. For the DX operator, the model 508 external VFO provides separate control of transmit and receive frequencies, or for the MARS and Net operator the 510X crystal oscillator provides up to 10 fixed channels. For breaking through those weekend QRM pile-ups there's no better cure, legally, than the Mark II Linear Amplifier with its 2000 watts of P.E.P.

TOP OF THE SWAN-LINE THE FAMOUS 500C TRANSCEIVER

520 watts P.E.P. input on 10, 15, 20, 40 and 80 meters. Finest crystal lattice filter with 1.7 shape factor. ½ microvolt receiver sensitivity. Voice quality, performance and reliability are in the Swan tradition of being second to none. **$565**

MODEL 508 EXTERNAL VFO

Provides full coverage of 80, 40, 20, 15 and 10 meters in 8 ranges of 500KC each. Enables you to transmit and receive on separate frequencies. Plugs directly into either the 500C or 270. **$145**

CRYSTAL CONTROLLED MARS OSCILLATOR

For Mars or Net operation. Model 510X. 10 channels. Plugs directly into 500C or 270. Less crystals. **$55**

POWERHOUSE MARK II LINEAR AMPLIFIER

2000 watts, P.E.P. input, 10 through 80 meters. Uses two 3-500Z triodes. Complete with matching power supply. **$660**

MODEL 117XC MATCHING AC SUPPLY FOR 500C TRANSCEIVER

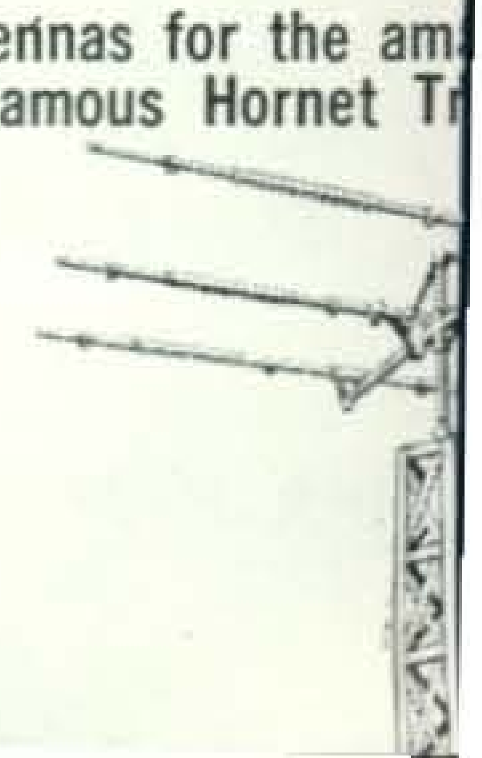
For 117 volts, 50-60 cycles, with speaker and phon jack. **$10**

12 VOLT DC POWER SUPPLY FOR 500C TRANSCEIVER

Model 14-117, designed for mounting under hood. In cludes cables, plugs and fuses. Can operate from 11 volt AC by detaching DC module and plugging in 11 volt line cord. **$13**

SWAN HORNET BEAM ANTENNAS

Latest addition to the Swan-Line.
High quality, high performance antennas for the am teur bands. Best known are the famous Hornet Tr banders, made in 2, 3 and 4 element models. The TB-1000 series is rated at 2000 watts, the slightly smaller TB-750 at 1500 watts.



TB-1000-4 4 element. . .$159
TB-1000-3 3 element. . . 129
TB-750-2 2 element 89
TB-750-3 3 element. . . . 109

FIELD EFFECT TRANSISTORS

BY MALCOLM M. BIBBY,* GW3NJY

Part I

This two part article describes the basic field effect transistor and the newer, more advanced types. Part I covers the JFET, MOSFET and the various modes of operation. Part II will cover the device characteristics, biasing, dual gate FET's and circuitry.

THE number of new field effect transistors appearing in the open market, and hence available to the amateur, is steadily growing. Some of these new devices are improvements on existing products but others, due to technological difficulties in the manufacturing process have previously been in existence on paper only. The characteristics and operation of the different types are explained below. Two different types of FET's are available, these are the Junction Field Effect Transistor and the Insulated Gate Field Effect Transistor

*2748 Juno Place, Akron, Ohio 44313.

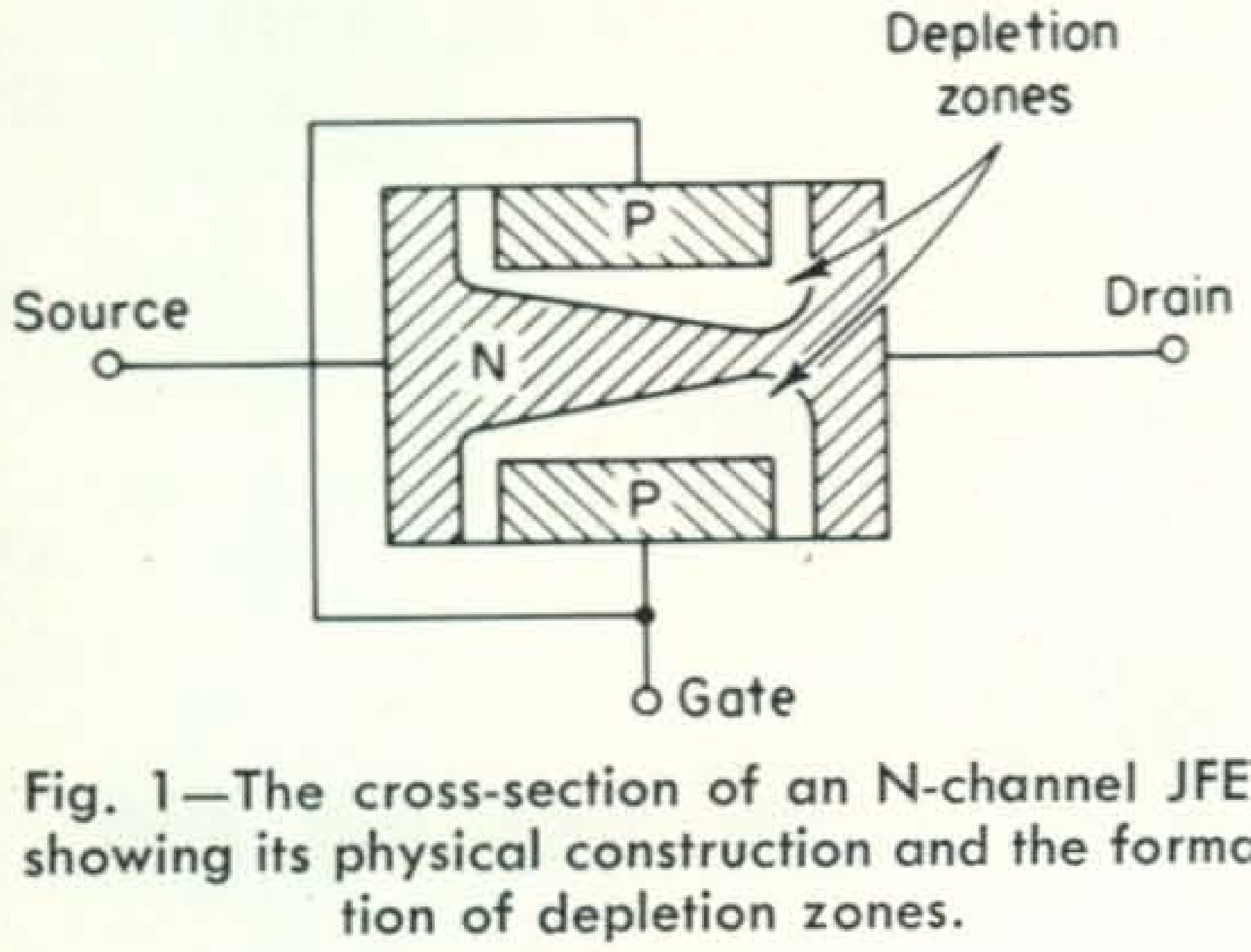


Fig. 1—The cross-section of an N-channel JFET showing its physical construction and the formation of depletion zones.

Junction Field Effect Transistors (JFET)

The operation of devices in this family rely entirely on the properties of a reverse biased diode. It is well known that when a P-N junction is reverse biased very little current flows through it and in fact the junction behaves like a capacitor (e.g. varactors, VVC's, *etc.*). This effect results from the production of a depletion layer at the junction interference. This depletion layer is free of any current carriers and hence acts like an insulator in between the P and N semiconductor sections. The thickness of this depletion layer increases with an increase in the reverse bias across the P-N junction.

Figure 1 illustrates the operation of a JFET. Note the existance of depletion layers between the gate and the N-type channel and how they reduce the channel width between the source and drain. The resistance between source and drain is inversely proportional to the channel thickness and is increased as the reverse bais increases; this produces a decrease in the drain current.

This mode of operation is termed the DEPLETION MODE of operation and all JFETS are of this type. When the gate is made of P-type material diffused into an N-type channel, the JFET is an N-channel depletion type

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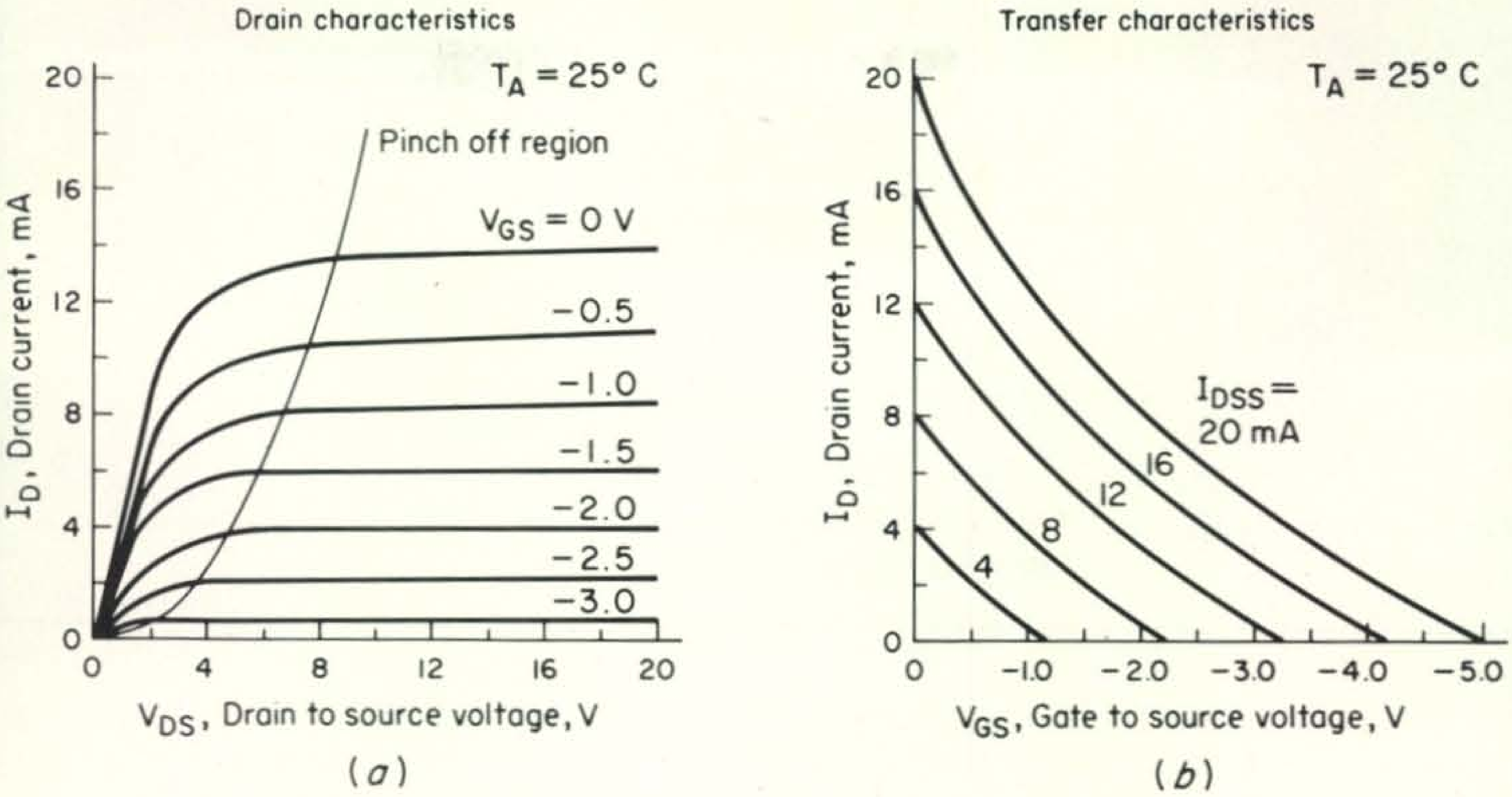

Fig. 2—The drain and transfer characteristics of the Fairchild 2N5163 N-channel JFET.

and the current carriers are electrons. When the gate is made of N-type material diffused into a P-type channel then this is referred to as a P-channel depletion type and the current carriers are holes. The characteristics of both types are shown in fig. 2 and 3.

It can be seen that JFET characteristics are very similar to those of the pentode tube. The area to the right of the dotted line in fig. 2 is referred to as the 'pinch-off' condition. This pinch-off region is the normal operating area of JFET operation.

Depletion layers can and do exist within a JFET even when the external gate-source voltage is zero due to the reverse bias that exists between the gate and the drain end of the channel when V_{DS} is present. At pinch off, as the drain-source voltage is increated, the tendency for the device to pass a larger current is counteracted by the reduction in channel width, and hence higher channel resistance, due to the thicker depletion layer caused by the increase in gate-drain reverse bias.

Metal Oxide Semiconductor and Insulated Gate Field Effect Transistors

The MOSFET and IGFET titles both refer to the same device with IGFET the more general name. As the name implies the gate of an IGFET is insulated from the source-drain channel junction and hence there is no gate-channel junction and thus no depletion layer. Now, however, depending upon the device geometry two modes of operation are possible; these are the *enhancement* mode and the *depletion* mode. Enhancement refers to the increase of current carriers in the channel when the gate voltage increases. The enhancement mode type has essentially zero drain current flow for zero gate voltage. Instead the drain current increases. as the gate-source voltage is increased.

IGFET—Enhancement Mode

Figure 4 shows the construction of an enhancement mode P-channel IGFET. The

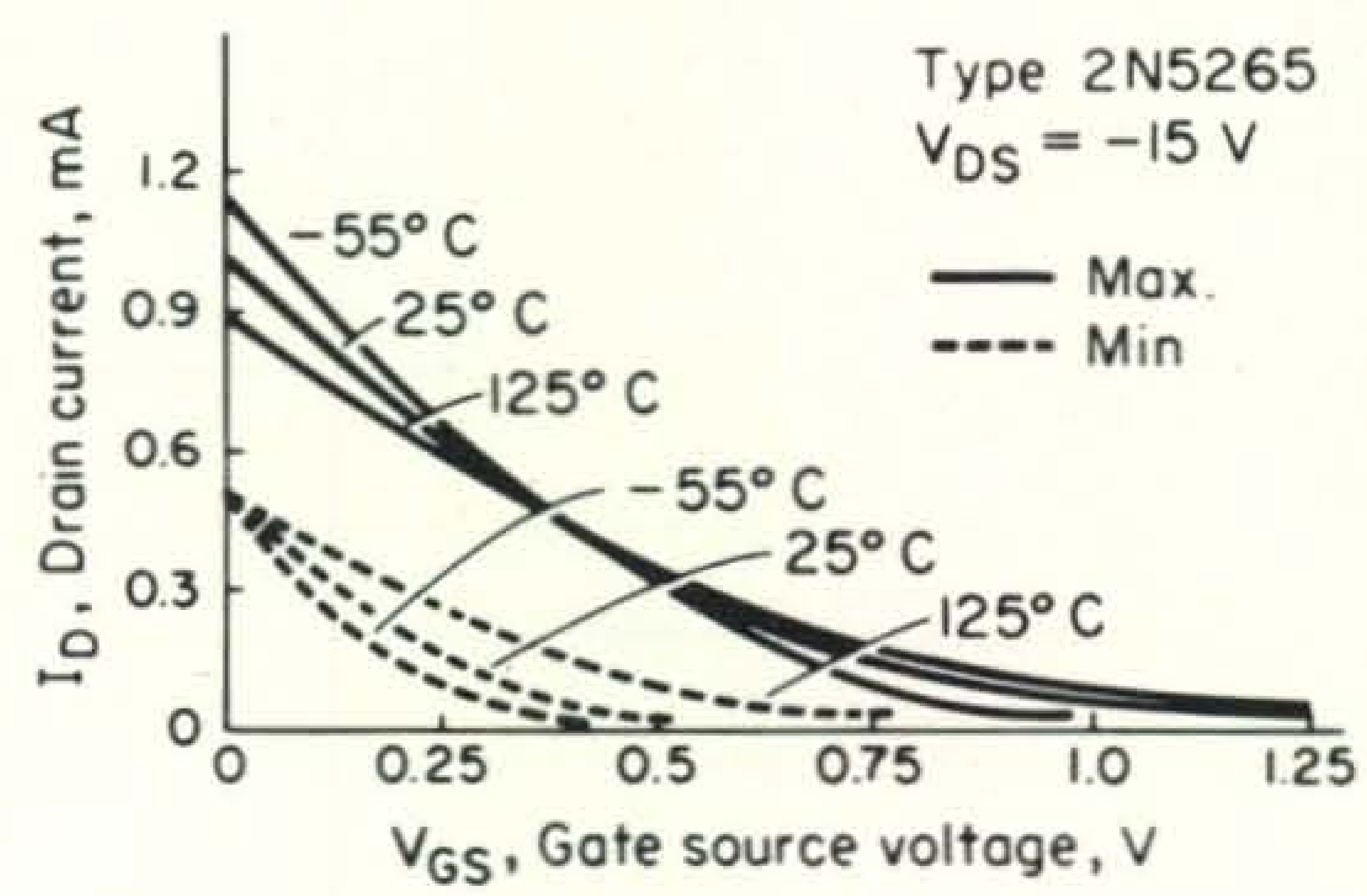

Fig. 3—The transfer characteristics of the Motorola 2N5265 P-channel JFET. The curves illustrate the effect of temperature on the maximum and minimum drain currents encountered with the device.

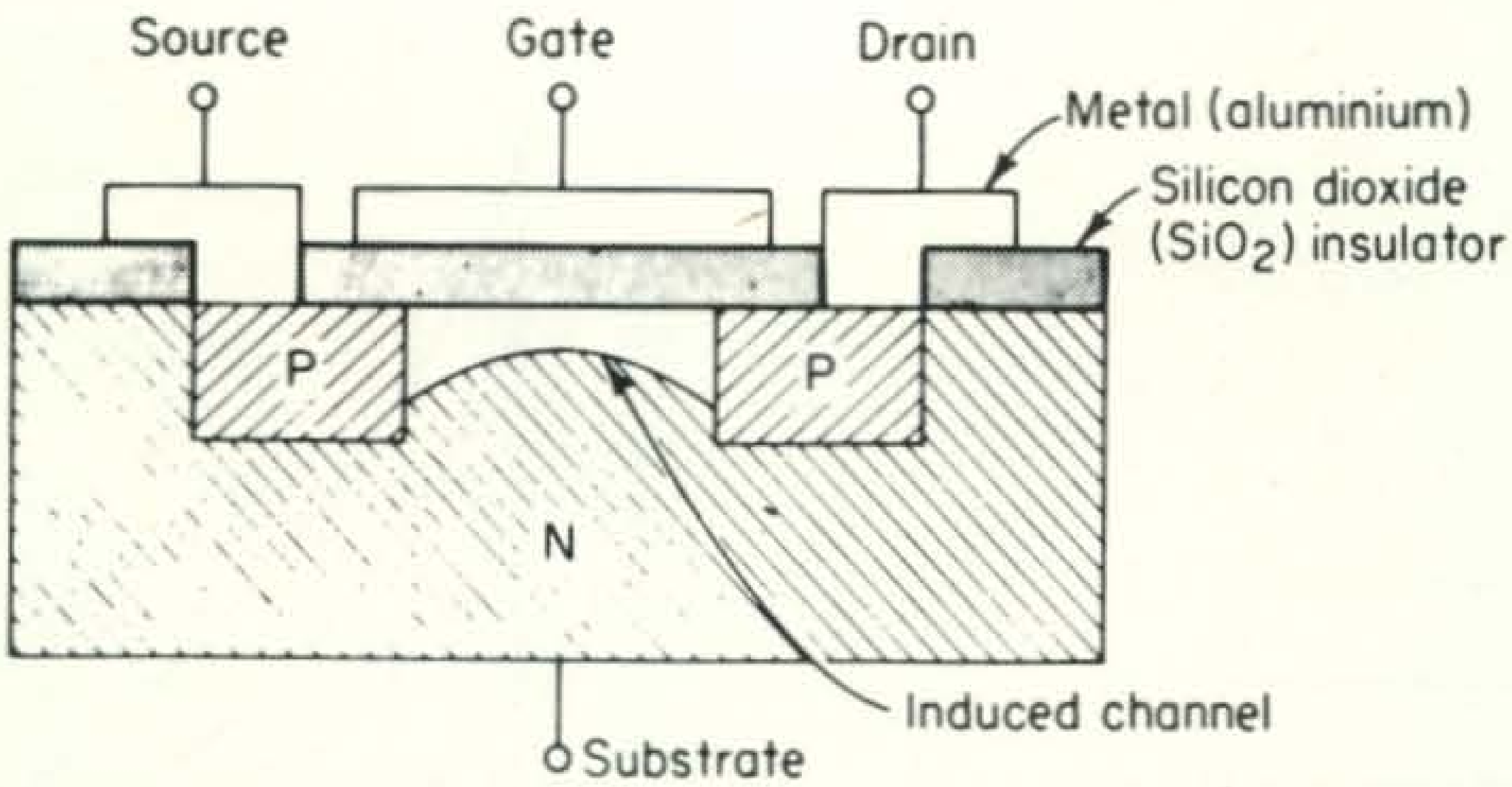

Fig. 4 — The construction of an enhancement mode P-channel IGFET showing the region of formation of the conducting P-channel.

SiO_2 (silicon dioxide) layer is an insulator from which the device derives its name. The aluminum deposit forming the gate, the silicon dioxide and the N-type substrate all combine to form a simple capacitor.

Consider the operation of a P-type IGFET. When a voltage is applied between the gate and the substrate with the gate negative, electrons will be drawn away from the substrate region just below the gate between the source and drain regions. This leaves holes to act as current carriers between the source and drain regions. Thus, if a potential difference exists between the source and drain, a current flow will be supported by the excess holes under the gate region, provided there are sufficient holes. For each device a threshold voltage, V_{TH}, which causes current to begin to flow, will exist. The N-channel enhancement-mode IGFET works in a similar way. Figure 5 shows typical characteristics for a P-type enhancement-mode IGFET. The P-type is the more common device due to an easier manufacturing process.

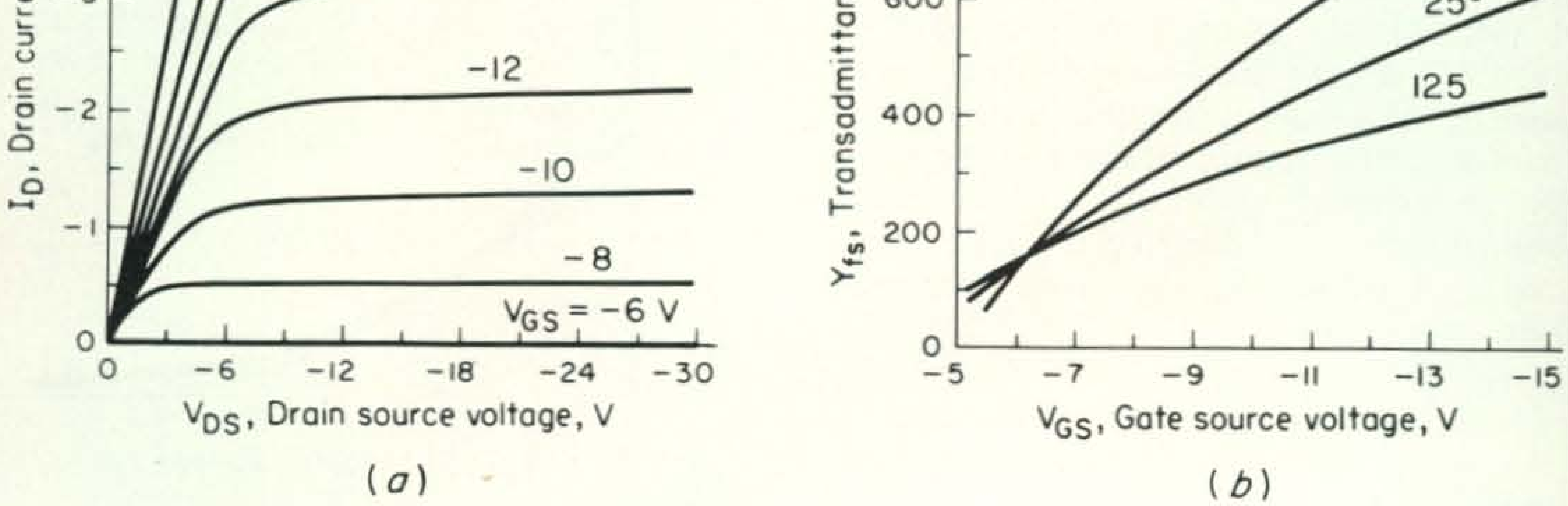

Fig. 5—Characteristic curves for the Fairchild 2N4065 enhancement-mode P-channel IGFET. More modern FET's have much higher trans-admittance values than those shown here.

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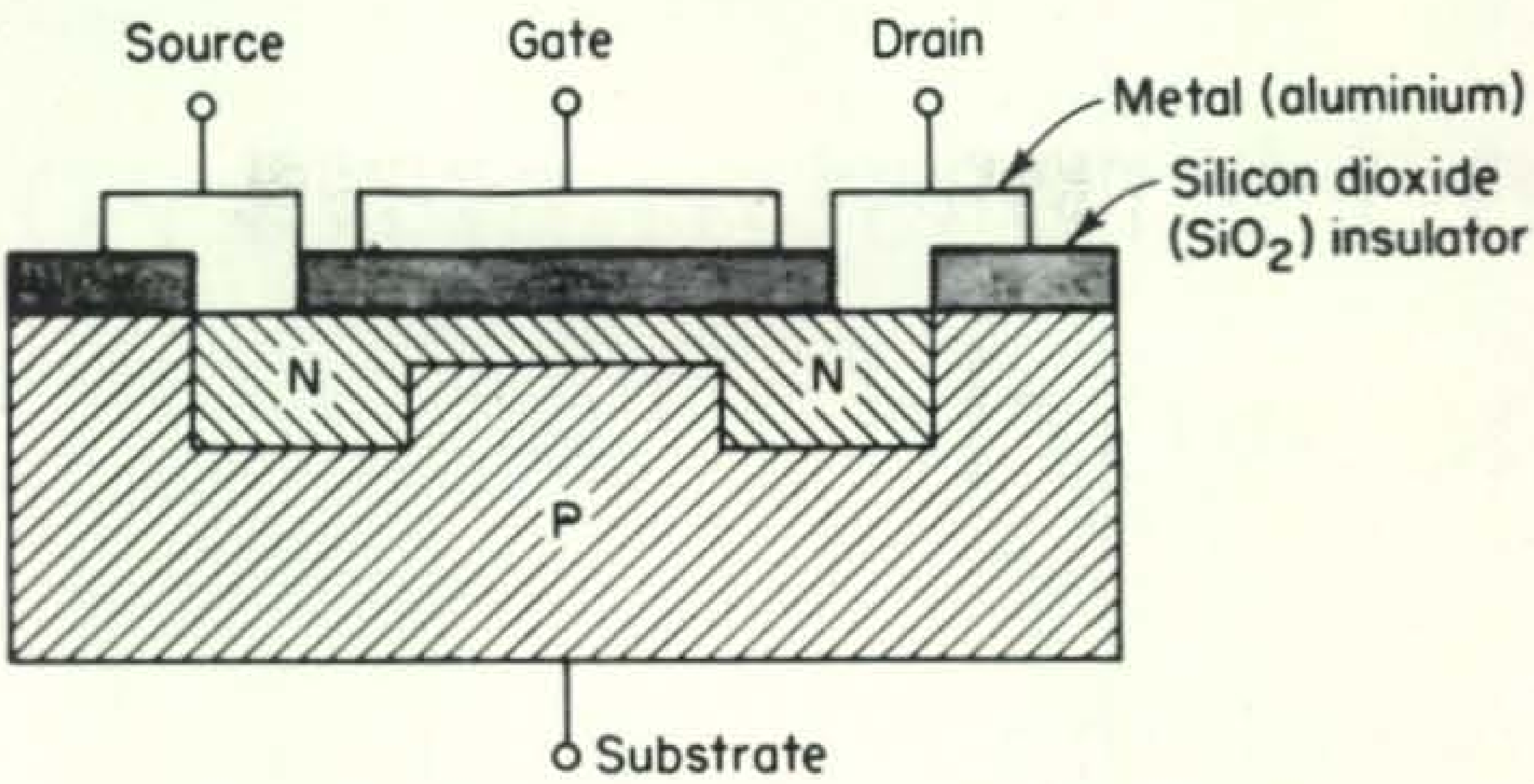

Fig. 6—The construction of an N-channel depletion mode IGFET.

IGFET—Depletion Mode

While both N-channel and P-channel depletion mode devices are feasible the N-channel unit will be described as it is the one more readily available. The construction of this type is shown in fig. 6. It can be seen to be half way between the IGFET construction of fig. 4 and the JFET of fig. 1. The source-drain channel is diffused into the P-type substrate and the aluminum gate surface is again insulated from the rest of the device by the silicon dioxide layer. When a negative voltage is applied between the gate and the substrate, electrons are drawn from the channel, by capacitor action, leaving only holes. As the current carriers in N-type material are electrons the drain current is reduced. Thus the depletion mode in IGFETS is similar to that in JFETS.

This device, however, can also be made to operate in the enhancement mode by applying a positive potential to the gate. This draws electrons from the P-type substrate into the N-channel and thus increases the drain current by increasing the channel conductivity. Figure 7 shows typical characteristics for an N-channel depletion mode IGFET. Figure 8 summarizes all possible modes of operation.

[*to be continued*]

Part II of this two part series covers FET characteristics, biasing, circuit configurations, dual gate FET's and FET applications.

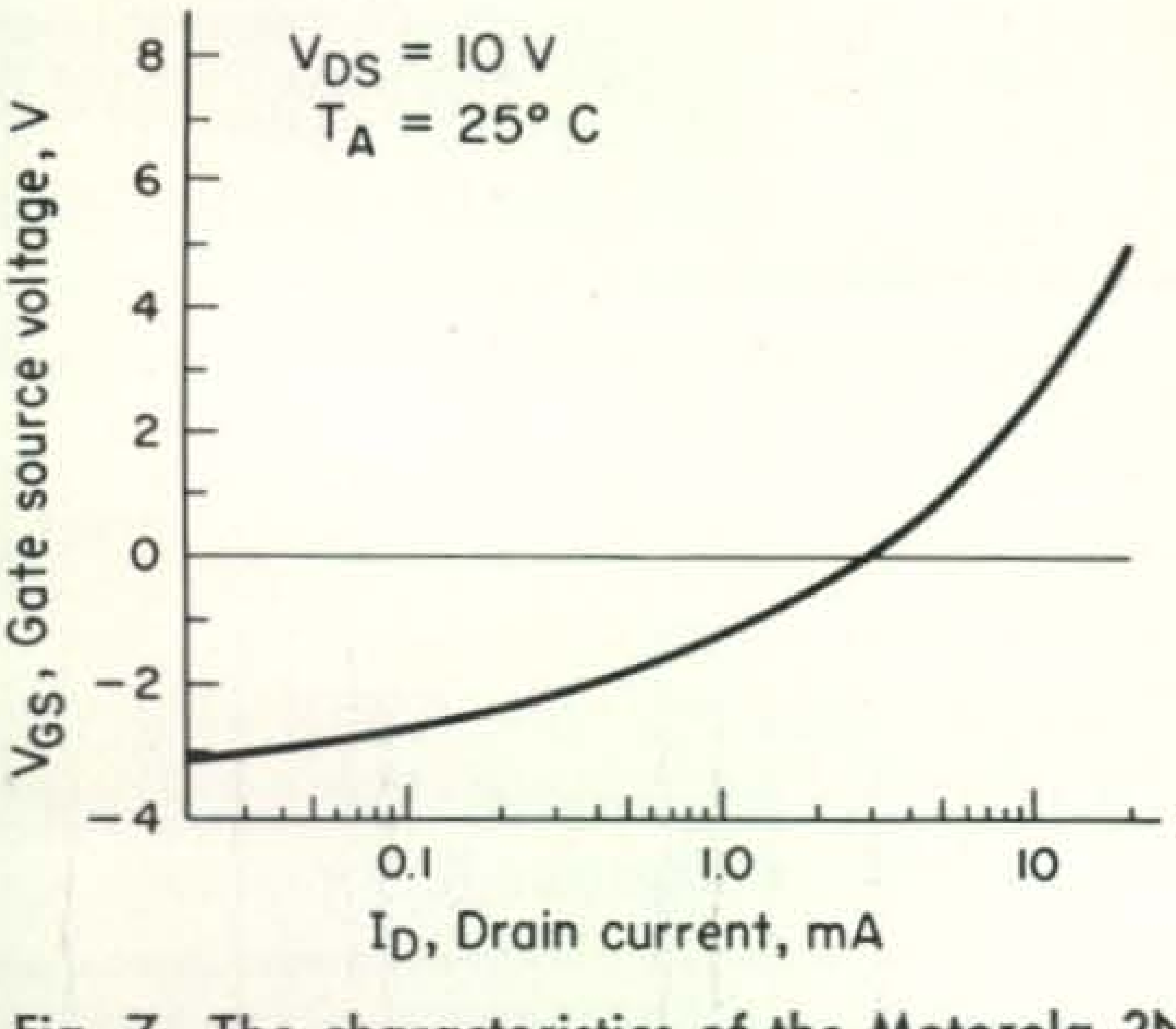

Fig. 7—The characteristics of the Motorola 2N-3797 depletion mode N-channel IGFET showing the property of both enhancement and depletion mode behaviour.

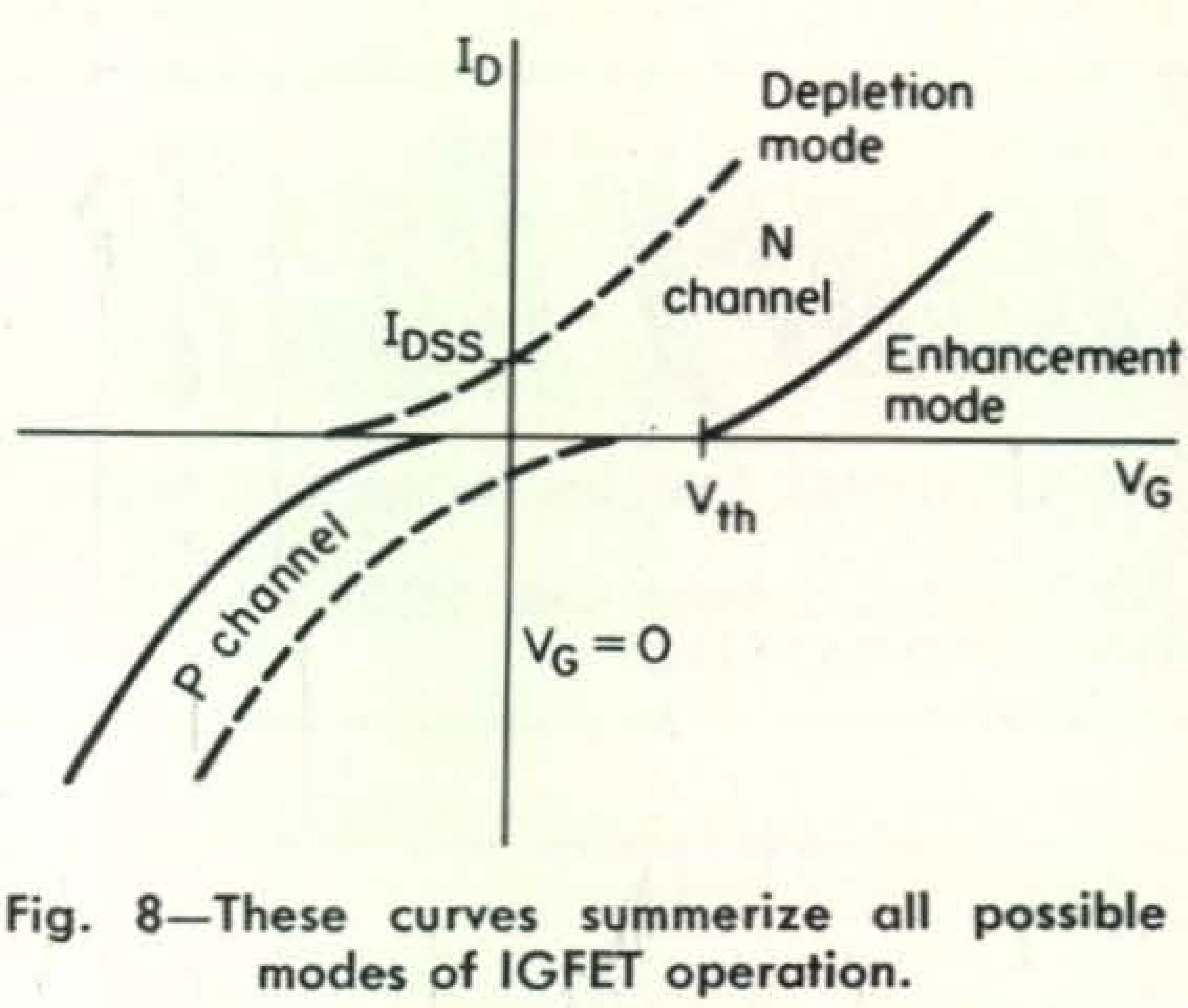

Fig. 8—These curves summerize all possible modes of IGFET operation.

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DESIGN FOR A SOLID STATE REGULATED POWER SUPPLY

BY J. W. HERBERT,* ZL2BDB

THIS solid state power supply was designed to meet the requirements of an amateur radio transceiver. Amateur radio transceivers generally require a high voltage supply of nominally 250 volts and must be capable of delivering output currents of up to 200 ma.

Unfortunately, the current drawn from the power supply can vary widely between the transmit and receive functions, thereby requiring excellent regulation in the power supply. Poor power supply regulation may result in tube and component damage within the equipment due to excessive heating as a direct consequence of the incrased voltage present when the power supply is lightly loaded.

These are some of the problems the author came up against with a commercial s.s.b. transceiver. In addition, the local power mains suffer from poor regulation, particularly during the winter evenings when the domestic heating demand is at its peak. This resulted in varying performance of the transceiver as the voltage changes shifted the operating points of the amplifier stages.

In order to overcome these problems it was decided to develop a simple but adequately regulated power supply capable of delivering 250 volts d.c., will filtered and protected against overload and short circuits. It was also considered essential to provide adequate regulation over an output current range of 0-250 ma to ensure conservative operation of the regulator, particulary in view of the fact that the requirements of the author's equipment was approximately 170 ma, maximum.

The following text gives the procedure adopted for the design of the regulated supply. The design procedure employs simplified approximations which are presented here to enable the home constructor design to meet his own specifications. Despite the approximations a reliable power supply design is assured.

*3C Cumberland Grove, Porirua, New Zealand.

Design Considerations

For reasons of economy the inexpensive range of RCA silicon high voltage power transistors were used in the design of the supply. Three main requirements had to be met, namely: (1) The voltage applied between the collector-emitter junction must be less V_{CER} (sustained) for the transistors under any output load condition. (2) The current flowing through the transistors must be less than I_C (max) under any output load condition. (3) The transistors employed should have a high value of to permit the use of as few stages as possible for a given degree of regulation.

In the interests of reduced power dissipation and economy a two stage series regulator was chosen using RCA economy power transistors Types 40313 and 40327. The basic circuit configuration is shown in fig. 1. In order to keep the operating voltages across transistor Q_1 to a minimum a zener voltage

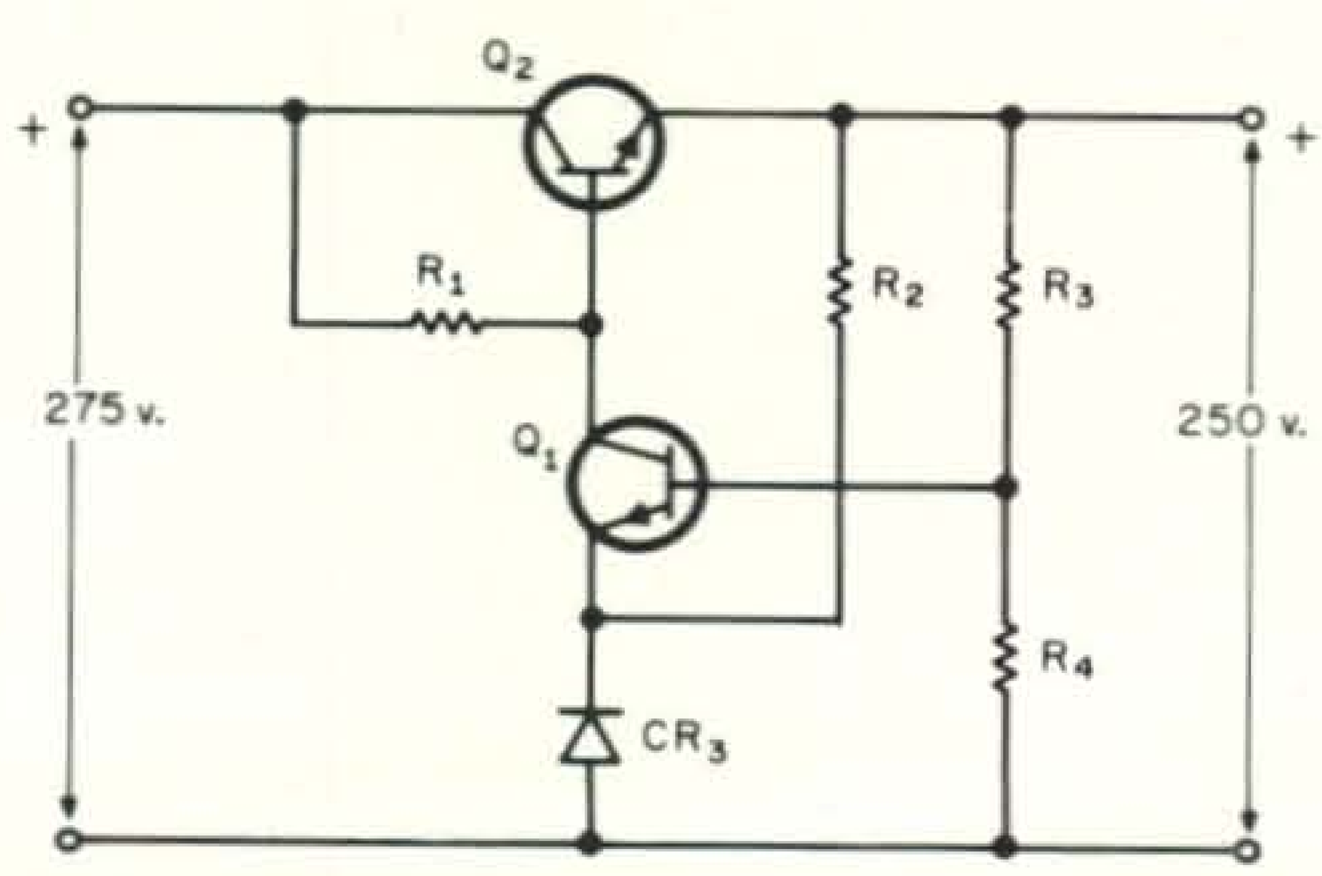

Fig. 1—Basic d.c. regulator circuit.

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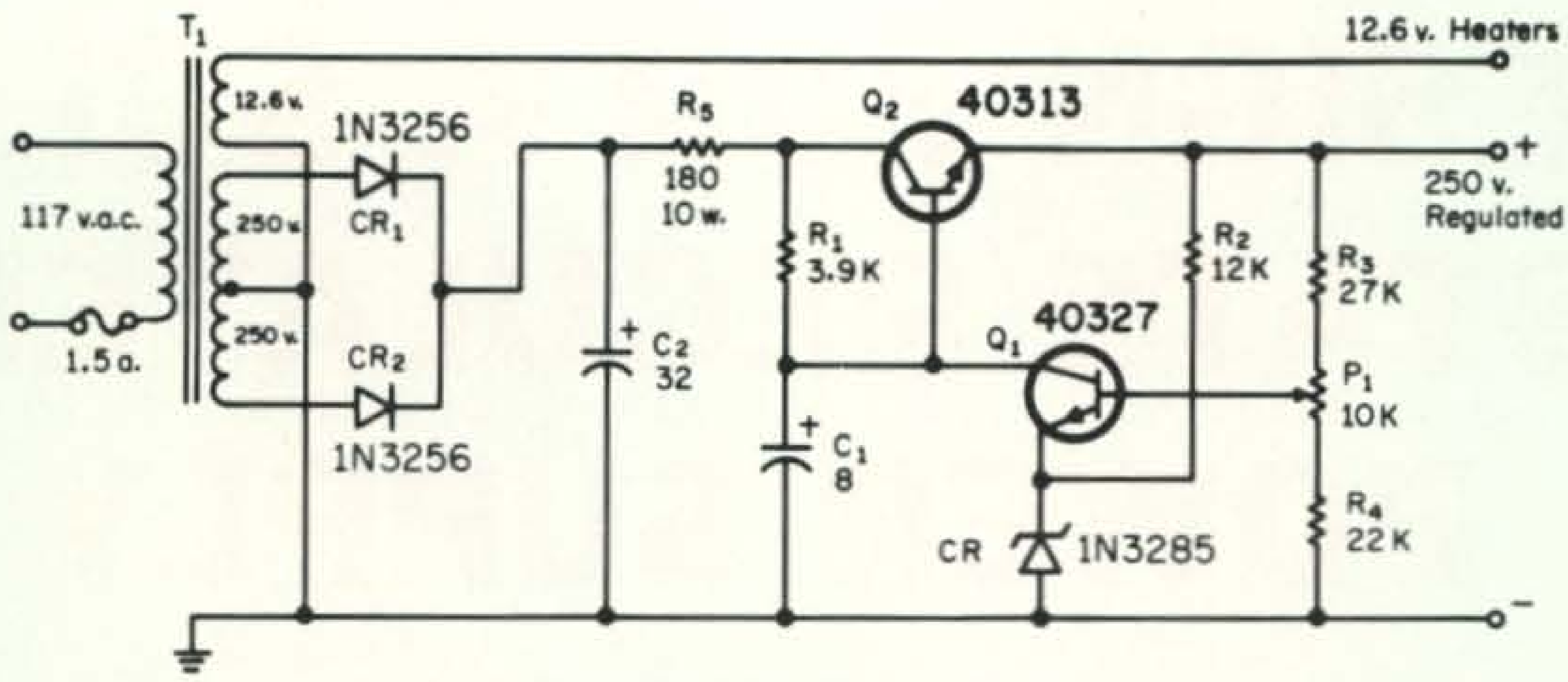

Fig. 2 — Complete regulated power supply circuit. The power transformer must provide 500 v.r.m.s. center tapped, at 250 ma. All resistors are 1 watt unless otherwise specified; capacitors are in mf.

of 120 volts was chosen leaving an operating V_{CE} of 130 across Q_1. The input voltage was chosen to be approximately 275 volts to give an operational V_{CE} of 25 volts across Q_2.

D.C. Circuit Design

The d.c. operating conditions together with component values were then determined as follows:

(1) Q_2 (40313) Characteristics:

$P_c = 35$ watts max.

$I_c = 2$ amps max.

$\beta = 40$ min.

(2) $I_c\ (Q_2) = 250$ ma max.

$I_b\ (Q_2) = 250$ ma/40

$= 6.25$ ma.

(3) $$R_1 = \frac{V_{in} - V_{out}}{I_b\ (Q_2)}$$

$$= \frac{275 - 250}{6.25} \times 10^3$$

$= 4$ k

(4) $P_c\ (Q_2) = (V_{in} - V_{out})\ I_e$

$= (275 - 250)\ 0.25$

$= 6.25$ watts.

(5) Q_1 (40327) Characteristics:

$P_c = 5$ watts max.

$I_c = 1$ amp. max.

$\beta = 40$ min.

(6) CR_3, Zener diode Characteristics (1N3815):

$V_{zener} = 120$ v.

$I_{min} = 1$ ma

$I_{max} = 10$ ma

(7) $$R_2 = \frac{(V_{out} - V_{CR3})}{I_{max}\ (CR_3)}$$

$$= \frac{250 - 120}{10} \times 10^3$$

$= 13$k

(8) $I_b\ (Q_1) = I_c$ (max.)$/\beta$

$= 6.25/40$

$= 155\ \mu$a (max.)

(9) Select an $R_3 + R_4$ bleeder current of 5 ma. Therefore:

$$R_3 = \frac{V_{out} - V_{CR3}}{I_{bleeder}}$$

$$= \frac{250 - 120}{5} \times 10^3$$

$= 26$k

$$R_4 = \frac{V_{CR3}}{I_{bleeder}}$$

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$$= \frac{120}{5} \times 10^3$$

$$= 24k$$

In practice a 10k potentiometer is inserted between the junction of R_3 and R_4 to permit accurate setting of the output voltage.

(10) The degree of regulation obtainable from the circuit may now be determined as follows:

Change in input current to Q_1 for a 0–250 ma change in output current:

$$\Delta I_b (Q_1) = 155 \mu a$$

Change in output voltage for 155 μa change in Q_1 base current:

$$\Delta V = I_b (Q_1) \times R_3$$

$$= 155 \times 10^{-6} \times 26 \times 10^3$$

$$= 4 \text{ volts}$$

$$\text{Regulation } \% = \frac{4}{250} \times 100$$

$$= 1.6$$

(11) Maximum power dissipation in Q_1:

$$P_c (Q_1) = V_{CE} \times I_c$$

$$= (250 - 120)\ 6.25 \times 10^{-3}$$

$$= 0.81 \text{ watts}$$

Thus all transistors are operating within their ratings.

Final Circuit Design

Figure 2 shows the final circuit configuration for the regulated supply. A potentiometer, P_1, has been added to perfit fine adjustment of the output voltage which can be set between 240-260 volts. A capacitor has been added between the base of Q_2 and ground to ensure adequate filtering of hum voltages present in the output.

Overload Protection

The most severe overload the regulator can be subjected to is a short circuit on the output. Such a condition would cause the full power supply voltage to appear across Q_2 and at the same time Q_2 would conduct heavily. The result would be the destruction of Q_2 and possibly Q_1 also. To overcome this problem the input voltage to the regulator is fed through a resistor which limits the maximum short circuit current to 2 amps or less, a value which Q_2 can accomodate. Additional protection is given by virtue of the fact that under short circuit output conditions the input voltage to the regulator drops to a low value. The input voltage to the regulator based on a 250 volt r.m.s. per side 250 ma power transformer and a 32 mf capacitive (C_2) input filter was determined as follows:

(1) Maximum voltage, no load condition:

$$V_{max} = \sqrt{2}\ \text{r.m.s.}$$

$$= 1.414 \times 250$$

$$\cong 350 \text{ volts}$$

(2) Maximum voltage across C_2 under a 250 ma maximum load may be calculated as follows:

$$Q = I \times t$$

$$= 0.25 \times 0.01$$

$$= 25.1 \times 10^{-4} \text{ coulombs}$$

where

Q = charge on C_2 in coulombs

I = maximum current

t = 0.01 for full wave rectification

The peak to peak ripple voltage may be calculated from:

$$V_r = \frac{Q}{C}$$

$$= \frac{25 \times 10^{-4}}{32 \times 10^{-6}}$$

$$= 78 \text{ volts}$$

where

V_r = peak to peak ripple voltage

C = filter capacitance in mf.

To calculate the maximum voltage, V_d, across C under maximum current, we have:

$$V_d = V_{max} - \frac{1}{2} V_r$$

$$= 350 - (78/2)$$

$$= 311 \text{ volts}$$

(3) To calculate the value for R_5 assume a 200 ma load and proceed as follows:

$$R_5 = \frac{311 - V_{\min}}{I\ \max}$$

$$= \frac{311 - 275}{0.2}$$

$$= 180 \text{ ohms}$$

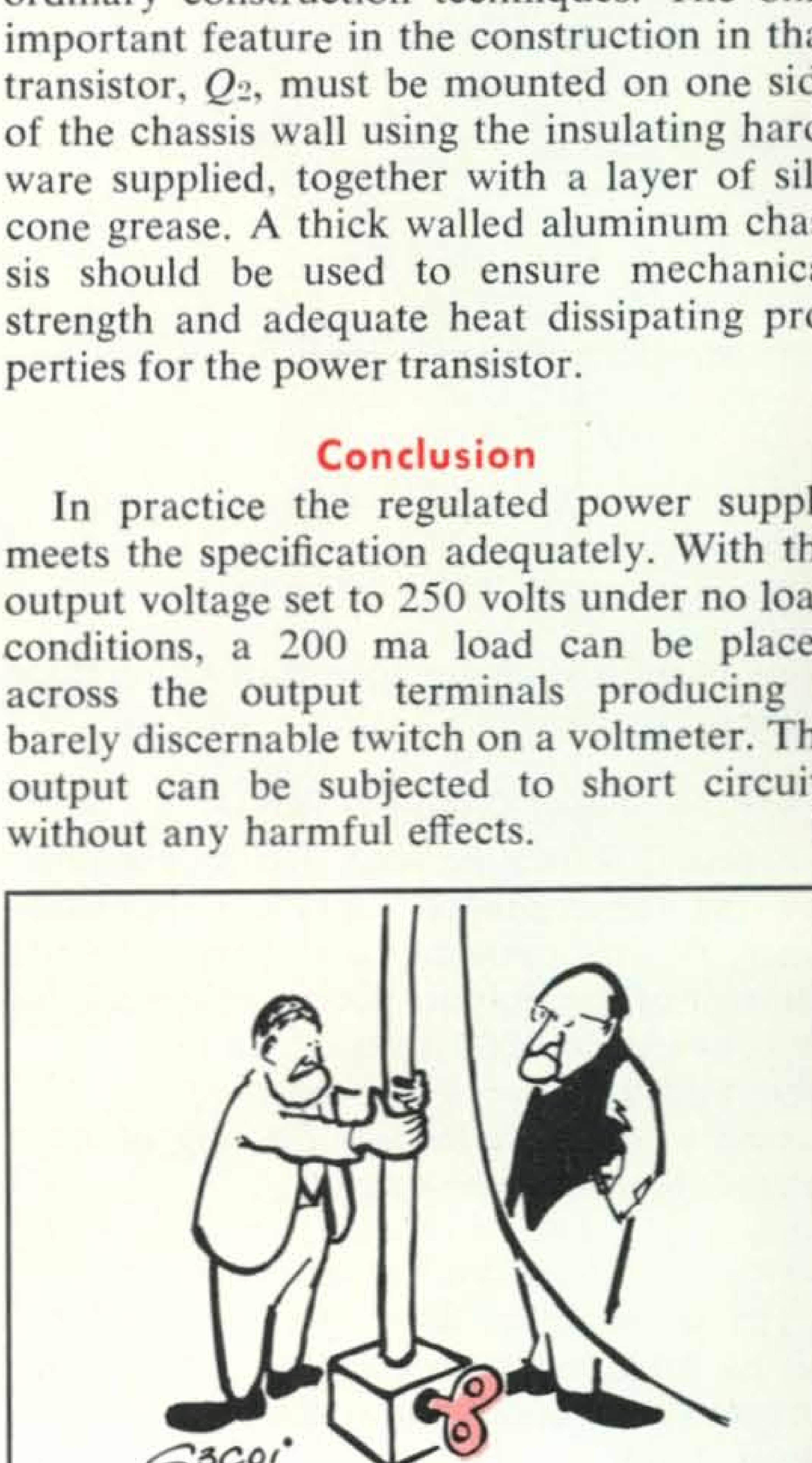
Since under prolonged short circuit conditions the transformer primary fuse will blow, a 10 watt power rating for R_5 is satisfactory.

Construction

The regulated power supply was built using ordinary construction techniques. The only important feature in the construction in that transistor, Q_2, must be mounted on one side of the chassis wall using the insulating hardware supplied, together with a layer of silicone grease. A thick walled aluminum chassis should be used to ensure mechanical strength and adequate heat dissipating properties for the power transistor.

Conclusion

In practice the regulated power supply meets the specification adequately. With the output voltage set to 250 volts under no load conditions, a 200 ma load can be placed across the output terminals producing a barely discernable twitch on a voltmeter. The output can be subjected to short circuits without any harmful effects. ■



"I find one wind will take me through a contest, beamwise."

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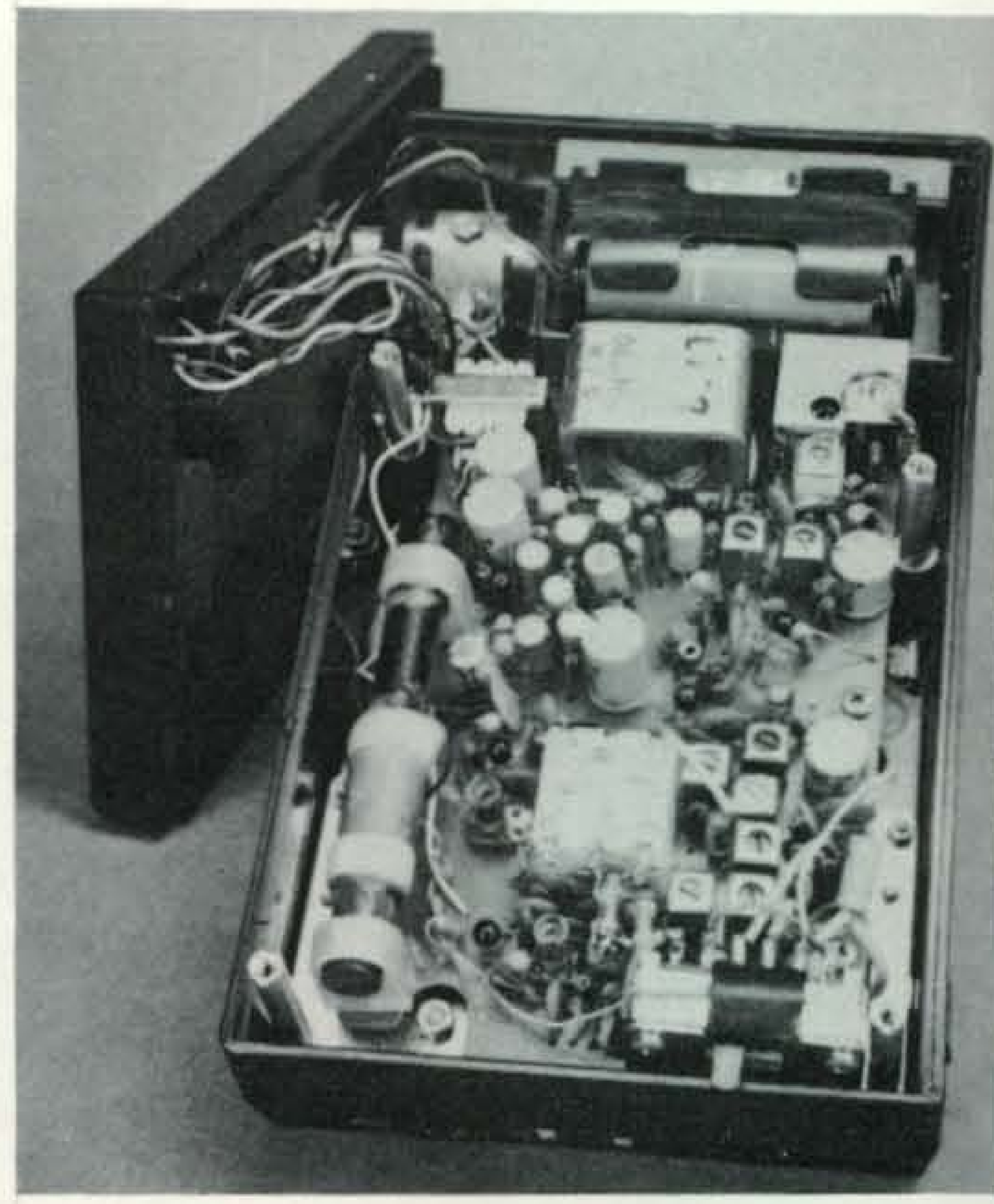
Front and rear views of the Lafayette Guardian II after modification for coverage of the 50 to 54 mc amateur band.



A MONITOR FOR THE 50-54 Mc BAND

BY HOWARD G. McENTEE,* W2SI

IT seems impossible to find a compact transistor receiver to monitor the amateur 50-54 mc band. After a vain search of the market, it was decided the only out was to convert a commercial transistor receiver. Units covering the 30-50 mc band are widely available; while these are f.m. units, a simple change makes them usable for a.m. reception. Then came the search for the most suitable unit to convert, and after checking into several, we settled upon the Lafayette #99T 3534L, an a.m.-f.m. receiver covering the regular a.m. broadcast band and the 30-50 mc f.m. band. (It costs $21.95 with batteries.)

Choice of this receiver was based upon the facts that it has a "sliderule dial"—easy to recalibrate and it has an a.g.c. system on the f.m. section (unusual in f.m. receivers). The latter operates by picking off a small portion of the 2nd i.f. amplifier output, rectifying it and using this voltage to vary the base bias of the r.f. amplifier. It is quite effective. The set is of reasonable size; it can be carried i a large coat pocket.

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Modification

After removal of the case back, and th four pen cells from their holder, the batter holder insulation was pulled loose. It is lightl cemented in place on foam plastic. Thre leads must then be unsoldered, items *A* i fig. 1. One is the antenna lead from set to lug held by a threaded post. The other tw are ground leads, a thin wire and a meta braid. Remove the thin wire at the uppe end, the braid at the bottom end.

Remove two threaded posts and one screw all indicated on fig. 1 as *B*. The entire chassi may be removed from the case after this. I is not necessary to disconnect any of th leads in the corner over the antenna uppe end, or the two wires to the speaker. All thes leads are long enough to allow easy chassi removal, and the small amount of work tha must be done on it while removed.

Note on fig. 1 that there is a metal shiel

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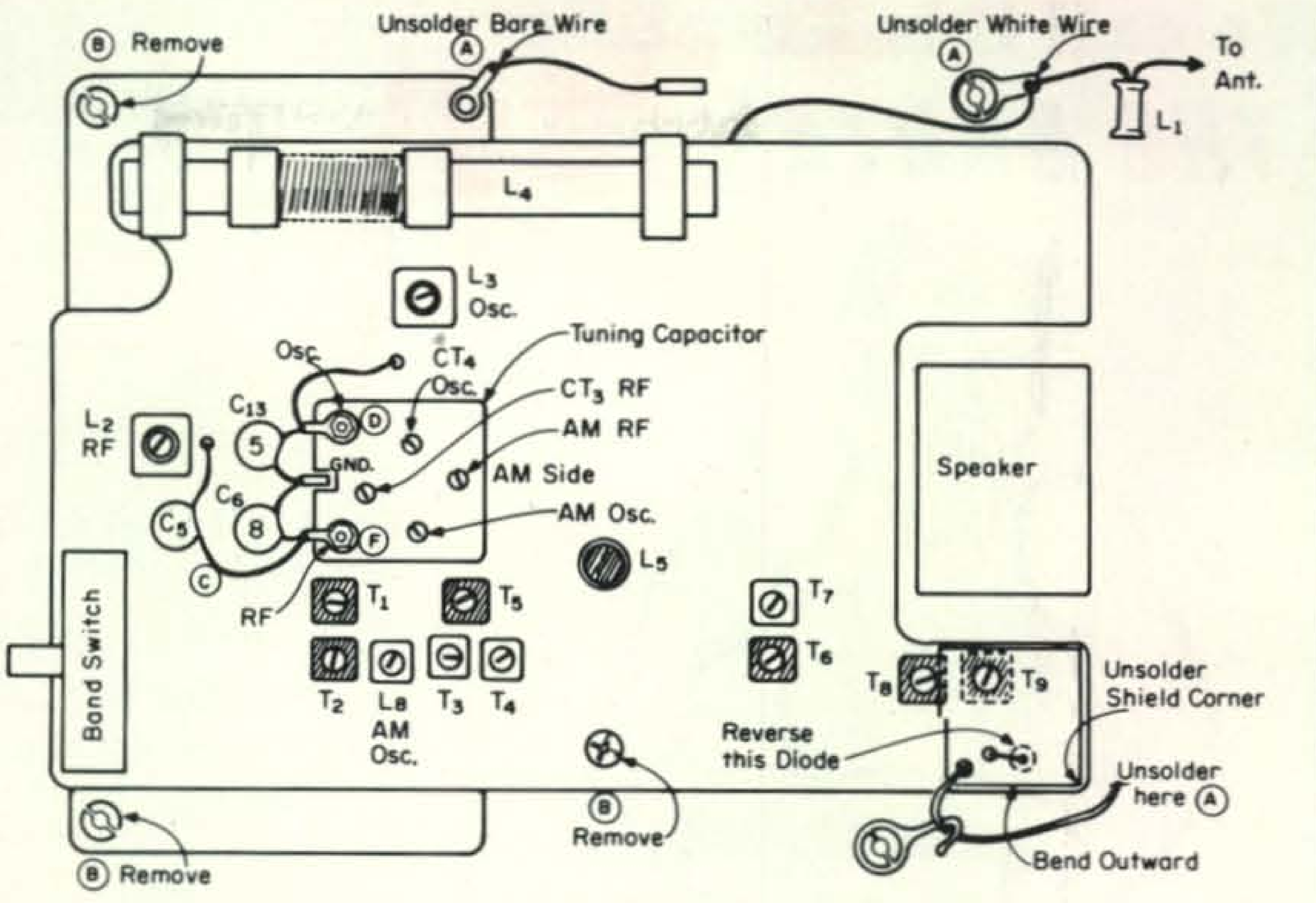

Fig. 1—Drawing of the rear view of the Lafayette Guardian II, an a.m. f.m. portable receiver that is modified for reception on the 50 to 54 mc amateur band. The shaded cans are in the f.m. i.f. section operated at 10.7 mc.

overing T_9 and several small components on ne chassis corner. This is the f.m. detector ection. To make a useable a.m. channel from vhat was originally the f.m. channel, we imply remove one of the two diodes under his shield and reverse it on the p.c. board. The edge of the shield indicated in fig. 1 is nsoldered and the side bent carefully outvard. This will allow easy access to the diode. Try not to overheat the diode while you are hifting it. Then bend the shield side down nd resolder the corner.

The chassis could be put back in the case ow, but we suggest one further job. The lider under the two dial openings is quite vide; it would be impossible to make a close calibration with it. Our fix was to draw a line on a strip of white adhesive-backed tape (the ame as that used to mark the new dial calibrations) and stick it to this slider. Make ure the line is perpendicular to the dial window openings.

Put the chassis back in the case, reconnect he three wires and put the battery case nsulator back; all further work is done above he p.c. board.

Referring again to fig. 1 (which shows the et, before any modifications), remove the wo tiny disc capacitors from lugs *D*, *F* and *GND* of the tuning capacitor. These are C_6 and C_{13} on the receiver schematic. (The instruction booklet furnished with the set has a complete schematic with all parts values ndicated; note thereon the changes that we make, as we go along.) Capacitor C_6 is reused, as seen in fig. 2, which shows the parts *after* the modifications. What we must do with the tuned circuits is to raise the tuning range somewhat, and apply much greater bandspread. While the set tuned a range of 20 mc as it came, we wish it to tune only about 4.5 mc, the full amateur 50-54 band plus a bit on each end. The 12 and 15 mmf capacitors at the top of fig. 3 give us bandspread, while the 8 and 15 mmf capacitors that are connected vertically determine where the tuning range starts (from the high frequency end of the range); the cores of the oscillator r.f. inductors, L_3 and L_2, and the two trimmer capacitors marked CT_3 and CT_4 figure in here, too, of course. Capacitors CV_3 and CV_4 in fig. 3 are the main tuning capacitor sections for the u.h.f. range. (We do not show the a.m. broadcast band capacitors here.)

Wire *E* comes from beneath the p.c. board and is the lead from L_3. Similarly, lead *C* is

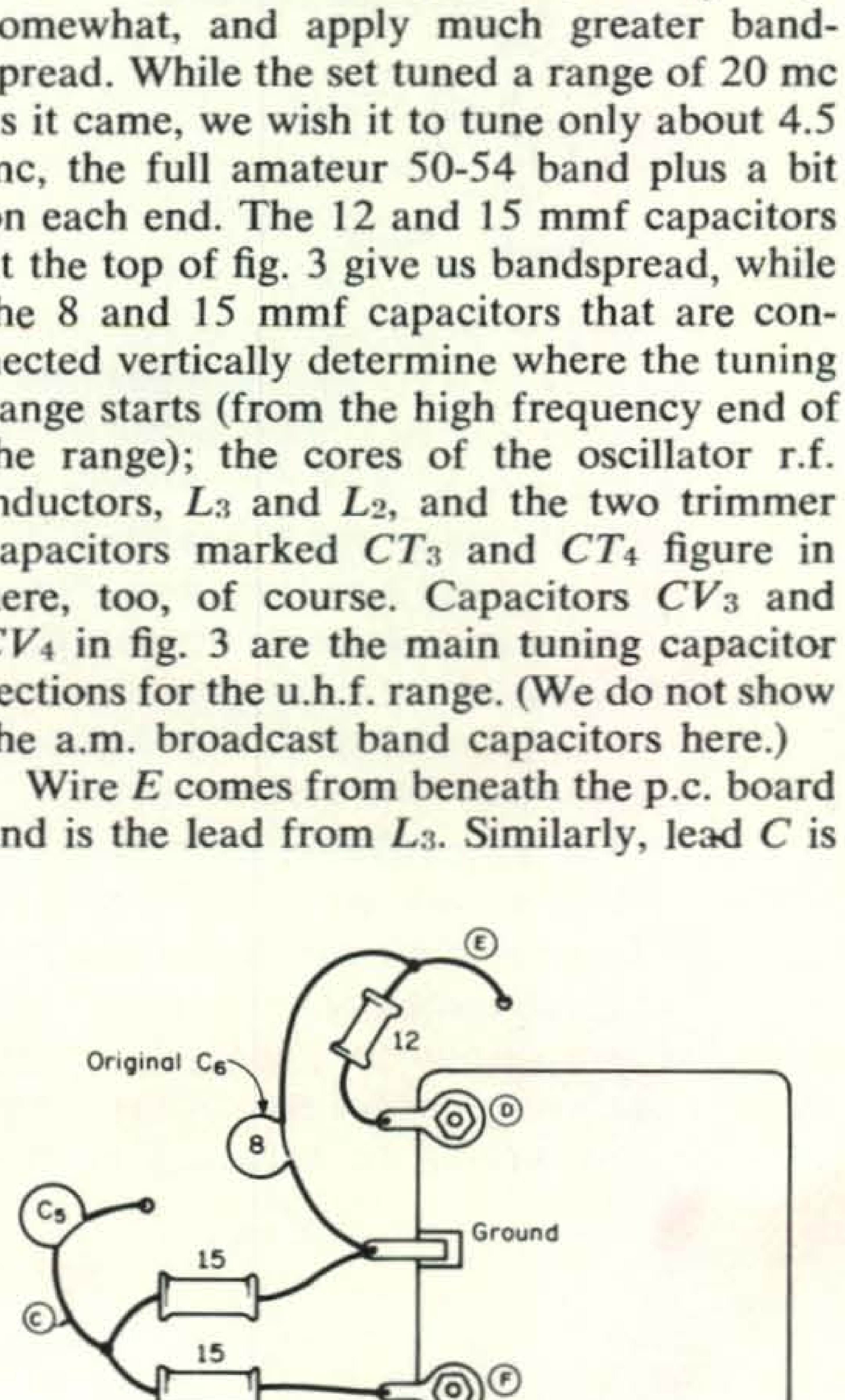

Fig. 2—View of the area around the tuning capacitor showing the component locations after modifications.

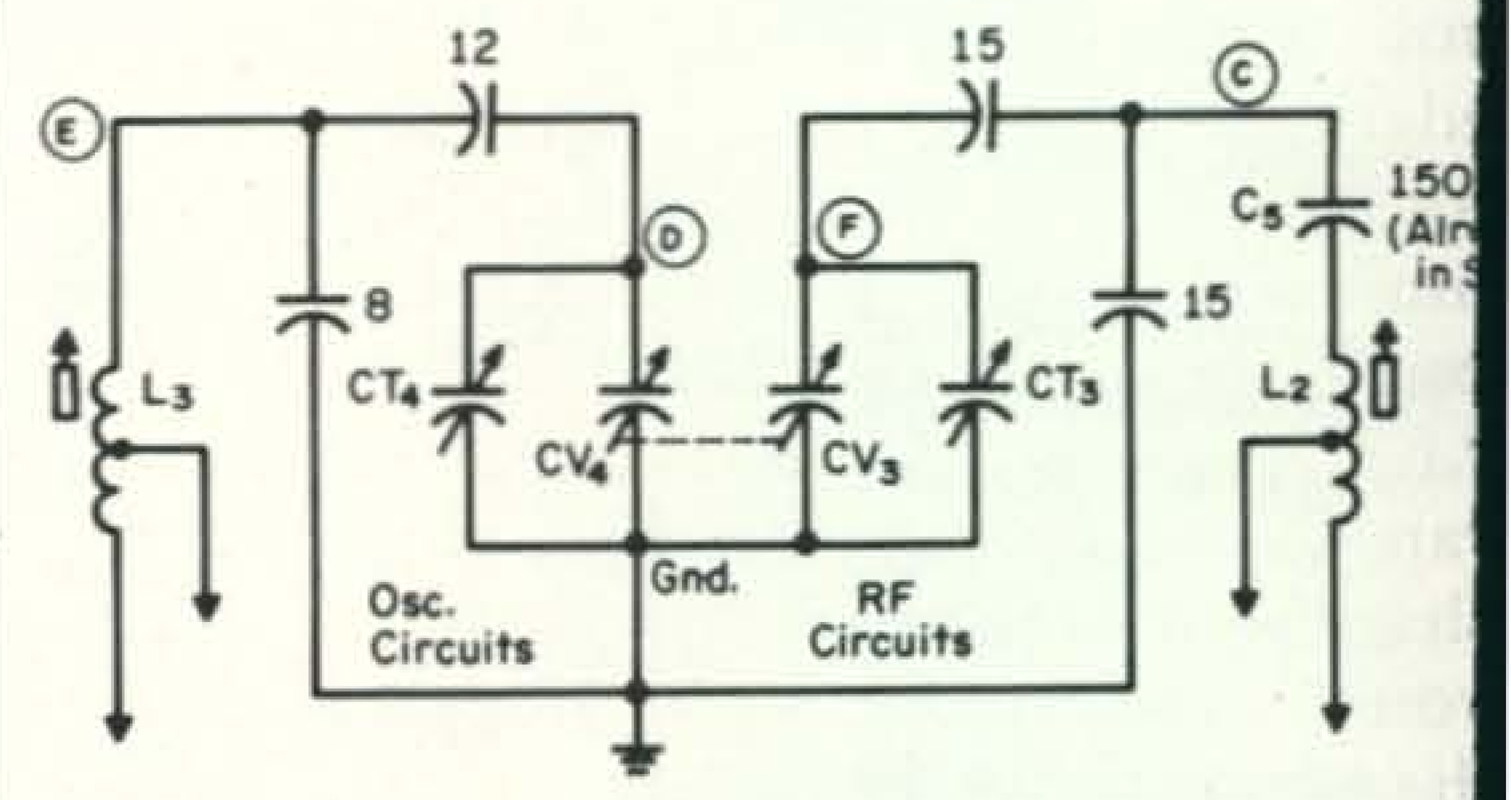

Fig. 3—Circuit of the Guardian II receiver moc fied for the amateur band from 50 to 54 m

one end of capacitor C_5, which has its oth lead attached to L_2 under the board.

Be sure to use zero temperature coefficie types for the 12 and 15 mmf capacitors. Ti silver mica capacitors would also do nicel Centralab type TCZ units were used her Note in fig. 2 that the original part, C_6, re-installed in another spot.

Recalibration

With all changes made and checked car fully, you are ready to recalibrate. Needle to say, some sort of signal generator is pret much a necessity here, the more accurate th better. Hams might be able to use their v.f. output here, of course. A strip of pressur sensitive white tape was used for the ne scale; this had a very glossy surface, so it wa roughened slightly with very fine abrasi paper, so pencil markings take better. It wa simply applied to the outside of the cas covering the original 30-50 mc scale mar ings. Calibration points were marked on th scale for the 50 and 54 mc band ends, abo 1/16" from the pointer movement limit the high frequency end and 1/8" from th low; the limit points were also marked. Th reason for the uneven lengths is that th particular capacitor used in these receive spreads the low frequency end of the sca much more than the high. A coverage of mc at the low end, for example, took abo 15/16", while from 53-54 mc is only abo 7/16". We must take this tuning capacitor it comes, of course, however, the area of th band most used by ham operators is we spread out.

The calibration method is as follows: S CT_4 (osc. trimmer) for the desired frequenc range; the L_3 core was adjusted to move th range on the scale so it coincided with th two band edge marks. You'll have to mov back and fourth between the two sever times to get the band exactly as you want i

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Before starting, of course, the oscillator and r.f. trimmer capacitors were set to mid-range; you can see the movable and fixed plate edges through the holes in the plastic capacitor case. Our full scale range (absolute tuning limits) is about 49.75-54.25 mc. After the oscillator is set as desired, you can adjust the r.f. trimmer and L_2 core to track over the full range. The oscillator components tune very sharply while the r.f. tuning is broad. Be sure you get the oscillator set 10.7 mc *lower* than the signal frequency.

After the exact band edge spots have been attained you can go over the band and mark all the calibrations points you desire. This particular receiver has been utilized mainly to monitor radio control spots in the band, most of which are above 53 mc, so only a few main calibration points were marked out. The numerals were made with a 1/8″ high "press-on" marking outfit. These markings should be protected by a clear coating. Krylon was found to work well; check whatever you wish to use here, to be sure it won't dissolve your letters!

As there is only one tuned circuit on the signal frequency (on v.h.f.) it will be no surprise that selectivity isn't sensational. The 10.7 mc i.f. handles image interference pretty well. Actually, amateur signals of moderate strength are quite tunable. Input tuning could certainly be much improved in sharpness, and the sensitivity greatly raised by using a tuned input inductor in place of L_1, an r.f. choke of about 1.9 μh. A small slug-tuned coil could be put in the area of the antenna in place of L_1, and tuned to the desired incoming signal. It would boost the desired signal considerably and help cut out spurious signals. For strong signals this inductor would not need to be touched, but could be left in an "average" position for the frequency range of interest. In areas of strong TV and f.m. signals you may hear some of these over the range, again due to the minimal frequency selection at the receiver input.

It should be recognized that the modified receiver is best only for strong signals; it isn't intended for DX reception. A tuned circuit at L_1 would pep it up considerably, of course. If you feel your unit it too "dead", you could try touching up the i.f. cans associated with the v.h.f. circuitry. These are indicated by the shaded can tops shown in fig. 1. Generally these should *not* be altered,

[*Continued on page 91*]

APPLICATIONS OF INFORMATION THEORY TO SLOW SCAN TELEVISION

BY T. E. INGERSON,* WA7MKA

Now that the FCC has approved the use of slow scan television on the h.f. bands, it behooves us to investigate the problems associated with this medium of communication. Narrow band television can be approached by simply slowing down the time constant of ordinary television, decreasing the number of lines or frames/sec or both, in an effort to decrease the bandwidth. Unfortunately, this approach, while direct and easy, leads to very poor television under the restrictions which are imposed by the new rules. The pictures involved are of low resolution, repeat only infrequently, and are generally unsatisfactory for anything but novelty.

If, however, we approach the problem with a broader perspective, it is entirely possible that interested and ambitious amateurs may be able to make a worthwhile contribution to the state of the art, and develop proper television systems within the bandwidth restrictions provided. To do so, it will be necessary to study the nature of a television picture carefully, in order to determine how it may best be coded onto a carrier, and thus to send the best possible picture with the smallest possible bandwidth.

We can do this best by recourse to the study of information theory. This is a fascinating subject with wide application. It is my hope that this article and some of the construction thoughts contained in it may induce some people to embark on meaningful experiments with bonefide hardware. But, whether this is done or not, the concept of information theory is a subject which could be very useful in many regions of amateur and professional research.

*Assistant Professor of Physics, University of Idaho, Moscow, Idaho 83843.

Information Theory

Information theory is the study of the amount of knowledge present in a given system, and therefore the study of the methods of transmitting information from one location to another as efficiently as possible. We can mathematically define this concept by first speaking of the information required to make a choice between two equally likely alternatives. Such an amount of information is called a "bit." To make a choice between four equally likely alternatives requires exactly twice as much information, *i.e.* two bits, one to make a choice between pairs of alternatives 1 & 2, and 3 & 4, and a second to choose between the two members of the two pairings. It is easy to see that to choose between eight alternatives requires 3 bits, 16 4 and so on. Or in general, we can say that "If we have a system, which can be in any of N states, all of which are equally likely then it requires $Log_2 N$ bits of information to decide which state the system is actually in."

Suppose we would like to know how much information capacity a voice channel possesses. If we have a bandwidth of 5 kc, then that bandwidth can send 5,000 choices per second over the channel. Let us suppose that the signal to noise ratio is 40 db, so we have the ability to make choices between 10,000 alternatives 5,000 times per second. Now log_2 10,000 is about 13, so such a communication channel can transmit 65,000 bits per second. Notice that the information carrying capacity of a channel increases as the S/N ratio increases.

Do we use this information carrying capacity efficiently in current communication systems? Certainly not. We are actually very poor at using it. We have no method of ex

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tracting any additional information from additional S/N ratio, nor do we pay any attention to the efficiency with which information is transmitted. Television pictures are among the worst offenders in this regard. Consider what is normally happening in a TV picture. As a rule, the vast majority of television pictures are highly redundant. That is, each TV frame is very nearly identical with the preceeding frame. We send a brand new picture each time, without paying the slightest amount of attention to the preceeding pictures, transmitting every bit of the information anew on every picture. The information which we are sending is quite ordered, and if we take advantage of this ordering, we can do a lot better in sending it.

Now, let us consider the amount of information required to send an ordered set of data. Without proof, I state that it can be shown that, "If a system can be in any one of a set of states numbered 1, 2, 3 . . . and the probability of being in state 1 is p_1, state 2 p_2, and so on . . . , then the minimum information required to determine which state the system is actually in is

$$-\sum p_i \log_2 p_i$$

summed over all possible states."

Let us apply this formula to two simple systems to illustrate its application. Suppose that we have a system which can be in any one of four possible states each of which is equally likely. The probability of each state is 1/4. Therefore, each term of the sum is equal to $1/4 \log_2 (1/4)$. But the $\log_2$ of 1/4 is -2. Therefore, each term of the series is equal to $-1/2$, so that the four terms of the sum add up to -2, which with the minus sign in front of the sum, gives 2 bits of information required, which is exactly what we would expect.

Suppose however that we knew in advance that one of the states was much more likely than any of the others. Suppose that this state had a probability of 90%, and one of the others had a probability of 6%, with each of the other two having a probability of 2% each. Now it obviously requires less information to figure out which state the system is actually in with this set of probabilities. But only with the use of information theory can we calculate how much information is needed. By our formula, we compute that

$$I = -\sum p_i \log_2 p_i$$

$$= -(0.9 \log_2 0.9 + 0.06 \log_2 0.06 + 0.02 \log_2 0.02 + 0.02 \log_2 0.02)$$

$$= 0.61 \text{ bits}$$

or 0.61 bits of information is required to make the decision. Therefore, with such a system, only 1/3 as much information is required to make a decision. The problem is how to code things so that this apparent 3:1 saving in information carrying channel capacity could be used.

Slow Scan

For example, let us consider a television system which might be suitable for slow scan ham work. The numbers are rather arbitrary, but we will pick some for our calculations, understanding that this is only a representative possibility.

The ordinary American TV system, as most people know, has 30 full pictures of 525 lines each per second, with about 250 horizontal detail units transmitted per line. This results in a bandwidth requirement of 4 mc. For our problem of slow scan TV, we want to develop a decent system in a bandwidth of 4 kc, which means that we have to make a 1000:1 reduction in the channel size. Quite a problem!

The most obvious beginning is to reduce the number of lines, and frames/ second, as well as the horizontal data units. We can still have a fairly decent picture with 100 lines, and flicker isn't objectionable at 16 frames/ second. Coupling this with 100 horizontal detail units would give a bandwidth of 160 kc. This is better, but we still are 40:1 from what we want. We could certainly get this factor of 40 by decreasing the scan rate to a picture every 2½ seconds, which is the usual approach, but the resulting picture isn't really very satisfactory. We want, therefore, to see if we can extract a better picture from this channel by using information theory.

Where might this extra information capacity come from? We could begin by calculating the information carrying capacity of our channel. Suppose that we could figure on a signal to noise ratio of 40 db. Then, we could figure on $4{,}000 \times 13 = 52{,}000$ bits/ second. Now, it is well known that a TV picture does not need 10,000 distinguishable intensity levels. In fact, as few as four will make a picture almost indistinguishable from a continuous one. This is similar to painting pictures "by the numbers", and noting that

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at a distance they look quite realistic. Therefore, we could satisfy ourselves quite well by determining which of four intensity levels each point of the picture should be expressed with, instead of 10,000. Suppose further that each successive picture were to be a 90% repeat of the previous picture. Then from our previous calculation, we might expect only about 1/2 bit per point to be required to determine the intensity of each point. We would know, you see, that there would be a 90% chance that each dot would be identical to the same point on the previous picture. This isn't an unrealistic assumption, especially on the sort of picture a ham would tend to transmit. We would expect that the usual picture would be either a slide, call letters (both 100% repetative) or the operator sitting in front of the camera, talking, a scene at least 90% redundant from frame to frame.

Now, a picture under these assumptions would take 160,000 × 1/2=80,000 bits of information per second, and could still have a 100 × 100 element picture, which, is of fairly good quality, repeating at 16 frames/sec. A bit more redundancy, or perhaps decreasing the frame rate to 8 frames/second, but repeating each frame twice before coming to the next, thus eliminating flicker, would reduce the data requirement to 40,000 bits/second, and would produce a pretty fair picture, a bit jerky, but still fairly realistic, and with the appearance of continuous motion.

Reducing Data

Now perhaps one would be led to think that this sort of data reduction would be impossible for an amateur to achieve in practice. Actually though, I think that feasible systems could be built which would approach the ideal of a good picture in 4 kc. Let's see how.

There are essentially three ways to reduce information content of a television signal. These are prejudice, history and invisible information. Let us take them one at a time.

Prejudice deals with preknown characteristics of a signal. Suppose that we were concerned with only four possible data points, but that we know from experience that brightness level 2 was more likely than any of the other three. This piece of preknown information reduces the required information for determining the state of the system. Any characteristic of the system which is known in advance is always helpful and reduces information required.

History deals with using the past history of a signal to establish current probabilities. This is different from prejudice, in that in prejudice we only know that, in the absence of other information, some levels of brightness are more likely, that is, they tend to occur more often in the average picture. History says that in the particular picture with which we are dealing, the picture element under consideration is more likely to be a repeat of some element in the past. In television, there are frame correlations, line correlations and dot correlations. Frame correlations say that an element is quite likely to be identical to the same dot in the frame of the previous picture. Line and dot correlations deal with the same sort of interrelations, but to the same element in the previous line, or the previous dot in the same line. All these correlations are clearly significant, and it is fairly obvious that the frame-frame correlation is the strongest. In a stationary non-panning picture, the probability is usually well above 90% that the frame correlation is valid. Obviously other correlations are possible, such as the chance that the picture will be merely one brightness level different from the previous frame, line or dot. This simply says that usually the brightness doesn't change suddenly. However, the frame correlation is so strong that we will consider this as the basis of suggested coding.

The third coding method we might use is that of invisible information. This sounds like a contradiction, but it isn't really so. Suppose we consider the color television subcarrier in the usual television system. This subcarrier is deliberately placed precisely half way between harmonics of the horizontal scanning frequency. This means that the color information on the screen is appearing as a series of dots which alternate line to line and frame to frame in intensity. Therefore, the alternating dark and light dots this gives on a black and white television screen cancel with the pattern of dark and light reversing with each line and frame so that the eye averages them out and never sees them. This method works well under certain conditions, but we won't pay a great deal of attention to it here.

Note that even a very simple application of the concept of clever information extraction can allow us to approach some systems in a more general manner. Suppose we had a slow-scan television system with a terrible signal to noise ratio. If we send the same information over and over again with endlessly repetative pictures, the noise is still there. But suppose we simply store the picture as we receive it, and then average each picture with the next one, adding each subsequent picture to the average, and storing it. Then, the noise will gradually cancel, while the signal will add, and even though the S/N ratio is terrible, eventually an exactly repeating picture (such as a slide) will come through perfectly. Assuming that the problems of sync and tuning can be solved (which they can), eventually even signals very much weaker than the noise can be detected if they are identical and repeat themselves over and over again.

Anyway, how can we use this sort of idea to improve our picture systems? We can make a good start by getting away from the entire concept of linear sequential scanning. We don't have to scan each line identically. We would like to skip over the lines which contain no new information, and go on to where our information will do the most good.

Memory

,We assume that both a proper transmission and reception system would possess a memory. By memory, we mean the ability to recall the state of previous picture elements, for the purpose of comparison. Without a memory, information theory does very little good, since we throw away our previous information, and kill any possibility of using it for correlations.

Making such an assumption, we begin by describing a very simple, yet feasible nonlinear transmission system. Suppose that we use a bit of our signal-noise ratio supply of information to send (say) seven distinct alternatives. We assume S/N is sufficient to distinguish these seven alternatives. These would be; 1. Vertical retrace; 2. Entire next line is identical to same line of previous frame; 3. Next ten elements are identical to same ten elements of previous frame; 4, 5, 6, and 7: brightness is level 1, 2, 3 or 4, where all brightness data was expressed in 4 levels.

Now, though it would be complex, this coding system is a feasible one to construct, and with integrated circuits, and simple logic, it shouldn't be too difficult to translate into hardware. Let us consider what the effect of this transmission system would be on a real picture. I will suppose that the receiver has a memory which contains the "best current reconstruction available of the picture." As new information is received, this picture would be updated continuously. The visual picture would be generated by scanning this reconstruction continuously at a conventional 20 or 30 f.p.s. rate. This would mean that no matter how slowly data was coming through, the visual picture would not give the appearance of flicker.

Now when a new picture appeared on the screen, with totally new data, if we used the 4 kc data point rate, and the 100 × 100 element picture, then we would require 2.5 seconds to scan the picture. This 2.5 seconds would produce our first reconstruction picture. The picture might be the station operator sitting at his console, speaking. If he were moving slowly, then it is reasonable to suppose that 50% of the lines would be unchanged from picture to picture, and that only 20% of each other line as divided into 10 bit segments, is varying.

The 50 repeating lines only take 50/4000 second to transmit. The 80% of the other 50 lines take 8 × 50/4000 second to transmit. The 20 elements which need to be sent individually in these lines take 20 × 50/4000 second. All of these would be followed by a vertical retrace pulse, which requires 1/4000 second. Totally then such a picture takes only about 1/3 second to send. This means that the motion would appear jerky, but semi-continuous and flicker free. A new picture would take 2.5 seconds. As the action involved smaller areas of the frame, the repeat time would be faster, and the motion (what motion remained) would be smoother and less jerky.

Even as it is, this system of coding would produce a picture which would border on being satisfactory. The picture would consist of a fairly sharp picture of the other operator, and as long as his motion was slight, it would appear to be a perfectly normal TV picture. If he moved, then the picture would begin to break up, but it would never take more than 2.5 seconds to reconstruct the data. Therefore, one could imagine realistic QSO's held with this sort of TV, and pictures transmitted which would give a decent television presentation of the operator on the other end. Scene changes would take time, but not too much, and the reconstruction would give the appearance of being a wipe scene change anyway, which isn't bad.

Data Transmission

Four thousand data points per second is fairly easy to transmit on a s.s.b. size channel,

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by sampling at 4 kc, and then putting on a very good low pass filter. One could be sure that the vertical retrace code was the maximum amplitude signal, so that this signal could be clamped and used as the reference to determine the a.g.c. voltage. It would probably be desirable to use single side band partially suppressed carrier, with some of the carrier remaining to allow properly phased reconstruction of the signal. A reference carrier is almost essential.

This system is merely one possibility. There are obviously many variations, based on what one would expect of the nature of the redundancies, as well as various coding schemes. Studies of the nature of various codes could be made, and it may be determined what kind of assumptions about the nature of the picture will yield the best reconstruction on the average.

We could improve our coding in this scheme further by increasing the code possibilities from seven to 343, which in principle gives us $7 \times 7 \times 7$ possibilities, and still asks for only a 30 db S/N ratio. This means that we could repeat this picture not 3 times/second, but 9 times, which isn't too far from a truly continuous picture. This is, of course, much harder, though in principle it would be done.

Probably, in a real system, we would have problems because as time wore on, the integrated opinion of the picture would deteriorate because the system has natural variations in its reconstruction characteristics. It might be necessary to send, say, 3 completely new lines per picture, and update the reconstruction continuously. This wouldn't decrease the scanning time very much, and would probably improve the picture.

At any rate, there is certainly no hardware existing to do this sort of thing. I'm a theoretical physicist, not an engineer. Nevertheless, it seems fascinating to me to consider the possibility that this sort of work could be done by amateurs, and that in so doing, they could make a real contribution to the state of the art. I would hope that someone might attack such a project. If they would like to, I will be glad to offer any help I can provide from the theoretical end.

Obviously, this is only one idea for a coding system. The efficiency of a coding may be calculated by computing the minimum information required, and dividing that by the information sent, in this manner calculating how much of an improvement in channel capacity is still available. Of course, the type of coding may well depend on the type of picture sent, and the use of this technique is more or less restricted to highly redundant pictures.

Data Storage

The data storage device is going to be the worst problem for construction. There are various ways to attack this problem, the most obvious being such exotica as memory cathode ray tubes. However, another approach might be used, by applying the prejudice idea instead of the history. Suppose one photographed a sample scene on a conventional monitor and used the photo as the reconstruction basis, with the code refering to the photograph rather than the reconstruction.

The photograph could be sent and averaged many times so that its quality would be very good. Then, of course, one could not move the camera, nor could one show slides or other things without the scanning rate decreasing to one picture every 2.5 seconds. Still, this is an attractive idea for amateur pictures, as the QRM wouldn't affect the reference picture, one wouldn't need very expensive storage apparatus, and the quality of the reference would be very good. A QSO might consist of first conventional scanning, and averaging for, say, one minute. Then a polaroid picture would be made, inserted into the reference apparatus, and the picture reconstructed. A continuous reconstruction storage device would then become desirable, but not necessary.

The rotating heads of a video tape recorder could be used for storage, but v.t.r.'s aren't very common yet. With only 10,000 data points to score per picture, one might be able to adapt magnetic tape loops in some way. But that's hardware, and is an interesting problem for anyone who would like to work on the concept. Good luck! ■

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Instant Service Nets WCARS—MWARS—ECARS

BY ED GRIBI,* WB6IZF

THE three Services each reacted in a different manner to hurricane Camille that devastated the Gulf Coast in late August. A W∅ mobile 5 called into MIDCARS and K9GPM on 7258 on the morning of the 18th with some of the first words out of Gulfport. K9GPM got some of the other stations in the area working on the crisis and at 1030 hours MIDCARS gave the frequency up to the Mississippi Sideband Net which continued operations handling important emergency traffic. MIDCARS tried to reestablish on 7265 but as Secretary Marv, W9WWE, said ..."MIDCARS died here"... Somebody came on WCARS, 7255, on the morning of the 19th and said that the FCC had declared 7254 an emergency frequency so WCARS moved to 7258 for three days. EASTCARS stayed on 7255 for the duration. Many individual participants in the several Services worked night and day throughout the emergency on several bands and frequencies. Amateur radio in general came through again.

The reactions of the three different Services suggests some areas for future improvements. EASTCARS maintained operation throughout on 7255 with no apparent interference to any operations in the distressed area. WCARS bent over backwards to comply with the FCC request to avoid 7254 by moving up. MIDCARS was out of service because their frequency was occupied by the Mississippi Sideband Net. There's no question about the priority of frequency usage of stations and nets maintaining communications in and to a disaster area. However, there are some gray areas involved here. No emergency operations were heard on the West Coast on 7254 at any time so WCAR was in no danger of any actual or potential threat of interference by maintaining its service on 7255. Incidentally, the FCC directive was a request, not an order–this is their usual procedure in such situations. I'm not sure how the Mississippi Sideband Net occupied 7258 as their published net frequency is 3947.5. The ARRL has abandoned its National Calling and Emergency Frequency scheme and has suggested to its appointives that they utilize WCARS, MIDCARS, and EASTCARS in the same fashion in lieu thereof. From the facts I have in hand, it would appear that WCARS, and perhaps MIDCARS, should have maintained their published frequencies in order to provide maximum facilities for service during the period.

Here are some thoughts regarding such situations in the future:

(1) A report brought on the air of an FCC declaration of emergency should not be the sole authority for the QSY of an active net or service. Verification of the text and meaning of the order from appropriate FCC authorities is the best procedure.

(2) It is much better to maintain an existing frequency as an open calling frequency. If required in extended emergencies, it is better to establish a continuing emergency group on a nearby frequency with several stations maintaining liaison with the primary frequency.

(3) Any active net or service should have

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procedures established to handle emergencies or other contingencies. This should include alerting methods, frequency designations, and liaison arrangements with groups such as ARPSC and RACES. These emergency plans should be tested and kept up to date.

In WCARS we're trying to perfect such a plan. Bob White, WA6TYR, is Assistant Net Coordinator in charge of Emergency Planning. Both is establishing procedures whereby 7255, West, will have a maximum number of strong, experienced control stations and well placed monitors on the frequency in the event of extended emergencies. 7255 will then be readily available to any agency—ARPSC, RACES, Red Cross, etc.—that requires the services of a calling frequency.

Brief Calling Procedures For 7255 And 7258

In case you came in late, this column is devoted to news of " The Instant Services"—WCARS, MIDCARS, and EASTCARS, and other amateur radio Public Service activities. These three groups maintain 7255 (East and West) and 7258 (Midwest) as monitored calling and emergency frequencies for your use. You should be acquainted with these calling procedures:

"BREAK-BREAK-BREAK" – Emergency only—used for messages having a life and death urgency—such as highway accidents—all stations stand by while control determines method of handling.

"BREAK-BREAK" – Priority or urgent traffic having a specific time limit. Traffic hazards and obstructions are priority.

"CONTACT" – Notifies control that you wish to contact a station just heard.

"INFORMATION" – Notifies control that you have information that may explain or expedite traffic at hand or for any other contingencies.

Your call letters only—the only proper way to break for routine matters—never say "break."

Never transmit more than one brief sentence without dropping your vox or mike button.

Always move all routine messages and contacts at least 4 kc. off of Service frequency.

Death Messages—There's sometimes some misunderstanding regarding the precedence of death messages on amateur radio. Such messages are never more than low Priority. After all, the person has died and there's nothing more that can be done for him. So far as I'm concerned, the only justification for using amateur radio for such messages is lack of any other communications facilities or poverty. Personally I never accept such messages except under very extenuating circumstances.

MIDCARS News (from *Radio Watch*)

Not much has been reported regarding MIDCARS services rendered during the past couple of months. I know there have been a lot of urgent incidents handled—let Ron, W8-NXD, know about them.

Here's the only one of which I have the details: W7OX/mobile ∅ (a Director of WCARS) called in on 7258 requesting assistance for vehicles involved in a non-injury accident near Murdo, South Dakota. WA∅-CEZ, Control, could not copy so WB6IZF/7, Lander, Wyoming, (Vice President, WCARS) relayed the information to K∅MSP who called the S.D. Highway Patrol. Even traveling as I do one gets an occasional opportunity to be where the action is.

W4TZI, Carl Ruh, MIDCARS member was elected to the Kentucky State House of Representatives. Congratulations Carl.

MIDCARS members have voted incorporate and establish $2.00 dues.

Quote from the *Radio Watch:* "There have been many requests to start a SOUTHCARS for the southern states. Would there be too much confusion with all the Services? . . ." What's your reaction?

To join MIDCARS—send a QSL or card and twelve six cent stamps to W9WWE, Secretary, Midwest Amateur Radio Service, Box 82, Seaton, Illinois 61476.

WCARS News (from WCARS *Sentinel*)

I was most impressed with the magnitude of the "Bring 'Em Back Alive!" program over the Labor Day weekend. WA6PCY operated from the Auto Club in Los Angeles with K6MVF relaying and filling in from San Diego. For the first time continuous of northern California was provided by W6EAM who organized a crew of stations to monitor and relay reports to the Auto Club in San Francisco. "Bring 'Em Back Alive!" is a program of presenting frequent regular traffic, road, and resort facilities on a maximum number of broadcast stations during any major holiday so that motorists will be alert to any potential helping by contributing reports by mobiles and base stations to fill in spots not covered

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by regular sources. The system seems to be working well and expanding its coverage. This is a great public service program which amateurs should join in any area where it is established.

WCARS participants helped a yachtsman seriously injured by a swinging boom in mid-Pacific during the Honolulu race in July. WB6KDS and WA6NOA with the fleet relayed vital information on 20 meters through the phone patch of W6VX to Long Beach Coast Guard. He was transferred in 12 foot seas to a cutter which sped him to a San Diego hospital where he recovered quickly. WA6-HRI and WA6OQW handled relays and liaison between 20 meters and 7255.

WA6BIU called in to report a car balanced over the edge of a cliff near Big Bear Lake. It's occupants were afraid to move for fear of having the car topple over the side. With WA6DOT as 7255 control, W6FJT called the California Highway Patrol. A wrecker arrived at the remote mountain scene in short order to pull the car and occupants to safety.

Some 21 other highway emergencies were known to have been handled on 7255, West, during the late summer period by a multitude of stations.

For information regarding West Coast Amateur Radio Service membership send a card to Wayne Nail, WB6CBW, President, 4924 Omar, Fremont, California 94538.

EASTCARS News (from *Monitor*)

Holy smokes, this outfit is exploding in both membership and magnitude of services—700 members as of the end of summer. Dues of $3.00 are now being established and the group plans to form a non-profit corporation soon.

A hit-run accident involving the car ahead got W4KXE mobile in pursuit of the driver in Virginia. K3FEC patched him in to the State Police. With the aid of two other motorists the chased car was cornered and the offending driver held authorieies arrived.

W1CDY acting as control picked up two calls in short order—WA4HWQ reported a two-car accident in Maryland requiring an ambulance and wrecker and 30 minutes later WA1IUF reported a motorcyclist off his machine in Massachusetts.

K3EBM got an ambulance to the scene in minutes for three girls in a car that went down a 100-foot embankment. WA3AES got the same service for a car with a woman pinned underneath near Bedford, Pennsylvania.

ECARS monitor control to W1AW: "What's your QTH old man?"

A number of stations and nets helped in a tornado disaster that struck near Mayville, western New York, on June 21. 6 and 2 meter nets maintained local communications and liaison with ECARS and other nets with the aid of emergency power. WA2BSG, WA2-UKE, K2RIP, K2DPT, W2SB, K2ISN, WB-2GBK, K2SWT, WB2HCT, W2CDX, WB2-HJV, K2JQT, and K2OKS were some who participated.

ECARS is considering moving to some other frequency, perhaps 7252 or 7253. There may be more on this by the time this column appears.

For information on joining East Coast Amateur Radio Service, send an SASE to Radio WBZ, Eastcars, Boston, Massachusetts 02134.

Instant Services Everywhere

Consider me a mad dreamer if you will, but I consider the achievement of several full-time monitored calling and emergency frequencies to be one of the most important accomplishments of amateur radio in the public service field in recent years and that there are many other possibbilities for extension of this type of service. Similar services are working in evening hours on 75 meters. Wouldn't it be great if there was a similar service on 20 meters, perhaps with a little different format? How about alternates on 15, and local coverage on 10, 6, and 160? One of my favorites is 2 meter repeaters. They provide a natural mode for local coverage in a 200 mile circle. Same goes for 220 and 432. Gee, I wonder how long it will be before we can have instant communication and instant service anyplace on the globe (and moon and...?) via amateur satellite? Dream on!

I'll see you on 7255 or 7258, your Nation's two calling frequencies.

73, Ed, WB6IZF/6

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CONVERT YOUR OLD NOVICE RIG TO 160

BY FREDERICK H. RAAB,* WAØATT

MANY hams begin their ventures into radio with some sort of simple transmitter and receiver. Later, when the ham receives his general class license, he buys an s.s.b. transceiver. The novice rig then is either placed on a shelf to collect dust or is sold for a low price.

Chances are your Novice rig can be converted to 160 meter operation with only a small expenditure of time and money. The additional inductance required for 160 meter resonance of the circuits does not take up as much space as you might expect; it should be possible to fit the larger coils into most Novice rigs, since these are not usually designed with miniaturazation in mind.

The converson of the Heathkit DX-60 transmitter and HG-10 is described below, and suggestions are given for conversion of other similar transmitters. Although the author used the eighty meter position of the bandswitch for conversion to 160, there is no reason that the reader could not install a bandswitch with one more position and have both 80 and 160 meter operation.

V.F.O.

A tuneable circuit covering 3.6 to 4.0 mc can be converted to a tuneable circuit for 1.8 to 2.0 mc by quadrupling the inductance. The change in inductance reduces the resonant frequency to one half of its original value. Thus, a properly converted v.f.o. can even use the same scale markings as before.

The HG-10 uses slug-tuned coil forms. The easiest way to increase the inductance of the 80 meter coil is to wind additional coil turns around it. Winding one direction will increase the inductance, and winding the other direction will decrease it.

Begin by unsoldering the connection at the top of the coil. (Refer to fig. 1.) Connect one end of a #26 enameled wire to this terminal;

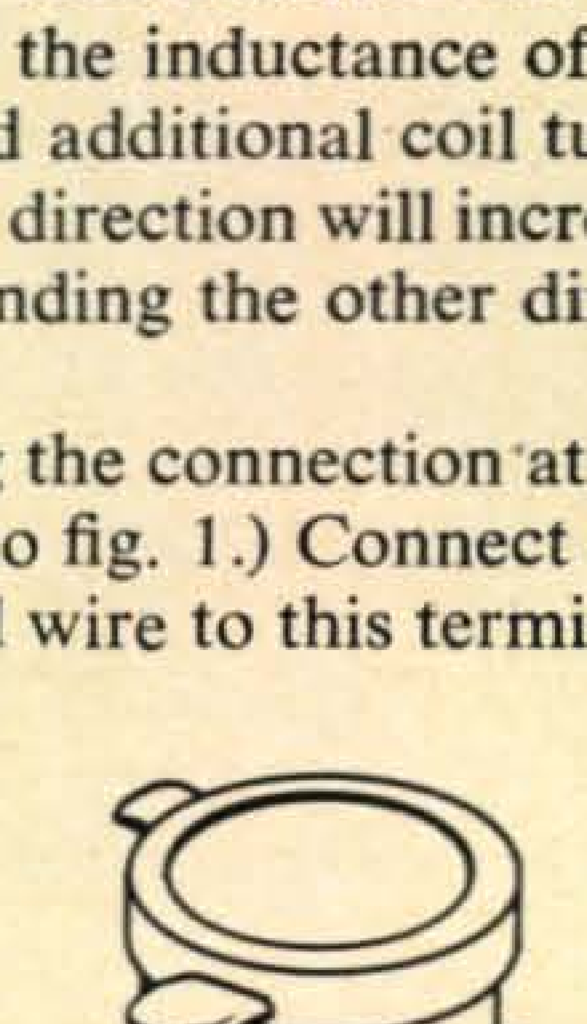

Fig. 1—New windings on the HG-10 oscillator coil to modify it for 160 meter operation.

*1414 Burnett Avenue, Ames, Iowa 50010.

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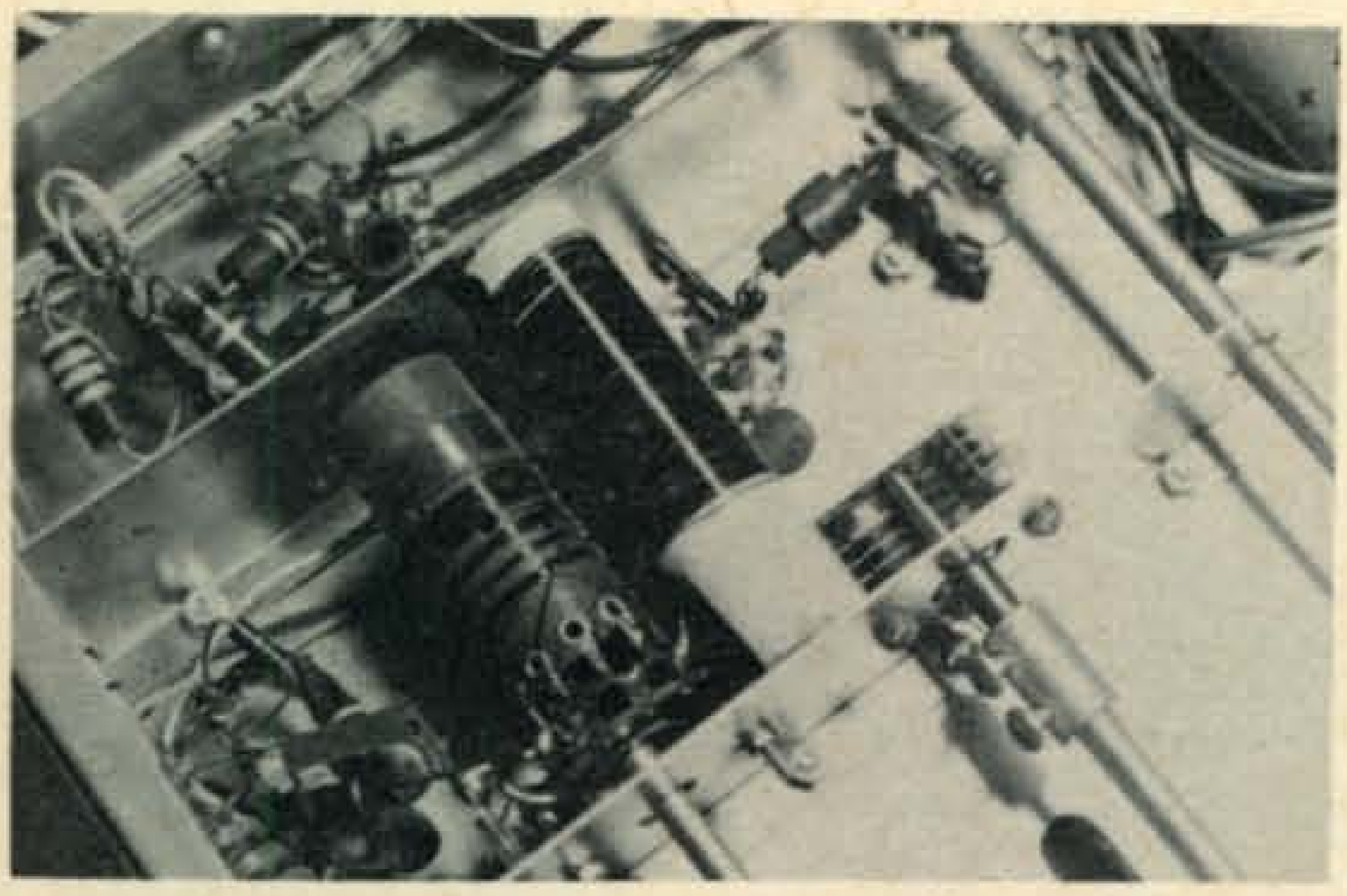

Top view of the DX-60 driver stage modified for 160 meter operation.

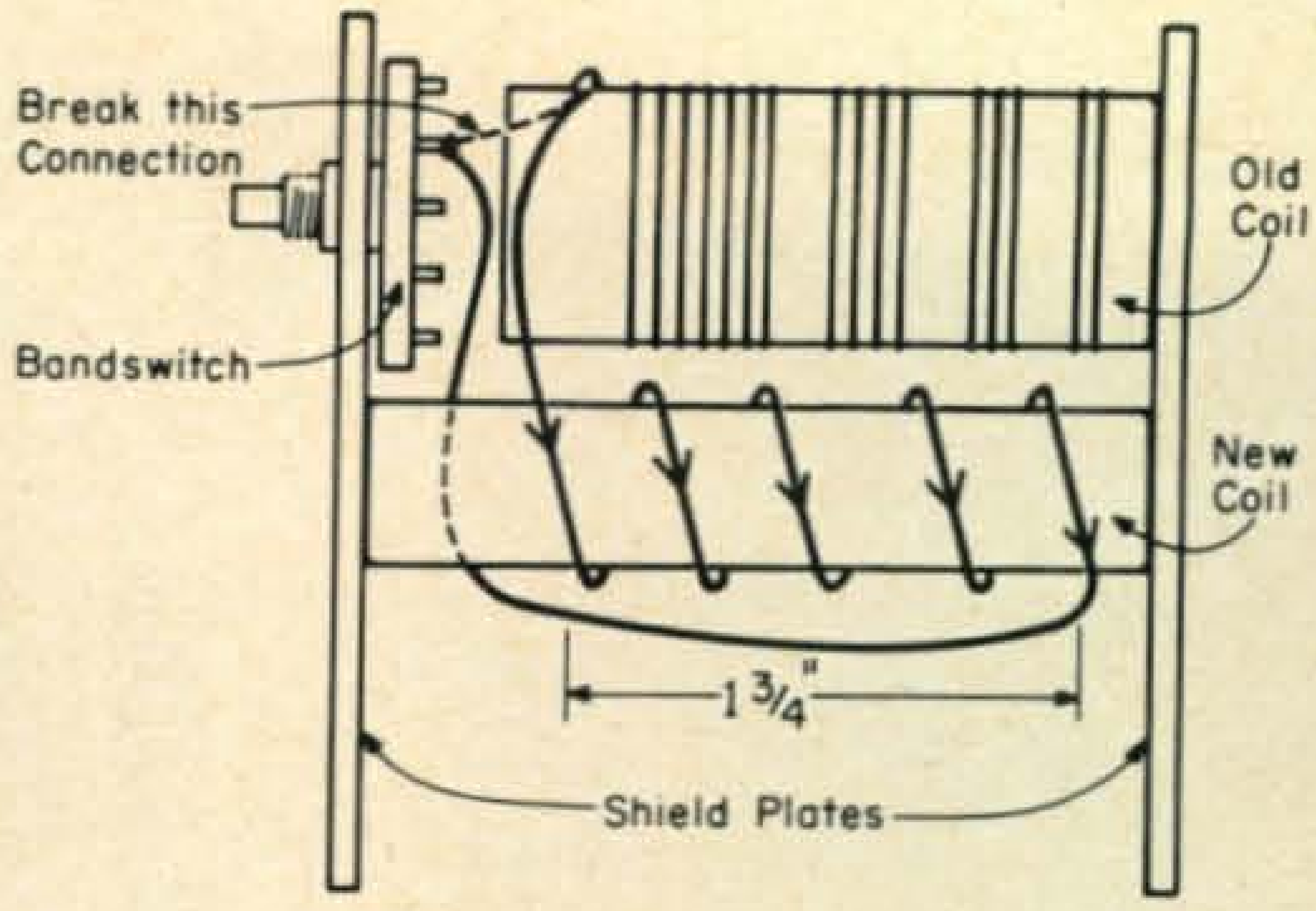

Fig. 2—Modification of the driver tank coil of the DX-60 for 160 meter operation.

then run it along the side of the coil for approximately 3/4 inch. At this point begin winding upward in a clockwise direction as viewed from the top. A total of 32 turns are required. Temporarily secure the windings with a piece of tape. Solder the remaining end of the #26 wire to the wire which had previously been connected to the top of the coil.

The following further changes will be required in the HG-10 v.f.o.:

1) Replace RFC_1 with a 2.5 mh choke.

2) Replace RFC_2 with a 2.5 mh choke.

3) Shunt C_{20} with a 390 mmf silver mica capacitor.[1]

4) Shunt C_{21} with a 390 mmf silver mica capacitor.[1]

Now allow the v.f.o. to warm up and then calibrate it in accordance with the procedures outlined in its instructional manual. Use the 3.6 mark for 1.8, 3.7 for 1.85, *etc.* When finished and satisfied with its operation, permenently secure the coil by applying a small amount of ordinary lacquer to the windings.

To convert other v.f.o.'s begin by increasing the tank coil inductance, as in the HG-10. Remember that if the additional turns are wound the wrong way, inductance will decrease and the resonant frequency will increase. The proper direction in which to wind them will probably have to be determined by trial and error, as will the number of turns.

After resonance on the 160 meter band is obtained, if the signal is not a pure c.w. note, some other components will have to be changed. Try the following:

1) Double the feedback capacitance.[1]

2) Double (or more) the blocking inductance (r.f.c.).

3) Increase bypass capacitance.

The above changes should be sufficient to restore a clear note. It is possible that only one or two (or none) of the above changes will be required. In general, values used here will not be at all critical. However, calibration should not be done until the desired tone has been achieved.

Transmitter Oscillator-Buffer

In the DX-60, this stage operates untuned on 80 meters, and untuned operation on 160 was also found to be satisfactory. No modi-

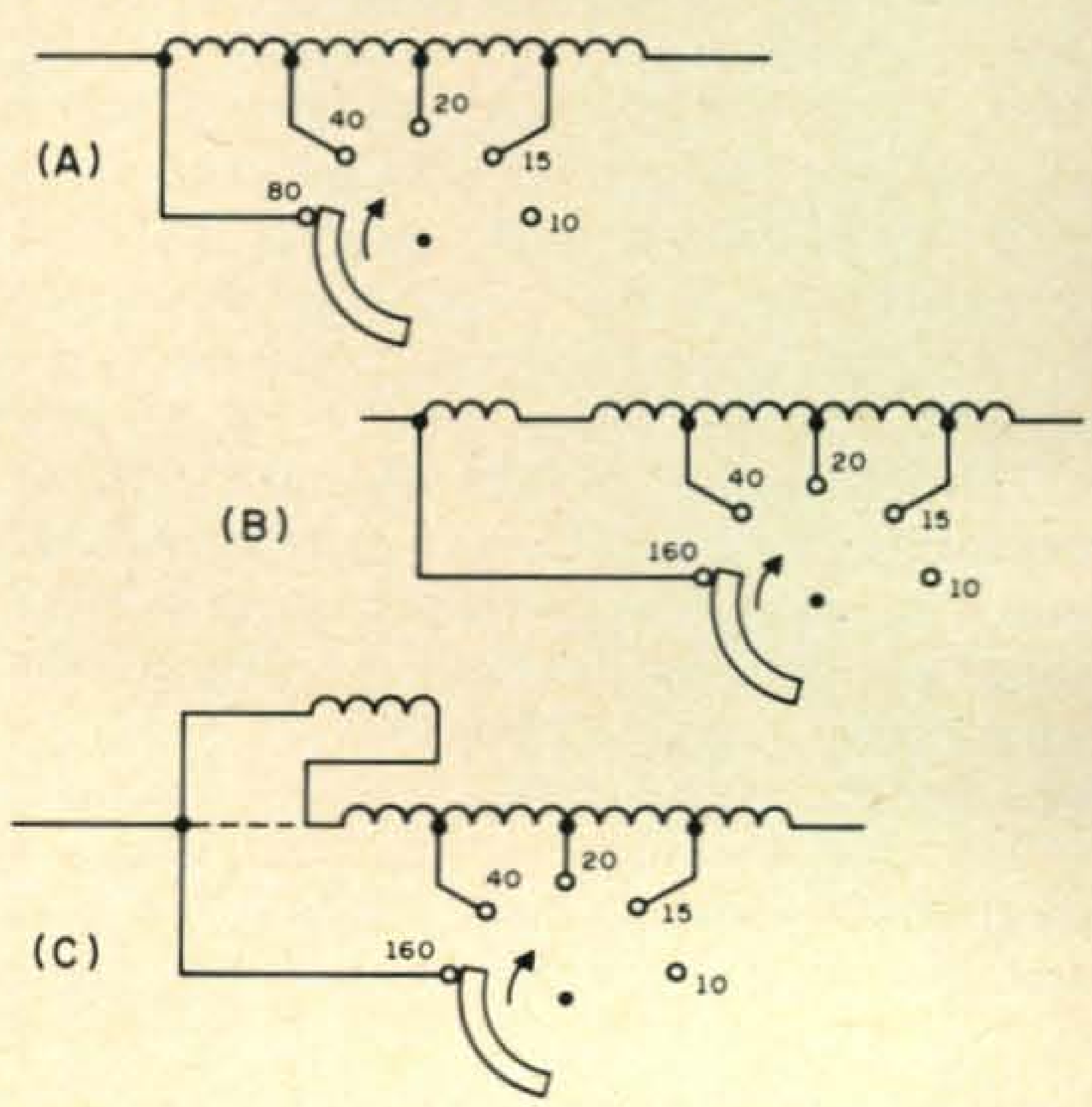

Fig. 3—DX-60 driver circuit modification for 160 meter operation. (A) Original circuit. (B) Additional coil added for 160 meter operation or (C) and additional winding over the original winding.

[1]If operation on both 160 meters and 80-10 meters is desired, it will be necessary to switch these added capacitors out of the circuit when not on 160 meters.

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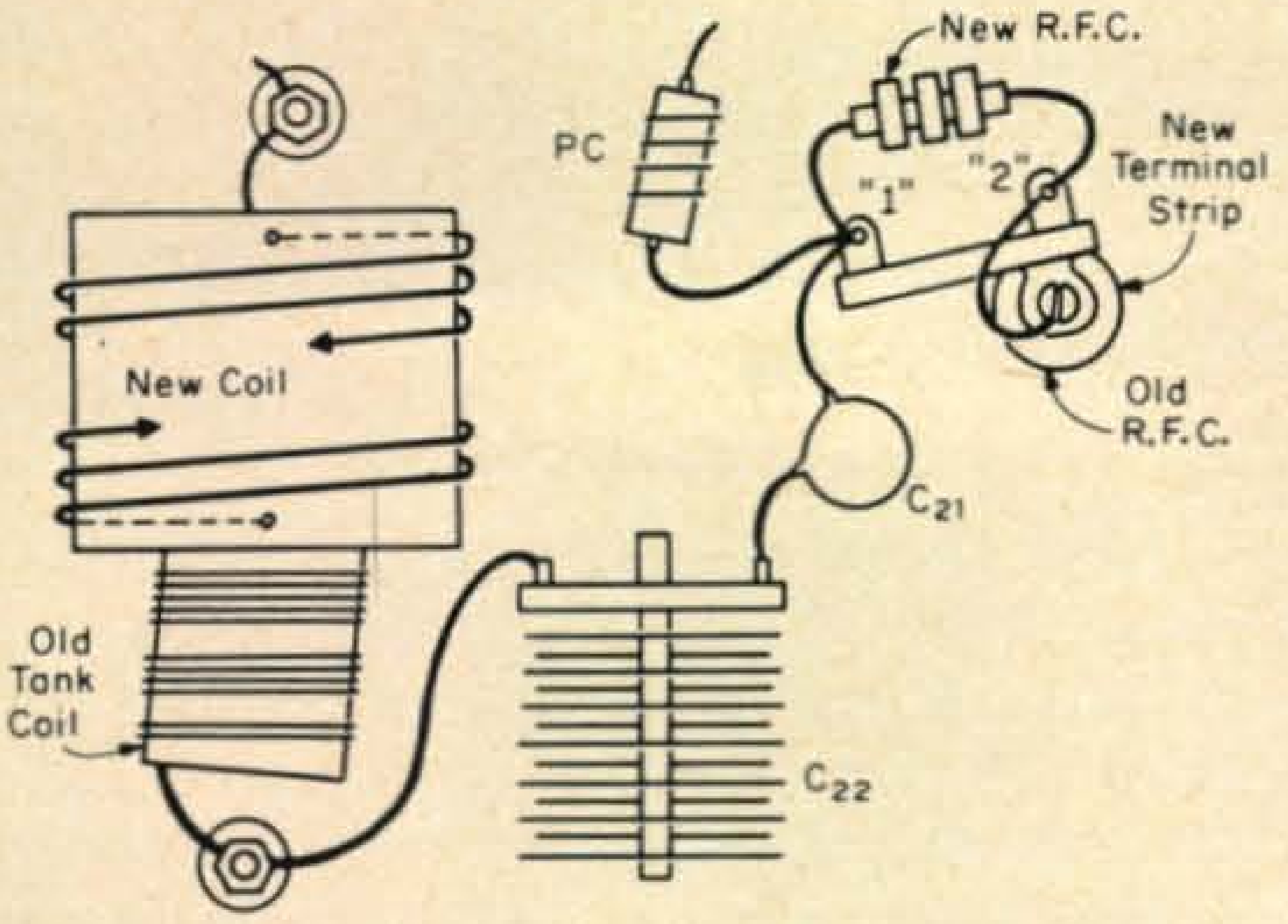
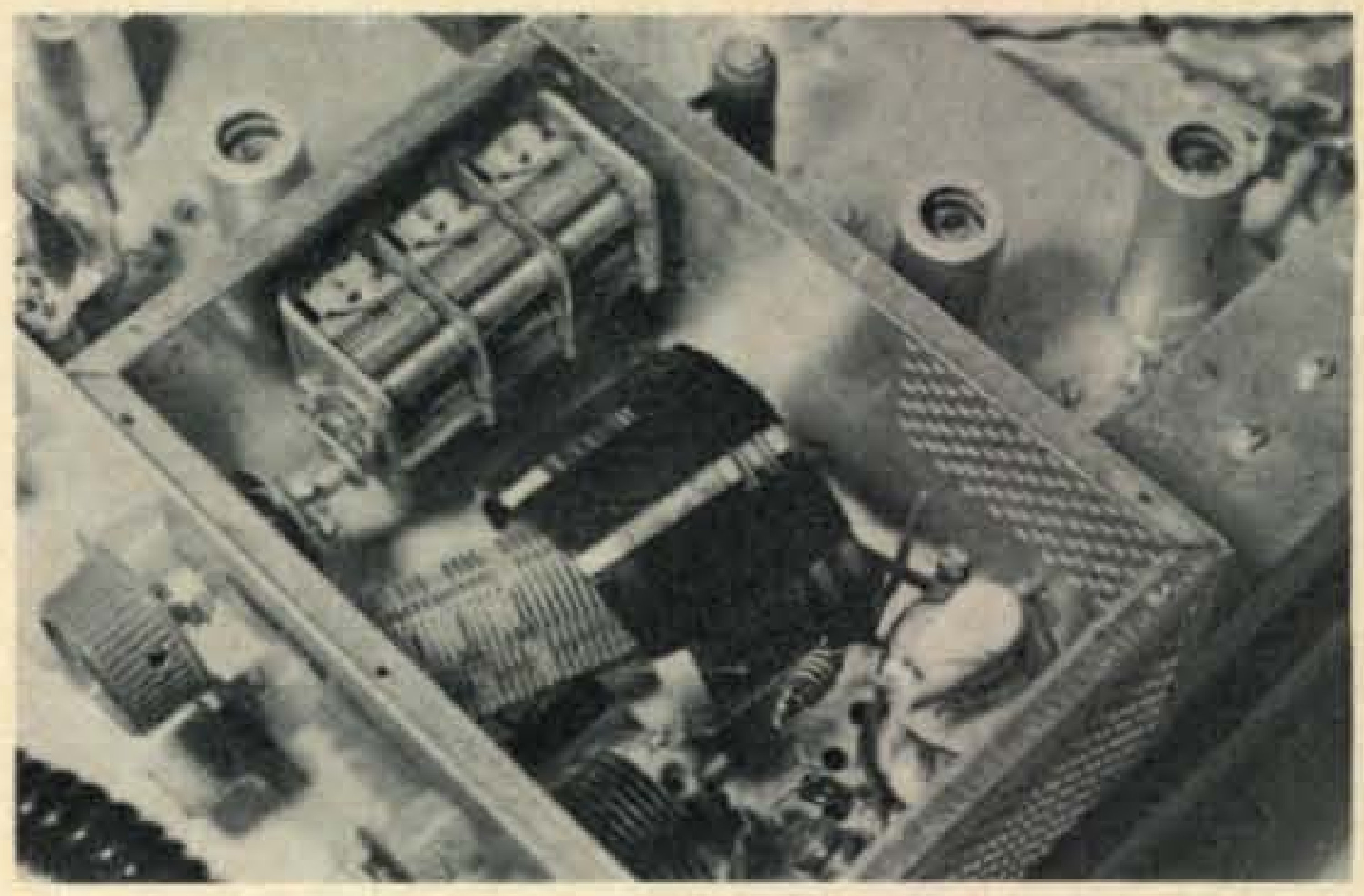


Fig. 4—Modified layout of the DX-60 final to permit operation on 160 meters.



Modified final of the DX-60 showing the new tank coil for 160 meter operation.

fications of this stage were required.

If this stage in the reader's transmitter is tuned, increase the inductance as done in the v.f.o. (above) or the driver (discussed below) to bring the circuit to resonance on the proper frequency. If, after resonance on 160 is acheived, the output is low, increase the value of the input coupling capacitor (from the v.f.o.) or the output capacitor to driver.

Transmitter Driver

Modification of this stage of the DX-60 is accomplished by inserting a separate coil in series with the existing coil to add the additional inductance.

The new coil was #26 enameled wire close wound for 1¾ inches on a 5/8 diameter piece of dowel. The coil is mounted by force-fitting it between two shield plates, as shown in fig. 2. The coil is connected by breaking the connection between the band-switch and old coil, and connecting one end of the new coil to each. Some trial and error adjustment of the length may be required to bring resonance at the proper setting of the drive tune control.

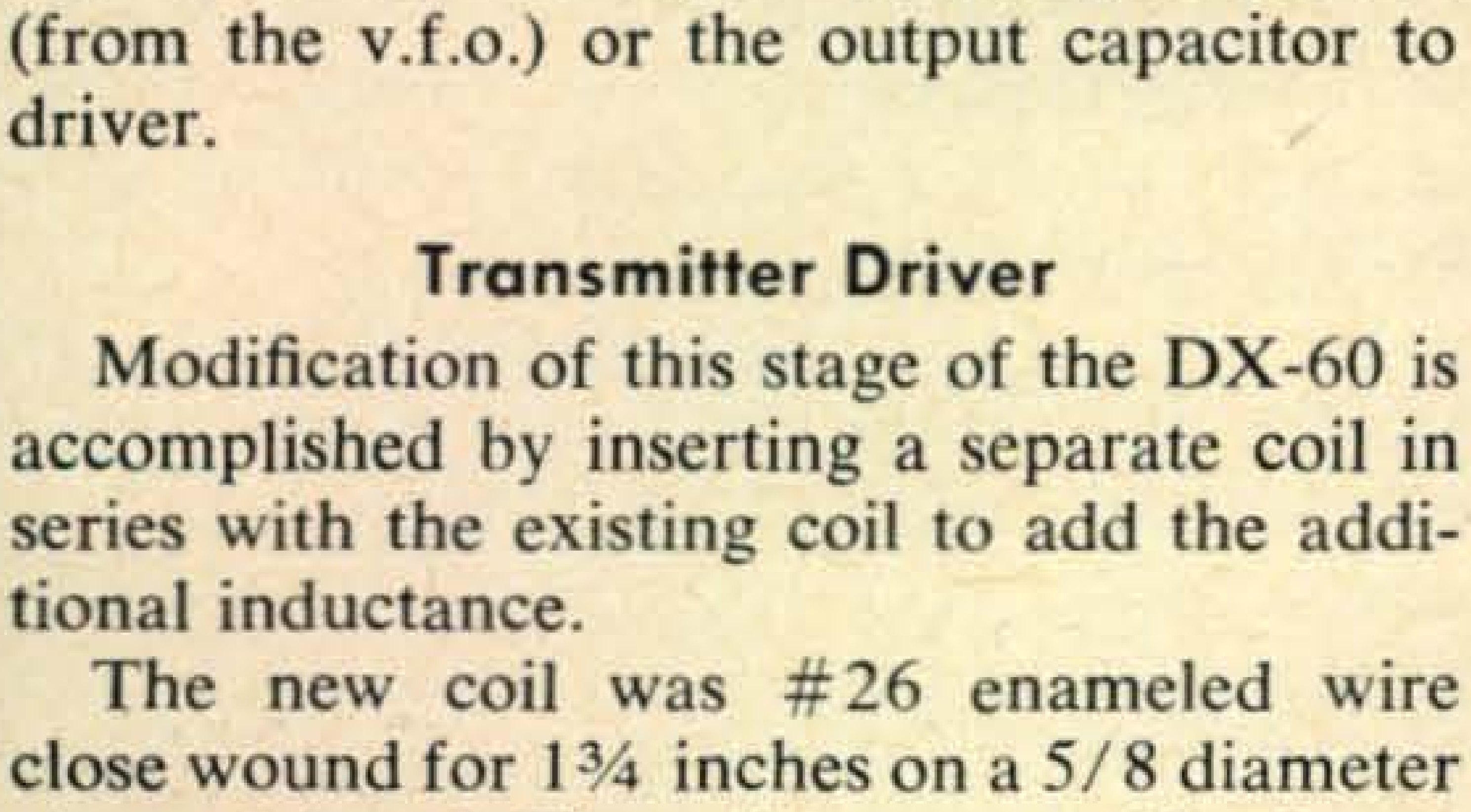


Fig. 5—Modified circuit of the DX-60 final. The value of the added capacitors across C_{22} and C_{24} are determined as described in the text.

Other transmitters can be modified either as above, by adding a separate coil, or as in the v.f.o., by winding over the old coil. Physical layout of the driver will dictate which is best. Refer to fig. 3 for wiring.

Final Amplifier

The first step in the modification of thet final amplifier is winding a new tank coil. The new coil for the DX-60 consists of 20 turns of #16 enameled wire wound evenly along a 2½ inch diameter cardboard form 2 inches long.

Disconnect the old tank coil from the insulator at the rear of the final cage. Slip the new coil over the old coil. Solder the 40 meter tap on the old coil to the front end of the new coil. The rear end of the new coil is then soldered to the insulator.

Now remove the ground lug from the top of the post type r.f. choke and mount a two lug terminal strip in its place. (Refer to fig. 4.) Replace the 0.001 mf capacitor with a 0.01 mf capacitor, connecting the end formerly connected to ground to one lug of the terminal strip. Connect a 2.5 ma choke between the lugs, and the lead from the post-type choke to the second lug of the strip. Also connect the parasitic choke to the first lug of the terminal strip. Finally, replace C_{23} (under chassis) with a 150 mmf capacitor. No modification of the loading control should be required. Loading for 90 watts should occur with the control set between 1 and 2 on the dial. (80 meters loaded between 3 and 4.)

To modify another transmitter, proceed as follows:

1) Estimate the total capacitance used for full-power resonance on 80 meters by adding the shunt capacitance to the value of the tuning capacitor multiplied by the fraction

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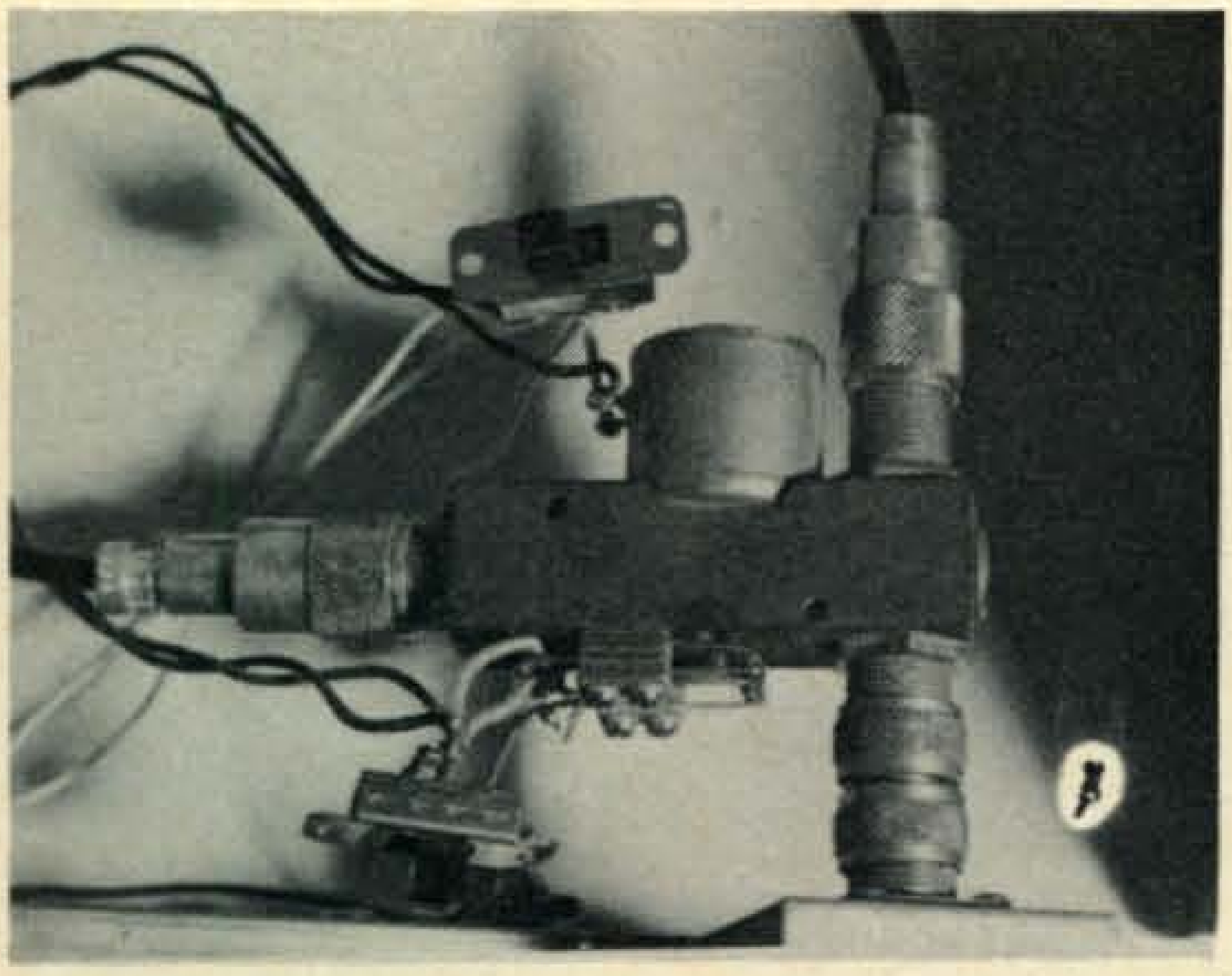

Coaxial relay assembly behind the DX-60. The upper slide switch is S_1 for c.w. or p.t.t. selection. lower switch, added for receiver muting, is not shown in any of the circuits.

of the amount it is closed. (Example: Shunt capacitance = 100 mmf. Tuning capacitor = 360 mmf, 2/3 closed. Total Capacitance = 100 + (2/3 × 360) = 340 mmf) Now add a shunt capacitance of 340 to bring the new total to twice this value, 680 mmf.

2) Observe the position of the loading control on 80 through 10 meters. Normally, it will follow a progression on the dial as the frequency is increased. If there seems to be enough room on the dial below the 80 meter position, chances are that no additional capacitance will be required. If not, estimate the value of the loading capactance at full power on 80 meters (as above), and add shunt capactance to double this value.

3) Wind a coil similar to the one described for the DX-60, and insert it in the circuit. Adjust its length to obtain proper tuning and loading.

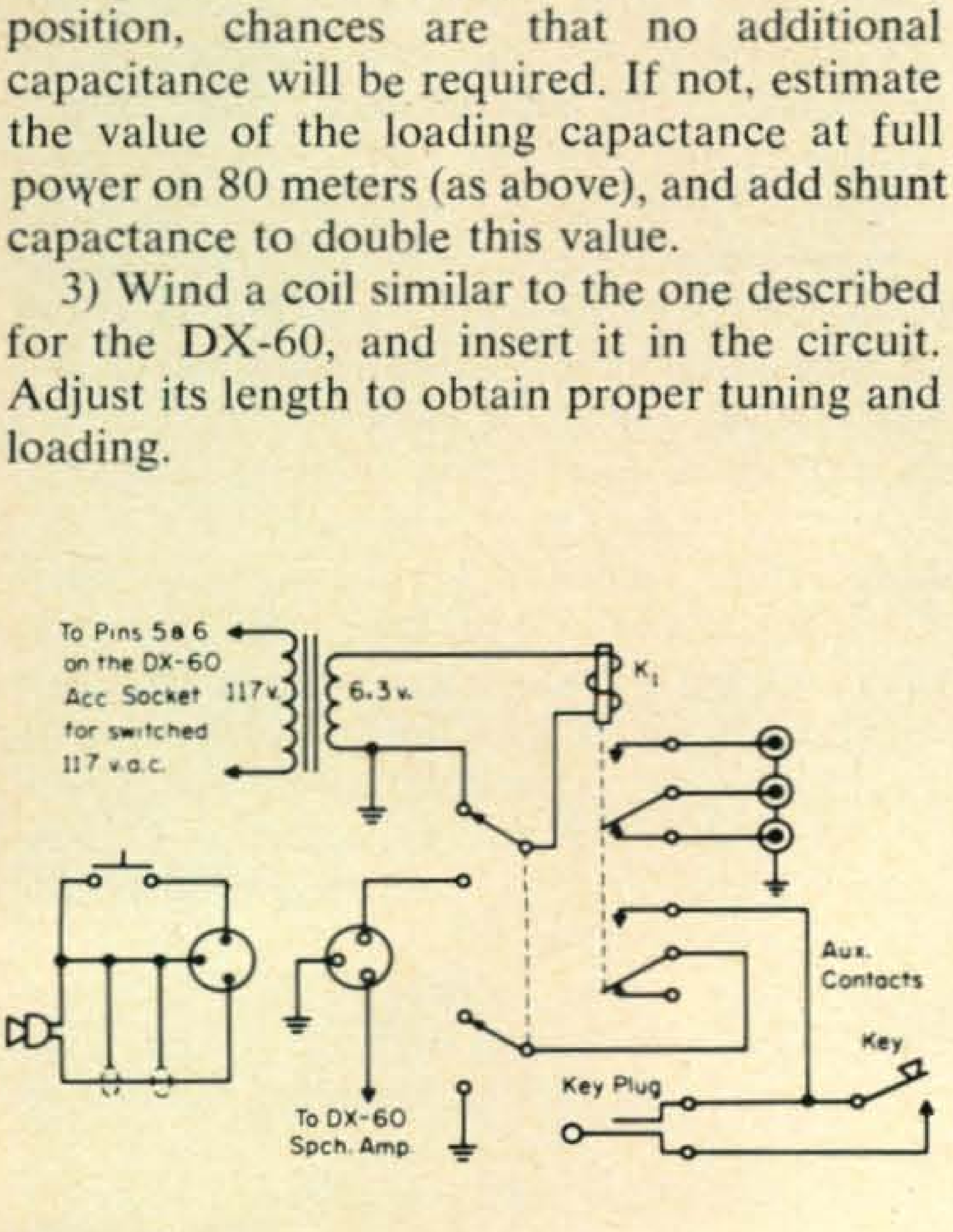

Fig. 6—P.t.t circuit added to the DX-60 Switch S_1 selects c.w. or p.t.t. operation with the DX-60 in the a.m. mode.

4) It is possible that the values of the coupling capacitor and/or blocking inductor will have to be increased, as in the DX-60. In general, twice the previous value should be sufficient.

Push-to-Talk

After having operated a v.o.x./p.t.t. transceiver, manual transmit switching on a.m. operation is likely to seem quite cumbersome. If the old coaxial relay is still available, a push-to-talk circuit can be easily connected.

The first (and most difficult) task is replacing the old microphone connector with a connector suitable for your p.t.t. mike. In the DX-60, this required removing the front panel, and separately punching a larger hole in both it and the chassis.

Wire the relay according to fig. 6. The switch S_1 (an economy slide switch) can be mounted by using short, heavy wire to connect it to the relay.

A.m. p.t.t. operation is accomplished by setting the DX-60 function switch to AM and S_1 to P.T.T. Depressing the p.t.t. button on the microphone keys the relay, which in turn keys the transmitter.

Wire the circuit shown in fig. 6. Note that the DX-60 operated the coaxial antenna relay by switching the 117 v.a.c. line feed. The circuit of the fig. 6 requires a 6 v.a.c. relay and with some types of antenna relays this changeover can be accomplished simply by changing coils. If this cannot be done, acquire a 6 volt coaxial relay. Do *not* eliminate the step down transformer, T_1, and use the 117 v.a.c. relay as this grounds one side of the a.c. line to the chassis and can create the extremely hazardous condition of placing the chassis of the equipment 117 v.a.c. above ground or at least cause you to blow out line fuses.

Operation

Operation of the transmitter on 160 is the same as it was before on the higher frequencies. A c.w. monitor (and frequency meter) is readily obtainable by tuning the s.s.b. transceiver to the 80 meter harmonic of the 160 meter signal.

The author has used the transmitter for several months and has had no problems with instability, key clicks, chirp, *etc*. The rig puts out a good signal, as verified by both a light bulb and many QSO's from all parts of the country. ■

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ANTENNA ADJUSTMENT, THE EASY WAY

BY WILLIAM R. HOLLY,* WA1HDP

I CHANGED the tap on the loading coil and climbed down the ladder from the roof for the fourteenth time in the past hour, dragged myself through the house to the shack and keyed the transmitter. The s.w.r. bridge needle hadn't budged a single millimeter. As I contemplated taking up something less strenuous than amateur radio, mountain climbing for instance, it suddenly occurred to me that what I needed was a remote keying circuit for the transmitter.

A little rummaging in the junk box yielded all the parts necessary. I mounted a normally off s.p.s.t. push button switch on the lid of a plastic pill bottle, drilled a hole through the bottom of the bottle, and pulled some lamp cord through. I knotted the cord and connected the leads to the switch and snapped the cover on. At the transmitter end I connected the lamp cord in series with the coil of a 110 v.a.c. s.p.d.t. relay and a line plug. All that remained was to wire the transmitter key across the contacts of the relay, take the s.w.r. bridge and the keying line out to the base of the antenna and start adjusting at my leisure. Typical switch and relay wiring is shown in fig. 1.

If you don't wish to relocate the s.w.r. bridge, the meter can be removed from the case and extended, using lamp cord, so that immediate indications are possible.

Of course, if the run from your shack to the base of the antenna is very short or you have sufficient voltage in the keying circuit, you could dispense with the relay altogether and key the transmitter directly. Also, a 6 or 12 v.d.c. relay with battery or d.c. power from the station receiver or transmitter could be easily substituted for the a.c. relay.

Another possibility, if you have a second coaxial feed line terminating at an antenna near the one being adjusted, is to wire coax connectors to your pill box switch and the relay and use the coax as your keying line. If using this latter method with 117 v.a.c. be sure to wire a neon pilot lamp from the shielded braid of the coax to ground. When you plug in the relay lamp glows if the braid and connectors are on the hot side of the AC line. Reverse the line plug in the socket and the braid and connectors will now be on the ground return side and the hot lead will be on the center conductor of the coax. See figures 1 and 2 for details of the various circuits.

Installing, adjusting, and maintaining the antenna will probably always be the bane of the ham's existance but this simple idea will enable one to spend less time adjusting and more time operating. ■

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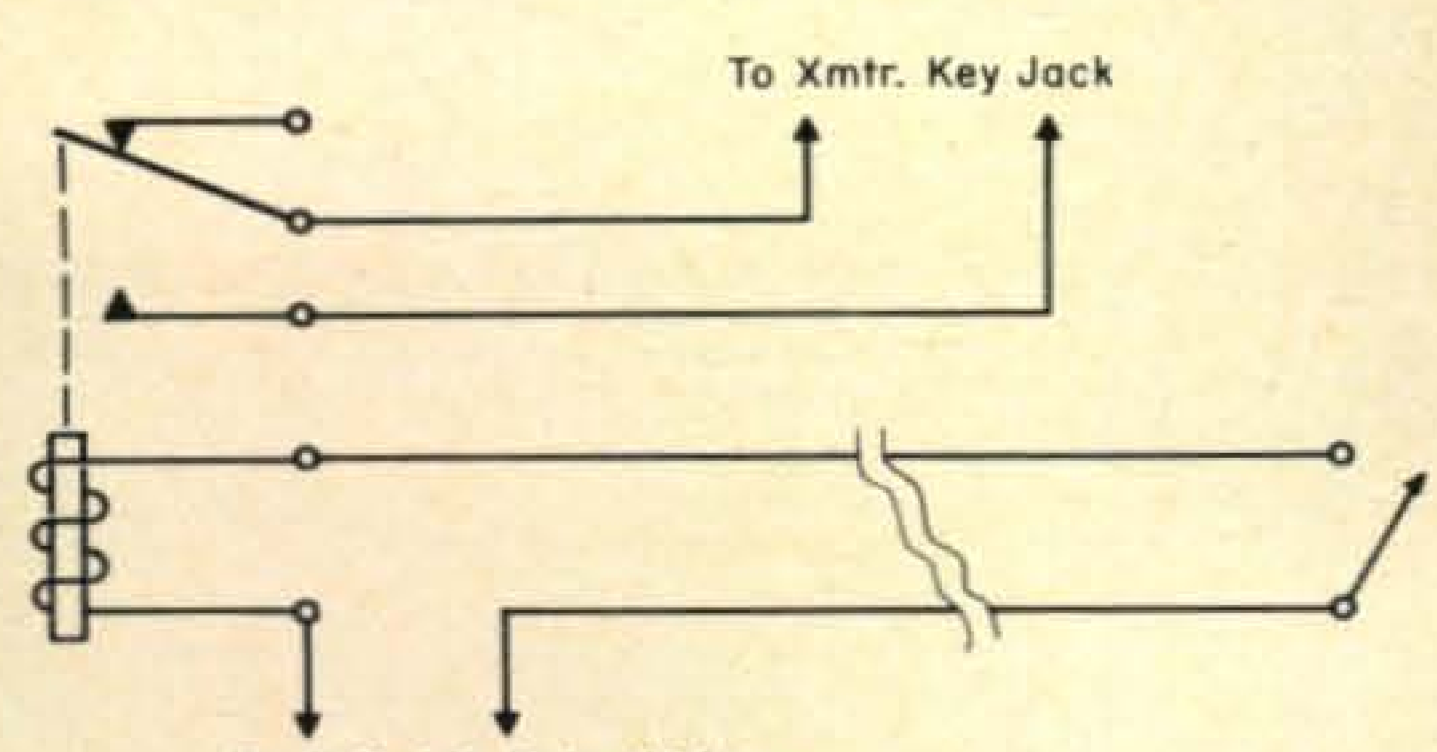

Fig. 1—Simple relay arrangement used to key the transmitter from a remote location.

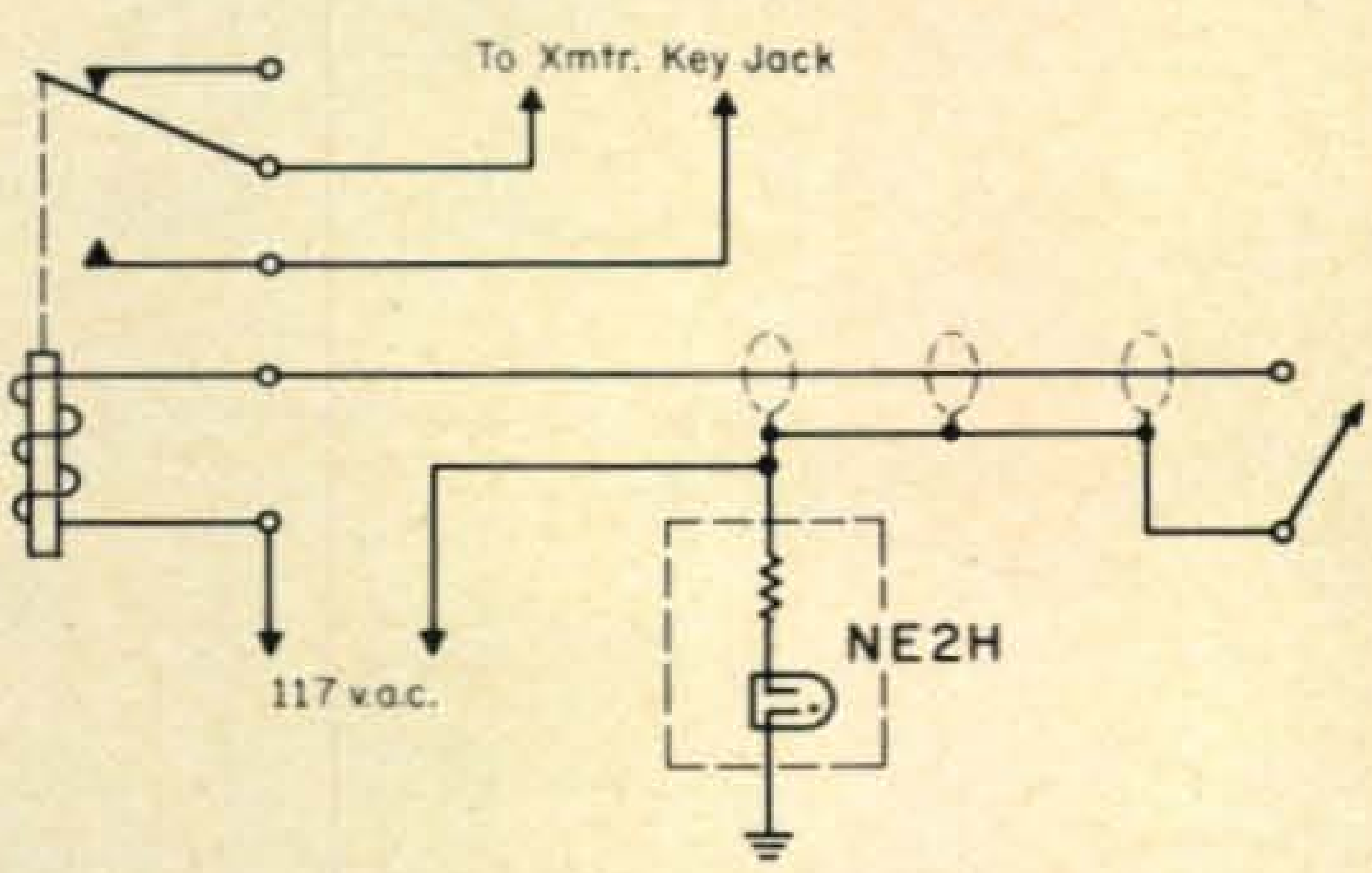

Fig. 2—Use of an existing coax feed line to control the keying relay. If 117 v.a.c. is used as shown, the braid must be on the cold side (ground) of the line. If the NE-2 lights, reverse the plug. The NE-2H comes complete with the resistor. If an NE-2 bulb is used, a 100K resistor is needed.

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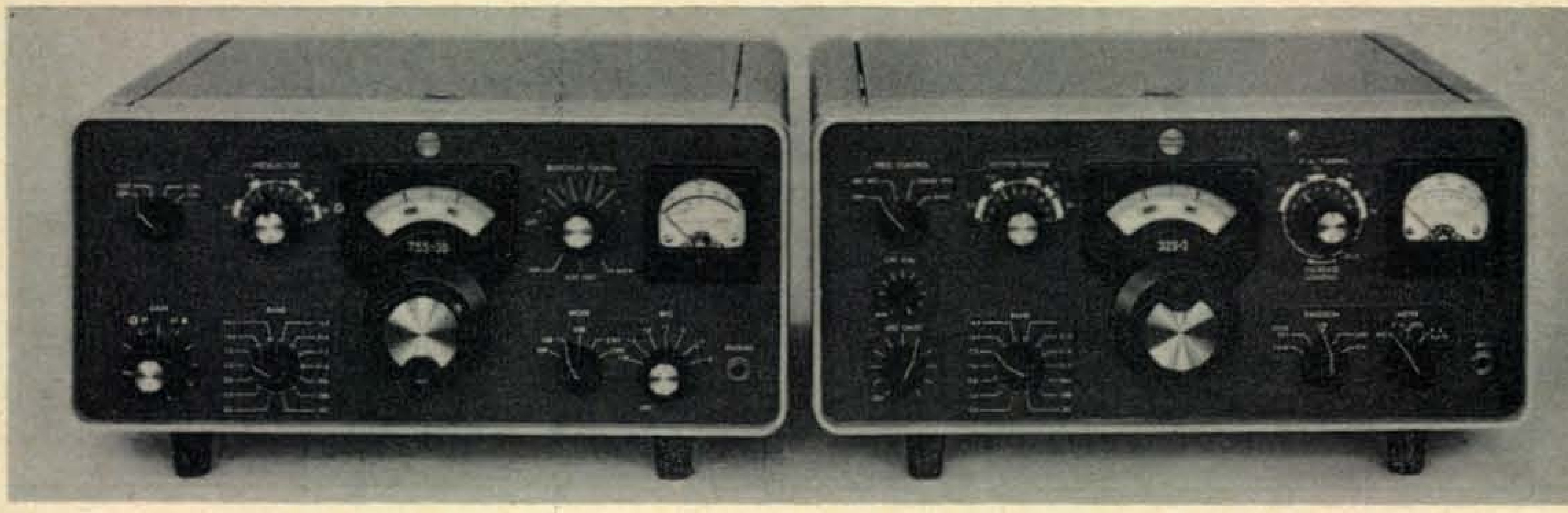

Two units in the Collins S-Line, the 75S-3B receiver at the left and 32S-3 transmitter at the right.

CQ Reviews:

The Collins S-Line

BY WILFRED M. SCHERER,* W2AEF

It has been ten years to the month since *CQ* last looked at the venerable Collins S-Line equipment. When last examined, the S-Line represented a fairly radical departure from the usual equipment then available. In the intervening years, much equipment has come and gone from the amateur scene, but only the S-Line remains intact, although greatly refined from its original design. The years have seen much growth in the quality and upgrading of all amateur gear, but still the S-Line maintains its popularity and esteem. What is there about it? What is the mystique that make the Collins label so desirable... or is it mystique? For the benefit of those who would like to know more about this fine equipment, and what the buyer gets for his money, this review is presented.

There are special features in this equipment that were originally developed or pioneered by Collins for the attainment of a high order of frequency stability, calibration and readout, as well as r.f. and i.f. selectivity. These, along with soundly engineered design principles, have largely contributed to the success of much of the present-day equipment in meeting the special needs for more sophisticated gear required for the now generalized use of s.s.b.

*Technical Director, *CQ*.

The Collins S-Line includes the 75S-3B amateur-band receiver and 32S-3 transmitter with 100 watts output for operation with s.s.b., c.w., a.m. or RTTY. The equipment also may be operated elsewhere in the 3.4-30 mc range. Rather than go into a listing of the various facilities included therein, we'll leave these to be found in the following descriptions which cover as many of the salient details as space permits.

75S-3B Receiver

As shown at the block diagram, fig. 1, double conversion is used in the receiver with a tunable 1st i.f. of 3155-2955 kc and a fixed i.f. of 455 kc. The h.f. heterodyning oscillator for the first conversion is crystal-controlled, while that for the 2nd conversion is a v.f.o. which has a tuning range of 200 kc. As a consequence, the receiver frequency range is covered in band segments of 200 kc each. The particular segment is determined by the frequency of the crystal switched in at the first conversion oscillator.

The heterodyning frequency is 3155 kc *plus* the frequency desired at the low end of the desired 200 kc segment. For example: the 3800-4000 kc segment requires a heterodyning frequency of 3800+3155 kc=6955 kc. A 3155-2955 kc i.f. is then produced by input

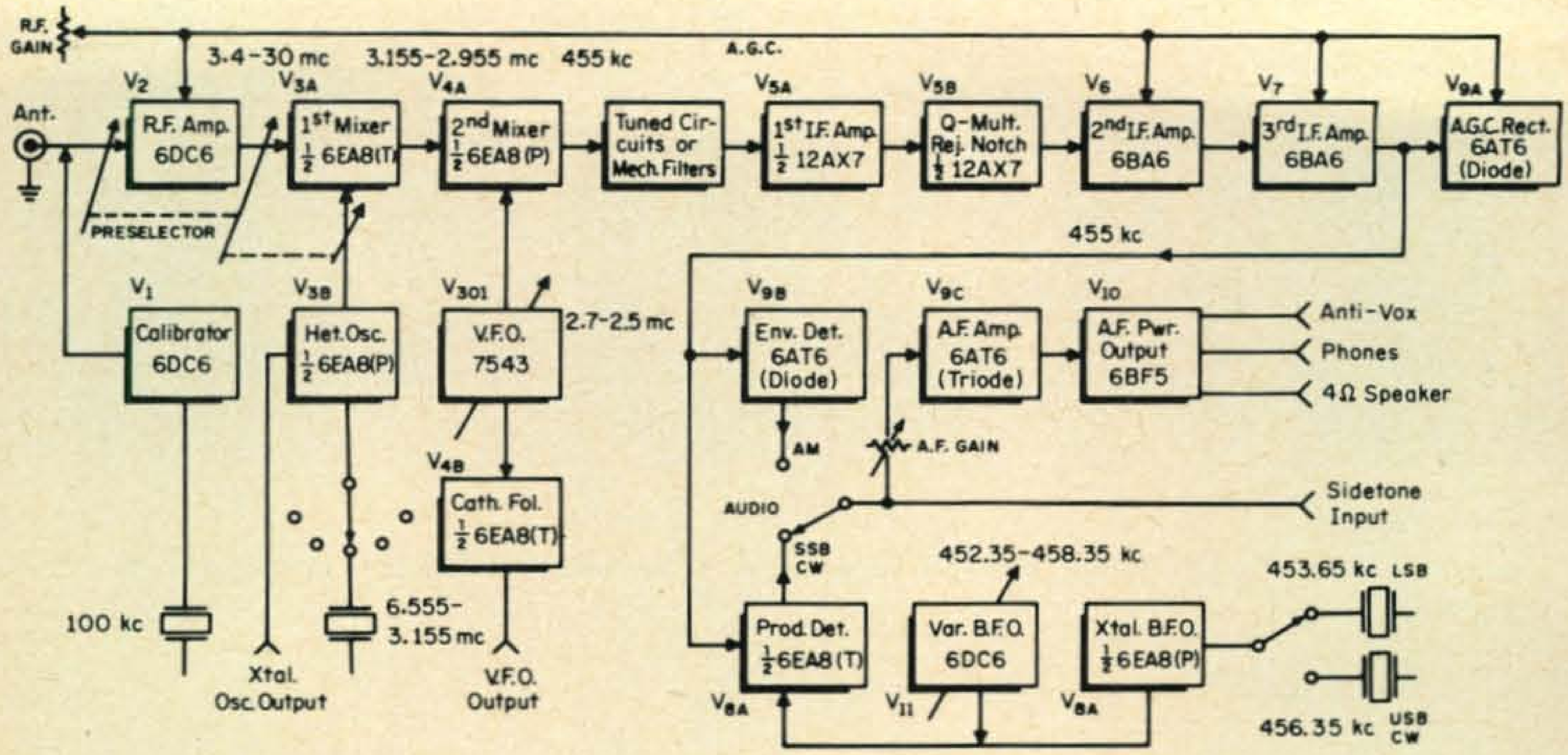

Fig. 1—Block diagram for the 75S-3B receiver. See text for special details. Extremes of the v.f.o. range are 1.35 kc higher for l.s.b., and 1.35 kc lower for u.s.b. Tuned circuits are used in place of mechanical filters for 5 kc b.w. on a.m. Mechanical filters are 2.1 kc for s.s.b., 200 or 500 c.p.s. for c.w.

signals of 3800-4000 kc (6955−3800 kc= 3155 kc, and 6955−4000 kc=2955 kc).

There are 14 crystal positions providing coverage of 3.4-3.6, 3.6-3.8, 3.8-4.0, 7.0-7.2, 7.2-7.4, 14.0-14.2, 14.2-14.4, 14.8-15.0 (for WWV), 21.0-21.2, 21.2-21.4, 21.4-21.6, 28.5-28.7 mc, plus two spares for other 10-meter band segments. Crystals for all 12 ranges are supplied with the set. By substituting other crystals, different segments may be obtained in the 3.4-5.0 and 6.5-30 mc spectrum. On bands above 12 mc the oscillator frequencies are doubled, so the crystal frequencies then are half the required heterodyning frequencies.

The v.f.o. range is 2700-2500 kc, which with the i.f. input of 3155-2955 kc at the 2nd mixer produces the 2nd i.f. of 455 kc (3155 −2700 kc=455 kc, and 2955−2500 kc= 455 kc). A 3155-2955 kc bandpass circuit is used between the two mixers.

Selectivity is obtained at the 2nd i.f. Four different degrees of bandwidth may be selected. For a.m. a bandpass of 5 kc is provided using transformer coupling throughout. Mechanical filters with sharp skirt selectivity are used at the i.f. input for other bandwidths.

The receiver is supplied with a 2.1 kc job that has a 2:1 shape factor. Optional mechanical filters may be installed at two other selectivity positions for individual bandwidths of 200, 500, 800, 1500, 3100, 4000 and 6000 c.p.s. Thus, the selectivity can be optimized for any mode of operation—c.w., RTTY, s.s.b. or a.m.

To further enhance selectivity and combat certain interference situations, a variable rejection-notch filter also is used at the 2nd i.f. This filter is a *Q*-multiplier which is an active element that provides a very high-*Q* setup which produces a deep and narrow slot.[1]

A diode envelope detector is used for a.m. and a single triode product detector for c.w., s.s.b. or RTTY. There are two b.f.o.'s. One is crystal-controlled with either of two crystals, 2.7 kc apart, that may be switched to allow l.s.b. or u.s.b. reception with s.s.b. on any band. When sidebands are thus changed, a diode switch simultaneously cuts in or out a padder in the v.f.o. that likewise shifts the v.f.o. frequency 2.7 kc and thus avoids the need for manually retuning the v.f.o. in either case.

The other b.f.o. is a self-excited tunable affair that permits the optimization of a beat note for various needs with c.w. or RTTY reception. It is tuned by means of a variable-capacitance diode as shown at fig. 2.

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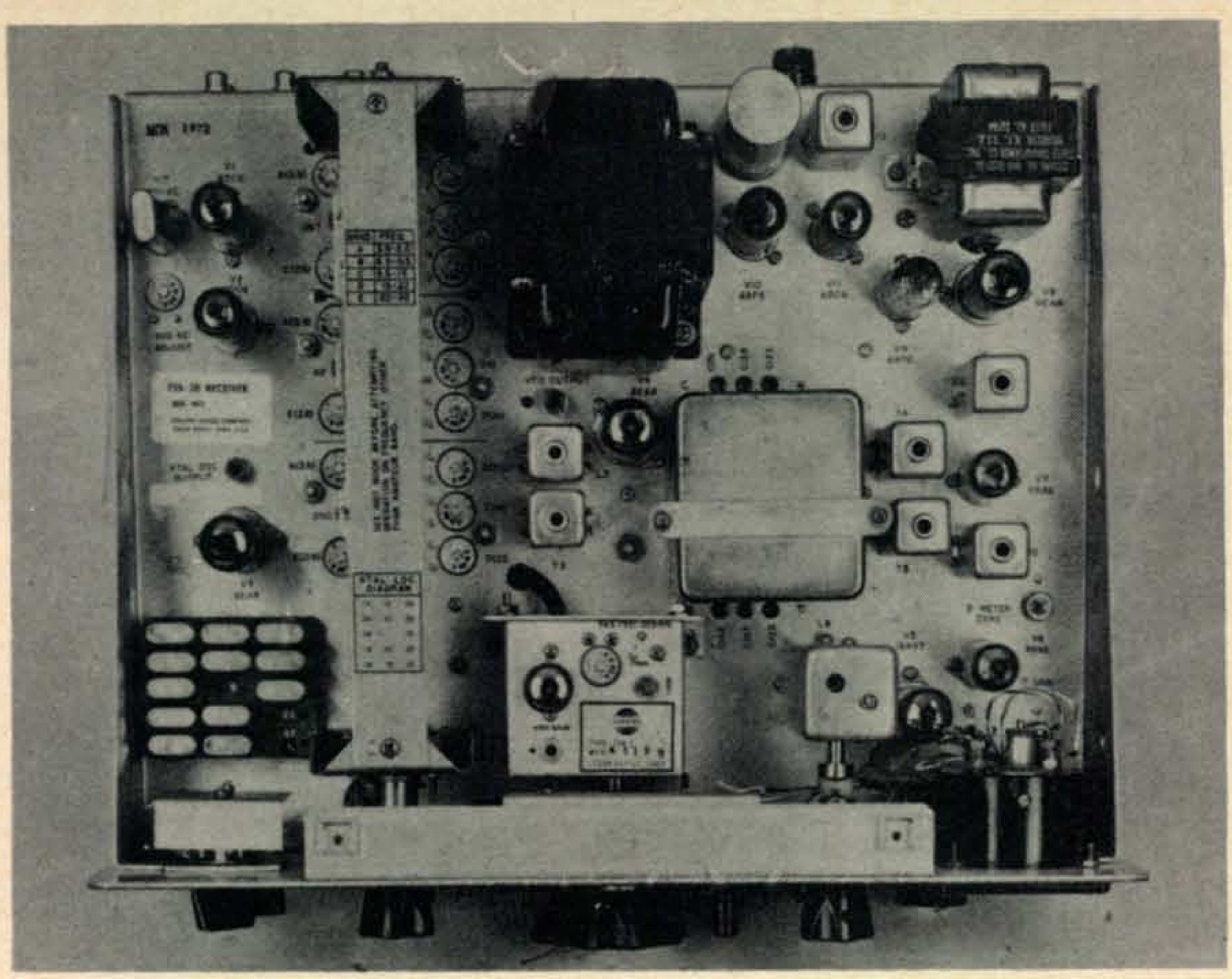
[1]The principle of *Q*-multiplier operation may be found by reference to:

Villard & Rorden, 'Flexible Selectivity for Communications Receivers", *Electronics,* Apr. 1952, page 138.

Chaplin, "Flexible I.F. Channel Selectivity", *CQ,* Oct. 1953, page 31.

Scherer, "*Q*-Multiplier". *CQ,* Jan. 1955, page 11.



Top view of the 75S-3B receiver. The h.f. heterodyning crystals plug into the board at the lower left. The v.f.o. is at lower center. The small square can at the right of it is the Q-multiplier notch filter. A box shield covers the mechanical-filter positions at the right of middle center. The long bracket, seen vertically at the left, supports the rack used for gang-tuning the preselector inductor cores.

A.g.c. is obtained from a diode rectifier and is a delayed system (for weak signals) with a choice of a fast or slow release. The r.f. gain controls a d.c. bias applied to the a.g.c. line. Muting is handled by a blocking bias.

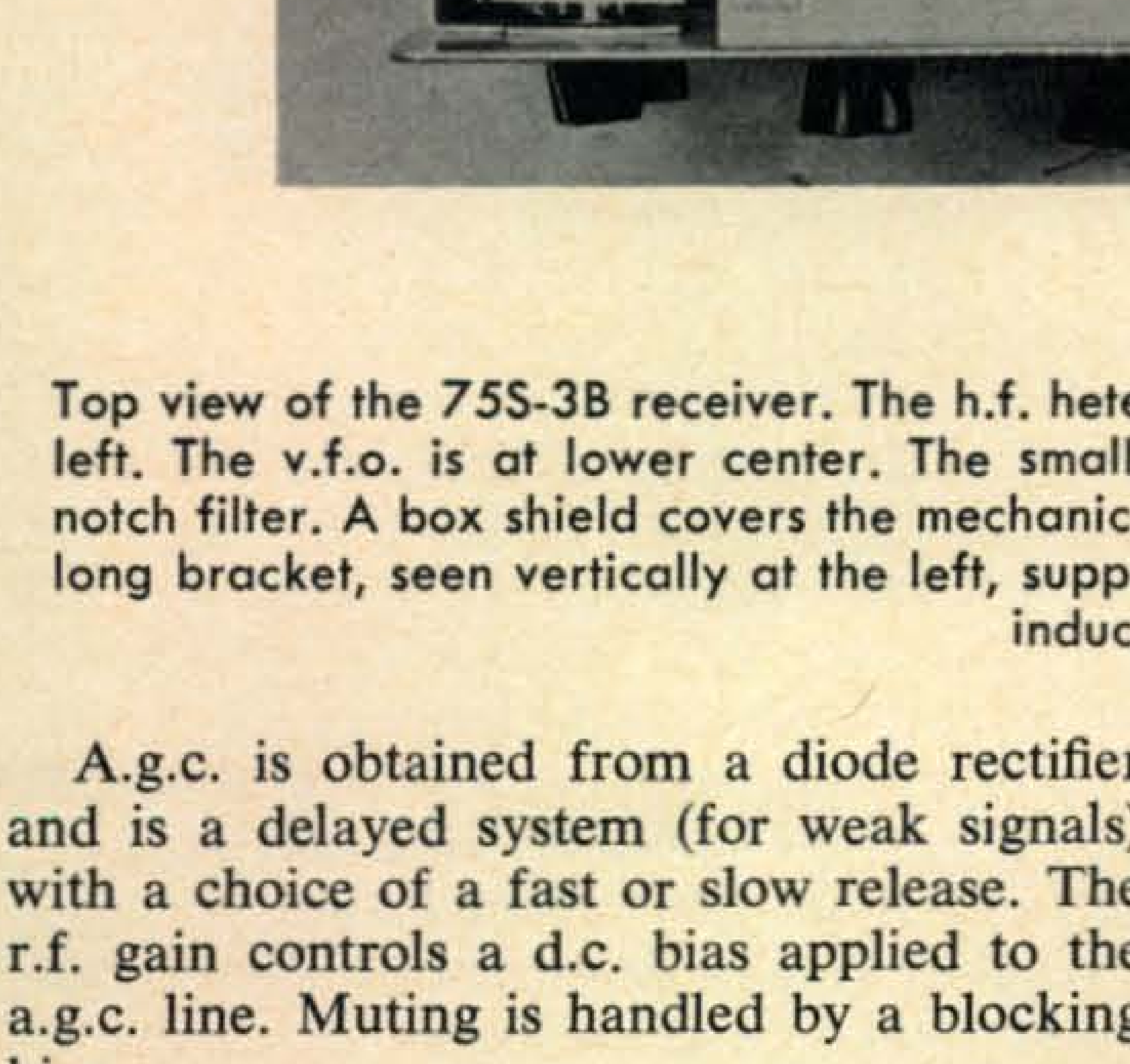


Fig. 2—Setup for the variable b.f.o. in the 75S-3B. It is tuned by the variable-capacitance diode, D_1. The diode's capacitance is controlled by a d.c. bias varied with R_1. The bias-supply voltage is held constant by Zener diode, D_2, operating from the +140 v. regulated line. A scale at the b.f.o. control is calibrated in 1 kc steps with special points indicated as initial references for RTTY.

The a.f. amplifier setup has a 4-ohm output for a loudspeaker, a higher-impedance one for headphones and 500-ohms for other needs such as anti-vox for the transmitter. A jack is provided for feeding a sidetone-monitor signal from the transmitter to the a.f. amplifier input.

A unique arrangement is that when the selectivity switch is at one of the c.w.-filter positions, it cuts in a capacitor across the a.f. amplifier input which reduces the nominal upper limit of the a.f. response from 3 kc down to 1.5 kc, thereby minimizing background noise.

Silicon-diode rectifiers are used in the power supply which furnishes potentials of 140 and 190 volts, plus a zener-regulated 140 volts for the oscillators. The use of comparatively low voltages minimizes power consumption and heating and places less stress on components.

Special Features

Among the original special features, to be found in the 75S-3B is the tuning concept associated with the conversion scheme.

Double conversion has been used as far back as the late '20's for the attainment of

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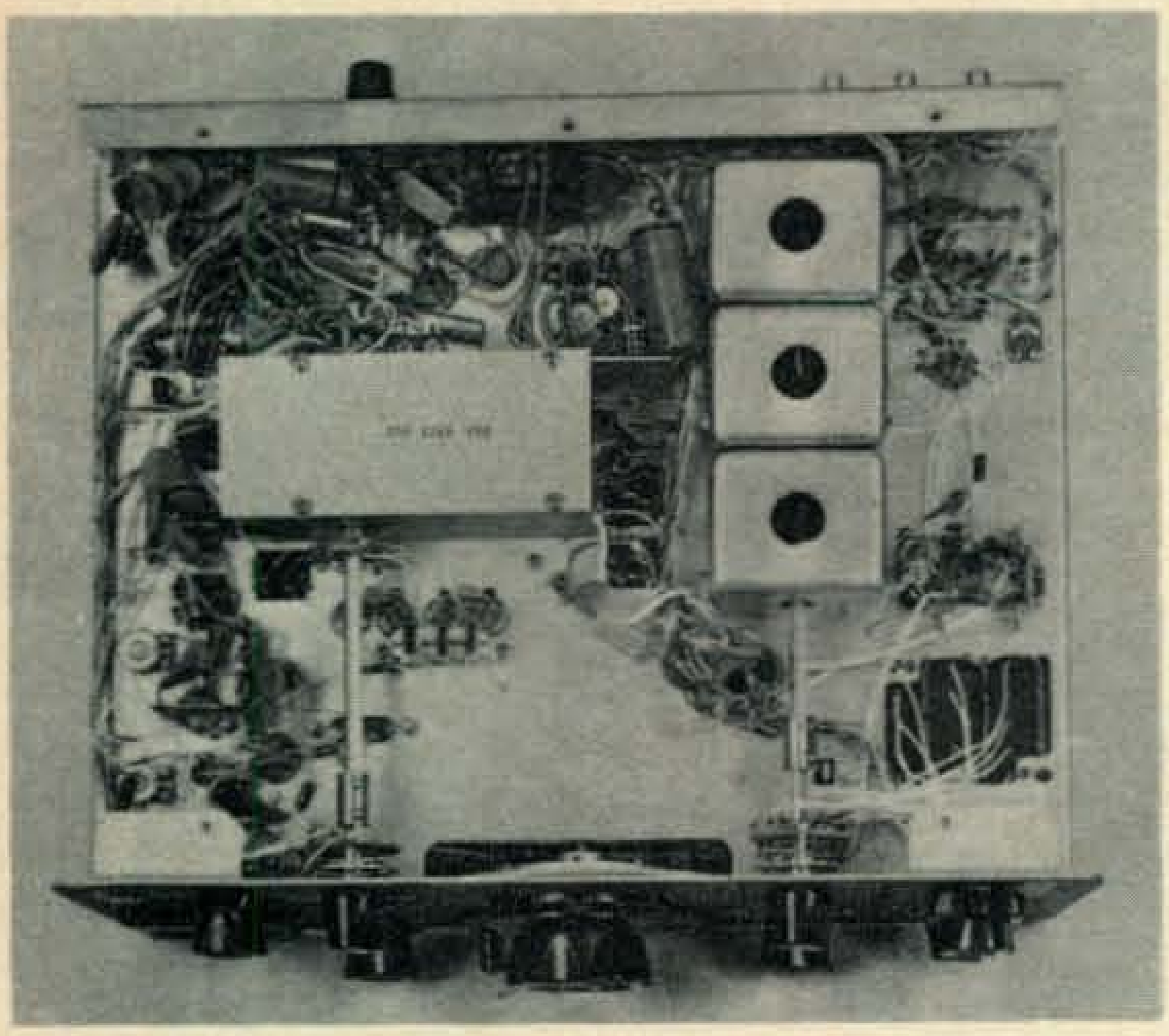
high image rejection with an h.f. 1st i.f. and high selectivity with an l.f. 2nd i.f., but as far as we know, Collins was the first to commercially employ a tunable or variable 1st i.f. where a variable heterodyning oscillator is used at the second-conversion mixer, rather than at the first-mixer. This allows the v.f.o. to be operated at a comparatively low frequencies where frequency stability can be attained more readily than at the higher frequency that would be required if the v.f.o. were used at the first-mixer, particularly on the higher frequency bands.

Furthermore, the v.f.o. always functions on one single frequency range, providing the same tuning rate and incremental calibrations for all bands.

The various band segments are selected by switching in different crystals at the first-conversion oscillator as previously described. The use of crystals here contributes to the overall stability of the equipment.

A Collins development that further contributes toward high stability is the v.f.o. itself. This is a permeability-tuned oscillator; that is, the frequency is varied by moving a powered-iron core in or out of the oscillator inductor and accordingly changing the circuit inductance and frequency, rather than by tuning the tank with a variable capacitance. This reduces the required number of turns for the inductor and enables a high *Q* to be had. This, along with high-fixed capacitance, aids stability.

Capacitance tuning, on the other hand, usually is a lower-*Q* system and may be more subject to the effects of temperature or humidity changes that affect the capacitor elements or the dialectric between the capacitor plates. Also, microphones are often experienced with capacitor tuning.



Bottom view of the 75S-3B.

In the permeability-tuned oscillator (p.t.o.) the winding pitch of the inductor can be precisely adjusted at the time of manufacture so that the frequency tuning varies at a linear rate in accordance with the rate of travel for the core, making it possible to provide uniform and accurate calibrations which in this case are in 1 kc steps.

Another system introduced by Collins into commercial communication receivers, in a way now widely used in amateur gear, is "preselector tuning" whereby the r.f. circuits are tuned or peaked separately from the frequency tuning[2], permitting superior front-end performance without the problems of range switching, alignment and tracking with the oscillator. Here too, the Collins gear employs permeability tuning, providing a hi-*Q* that improves front-end selectivity. More uniform gain is also realized over the entire tuning range.

The cores of the inductors for the various circuits and ranges are ganged together to one control. On the 75S-3B, five ranges are automatically switched, as needed, by the heterodyning-crystal selector to provide r.f. tuning anywhere over the range of 3.4-30 mc. The crystal-oscillator output is also tuned, with frequency doubling used for injection frequencies on bands above 12 mc.

Another Collins development is the mechanical filter. Its principle of operation is based on "magnostriction", a detailed explanation of which along with a description of the filter will be found elsewhere.[3]

The attributes of the mechanical filter are that it can be fabricated with uniform and steep skirt selectivity, with a minimum amount of passband ripple and with shape factors approaching that of the ideal filter. It is a stable device, requires no tuning adjustments and is very small in size.

It also is worthy to note that the first use of a *Q*-multiplier rejection-notch filter in manufacturered gear was made in one of the earlier Collins receivers.

[2]In the early days of the superterodyne receiver and before the advent of the ganged variable capacitor, r.f. circuits were individually tuned independently of the oscillator tuning. Later on, outboard manually-tuned r.f. pre-amplifiers were used by amateurs not only for adding gain to soup up a receiver, but also as a pre-selector for improving image rejection.

[3]Roberts, "Mechanical Bandpass Filters for I.F. Ranges", *QST*, Feb. 1953, page 23.

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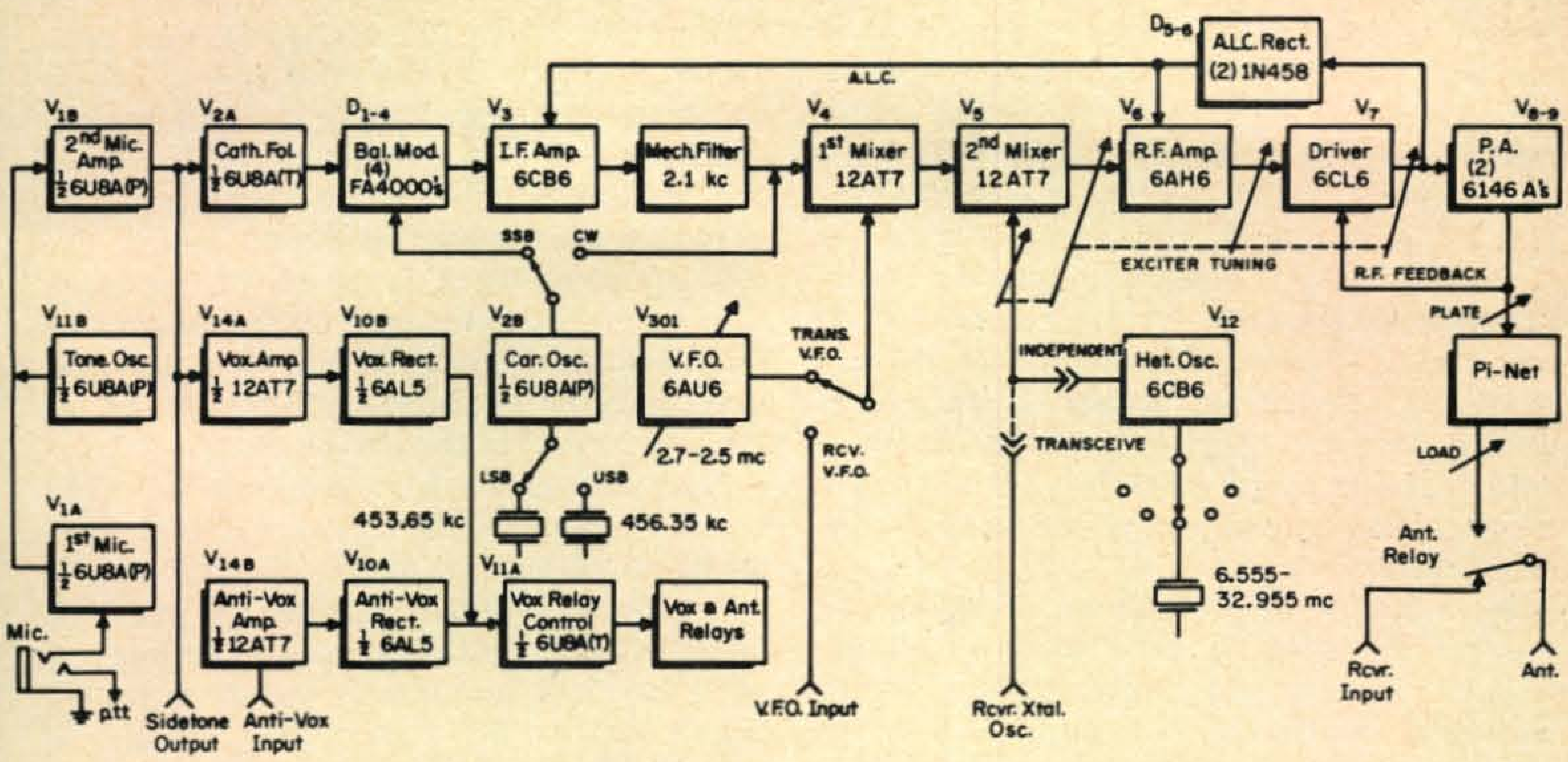

Fig. 3—Block diagram for the 32S-3 transmitter. The 6146A tubes in the p.a. operate in class AB_1.

32S-3 Transmitter

A block diagram for the 32S-3 transmitter is shown at fig. 3. The conversion scheme is the same as that used in the 75S-3B receiver, but the sequence is in reverse. The s.s.b. signal is generated at 455 kc with the 1st conversion made to 3155-2955 kc in conjunction with the v.f.o. The 2nd conversion is made to the 3.4-30 mc output frequencies in conjunction with the crystal-controlled oscillator frequencies. Sidebands are switched in the same manner as described for the receiver.

The balanced modulator is a ring type that employs four silicon diodes. Not usually incorporated in amateur equipment, but used here are balanced mixers for both conversions. In each case these suppress the oscillator-injection signals, thus minimizing the possibility of certain spurious-output responses.

The 1st mixer employes two triodes with the s.s.b. signal fed to the grids in push-pull. The v.f.o. signal is fed to the grids in parallel. The triode plates operate in push-pull. Two triodes also are used at the 2nd mixer with the i.f. signal fed to the grid of one triode, while the h.f.-oscillator signal is fed to both the cathode of this triode and the grid of the other one. The triode plates are connected in parallel.

Both the driver and the p.a. are individually neutralized. A feature here that ensures better linearity and low distortion-product levels, as will be noted later, is that r.f. feedback is used from the p.a. output back to the driver cathode as shown at fig. 4.

A Pi-network is used at the p.a. output with an adjustable loading control for matching to loads of 30-80 ohms with a maximum s.w.r. of 2:1. Permeability tuning is utilized at the low-power stages with all the inductor cores ganged together to provide "exciter" tuning in the same way as preselector tuning is used in the receiver. A bandpass-coupling setup is likewise installed between the mixers for the 3155-2955 kc i.f.

A.l.c. voltage is obtained in the usual manner by rectifying an a.f. component (during

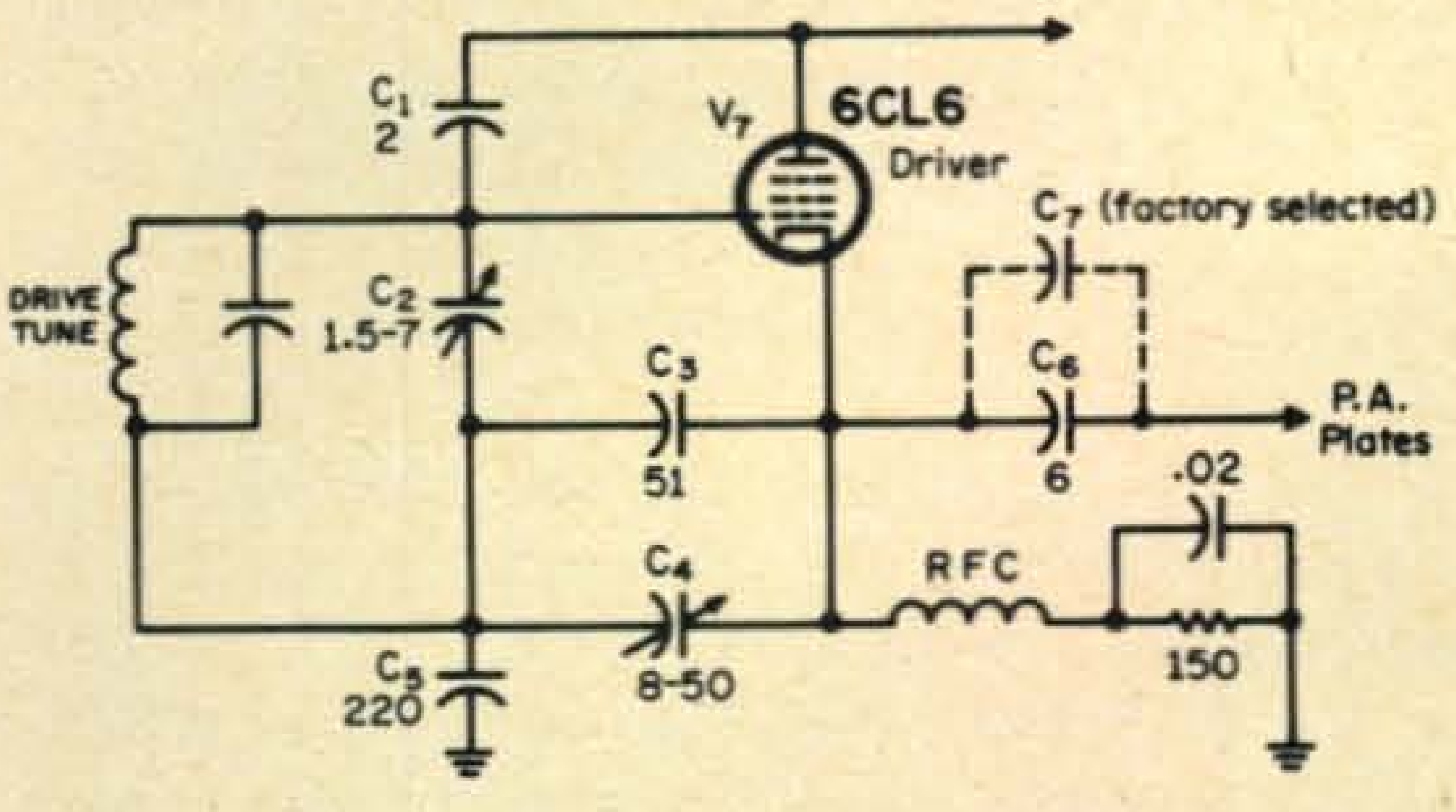

Fig. 4—R.f. feedback circuit used in the 32S-3. R.f. output from the p.a. plates is fed back to the driver (V_7) cathode through a dividing network consisting of C_3, C_4, C_5, & C_6. The proper voltage and phase relationships at set by C_4 for coincidence of p.a. grid-current dip with plate-current dip at resonance. C_1, C_2 & C_5 comprise the neutralizing circuit for the driver. Unrelated driver circuitry is not shown.

modulation) from the grid return of the p.a., caused as soon as overdrive or grid current tends to set in. Fast-attack and slow-release time constants prevent overdrive on initial syllables and hold the gain constant between words. The fast a.l.c. voltage is applied to V_6 (1st r.f. amp.), while the slow one controls V_3 (455 kc amp.). This setup, plus the application of a.l.c. to *two* stages, instead of only one, results in better-than-usual a.l.c. performance as attested by the performance data given later. A jack also provided for a.l.c. voltage from a linear amplifier. The degree of a.l.c. or compression is indicated in db on the panel meter.

Push-to-talk or built-in v.o.x. operation may be had using typical circuitry which includes an antenna-changeover relay. A handy feature is that the v.o.x. controls are easily accessible when the cabinet cover is lifted, and the controls are equipped with small knobs. No inconvenient screw-driver-adjust controls are involved. The p.t.t. circuit may be operated by a button on the microphone through the mic jack, or by a separate control, such as a footswitch, plugged into a jack at the rear of the unit.

For c.w. operation or tuneup an EMISSION switch disconnects the carrier-oscillator output from the balanced modulator and applies it directly to the signal input of the 1st mixer, thus bypassing the modulator and the mechanical filter. The l.s.b. crystal is used during these modes.

The r.f. is keyed at the 2nd mixer using the grid-block method. The power circuits and the antenna relay are actuated by the v.o.x. relay the control tube for which is keyed by the signal from a sidetone oscillator which operates at a frequency of about 750 c.p.s. The a.f. oscillator runs continuously and its output is fed to the 2nd a.f. amplifier which is keyed on and off simultaneously with the 2nd mixer.

The time constants on the blocking-bias line are such that the a.f. amplifier keying is accomplished with a fast attack, while that for the 2nd mixer has a slower attack. When the key is closed, the a.f. amplifier, and hence the v.o.x., are actuated with a fast rise time slightly before the mixer for which the rise is a bit slower. The release times for both stages is about the same.

The overall result is one that provides sharp sidetone keying and fast pickup of the antenna relay plus shaping of the r.f. signal for minimizing key clicks. In addition, a variable resistor makes it possible for the operator to adjust the r.f.-keying time constants, primarily on the release, to enable a choice to be made at will between various degrees of hard or soft keying. This control is accessible next to the v.o.x. controls.

A jack on the rear of the set goes to the a.f.-amplifier output to enable the sidetone signal to be fed to the receiver for monitoring with headphones or a speaker. The sidetone level may be individually adjusted by an internal control in the transmitter.

Operating power for the transmitter must be obtained externally for which the requirements are: 800 v.d.c. at 230 ma (p.a. plates); 275 v.d.c. at 190 ma (p.a. screens and low-power stages); negative bias adjustable for −50 to −90 v.d.c.; plus any of the following heater sources: 6.3 v.a.c. at 6 a., 6 v.d.c. at 6 a., 12-14 v.d.c. at 3 a., 24-28 v.d.c. at 1.5 a. These potentials are available from Collins power supplies 516F-2 (for 115/230 v.a.c. 50/400 c.p.s.), MP-1 (for 12 v.d.c.) and 516E (for 24 v.d.c.).

A preventive measure in the transmitter against accidental bodily shock is a mechanical grounding switch that short-circuits the h.v. line when the p.a. enclosure cover is removed. This quickly discharges the filter capacitors and maintains the short on the line should high voltage otherwise be present.

Transceiver Operation

Jacks are provided on both the 75S-3B receiver and the 32S-3 transmitter to enable the transmitter frequency to be controlled by the receiver v.f.o. and heterodyning crystals, thus allowing on-frequency transceive-type operation instead of independent frequency control of each unit.

Facilities also are provided through jacks on both units to enable 50 and 144 mc operation with a v.h.f. receiving/transmitting converter, the Collins Model 62S-1.

Construction

The fine construction and workmanship found in the Collins gear, along with its refinements and excellent performance (as well as the cost) have instilled many to call it the Cadillac of amateur equipment. While this may be a matter of personal opinion, there does appear to be something about this equipment that makes one feel he is handling a product that bespeaks of rich quality.

The light-weight aluminum, yet rugged, perforated cabinets have a flawless baked-

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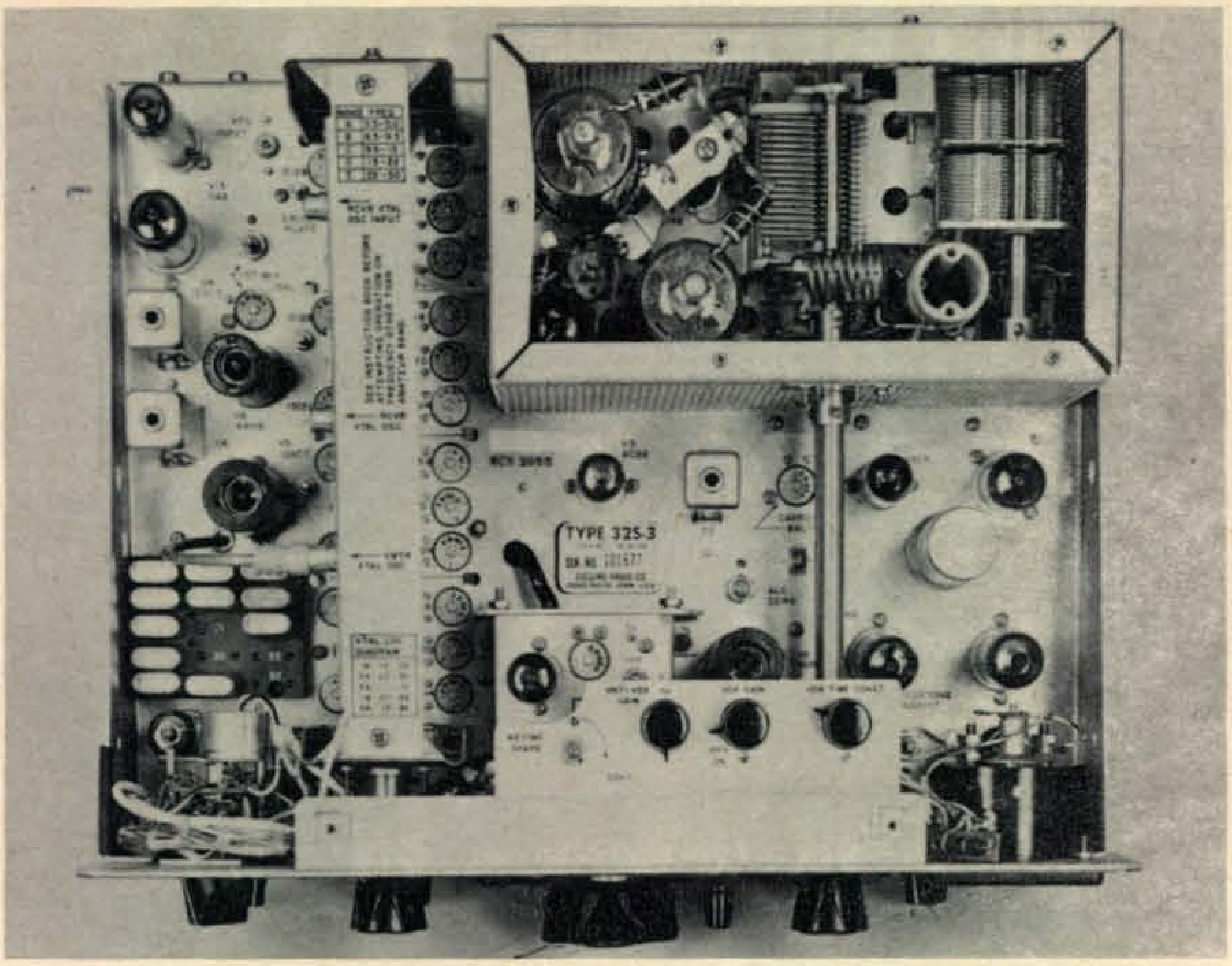


Top view of the 32S-3 transmitter. Much of it is like the receiver, except for the p.a. compartment which has been uncovered (at upper right) and the v.o.x. controls on the bracket at lower center.

enamel finish in light gray and the equipment panels are dark gray with a simulated-leather finish that has a rich appearance and which is not subject to finger marks. The labelling consists of white lettering or numerals embossed on a smooth embossed back-ground surface. The knobs are black with a satin-like finish, are easy the grip and manipulate and have a solid and comfortably smooth feeling. High quality panel meters are used.

A nice convenience is that the screw holes in the p.a.-enclosure cover are slotted with an over-size hole at one end. This permits the cover to be removed by slightly loosening the screws, sliding the cover to one side and lifting it off. Removal of the screws is not needed, lessening chances of their being misplaced and eliminating the chance of stripping the threads in the enclosure.

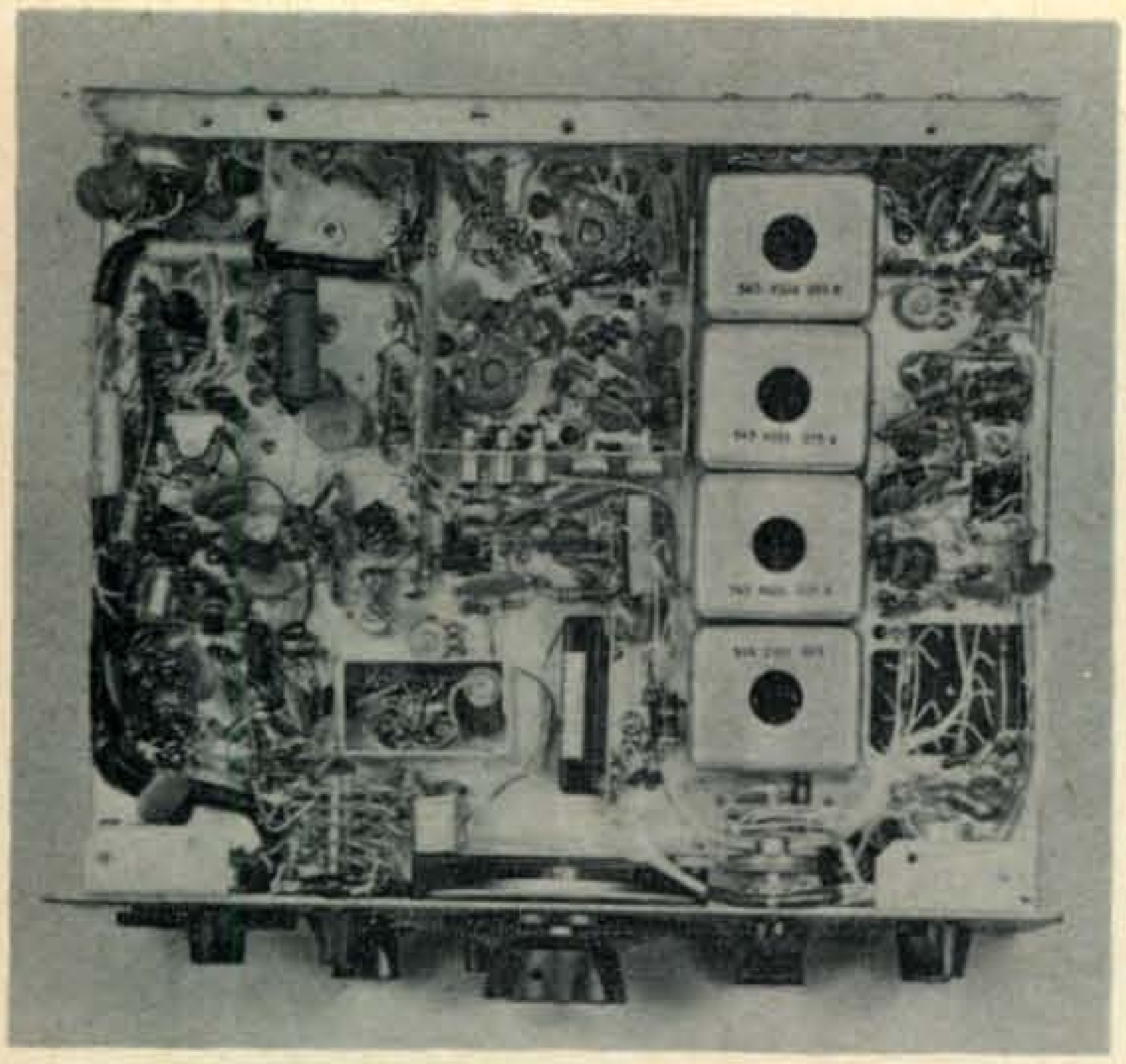
The chassis are made of heavy-gauge aluminum with a brushed finish. The tube sockets are identified by the schematic designation and tube-type. Other chassis components also carry the schematic designation, while all connectors are marked as to their function. These connectors are phono jacks for convenient and rapid installation of interconnecting cables which are supplied with attached plugs. Also included with the units are bristol set-screw wrenches.

An interesting factory procedure is that upon completion of each unit, it is subjected to a vibration test during which it must remain operational. A heat run also is made, subjecting the unit to 24 hours of alternately being turned on and off at preset time intervals.

An example attesting to the durability and reliability of the Collins gear, is Gus Browning's experience on one of his DX-peditions where his S-Line gear accidentally got a solid dunking in the briny sea; nevertheless, after a hosing with fresh water and a drying in the sun, the equipment was still operational to enable the expedition to be successfully completed. As a testimony to this, we understand that Gus's dunked gear has been on display at the Collins plant.

Operation and Performance

Except for one situation, handling the 75S-3B receiver is done in a conventional manner. Since we have been accustomed to receivers wherewith the standby position disables the set at all times, it was not at first realized that the 75S-3B must be placed in the standby



Bottom view of the 32S-3.

position to allow it to be muted during transmit, while still leaving it operational on receive. This necessity is given in the instructions only for "Transceive Operation with 32S-Transmitter." There are no instructions in this respect for normal operation with individual frequency control of the receiver and transmitter which is the setup we initially attempted.

The fine performance is indicated by the following results of measurements and observations made on the unit on hand (ratings where given in the manual also are indicated). Sensitivity: 0.1 μv or better for 10 db S+N/N with s.s.b. (rated at 0.5 μv). Band-to-band gain: within 3 db related to 14 mc. Image Rejection (rated at 50 db min.): 76, 74, 62, 54, 46 db on the 3.5, 7, 14, 21, 28 mc bands respectively. I.f. Signal Rejection (3100 kc): 45, 74, 90, 98, 99 db on above bands respectively. I.f. Signal Rejection (455 kc): over 100 db, except 88 db on 7 mc. Internal Tweets (rated at 1 μv max.): 0.3 μv equivalent at 7045 kc, 0.1 μv at 3650 and 14995 kc. No others found in amateur bands. Other Spurious Input-Signal Responses: −60 db.

Selectivity (as rated): *S.s.b.* 2.1 kc at 6 db, 4.2 kc at 60; *A.m.* 5 kc at 6 db, 25 kc at 60 db. Unwanted Sideband Suppression (2.1 kc filter): 50 & 65 db at 0.5 & 1 kc respectively on l.s.b. and 55 & 70 db on u.s.b. Rejection Notch: 55-60 db over its range. In this respect it should be noted that during on-the-air operation, the maximum effectiveness of the rejection notch (and sideband suppression) occurs when the r.f. gain is turned down, so that little or no a.g.c. is in operation; otherwise the a.g.c. may tend to defeat the purpose. This also applies to other receivers as well.

A.g.c. Characteristics: r.f. input changes of 0.1-1 μv (20 db), 1-10 μv (20 db) and 10-100,000 μv (80 db) resulted in a.f. output changes of 20, 8 and 10 db respectively. Approximately 0.1 second fast- and 1.0 second slow-release times from an S-9 signal. Smooth slow- a.g.c. operation was found with s.s.b. without adverse popping or pumping effects. Strangely though, is that the receiver recovery with transmissions during c.w. break-in was faster with the slow a.g.c. than with fast.

S-Meter: 50-100 μv for S-9 reading,depending on band (rated at appx. 100 μv). The meter also is calibrated in db with S-9 representing about 40 db over 1 μv at zero meter reading. Each S-unit is about a 4 db change.

Signal-Handling Capabilities: Side-by-side comparative measurements with the best receiver we've run across in this connection and one with like sensitivity to that of the 75S-3B, indicated the r.f. intermodulation characteristics of the 75S-3B on all bands were not quite as good. On the other hand, cross modulation and desensitization were slightly better due to the superior front-end selectivity of its permeability-tuned r.f. circuits. Blocking, due to overload, was on a par for both receivers. Actual figures for all the above are not given, inasmuch as no set of standards or specification methods have yet been set up by the amateur-equipment industry.

Frequency Stability (rated at within 100 c.p.s. after warmup): Checking a different band the first thing on different days and starting at an ambient of 70° F., the overall 30-minute warmup drift was a maximum of 200 c.p.s. with a 10 c.p.s. or less change during the next 4 hours. Variations in warmup drift were traced to the different heterodyning crystals in use for each band. With line-voltage changes of ±10%, the frequency held to within 10 c.p.s. on any band. Dial accuracy and Linearity—within 500 c.p.s. at each 10 kc point when indexed against calibrator signal at midscale (rated at 1 kc).

Transmitter

Operation of the 32S-3 transmitter is easily conducted once you catch on to the switching and adjustment procedures.

When the receiver and transmitter have been set up with the proper oscillator-interconnecting cables for transceiving, either transceive or independent (split) frequency

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operation may be quickly had by flipping a switch on the transmitter panel that disengages or engages the transmitter v.f.o. as the need requires. When this v.f.o. is disabled, its dial lamp is extinguished. The receiver crystals are used for both types of operation.

Should it then be desired to use independent frequency control with different band segments on receive than on transmit, such as may be needed for working out-of-band DX stations, besides flipping the v.f.o. switch for transmitter-v.f.o. use, you also have to lift the transmitter cover and rearrange the crystal-oscillator cables to enable the different heterodyning crystal to be used in each unit.

Independent frequency control is recommended for c.w. If transceive operation were employed for c.w., the receiver and transmitter frequencies would differ by an amount depending on the beat note for which the receiver is tuned and the actual frequency used at the b.f.o. The frequency offset could be anywhere between zero and about 2 kc.

Functioning at the rated d.c. input of 180 watts on tuneup, the r.f. output for the 32S-3 was at least 100 watts on all bands; slightly higher with p.e.p. Unwanted-side-band suppression was essentially the same as that for the receiver. Carrier suppression was stable and greater than 60 db.

3rd-order distortion products (rated at 30 db down from two-tone full output) were 37 db down even with 15 db of a.l.c.! This is at least 7 db better than we've run across with exciters using 6146's or other tubes, even when operating with little a.l.c. or below flat-topping. This is where the r.f. feedback setup and the excellent a.l.c. of the 32S-3 really show up to advantage.

It was possible to work with c.w. break-in (no v.o.x. circuit delay), semi break-in (with selected delay) or manual operation (with p.t.t. switch); however, relay clattering with full break-in was somewhat annoying. The keying characteristics were fine and by listening on a nearby receiver, the effects of the wave-shaping adjustment on eliminating key clicks or otherwise altering the characteristics was quite evident.

The frequency stability was essentially the same as that of the receiver. So was the calibration accuracy; in fact, during independent frequency control of each unit, we could set the transmitter-v.f.o. dial to the same frequency reading indicated at the receiver dial and come on frequency within the ballpark for s.s.b. operation.

Normal provisions for frequency spotting are use of the low-power stages, only, to zero beat the signal against the receiver for c.w.; while for s.s.b. to talk yourself on frequency or zero beat the acoustic feedback between microphone and loudspeaker.

Audio Frequency-Shift Keying (AFSK) may be had using an a.f. level not exceeding 80 millivolts. External cooling must be provided for the p.a. tubes during this mode.

The size of each unit is $6\frac{9}{16}'' \times 14\frac{3}{4}'' \times 11\frac{1}{2}''$ (H.W.D.). The 75S-3B weighs 20 pounds, the 32S-3 weighs 16 pounds. The 516F-2 a.c. power supply is $6\frac{9}{16}'' \times 9\frac{7}{8}'' \times 11\frac{1}{2}''$ (H.W.D.) and it weighs 30 pounds.

The Collins 75S-3B receiver is priced at $795. with 2.1 kc mechanical filter. The 32S-3 transmitted is priced at $865 with all needed cables for interconnecting with the receiver. Both units are supplied with 12 crystals for the band segments indicated in the text. The 516F-2 power supply is priced at $153. These are products of Collins Radio Company, Cedar Rapids, Iowa.

—W2AEF

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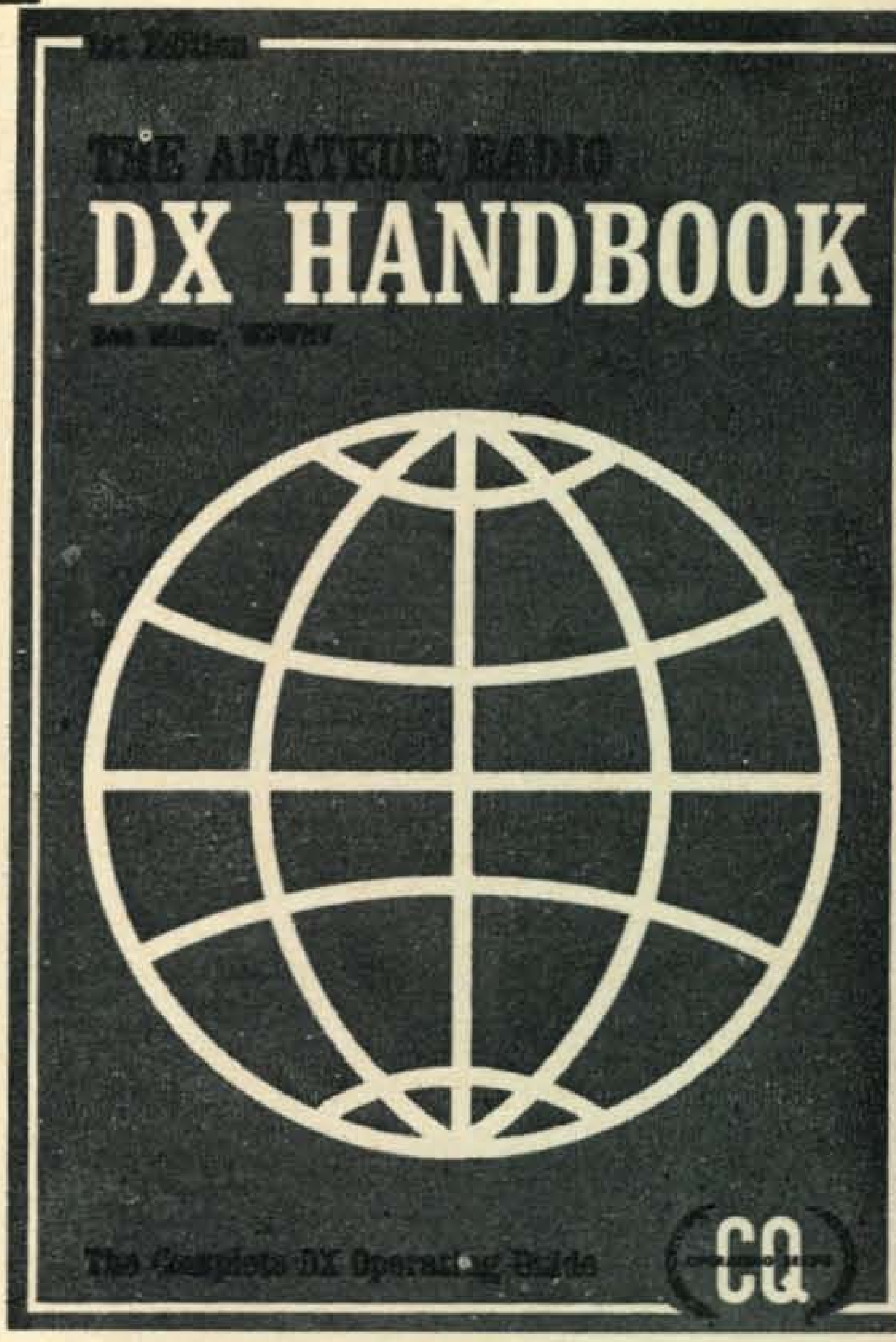
THE AMATEUR RADIO DX HANDBOOK
By Don Miller, W9WNV

It would be unfair to any radio amateur chasing DX to tell him not to buy Don Miller's DX HANDBOOK. It's a good investment. The book is so jam-packed with vital information, miscellanea, and trivia that there is something for almost everyone. The list of contents includes just about every conceivable DX'ing situation and happenstance. However, if you're looking for more dirt about the Miller vs ARRL controversy, you will be wasting time and money—it isn't here. In fact, Miller goes out of his way to thank W1LVQ and W2NSD for "their inspiration and generous contribution of material."

Published by Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, N.Y. 11050. Soft cover. 200 pages. $5.00.



Popular Electronics reviewed our *Amateur DX Handbook* in their June issue. Why don't you see for yourself what people are talking about. Inspect a copy at your local distributor or use the coupon below to order one. By the way, it would make a great Christmas gift.

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FSK FOR THE TRANSCEIVER

BY ROBERT H. JOHNSON,* W9TKR

A PROBLEM facing many budding RTTY enthusiasts, after getting the equipment set up to copy off the air, is how to key the transmitter. After all, it was great fun to copy the amateur signals, and maybe the AP and UPI services, but the urge to be able to transmit and actually communicate using this fascinating mode soon causes a search for the best method of keying.

There are a number of excellent reference books and many articles in the amateur publications covering various methods but none that refer specifically to transceiver circuits.

Here is a method of keying or frequency shifting those transceivers which use a Varicap diode for offset receiver tuning. This article will deal specifically with the popular Eico 753 transceiver, but could be applied to any transceiver with similar circuitry.

The simplicity of the circuit will appeal to the majority of us who would like to keep the mechanical changes to a minimum because of the resale value. The circuit modification in the transceiver consists of one minor wiring change, which can easily be restored to the original. The addition of a small phono jack to the rear lip of the chassis is easily done, as there is sufficient space near the octal power plug.

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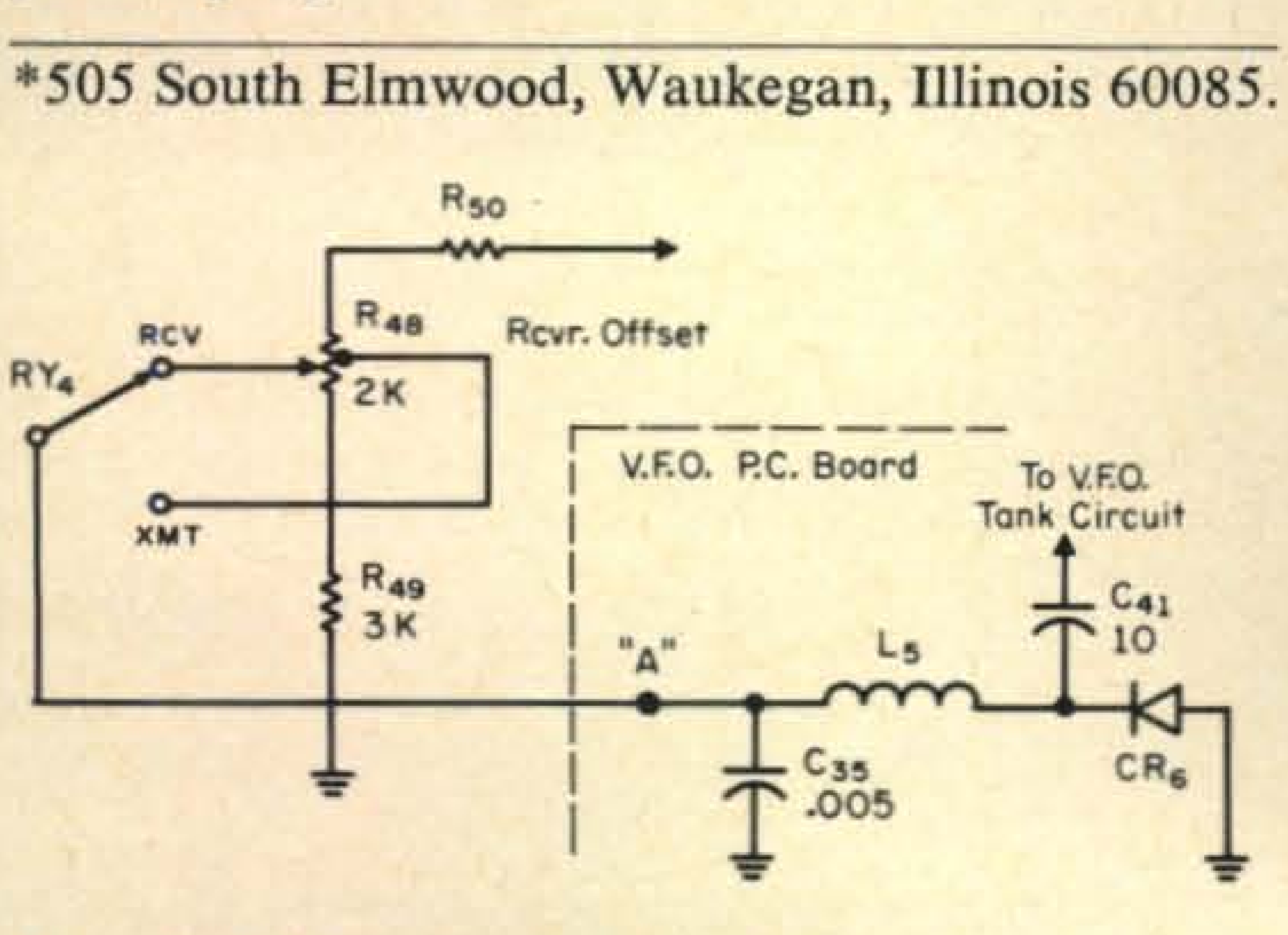


Fig. 1—Original receiver offset circuit in the Eico 753 transceiver.

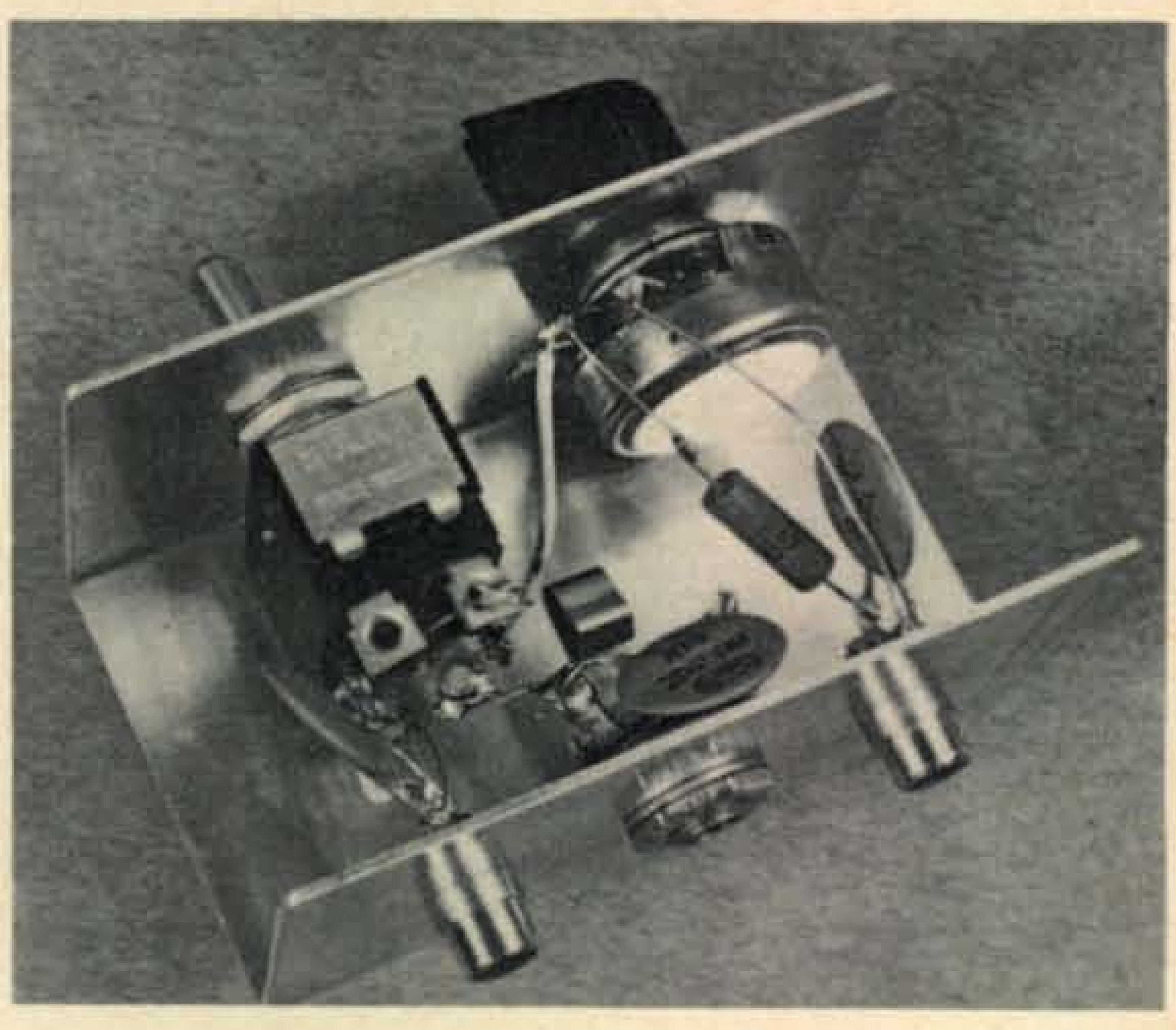
The control circuitry for adjustment of the frequency shift, and transmit/receive switching is contained in a small Minibox which may be located adjacent to the teletype printer for easy accessibility from the RTTY operating position. Again, simplicity is evident, as the box contains only three components, a fixed resistor, a d.p.d.t. switch, and the frequency shift potentiometer.

Theory Of Operation

Figure 1. shows the original receiver offset tuning circuit, which s part of the v.f.o. The control R_{48} allows the receive frequency to be offset from the transmit frequency by up to ±10 kc, by controlling the bias on the Varicap diode, CR_6.

Normally, during transmit, the bias on CR_6 is taken from the fixed tap on R_{48} so that the transmit frequency is not varied by the setting of the receiver offset control.

We will use the Varicap, CR_6, to frequency shift the v.f.o. during RTTY operation, and



Interior view of the f.s.k. control box showing component placement. The 0.01 disc bypasses the jack.

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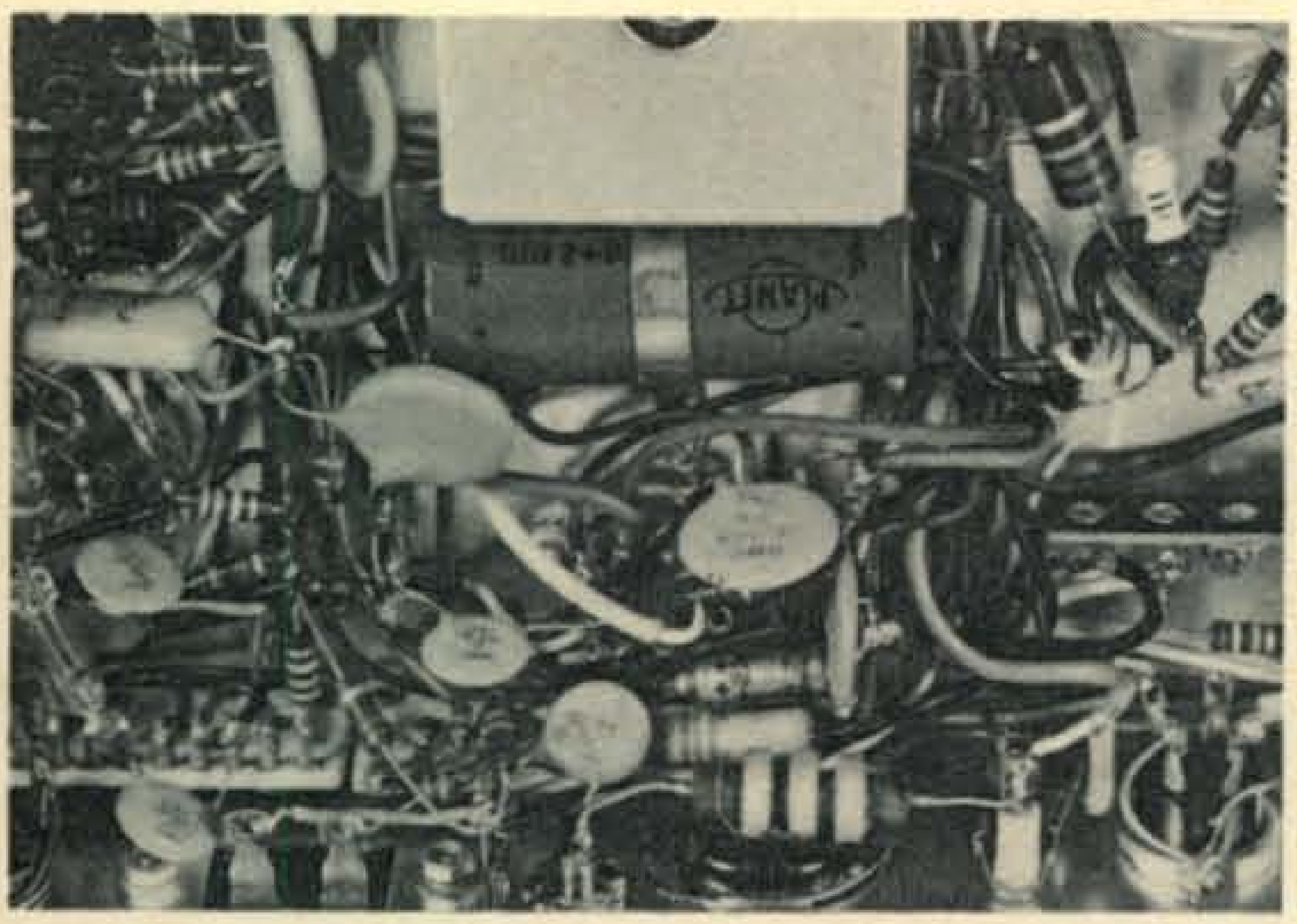

Interior view of the modified Eico 753 chassis. The new jack is in the center between the two screw terminal board and the power plug.

do it in such a way as to allow the receiver offset tuning and the frequency shift adjustment to remain as completely independent controls.

Circuit Modification

Figure 2. shows the revised circuit in the 753, and the control circuit external to the transceiver. There are no component changes on the v.f.o. printed circuit board, and only one wire is added at point *"A"*. In the RTTY transmit position of S_1, the relay RY_4 places the voltage divider R_1 and R_2 in parallel with R_{49} and a fixed portion of R_{48}. The RTTY key line at J_2 will switch a selected portion of R_2 to ground, causing the transmit frequency shift.

The receiver position of S_1 shunts R_2 so that it will not effect the receive offset tuning, while RY_4 selects the variable tap on R_{48}.

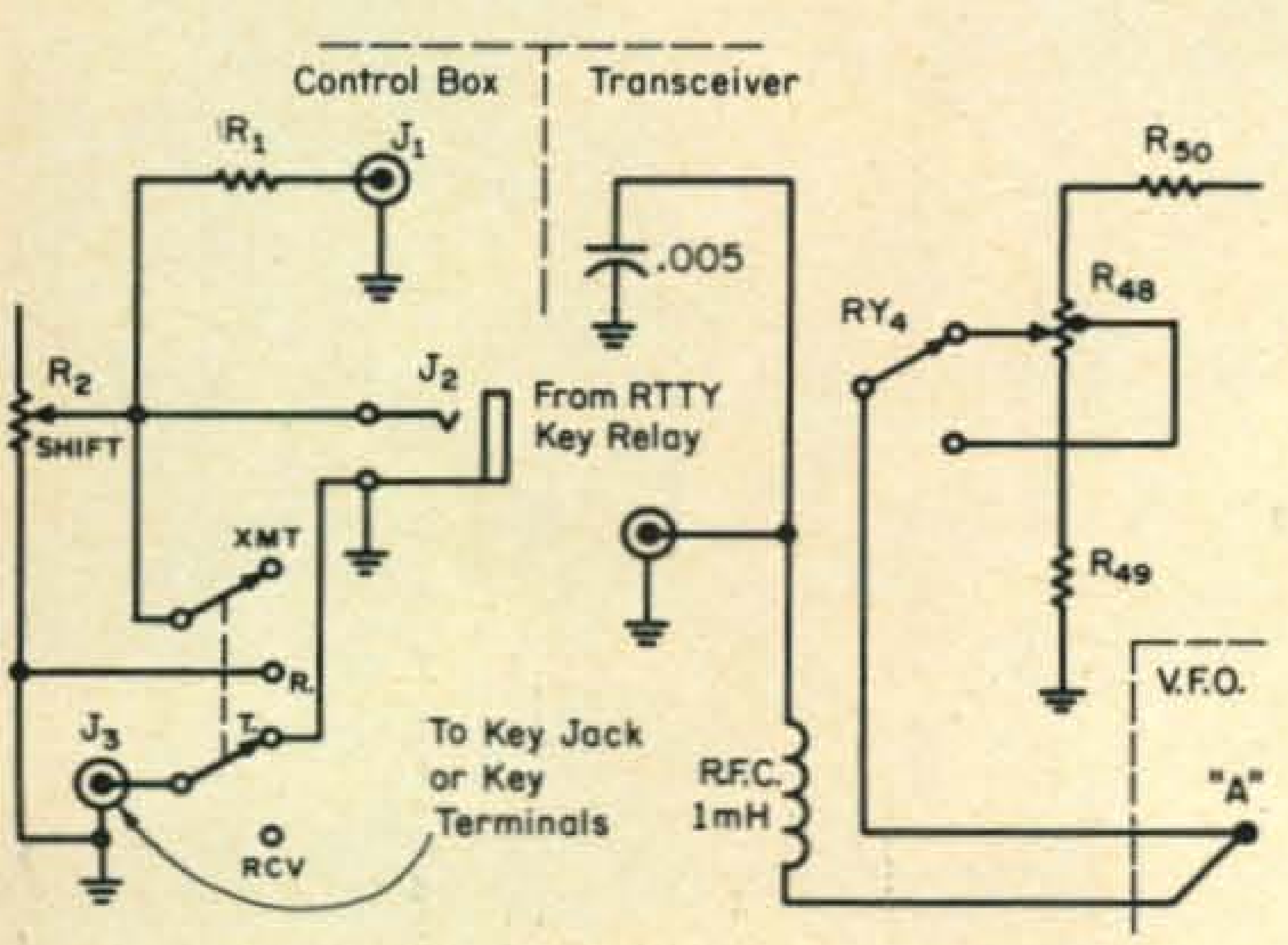

Fig. 2—Control circuit and the revised transceiver circuit for f.s.k. operation of the Eico 753 or similar transceivers.

Transceiver Modification

Remove the chassis from the cabinet, and place it bottom side up on the bench. Locate a position for a phono jack on the rear lip of the chassis, between the terminal board J_3 and the octal plug J_5, and approximately in line with J_2. Make sure that it will clear the two terminal board TB_1. See fig. 3. Use a small pilot bit first, and then enlarge to 1/4". Be very careful to reroute any wiring that might pass behind the hole location, so that you do not damage the wiring while drilling.

Mount a phono type jack in this hole. Phono jacks for single 1/4" hole mounting are available from most supply houses. Mount a small stand-off insulator or single terminal board on one of the mounting screws on J_6. Connect a 1 mhy r.f. choke from this point to the center terminal of the new jack. A 0.005 disk capacitor was also connected from the center terminal of the new jack to ground.

A length of hook-up wire should then be run from the r.f. choke connection at the standoff insulator, and routed back through the cable harness, past RY_4 to point *"A"* on the v.f.o. p.c. board. Point *"A"* will have an existing green wire which runs to relay RY_4. Solder the new wire to point *"A"* along with the green wire. Use a small pencil type iron, and do not apply excessive heat.

This completes the transceiver modification, and the control box may now be assembled. The transceiver v.f.o. alignment will be checked upon completion of the control circuitry.

FSK Adapter

The control circuits are contained in a 4" × 2¼" × 2¼" Minibox. The 1K pot and the d.p.d.t. switch are mounted on the front of the box, and the three jacks are mounted on the rear. Wiring is not critical, as we are dealing only with switching of d.c. potentials.

Suitable jumper cables must be assembled to match your choice of jacks. Cable #1 from

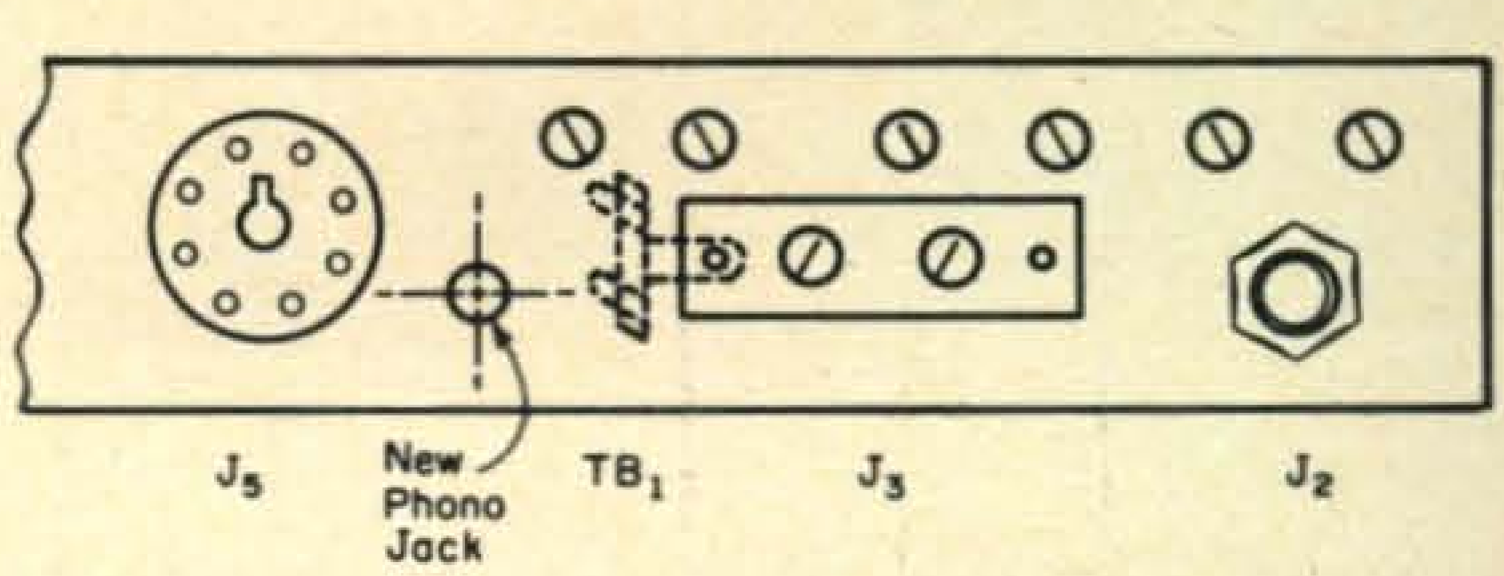

Fig. 3—Rear view of a portion of the Eico 753 chassis showing the best location for the new phono jack.

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J_1 on the control box runs to the transceiver for frequency shift. Cable #2 runs from J_2 to the RTTY transmit keyer. Warning: This circuit should be keyed only by a polar or mercury relay, or directly from the keyboard alone. DO NOT attempt to key directly from the normal d.c. loop to the printer magnets. Any voltage on the key line may damage CR_6. See fig. 4 for a suitable keying circuit. Cable #3 from J_3 may be plugged into the transceiver key jack, or can be clipped across the c.w. key terminals. Observe ground polarity on all three cables.

Check-out And Alignment

Alignment of the control circuit is merely a matter of setting the shift pot, R_2, for the desired frequency shift. This adjustment will hold for a reasonable change in transmitting frequency, but must be readjusted when changing bands.

With the cables connected, turn on the transceiver and check the receiver for proper operation. Check v.f.o. alignment with a suitable frequency standard, and align, if needed, according to the instructions in the operating manual.

Tune up the transmitter as you normally would for c.w. operation. In the case of the Eico 753, the manufacturer says the transceiver may be used for RTTY at low power levels, not to exceed 150 ma plate current. I use a "muffin" type fan sitting on top of the cabinet directly over the final amplifier compartment, with the airflow in an upward direction, so that the fan sucks the air through and up out of the cabinet. With this arrangement, I run 200 ma plate current with no overheating, even during long transmissions. Remember that RTTY is continuous carrier, or key down operation, and things will run very warm indeed unless you provide for increased cooling.

A similar arrangement, using a "muffin" fan on a Galaxy transceiver, was set up and it did the same fine job of kkeeping things cool.

After the transmitter is tuned, throw the switch on the f.s.k. control box to RTTY TRANSMIT position. The transmitter should now be keyed, and the plate current should be the same value that you adjusted for earlier. The frequency shift should now be adjusted by opening and closing the RTTY key line to the control box (J_2), and adjusting R_2. Standard wide (850 cycle), or narrow (170 cycle) shift may be obtained with this circuit.

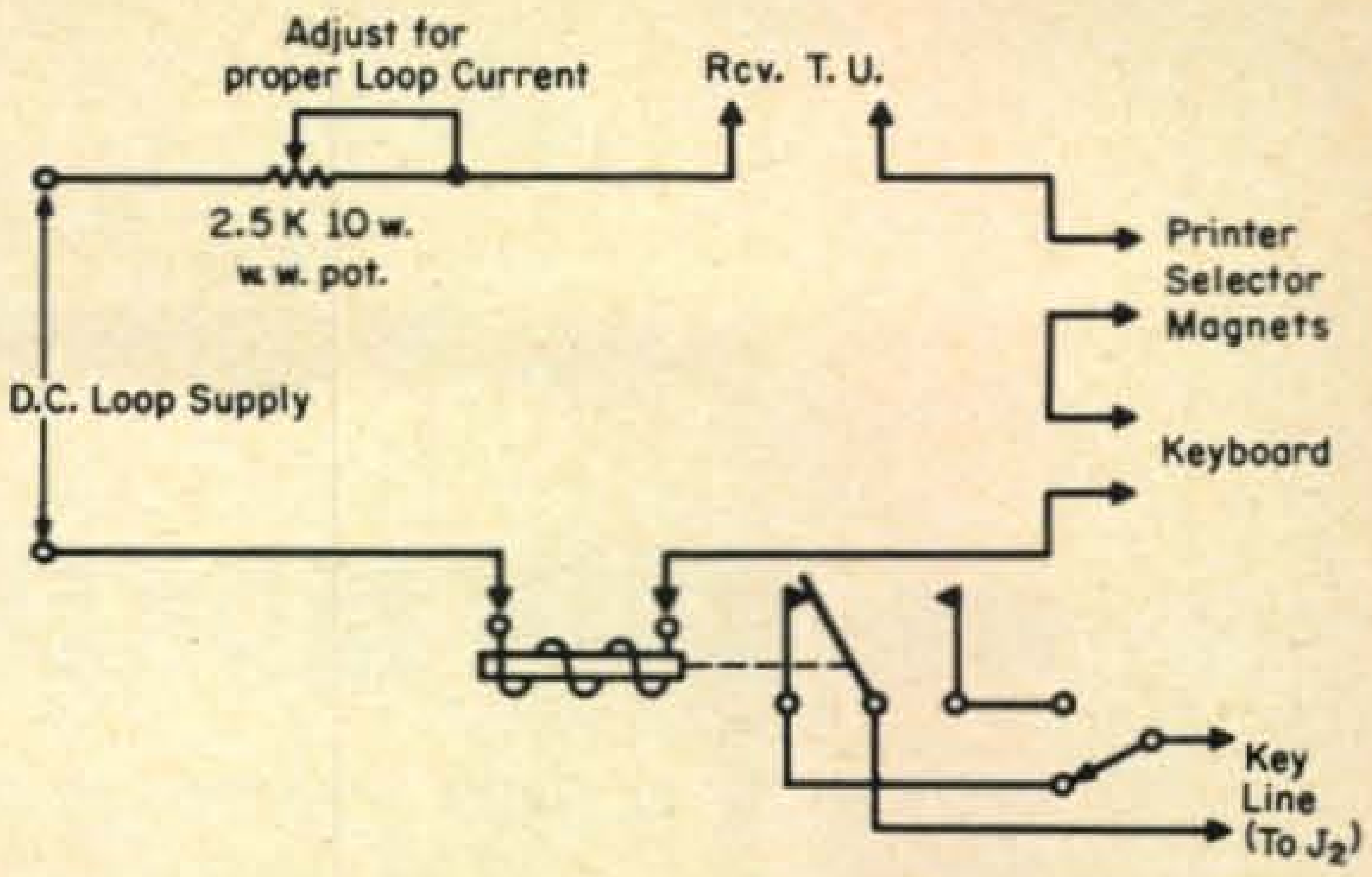
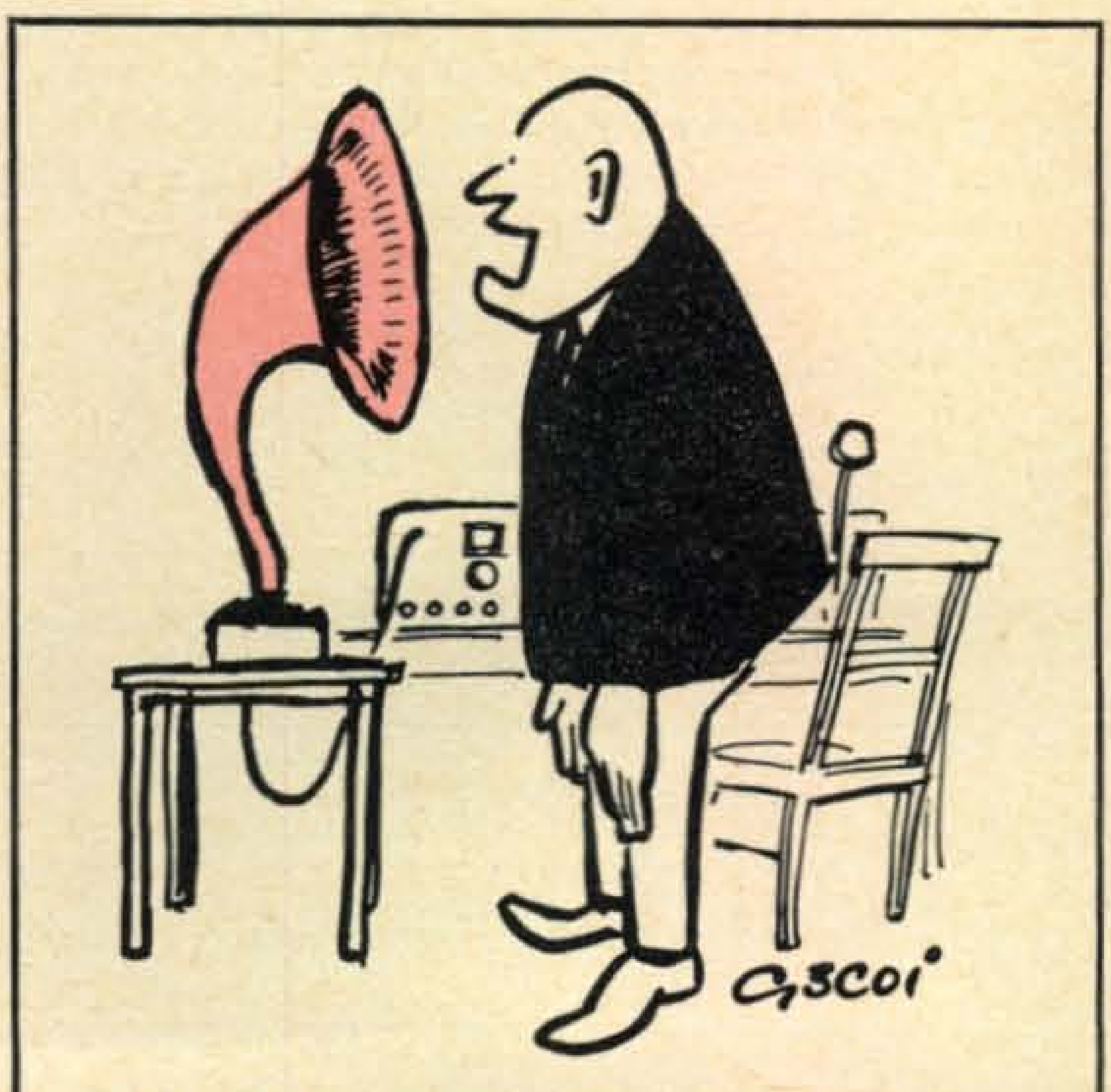


Fig. 4—Keying circuit that can be used with a standard d.c. loop. Relay K_1 is a mercury type with a 100 ohm coil (Clare type HG-1012 or "equivalent). If a polar relay is used the bias coil must be connected properly. Switch S_1 allows for "upside down" keying.

Comments

Use a good quality pot for the shift control. A refinement would be a ten turn precision potentiometer with a counter dial to allow high accuracy set and re-set. If you want to use the transceiver without the RTTY control box, make up a jumper plug consisting of a phono plug with a 3K 5% resistor connected from the center pin to the plug case, or ground. Simply insert this in this f.s.k. jack on the rear of the transceiver, and you are in business. The jumper plug maintains v.f.o. alignment.

This arrangement has been in use here for over a year, and many enjoyable contacts have been made, with excellent reports received. Hope to see you on RTTY f.s.k. soon. ■



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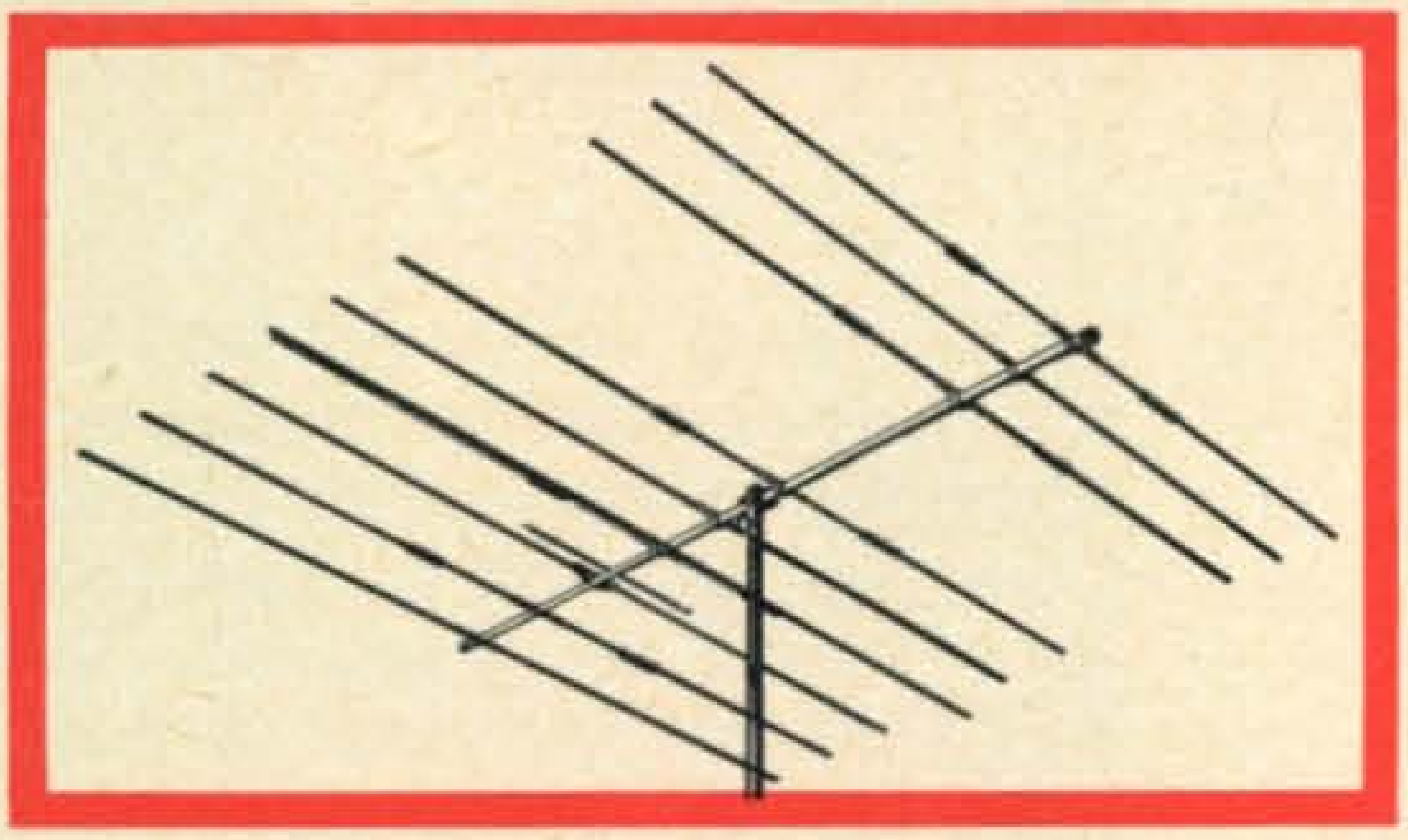
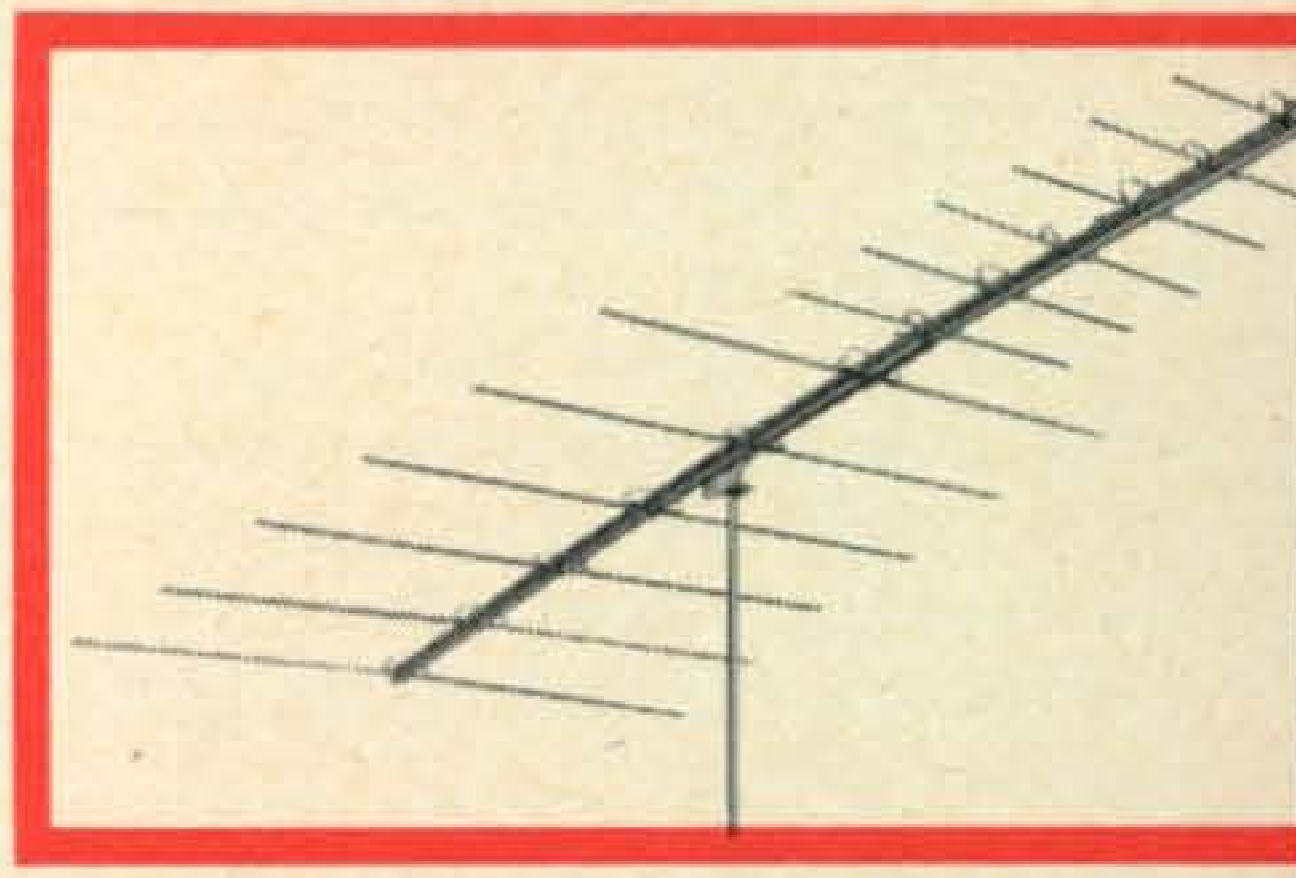
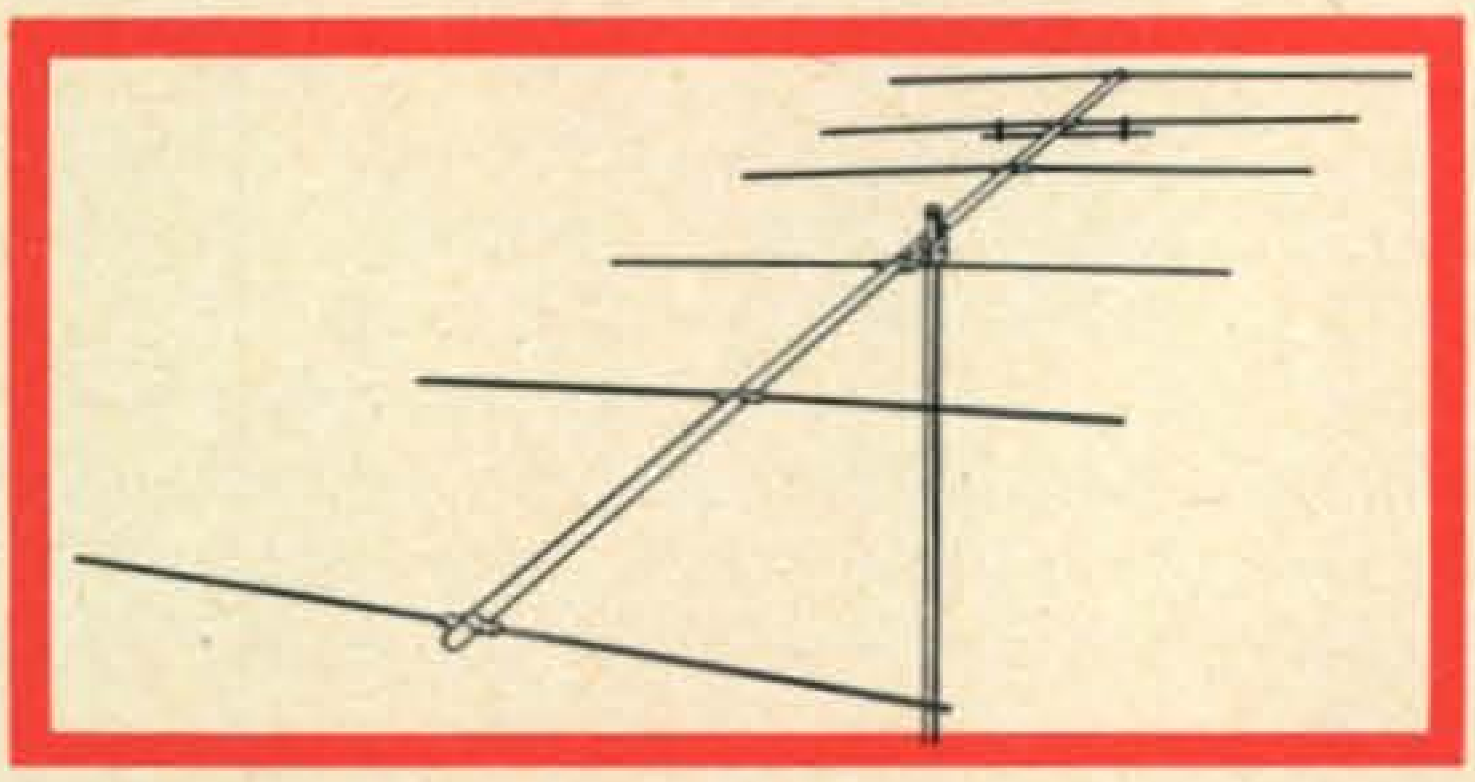
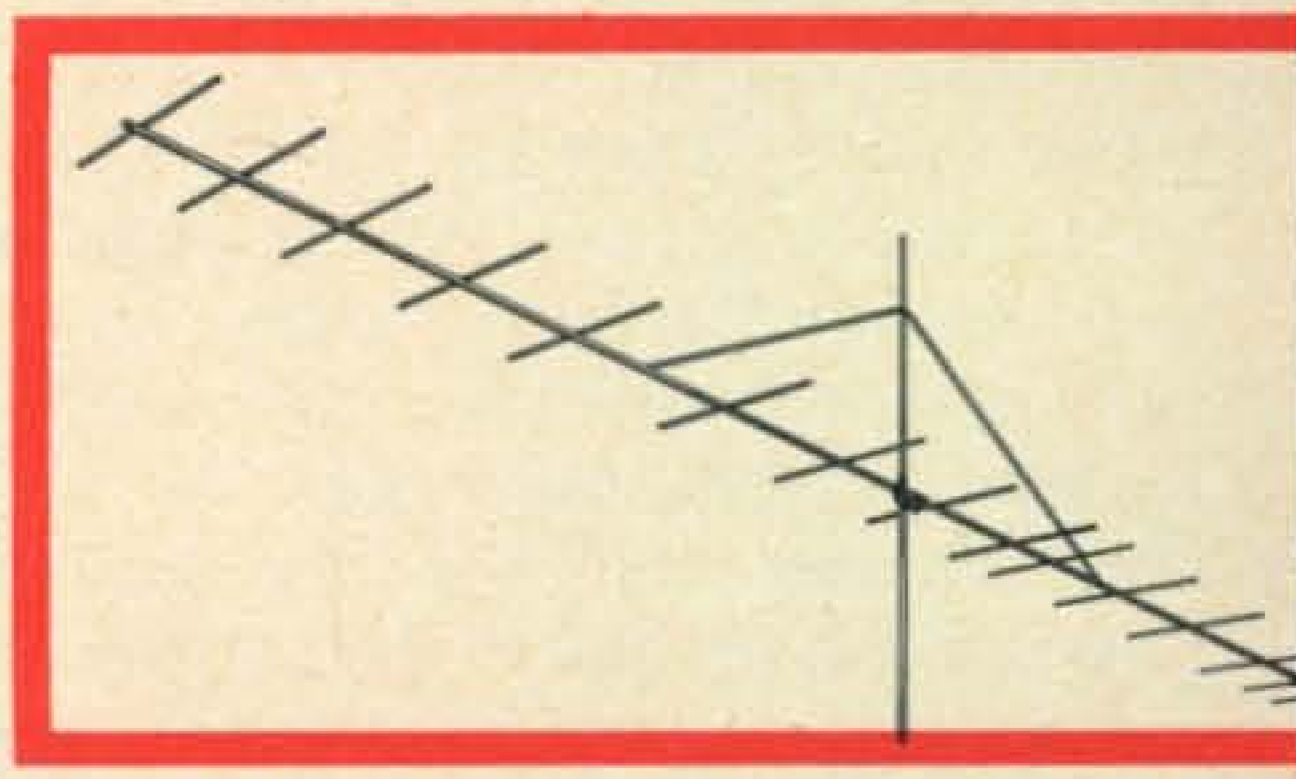








Hy-Gain Duo-Bander for 6 and 2 Meters—Single transmission line Duo-Beam for 6 and 2 meters...4 elements on 6 meters...18 elements on 2 meters. 8db forward gain on 6 meters and 15db gain on 2 meters. Outstanding 6 and 2 meter performance.

Hy-Gain's 6 and 2 Meter Log-Periodic (LP62)—For th very ultimate in uni-directional duo-band performanc 6 and 2 meters, LP62 delivers 8db gain on 6 meters and 15db gain on 2 meters. Unique skip band log peri design insures rated gain figures are maintained across the entire 6 meter and 2 meter bands with VSW than 2:1. Takes maximum input of 1 KW. Boom length of 24′ and a turning radius of 16′.

Hy-Gain 6 Meter Beams—All Take 1 KW Max. Power Input. VSWR At Resonance 1.5:1 or Better.

Model	Elements	db Gain	F/B Ratio	Boom Length	Turn Radius
63B	3	10	20-25db	8′	6′
64B	4	12.7	20-25db	12′	8′
66B	6	15	20-25db	24′	12′6″
611B	11	19	20-25db	47′	24′2″

Hy-Gain 2 Meter Beams—All Take 1 KW Max. Power Input.

Model	Elements	db Gain	F/B Ratio	Boom Length	R
23	3	9	20	3′	
28	8	14.5	25-30	14′	
215	15	17.8	20-30	28′	

FOR THE MOST ADVANCED ANTENNAS UNDER THE SUN

See page 104 for New Reader Service

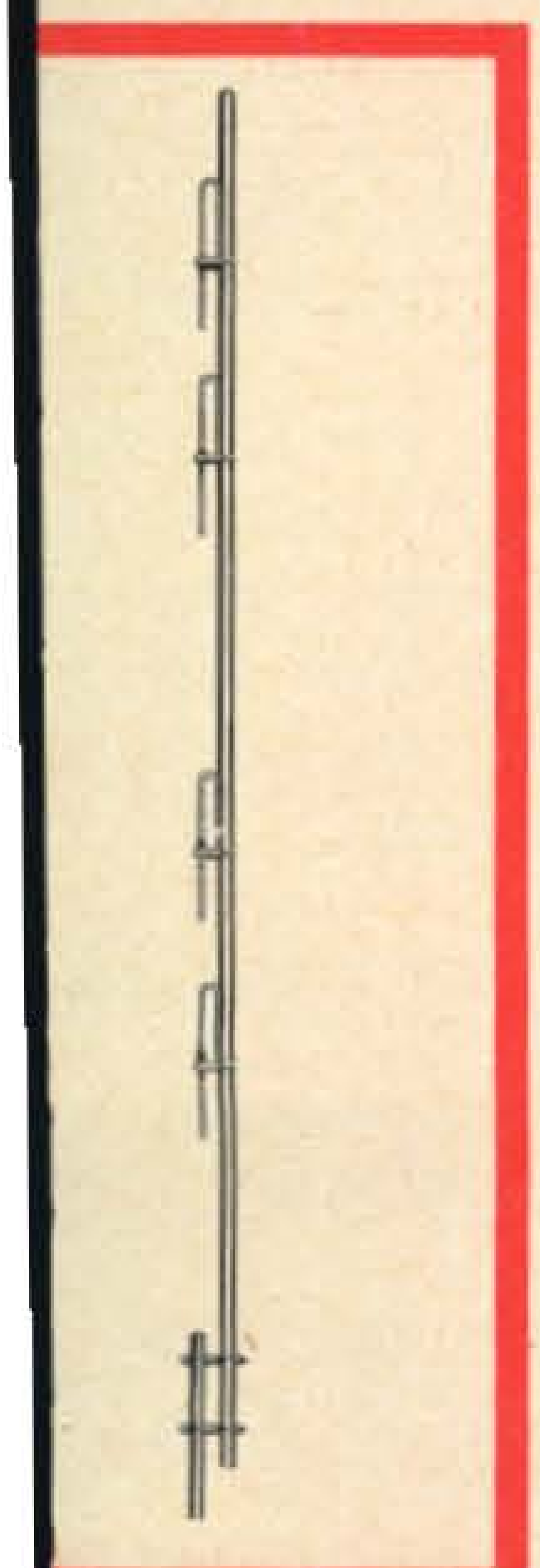
Hy-Gain's maximum performance beams put your signal where the action is. Not just by accident, but as the rewarding result of years of experimentation and computerized research in the most modern antenna and RF laboratory as well as exhaustive field testing.

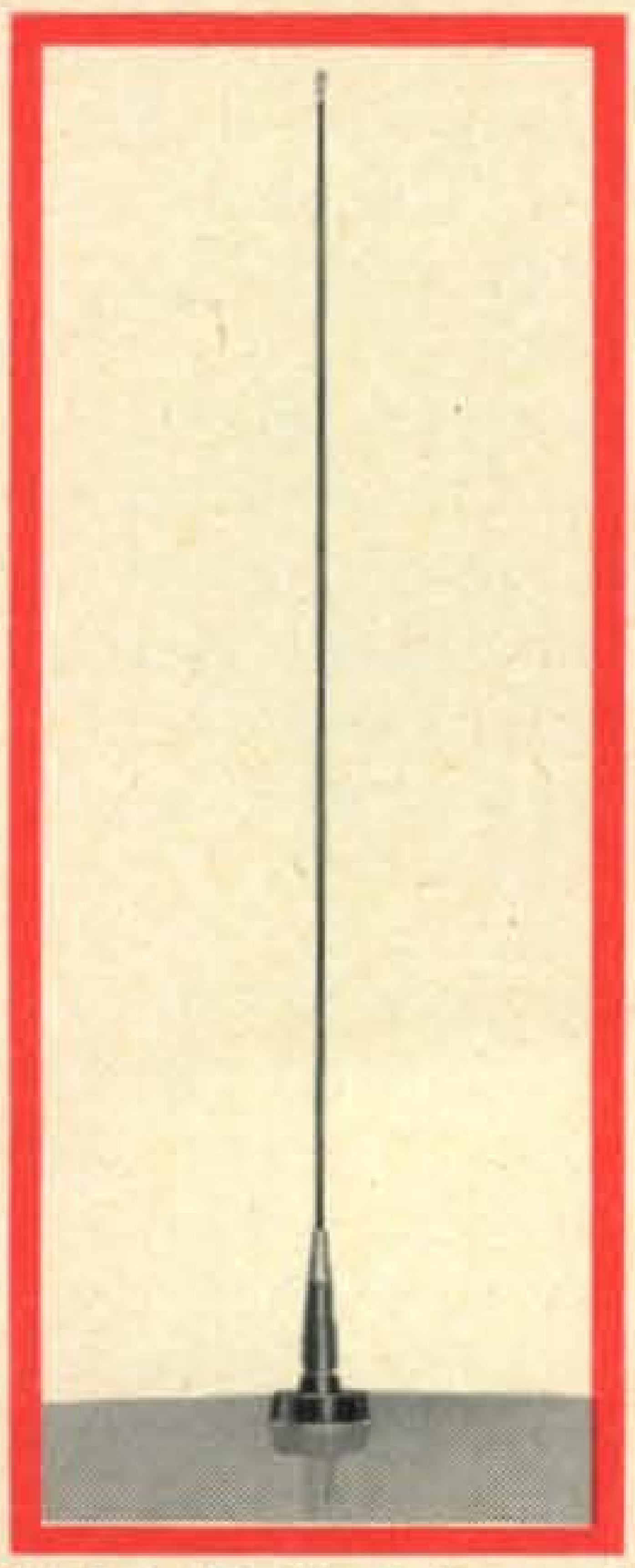
Strategically staggered, optimum spaced elements along the boom are referenced solely to increased field strength intensity and pattern control, thus delivering tremendous increase in directional gain not attainable with close spaced beams or optimum spaced beams using linearity as the sole reference.

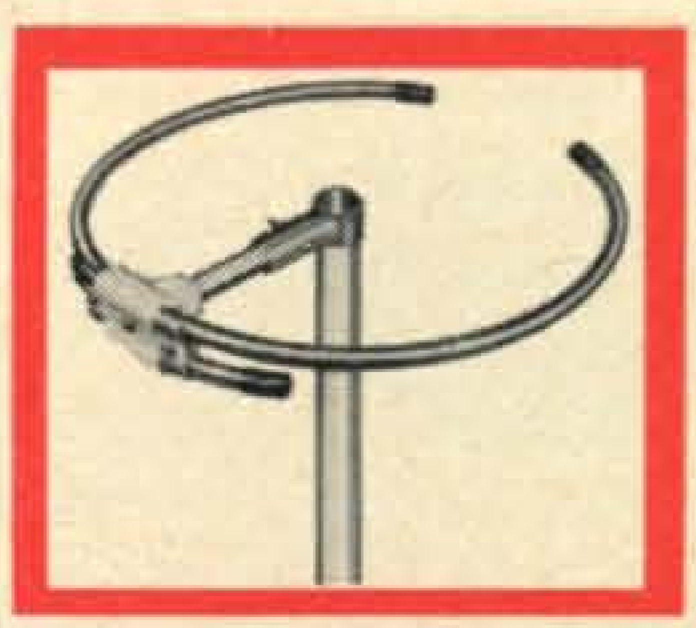
Exclusive Hy-Gain Beta Match – All Hy-Gain VHF Beams feature a special VHF Beta Match configuration. The unique pre-tuned Beta Match permits maximum gain and front-to-back ratio with a nominal 50 ohm feed point impedance without de-tuning any of the parasitic elements. An optimum transfer of energy thus results without sacrifice in gain or pattern control.

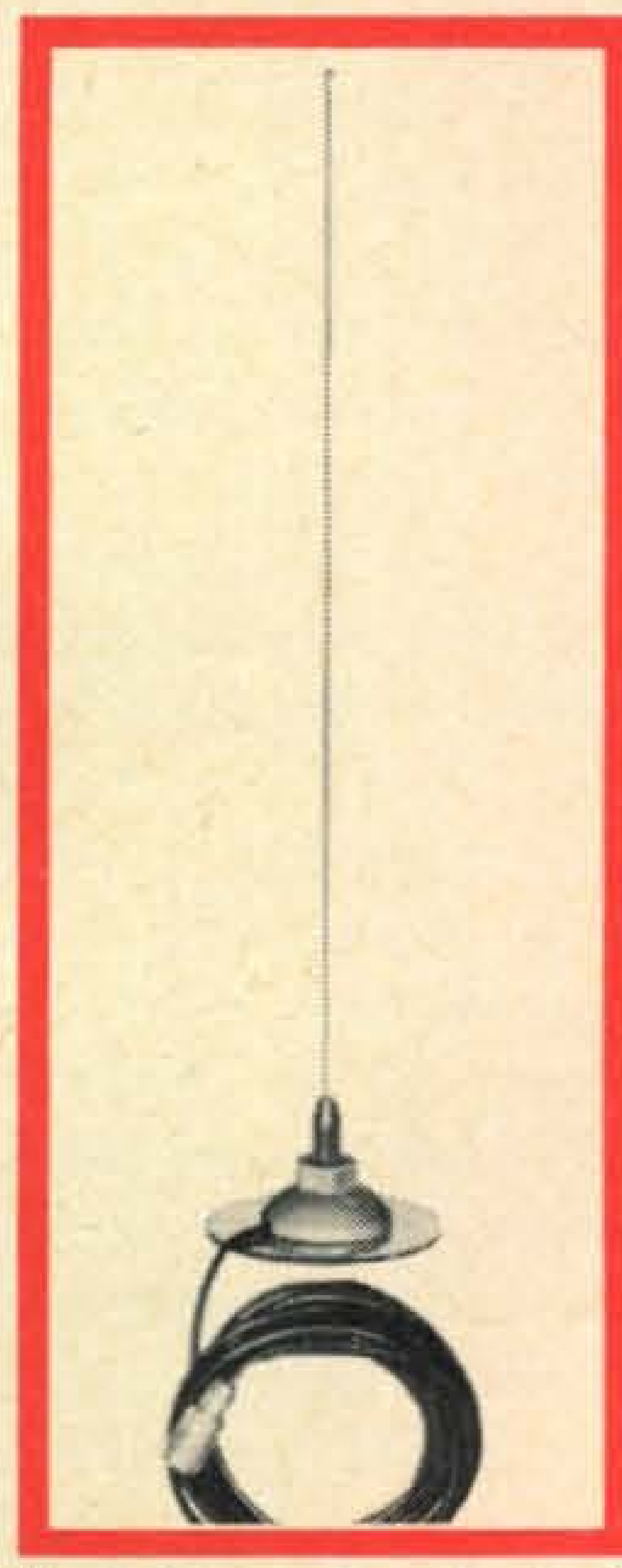
Coaxial Balun – All Hy-Gain VHF Beams are supplied with a coaxial balun.

Mechanical Reliability – The rugged, long life construction is available only in Hy-Gain antennas which feature heavy walled, seamless aluminum tubing. All element-to-boom clamps are machine formed of heavy gauge aluminum. All steel hardware is iridite treated to Mil-Specs for the kind of long life reliability our Government expects in equipment they buy.









Gain's 4-Element Stacked Jay-Pole for 2 Meters – 4-element stacked Jay-Pole delivers db gain. Phasing and matching harness maintains perfect parallel phase relationship and is center fed to minimize beam tilting for better angle radiation. May be side-mounted on mast or mounted on roof saddle.

Hy-Gain Mobile Antennas for 6 and 2 Meters – For the very highest degree of mechanical reliability, while eliminating pattern distortion generally prevalent in off center mount halo's, Hy-Gain's center mount halo's are unsurpassed. They feature the exclusive Hy-Gain Beta Match to insure optimum transfer of energy.

CRG150 – Vertically polarized omni-directional 55" whip with photographically etched copper base matching coil. Exclusive "Claw" mounting device easily installs in any hole ⅜" to ¾".

HH6BK – Center mount 6 meter Halo with mast and bumper mount kit. Complete w/everything for quick installation. Perfect omni-directional pattern and excellent impedance control. Supplied with tuning rods for precise frequency adjustment.

HH2BA – Rugged center mount 2 meter Halo eliminates pattern distortion prevalent with off-center mount halos. Most efficient 2 meter halo available. Exclusive Hy-Gain Beta Match assures optimum energy transfer.

MAG150 – Alnico magnet base allows quick installation. Can be removed just as easily when parking in uncertain places. No need to scrape paint...the MAG150 is capacitively grounded. Superb performance from so versatile an antenna.

Y-GAIN ELECTRONICS CORPORATION
P. O. Box 868-FL, Lincoln, Nebraska 68501

See page 104 for New Reader Service

Australis-Oscar 5 Progress Report

BY GEORGE JACOBS,* W3ASK and JAMES A. KING,* K8VTR/3

We had hoped to announce in this month's column the news that all amateur radio has been waiting for—the successful launch of the AUSTRALIS-OSCAR (AOA) radio amateur satellite. Unfortunately, this is not yet possible. The launch of the primary satellite with which AOA is to ride piggy-back into space, originally scheduled for mid-October, then delayed to late November, has been further postponed, this time to early or mid-December. If the technical difficulties encountered in the launch vehicle are corrected, AUSTRALIS-OSCAR should be in orbit later this month, but even this isn't firm. If dissappointed, remember it is wiser to delay a launch than to have a failure.

As soon as the launch vehicle difficulties are corrected, AOA is ready to go. The satellite has passed all its pre-launch tests with flying colors. Both beacon transmitters operated satisfactory under all test conditions. R.f. power output under ambient conditions and maximum battery voltages are as follows:

H.f. (10 meters) transmitter: 180 mw at 29.450 mc.

V.h.f. (2 meters) transmitter: 120 mw at 144.050 mc.

The power output of the 10 meter transmitter falls fairly linearly with decreasing battery voltage, but the 2 meter transmitter output falls very rapidly, especially under hot conditions (down to 20 mw at 62°C. for a battery voltage of 17 volts). To maintain sufficient 2 meter output it is important that the spacecraft temperature remain at low values.

The continuously operated 2 meter beacon is expected to have a life of approximately 6 weeks. The 10 meter beacon, which will be operated intermittently and from 0700 GMT on Fridays to 0700 GMT on Mondays, should last for 8 weeks or longer.

*c/o AMSAT, P.O. Box 27, Washington, D.C. 20044.

Calibration Corrections

The telemetry system has operated satisfactorily during all phases of testing. Almost identical calibration curves have been obtained during several vacuum tests, and these appear on page 24 of the September, 1969 issue of *CQ*. The temperature curves (fig. 4 and 5) may be extended to +60°C by a linear extrapolation.

Additional information is now available concerning telemetry channels 2, 4 and 6. The current read by the horizon sensors when looking into space ("dark current") should give a telemetry reading of 510 c.p.s. at 10°. and 640 c.p.s. at 60°C. on these channels.

Last Minute Suggestions

Here are some last minute suggestions by the Radio Amateur Satellite Corporation (Amsat), for observing AUSTRALIS-OSCAR 5 once it is in orbit.

AOA will be a telemetry satellite that will report information about itself and its environment. The telemetry data will be useful to designers of the future amateur radio satellites. In addition, carefully documented data pertaining to exact times and signal strengths could yield important information for ionospheric propagation and space research. Here are several experiments in which radio amateurs can participate.

1. *Acquiring the satellite.* Generally listen for the 2 meter beacon before trying for the 10 meter beacon which may be on intermittently or only during weekends. Observe telemetry channel #1 to see if the 10 meter beacon is on. A battery current of 50 to 60 ma (during the first month of operation) will indicate that the 10 meter transmitter is also operating, while a reading of 25 to 30 ma shows it is off.

2. *Temperature records.* Keep an accurate record of internal and skin temperatures (telemetry channels #5 and #7) during each pass. South or north overhead passes will occur at your location around 1500 *local time* every day. Temperature readings are of interest for the

See page 104 for New Reader Service

thermal designer of future amateur satellites. Of great interest is the temperature during the north-south pass at 0300 local time daily, when the satellite will be going through a dark (colder) period. Another useful measurement is the difference in temperature between the skin and inside of the spacecraft.

3. *Horizon sensor.* This experiment is a *first* for amateur radio satellites. Three horizon sensors are mounted on the satellite with the following alignment:

x axis sensor—parallel with the 2 meter antenna
y axis sensor—perpendicular to both antennas
z axis sensor—parallel with the 10 meter antenna

When a sensor is not viewing the earth, the telemetry channel (#2 for the *x* Axis; #4 for the *y* axis and #6 for the *z* axis) emits a tone between 510 and 640 c.p.s. When the sensor views a portion of the earth, the tone will be higher, probably around 1000 to 1200 c.p.s. An indication of the satellite spin rate can be deduced by the amount of time each frequency is present. Comments regarding your observations on channels 2, 4 and 6 should be added to your telemetry report.

A word of caution. If the satellite spin rate is high about a given axis, one or two sensors may have an ON time shorter than the duration of the sampling period. In this case, be careful not to confuse the ON-OFF transition with a telemetry channel change. Probably the spin rate around the *z* axis will always be slow (about 4 r.p.m.), but confusion may sometimes arise even at this slow rate.

Occasionally a short transition may occur on one of the sensors as it sweeps across the sun or the moon. Note the time, the particular sensor, and tone frequency when this happens. Also report if the signal is in a null or a peak at the time. You might try to compute the attitude of the spacecraft from the sensor readings, and correlate it with signal strength and polarization of the beacon antennas.

The *x* axis sensor data can be used to assess the effect of the magnetic attitude stabilization system (MASS). The *x* axis spin rate should gradually decrease during the first several days in orbit as the axis comes into alignment with the geomagnetic field.

4. *The propagation experiment.* The 10 meter beacon operating at 29.450 mc is probably the satellite's most important source for scientific information. It also requires greater sophistication on the part of the observer. To fully participate in this project it will be necessary to track both beacons simultaneously and preferably to record them on magnetic tape or paper charts.

Estimate the time you expect to acquire the satellite and start listening several minutes beforehand. Note the time difference beween acquisition of the 10 meter and 2 meter signals. Similarly, note the time difference between loss of signals. Note any difference in fading rates as well as any other signal anomalies.

Compute the ratio of the 10 meter and 2 meter signal strengths (S_{10}/S_2), measured in either linear units or db. Compute this ratio for as many points during a pass as possible. Compare it with similar passes on other days. Note whether it stays particularly large or small during certain passes. The ratio of the 10 and 2 meter signals can be useful in the analysis of ionospheric effects at the opposite side of the earth from your location.

5. *Other experiments.* The above is not comprehensive. Imaginative observers will certainly devise other experiments. Whatever the observation or experiment, BE SURE TO USE THE OFFICIAL REPORTING FORM, which appears on page 23 (fig. 1) of the September, 1969 issue of *CQ*. Copies of this form, as well as other information concerning the AUSTRALIS-OSCAR project can be obtained directly from AMSAT, P.O. Box 27, Washington, D.C. 20044. There is no charge, but be sure to include s.a.s.e.

Another suggestion. Be sure to reread the following articles before participating in the AUSTRALIS-OSCAR project:

"AUSTRALIS-OSCAR, Amateur Radio's Next Satellite in Space," *CQ*, Aug. 1969, p. 63.
"AUSTRALIS-OSCAR Telemetry Calibration Data and Reporting Instructions," *CQ*, Sept. 1969, p. 22.
"AUSTRALIS-OSCAR 5 Progress," *CQ*, Oct. 1969, p. 49.
"The Oscalator," *CQ*, Aug. 1965, p. 54 and Feb. 1966, p. 28.
"Predicting OSCAR's Orbit with Ease," *CQ*, June 1962, p. 58.
"AUSTRALIS-OSCAR 5: Where It's At," Danielson, W. and Glick, S., *QST*, Oct. 1969, p. 54.
"Experiments With the AUSTRALIS-OSCAR 5," King J. A., *QST*, Dec. 1969.

After December 1, check W1AW daily for special bulletins concerning the launch of the AUSTRALIS-OSCAR amateur radio satellite. ■


"The antenna here is rather unusual."

THE TRANSISTOR SCREEN SWITCH

BY DAVID R. WOJCINSKI,* WA9FDQ

A solid state version of the vacuum tube screen grid clamping circuit.

ONE of the transistor's properties is that the effective resistance between its collector and emitter can be varied. This resistance can be as high as hundreds of megohms, or as low as a few ohms, or anywhere in between. The reason this change in resistance is possible is because the base can control the amount of emitter-to-collector current. The more current allowed to flow by the base the lower the emitter-collector resistance. The opposite is also true.

It so happens that a switch has basically the same property. When the switch is open the resistance between its terminals is high, in fact, it's infinite. When closed, the switch has a very low resistance between its terminals (a few milliohms).

Since both the switch and transistor have the same properties one can be substituted for the other in applications where this is advantageous. In applications where fast switching times, freedom from machanical breakdown, a resistance of a few ohms is acceptable and only moderate power levels are switched, a transistor is the choice. If moderate switching times, very low resistance and high power handling capabilities are requred, a mechanical switch, such as a relay, is used.

*8556 Hohman Ave., Munster, Indiana 46321.

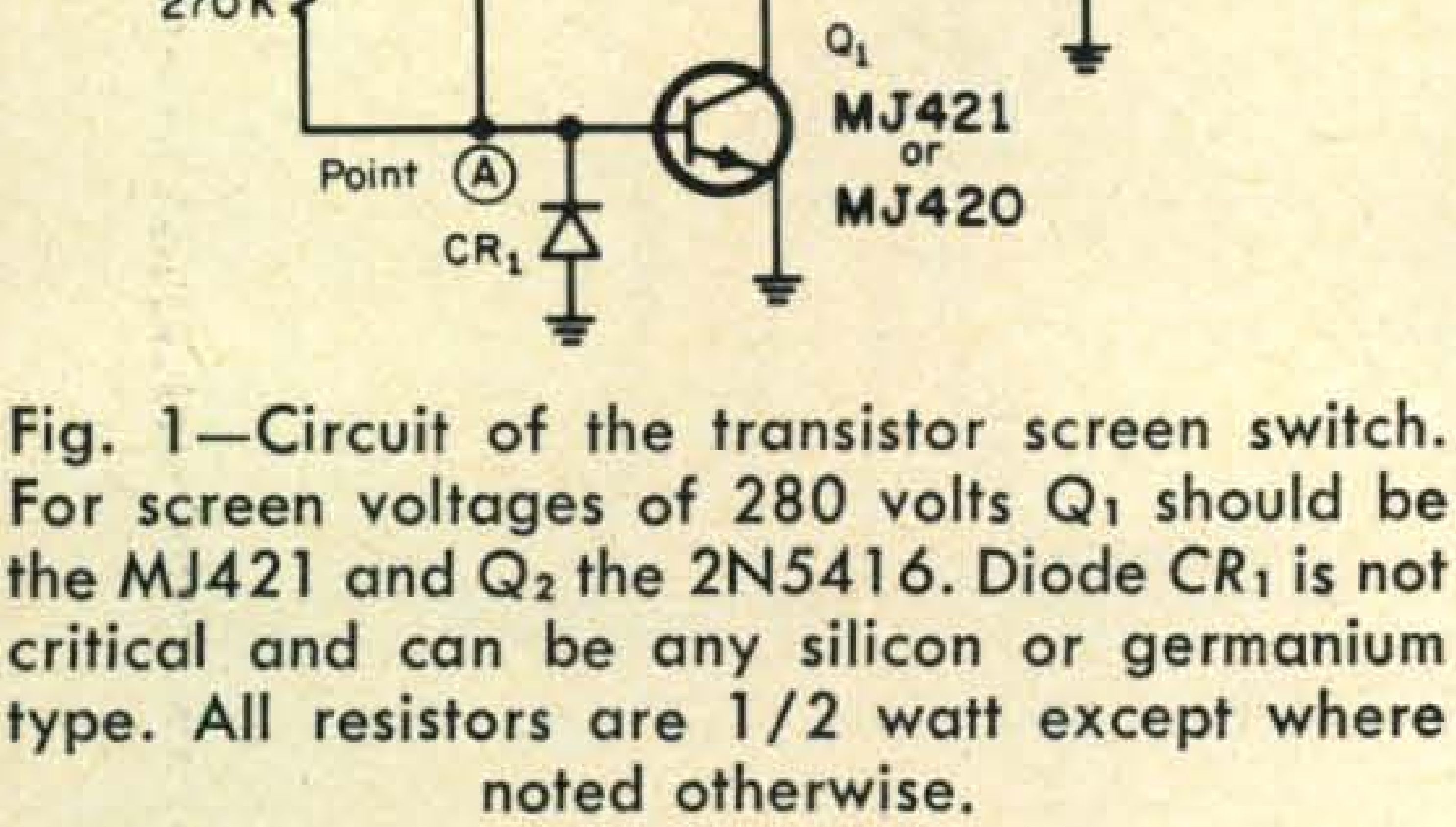


Fig. 1—Circuit of the transistor screen switch. For screen voltages of 280 volts Q_1 should be the MJ421 and Q_2 the 2N5416. Diode CR_1 is not critical and can be any silicon or germanium type. All resistors are 1/2 watt except where noted otherwise.

It was for the former reasons that a transistor was chosen to perform a switching function which is common to most transmitters. This switching function consists of removing the screen grid voltage from the final amplifier tubes during standby periods. Removing the screen voltage reduces the plate of the finals to zero. This protects the finals from excessive current flow if bias should suddenly be lost. Also, if a TR switch is used, the receiver will pick up diode noise generated by the finals. Removing the screen voltage eliminates this noise and prevents the masking of weak signals.

Clamp Tubes

In a.m. transmitters there is usually a clamp tube circuit removes the screen grid voltage. The clamp tube is connected between the screen and ground. During standby the clamp tube is biased so that it will conduct heavily and cause most of the screen voltage to be dropped across the screen resistor. In s.s.b. transmitters the screen voltage is usually removed by a s.p.s.t. switch on the v.o.x. relay. Both of these methods are unsatisfactory when compared to transistor switching. The clamp tube consumes too much power and the v.o.x. relay is not fast enough to follow high speed keying. Fast switching is required when full break-in is used.

Transistor Switch

The circuit of the transistor screen switch, shown in fig. 1, is simple and straightforward.

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Transistor Q_1 keys Q_2 and both transistors are either on or off at the same time.

With the key up, point *A* of the voltage divider R_1, R_2, is below ground. Point *A* is therefore negative with respect to ground. (See fig. 2.) Since the base-emitter junction of Q_1 requires a positive voltage with respect to ground to conduct, it is reversed biased and Q_1 is cutoff. Diode CR_1 prevents the reverse bias voltage from exceeding the breakdown voltage of Q_1's base-emitter junction. (See fig. 3.) With transistor Q_1 cutoff only a small leakage current can flow to the base of Q_2. This current is in the low microampere range and cannot saturate the base-emitter diode of Q_2 and cause it to conduct. The off resistance of Q_2 is 500 megohms. This resistance, in conjunction with R_4, forms a voltage divider that brings the screen to almost ground potential.

With the key down, point *A* of fig. 1 becomes positive with respect to ground. This forward biases the base of Q_1 with about 50 microamperes of current. With Q_1 turned on current is allowed to flow to the base of Q_2. Resistor R_3 limits this current to about 1 ma. The emitter-collector resistance of Q_2 is now low enough so that only a few tenths of a volt appears across the transistor, while the voltage on the screen is close to the supply voltage. The screen is drawing its full current at this time, which is about 15 ma.

When the key is opened again the transsistors will turn off just as fast as the key waveform permits them to. The capacitor, C_1, however, will retain the screen voltage value longer than it takes for the transistors to turn off. This is because neither the screen nor Q_2 offers a low resistance discharge path for C_1. Resistor R_4 was added to provide such a path. The screen voltage will now drop completely to zero between dots and dashes.

Circuit Variations

With the values shown the circuit worked well with a key voltage of between -15 and -50 volts. For key voltages of B plus values much different than were used, experimentation with the values of R_1 and R_2 will be required. It may be somewhat difficult to make the circuit work if the key voltage is only a few volts and B plus is around 200 volts. With these conditions, removing diode CR_1 may help. because with the key up CR_1 is forward biased and is loading the key line. Remember that with CR_1 removed, Point *A* must not exceed a -5 volts with the key up.

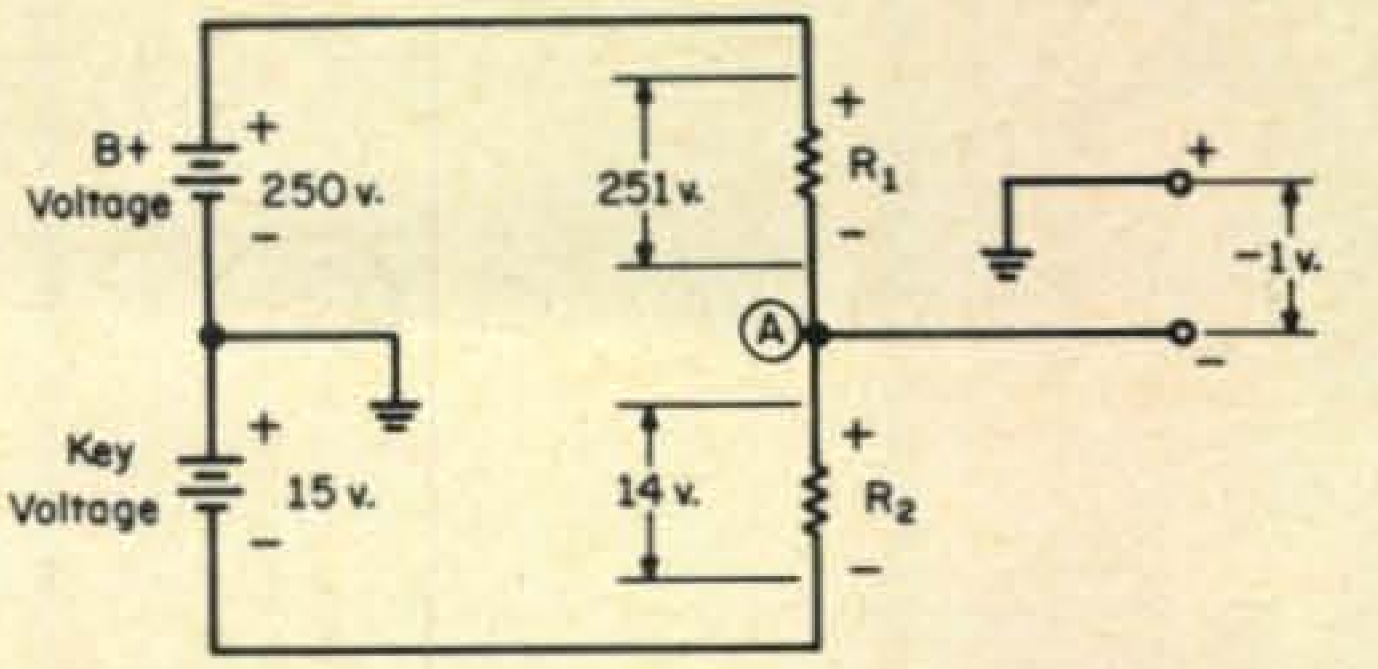


Fig. 2 — Key up condition for R_1 — R_2 voltage divider. Note that R_1 drops all the B plus voltage plus one volt of the key voltage. For different values of key voltages the ratio of 1:17 between R_1 and R_2 should be kept approximately the same. The voltage applied to Q_1 should not exceed minus 5 volts.

If it does, transistor Q_1 will be damaged.

Transistor Types

Transistors are available that can be used with screen voltages up to about 280 volts. They are the 2N5416[1] and the MJ421. The 2N5416 is an expensive device, but it is the only PNP transistor with a V_{CEO} of 300 volts and a TO-5 package, which makes for an easy and compact installation. Other PNP transistors that have high V_{CEO} ratings but bulkier packages, such as the MP3731 by Motorola, are available at lower cost.

[1]All transistors are available from Newark Electronics, 500 North Pulaski Rd., Chicago, Ill. 60624. However, the 2N5416 may be a special order item. A second source for it is, Semiconductor Specialist Inc., P.O. Box 66046, O'Hare International Airport, Chicago, Ill. 60666. Include postage and insurance plus tax if Illinois resident. Cost of the 2N5416 is $4.95.

[*Continued on page 91*]

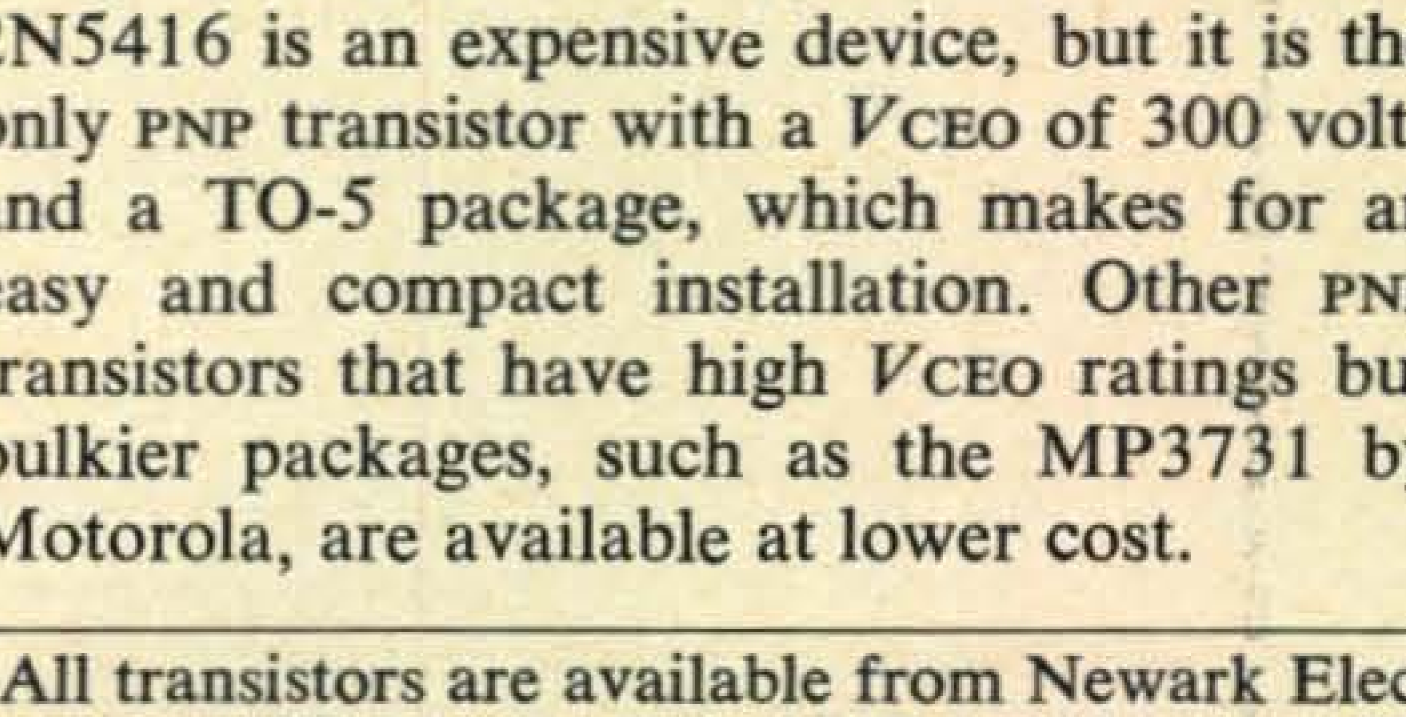


Fig. 3—Loading effect of diode CR_1 in the screen switch circuit is shown above. The arrow shows the low resistance path if CR_1 is in the circuit. The value of R_2 is low compared to R_1 because it drops only 1/18 of the key votage and B plus voltage.

DX

BY JOHN A. ATTAWAY,* K4IIF

S.S.B. DX Honor Roll							
WA2RAU	319	W6YMV	303	F2MO	292	G3WW	269
W2TP	318	WØQVZ	303	W2FXN	292	MP4BBW	267
W9ILW	316	XE1AE	302	K1IXG	288	W8BVF	266
VK3AHO	315	W2BXA	302	SM6CAS	286	G2PL	265
W3NKM	315	G3AWZ	301	W2LV	286	G2BVN	264
W6EL/		G3DO	301	W6EUF	286	W2FXE	264
K6CYG	315	G6TA	301	K8RTW	286	WA6GLD	263
TI2HP	314	WA2EOQ	301	W9EXY	284	W2MJ	261
W2RGV	314	W3DJZ	301	W3KT	281	W9QLD	261
W8DE	314	G3HDA	300	W1LLF	280	W6PTS	260
DL9OH	313	VE3ACD	300	W6UOU	280	W6WNE	259
I1AMU	312	K1SHN	300	W3FWD	279	PJ2AA	258
WA2IZS	312	W4IC	300	W4RLS	279	PAØEEM	256
K6LGF	312	W9JT	300	K4OEI	279	CT1PK	254
G3FKM	310	W4SSU	299	DL3RK	278	ZS6LW	253
KP4CL	310	5Z4ERR	298	DL1IN	276	HP1JC	252
W4NJF	310	K2DX	297	K4HYL	276	PAØSNG	252
WA8AJI	310	W4QCW	297	W7DLR	276	K4GXO	252
W4OPM	309	W8BT	297	PZ1AX	274	VE6TP	251
K6YRA	309	KØUKN	297	K9EAB	273	W8ILC	251
G8KS	307	K8IKB	296	K9LUI	273	W1AOL	250
W5KUC	307	W4PAA	294	W6RKP	272		
SM5SB	305	W8EVZ	293	G3NUG	270		
W2ZX	305	K8ONV	293	K9PPX	270		

This month's column doesn't contain the information on rare zones, prefixes, and s.s.b. stations which we normally publish. This change was dictated by a business trip to DJ-DL land, which made it necessary to submit the column about 2 weeks ahead of the normal deadline. This also explains the small number of WAZ, WPX, and S.S.B. DX Awards authorized. There were only half the normal number of certificates because we had only half the usual time for checking cards and processing applications. Things should be back on a regular basis next month.

RM-1393, The Final Disposition

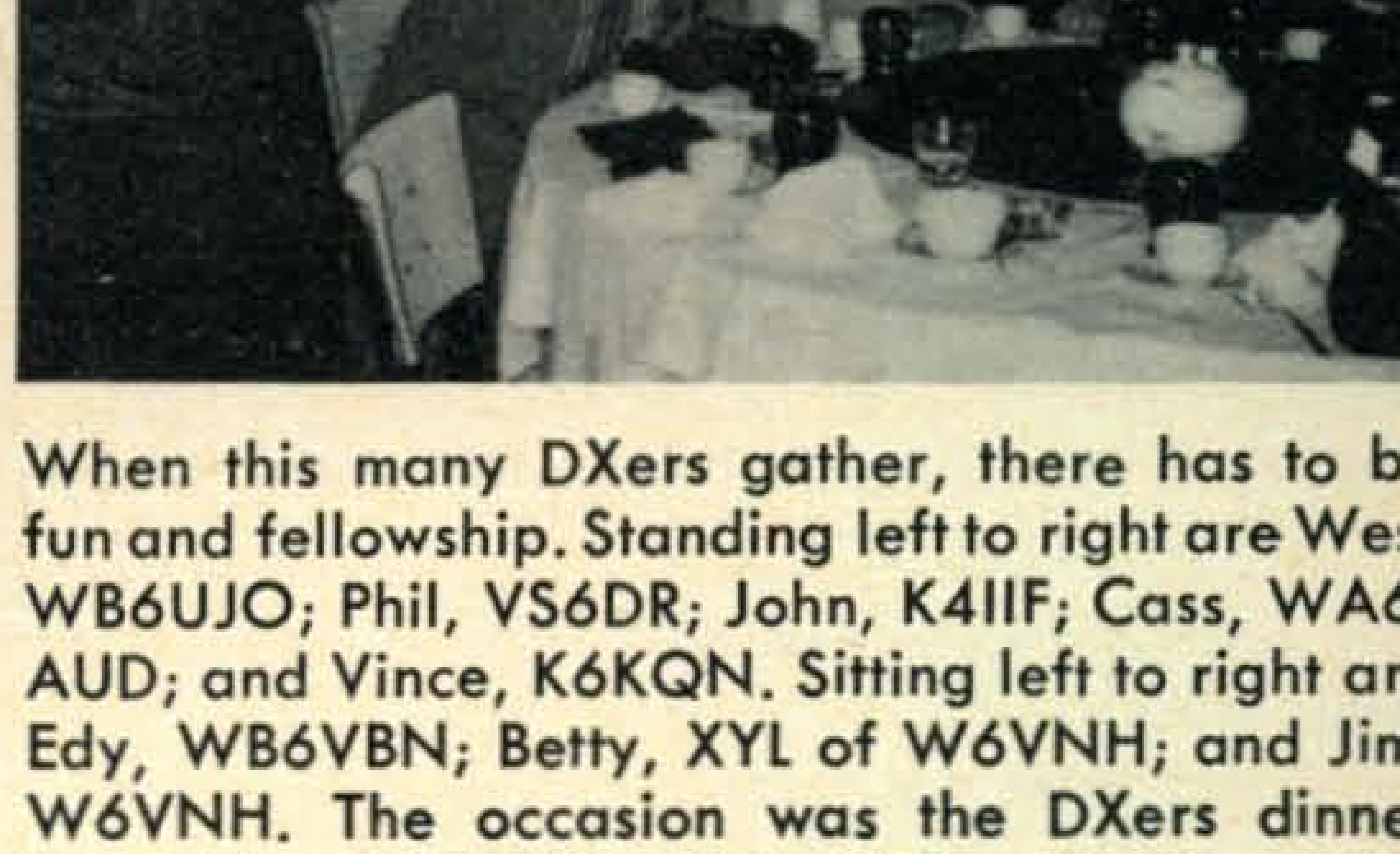
Those of you who follow this column regularly are aware that De Extra had grave misgivings about the Incentive Licensing program, particularly as it applied to the high frequency c.w. bands. We were sufficiently concerned to petition the FCC not to expand the restricted frequencies to include 14025-14050 kc and 7025-7050 kc. This petition was assigned the now well-known file number RM-1393, and many amateurs were quick to support it. We thank you one and all, because the battle has been won, and every supporting letter was a contribution to the victory.

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

Amateur exhibition in the Town Hall of Quelimante, Mozambique in January, 1969. The event was sponsored by the Liga dos Radio-Emissoers de Mozambique. *(Photo courtesy CR7EY)*.

In it's order adopted Sept. 24, 1969 and released Sept. 26, 1969, the FCC not only agreed with the provisions of RM-1393, it went a step further in extending them to include the 80 and 15 meter c.w. bands as well. The exact words of the application portion of the order are as follows:

"The exclusive telegraphy sub-bands for the Amateur Extra Class licensees are relatively lightly used compared to the telegraphy usage of the balance of the band by other Classes of operators. Therefore, further expansion is not justifiable as a produc-



When this many DXers gather, there has to be fun and fellowship. Standing left to right are Wes, WB6UJO; Phil, VS6DR; John, K4IIF; Cass, WA6-AUD; and Vince, K6KQN. Sitting left to right are Edy, WB6VBN; Betty, XYL of W6VNH; and Jim, W6VNH. The occasion was the DXers dinner hosted by K6KQN and his XYL, Alberta, at the Imperial Restaurant on the "sunny side of Chinatown".

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The WAZ Program

725........I1YRK	728........HS3DR
726........WA6RTA	729........YS2CEN
727........K8ZFI	

C.W.—Phone WAZ

2771........WA9AZL	2776........EI8H
2772........W1SEB	2777........CR7BN
2773........K1SLZ	2778........OH2QQ
2774........W1QUS	2779........W7GVA
2775........SM3ARE	2780........WØCY

Phone WAZ

425........K6GRV	426........W3JK

Complete rules and an application blank for WAZ may be obtained by sending a self-addressed, stamped envelope to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

tive incentive to qualify for the Extra Class license at this time."

This should be reassuring to everyone, as it demonstrates that an individual can still be heard. A well-written petition submitted to the FCC in proper form will receive the same consideration as one from a large organization.

De Extra

An outstanding new DX Award which recently arrived on the scene is the International Call Areas Award (ICAA) sponsored by the International DX Organization (IDXO) based in Geneva, Switzerland. For the purpose of this award the world is divided into 450 call areas. It differs from WPX in that in populous countries there may be more than one call area designated by a single prefix. For example, each of our 50 states is separate, so that Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont count as individual call areas even though all are W1. However, there is no separate distinction for K1, WA1, KN1, etc. The call area counts once no matter how many different prefixes you may have confirmed from it. A 6-page leaflet containing the rules and official list of areas may be obtained by sending a self-addressed envelope and 2 International Reply Coupons to IDXO, P.O. Box 543, Geneva, Switzerland.

The rules and call areas were developed after a study lasting over a year. Every point was resolved by a majority vote of the IDXO Board of Directors composed of well known DXers from all continents. The officers of the IDXO are President, Roy F. Stevens, G2-BVN, Past President of the Radio Society of Great Britain; and Coordinator, Gerard de Buren, HB9AW/WA6QAU, a longtime, highly active member of the Internation Amateur Radio Club. The Directors from Africa are Charles Martz, TU2AY; Mike Dransfield, 5N2AAF; André Saunders, 5Z4KL; and Ulli Dehning, 7P8AR. The Directors from Asia are Robert A. Adams, OD5BZ; Herbert Asmussen, VS6AD; Bill L. Mitchell, XW8AX; and Paddy Gunasekera, 4S7PB. The Directors from Europe are Henrique Pessoa, CT1HX; Walter Gehrhalter, DL3-RK, Editor of *DX-MB* and a Member of the *CQ* DX Committee; Claude Ronsiaux, F9MS, DX Editor of *R.E.F.* and a member of the

OE5HGL operating in one of the recent CQ World Wide DX contests. QSL this OM through K9UTI, Box 567, Metropolis, Ill. *Photo courtesy K9UTI.*

A powerful DXing trio from the Caribbean. Left to right, Alvin, VP2LA, Lionel, VP2LS, and Herb, VP2LZ/KV4FZ. This photo was taken during Herb's recent stay in St. Lucia.

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One of Switzerland's most outstanding DXers, Rene Dehniger, HB9AHA, who recently received his coveted WAZ certificate after three years on the air.

S.S.B. DX Award

100 Countries

595........K8ZFI	600........ZL1LD
596........OX5AP	601........DL3VX
597........G3TLV	602........DJ1XU
598........VE3GMT	603........WAØPVW
599........JA6QZ	604........WA9PRO

200 Countries

183........OE2EGL	186........VK3XB
184........OZ3SK	187........K8ZFI
185........ZL1AGO	188........VE2DCY

300 Countries

46........OK1ADM	47........VE3ACD

Complete rules and an application blank for the S.S.B. DX Awards may be obtained by sending a self-addressed, stamped envelope to Award's Manager, 3785 Susanna Drive, Cincinnati, Ohio 45239, or to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

CQ Committee; Roy F. Stevens, G2BVN; Franco Armenghi, I1LCK; and Kjell Edvardsson, SMØCCE.

The Directors from North America include Barry Goldwater, K3UIG/K7UGA; John A. Attaway, K4IIF, DX Editor of *CQ;* Jim Fisk, W1DTY, Editor of *Ham Radio;* Jim Lawson, (ex-WA2SFP) longtime contest great; David P. Baker, W6WX, Member of the *CQ* Committee; and Rev. H. A. Maxwell Whyte, VE3BWY. The Directors from Oceania are Raoul Thomas, FK8AU; Philippe Postaire le Marais, FO8BO; David H. B. Duff, VK2EO; and Jock White, ZL2GX. The Directors from South America are Joaquin Galvez, CE3ZN; Dr. William Elasmar, HK3RQ; Gustavo Reusens C., OA4AV; and Gastao Carlos de Almeida, PY7AOA.

In addition to HB9AW, the Geneva headquarters team is composed of Len Jarrett, HB9AMS/VE3EWE; Richard Kay, HB9-ANW/G3OGF; Armin F. Loosli, PY1CYI/CE3ACL; and Jon Sigurdsson, TF3JS.

De Extra recommends ICAA as a very well-planned award and certainly well worth chasing.

A recent member of the WPX gang is Felix, HB9-AKJ, of Dielsdor. This young man splits his time about equally between c.w. and s.s.b. *(Photo via K4DSN).*

Prefix Master Sheet

Howard Kelley, K4DSN, *CQ*'s WPX Award Manager, has just completed preparation of the most through Master Worldwide Prefix List ever compiled. It is now available from Howard for only a self-addressed, stamped envelope, or self-addressed envelope with one IRC. Having seen the beautiful printing job I feel that this is the biggest bargain in amateur radio, and is a must for all prefix chasers.

QSL Manager of the Month

This month's honoree is very active DXer, Contester, and QSLer, Ron Kreger, VE3DLC, president of the Canadian DX Association. Ron is currently riding herd on logs and cards for the following stations from his home QTH at 30 Zenith Drive, Scarborough, Ontario: HI8XJA, HI8XPM, OX5AY, VP1-FW, VP2GN, VP2GBG, VP2GBH, VP2KF,

See page 104 for New Reader Service

The WPX Program

C.W.

967........OK3CEG
968........PZ1AV
969........JA2AYX
970........W4OWE
971........YU1NOL
972........K4TSJ
973........EA3KI

S.S.B.

456........DJ2YE
457........5A2TR
458........K3BYV
459........ON5DJ
460........ZS6DP
461........LU8KDA
462........VE7AHD
463........VS6AL
464........K4TSJ

Mixed

210........W4RJC
211........ZL3RQ
212........W2KF
213........YU2OB

Endorsements

S.S.B: VE7AHD–400, W6ZC–350, ZS6PP–350, HS3DR–300, VS6AL–300, WAØOTE–300, 5A2TR–300, G3TLV–250, ON5DJ–250, and WA6TAX–250.

C.W.: OK2PO–450, EA3KI–400, W2MBU–400, W2NEP–400, and OK3CEG–350.

Mixed: ZL3GQ–450.

Phone: W8PGD–400 and WA6TAX–350.

Europe: DJ2YE, OK3CEG, YU2OB, and ZL3GQ.

North America: K2DDK.

Oceania: DL1QT and WA5LOB.

20 Meters: EA3KI, GM5AHS, and ZL3GQ.

To obtain rules and an application blank for WPX send a self-addressed, stamped envelope to WPX Manager, 6563 Sapphire Drive, Jacksonville, Fl. 32208, or to DX Editor, P.O. Box 205, Winter Haven, Fl. 33880.

VP2MY/A, VP8JI, 6Y5CB, 6Y5GB, 6Y5-RM- 7XØAH, 8P6AH, 8P6AZ, 8P6BM, 8P-6BN, 8P6BX, 8P6CD, 8P6CE, 8P6CL, 8P-6CP, 8R1S, 8R1X, 8R1Z, 9Q5EP.

One interesting innovation which Ron uses is a special gummed sticker to explain difficulties with particular QSL requests. The sticker is headed *YOUR QSL DELAYED BECAUSE*, followed by a checklist of the following possibilities:

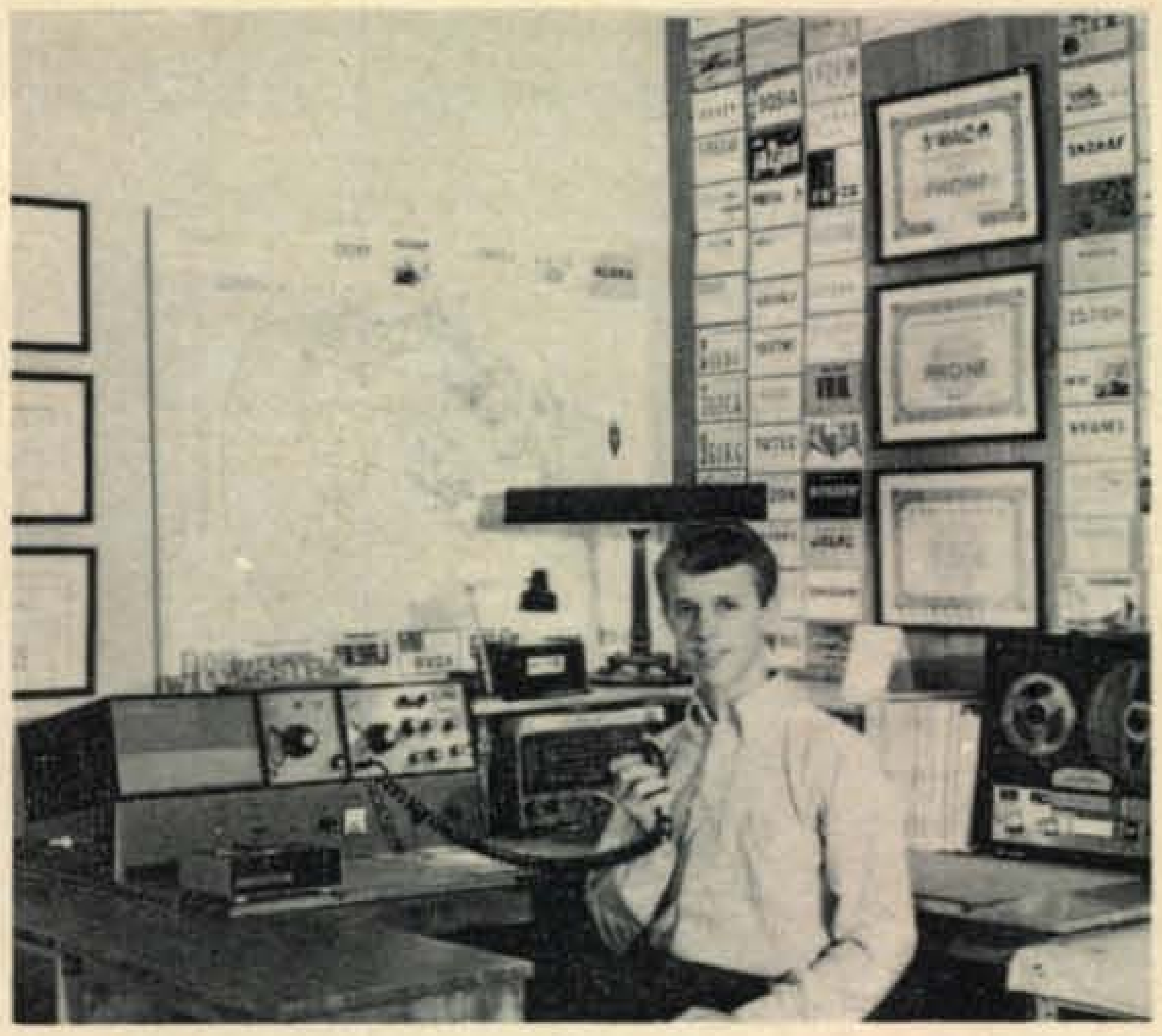
- ☐ U.S. postage not valid in Canada.
- ☐ No self-addressed envelope enclosed.
- ☐ Date and time not in GMT.
- ☐ Not in log. Check time and date.
- ☐ No return postage enclosed.
- ☐ Insufficient return postage. Airmail requires (   ) IRCs
- ☐ Log information delayed.

Amateur Radio in Other Countries

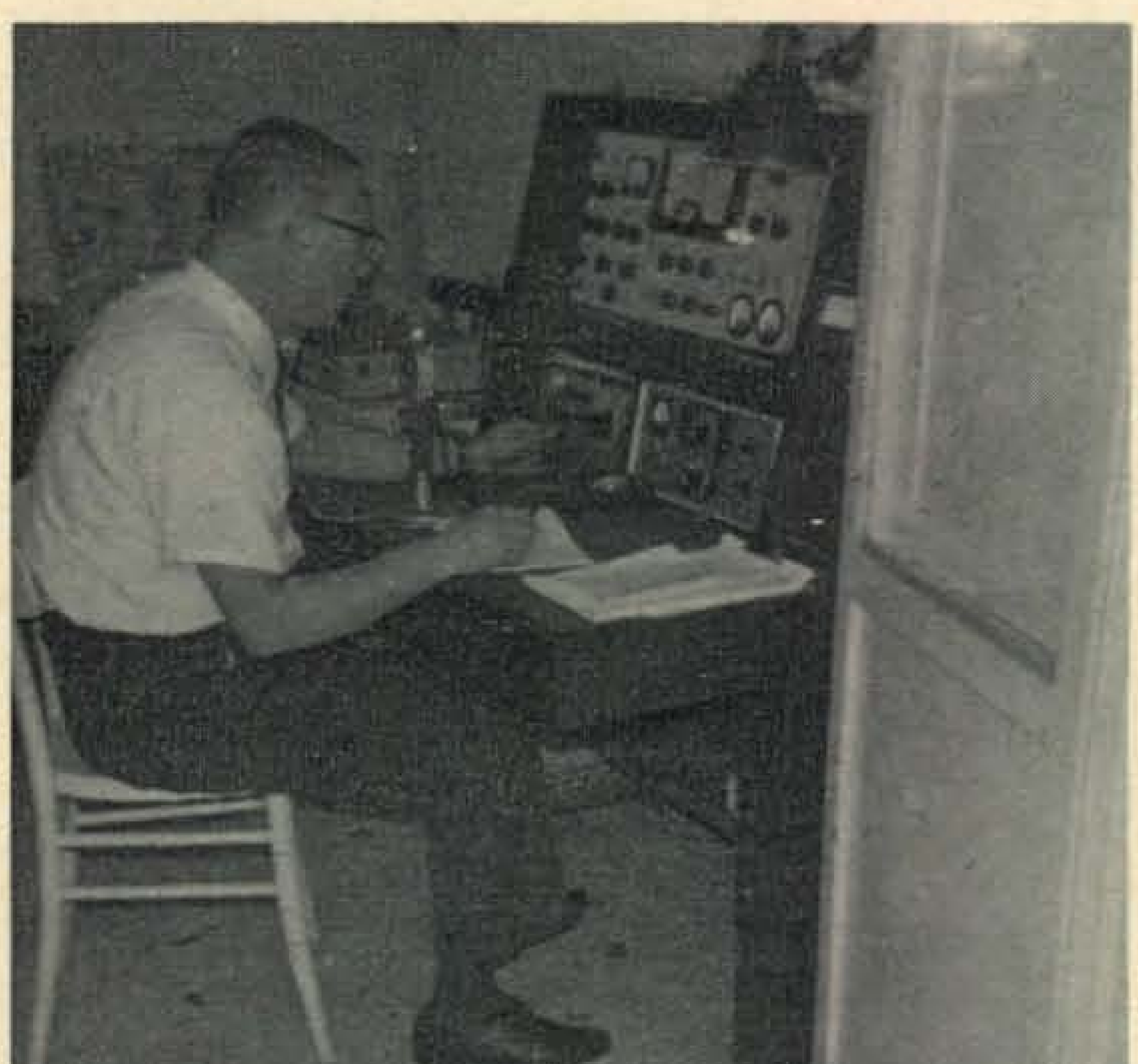
This is another in our series on ham radio abroad. The material was provided by Alberto Paleari, I1LA, the *CQ* DX representative in Italy and Marino Miceli, I1SN, a pioneer Italian amateur. We hope you enjoy these stories as we plan to feature France and Germany in upcoming columns, and will continue with other countries if popular with the readers.

Amateur Radio in Italy: The beginning was in that period between the first experiments by

[*Continued on page 92*]



Courtney Krehbiel, WA9TFM, of Geneva, Ill. This outstanding young DXer is very active in the CQ DX Awards program.



Dr. Rosario Pentimalli, I1AA, of Reggio Calabria. Dr. Pentimalli recently qualified for WAZ and the neat setup along with first class operating shows why.

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

Dec.	6-7	Alexander Volta RTTY
Dec.	6-8	Nevada QSO Party
Dec.	6-7	CHC International C.W.
Dec.	13-14	CHC International SSB
Jan.	3	Pacific DX Net QSO Party
Jan.	17-18	Louisiana QSO Party
Jan.	**24-25**	**CQ WW DX 160 Contest**
Jan.	24-26	Arkansas QSO Party
Jan. 30–	Feb. 2	Old, Old Timers QSO Party
Jan. 31–	Feb. 1	French C.W. Contest
Feb.	7-8	ARRL DX Phone Contest
Feb.	14-15	YL-OM Phone Contest
Feb.	21-22	ARRL DX C.W. Contest
Feb. 28–	Mar. 1	YL-OM C.W. Contest
Feb. 28–	Mar. 1	Operation's Day
Feb. 28–	Mar. 1	French Phone Contest
Feb. 28–	Mar. 2	Vermont QSO Party
Feb. 28–	Mar. 15	IARC Prop'tion CW/RTTY
Mar.	7-8	ARRL DX Phone Contest
Mar.	21-22	ARRL DX C.W. Contest
Mar. 28–	Apr. 19	IARC Propagation Phone
Apr.	4-5	Florida QSO Party
Apr.	**11-12**	**CQ WW WPX SSB Contest**
Apr.	18-19	Helvetia XXII
Apr.	25-26	DARC WAE RTTY Contest

Nevada QSO Party

Starts: 0001 GMT Saturday, December 6
Ends: 0800 GMT Monday, December 8

This is the first Nevada QSO Party and to commemorate the affair all certificates will be signed by Governor Paul Laxalt.

Exchange: QSO nr., RS/RST and QTH. Counties for Nevada stations, ARRL section or country for all others.

Scoring: Nevada stations score 1 point for each out of state QSO, multiplied by ARRL sections and DX countries worked.

Out-of-state stations score 5 points for each Nevada station worked, multiplied by number of Nevada counties worked. (max. of 17)

The same station may be contacted on each band and mode for QSO points.

Frequencies: C.W.–3735, 7175, 14135, 21135, 28035. RTTY–3620, 7140, 14090, 21100, 29010. Phone–3935, 7275, 14335, 21435, 29000. VHF–52.525, 145.8, 146.34, 146.94.

C.W. and RTTY operation is scheduled on the odd hours, phone on the even hours. (GMT)

Portable and mobile stations may also enter.

Awards: Certificates to top scorers in each ARRL section, DX country and Nevada county. Also each state and VE province. (other than a section winner, min. of 5 contacts) Novices in each state will also be rewarded.

Logs must show date/time in GMT, and also indicate band and mode used, and your location if portable or mobile.

Mailing deadline December 22 to: Nevada QSO Party, P.O. Box 73, Boulder City, Nev. 89005. Include a large s.a.s.e. for results.

Alexander Volta RTTY

Starts: 1400 GMT Saturday, December 6
Ends: 2000 GMT Sunday, December 7

The SSB & RTTY Club of Como, Italy announces its fifth contest honoring Alexander Volta.

Use all bands, 3.5 thru 28 mc. The same station may be worked on each band for QSO and multiplier points.

Exchange: Signal report and zone number. (The CPR Zone and ARRL Country lists. KH6, KL7 and VO considered as countries.)

Points: Two points for QSOs with stations in one's own Zone. Contacts with stations in other Zones have value as indicated in the Exchange Points Table.

Final Score: Total points multiplied by the sum of countries worked on each band.

Awards: Certificates to two top scorers in each country and US call area, and three top scorers using input of under 100 watts, and three top s.w.l. scorers.

Mailing deadline January 10th, to Contest Manager, Fanti Dott. Franco, Via A. Dallolio n. 19, 40139 Bologna, Italy.

Pacific DX Net QSO Party

From: 0400 to 1000 GMT Saturday, January 3

*14 Sherwood Road, Stamford, Conn. 06905.

See page 104 for New Reader Service

This is the first annual QSO Party for the PAC DX NET, and a good opportunity to work some of those elusive Pacific islands.

Net members can work anyone, non-net stations are limited to working net stations only.

Exchange: QSO nr., RS report and net number for Net stations, state for W/K stations. (The call will identify the country for DX stations)

Scoring: NET members get 1 point for each QSO, non-members 2 points for each QSO.

Multiplier: NET members, 1 for each W/K state and country worked. Non-members, 1 for each NET country worked.

Final score: QSO points X multiplier. Net stations will be found between 14260 and 14270 mc on SSB.

Awards: Certificates to the top ten NET members and to the top scoring non-member in each counry, W/K state and VK, ZL, JA call district.

There is a special "Pacific DX Net Award" for stations working at least 25 NET members, in at least 10 countries. Contacts in the QSO Party will be endorsed for this Award. (There is a .50 fee for members and $1.00 for non-members for this Award.)

Mailing deadline is Feb. 1st and logs go to: QSO Party Chairman, KH6GLU, P.O. Box 762, Kaunakakai, Hawaii 96748. Include a s.a.s.e. for copy results.

Louisiana QSO Party

Starts: 1800 GMT Saturday, January 17
Ends: 2200 GMT Sunday, January 18

This is the fifth annual party sponsored by the Lafayette ARC. Use all bands, c.w. and phone. The same station may be worked on each band and mode for QSO points.

Exchange: QSO nr., RS/RST and QTH. Parish for La. stations; state, province or country for all others.

Scoring: Louisiana, 1 point per QSO, including contacts with other La. stations. Total multiplied by number of states, VE provinces and DX countries worked.

All others, 1 point for each La. QSO. Total multiplied by number of Louisana parishes worked. (max. of 64)

Frequencies: 3600, 3910, 7075, 7260, 14075, 14300, 21075, 21400, 28100 and 28700.

Awards: For Louisiana, certificates to that 1st, 2nd and 3rd place winners. And the W5PM Trophy to the Top La. station.

Out-of-state, certificates to the top scorer in each state, VE call area and DX country. (min. of 50 points for W/K stations, 25 points for DX stations.)

Logs go to: Lafayette A.R.C., att: Danny Griffith K5ARH, 123 Normandy Road, Lafayette, Louisiana 70501. Mailing deadline Feb. 28th include s.a.s.e. for copy of results.

That smiling fellow on the left is one of the world's best-known contest operators, Walter Skkudlarek, DJ6QT. The other smiling chap is Freddie, W2IWC again making another presentation. This time its the CQ Plaque for winning the European All Band Championship in the 1967 Phone Contest.

CQ WW 160 Contest

Starts: 0000 GMT Saturday, January 24
Ends: 1500 GMT Sunday, January 25

No changes in the rules, everything remains same as last year. Not the conditions we hope, they were pretty horrible for the last one.

1. This is a c.w. *only* contest. No c.w. to phone or cross band contacts allowed.

2. For W/VE/VO stations: Contacts with other W/VE/VO stations, 2 points per QSO. Contacts with all other countries, 10 points.

3. For all other countries: 2 points per QSO with stations in the same country, 5 points with stations in other countries. Except contacts with W/VE/VO stations, which count 10 points.

4. For all stations: A multiplier of one (1) for

The 14GAD gang from Bologna, world high scorers in the Multi-Operator, Single Transmitter catagory of the 1967 Phone Contest. L. to R.—Bob, I1TAE; Franco, I1LCK; our own Freddie, W2IWC presenting the John Knight, W6YY Trophy to Enrico, I1GAD; Augusto, I1AUM and Giancarlo, I1BXN.

See page 104 for New Reader Service

United States & Possessions 160-Meter Operating Regulations

Area	Maximum D.C. Plate Input Power in Watts															
	1800 to 1825 kc		1825 to 1850 kc		1850 to 1875 kc		1875 to 1900 kc		1900 to 1925 kc		1925 to 1950 kc		1950 to 1975 kc		1975 to 2000 kc	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Alabama	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Alaska	200	50	0	0	0	0	200	50	0	0	0	0	0	0	0	0
Arizona	0	0	0	0	0	0	0	0	0	0	200	50	500	100	1000	200
Arkansas	1000	200	200	50	100	25	0	0	0	0	100	25	100	25	500	100
California	0	0	0	0	0	0	0	0	100	25	200	50	200	50	500	100
Colorado	200	50	0	0	0	0	0	0	0	0	200	50	200	50	1000	200
Connecticut	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Delaware	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
District of Columbia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Florida	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Georgia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Hawaii	0	0	0	0	0	0	0	0	200	50	100	25	100	25	500	100
Idaho	100	25	0	0	0	0	100	25	100	25	100	25	100	25	500	100
Illinois	1000	200	200	50	100	25	0	0	0	0	0	0	0	0	200	50
Indiana	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	200	50
Iowa	1000	200	200	50	200	50	0	0	0	0	100	25	100	25	500	100
Kansas	500	100	100	25	100	25	0	0	0	0	100	25	200	50	1000	200
Kentucky	1000	200	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Louisiana	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Maine	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Massachusetts	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Michigan	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Minnesota	500	100	100	25	100	25	100	25	100	25	100	25	100	25	500	100
Mississippi	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Missouri	1000	200	200	50	100	25	0	0	0	0	100	25	100	25	500	100
Montana	100	25	0	0	0	0	100	25	100	25	100	25	100	25	500	100
Nebraska	500	100	100	25	100	25	0	0	0	0	200	50	200	50	1000	200
Nevada	0	0	0	0	0	0	0	0	100	25	200	50	200	50	1000	200
New Hampshire	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
New Mexico	100	25	0	0	0	0	0	0	0	0	100	25	500	100	1000	200
New York	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
North Carolina	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
North Dakota	500	100	100	25	100	25	100	25	100	25	200	50	200	50	1000	200
Ohio	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Oklahoma	500	100	100	25	100	25	0	0	0	0	100	25	200	50	1000	200
Oregon	0	0	0	0	0	0	0	0	200	50	100	25	100	25	500	100
Pennsylvania	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Rhode Island	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
South Carolina	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
South Dakota	500	100	100	25	100	25	100	25	100	25	200	50	200	50	1000	200
Tennessee	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	200	50
Texas	200	50	0	0	0	0	0	0	0	0	0	0	100	25	500	100
Utah	100	25	0	0	0	0	100	25	100	25	200	50	200	50	1000	200
Vermont	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Washington	0	0	0	0	0	0	0	0	200	50	0	0	0	0	500	100
West Virginia	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Wisconsin	1000	200	200	50	200	50	0	0	0	0	0	0	0	0	200	50
Wyoming	200	50	0	0	0	0	100	25	100	25	200	50	200	50	1000	200
Puerto Rico	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Virgin Islands	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Swan Island	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Serrana Bank	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Roncador Key	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Navassa Island	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Baker, Canton, Enderbury, Howland	100	25	0	0	0	0	100	25	100	25	0	0	0	0	100	25
Guam, Hohnston Midway	0	0	0	0	0	0	0	0	100	25	0	0	0	0	100	25
American Samoa	200	50	0	0	0	0	200	50	200	50	0	0	0	0	200	50
Wake	100	25	0	0	0	0	100	25	0	0	0	0	0	0	0	0
Palmyra, Jarvis	0	0	0	0	0	0	0	0	200	50	0	0	0	0	200	50

CQ Form 1063 effective January, 1969.
Additional copies may be obtained for a self-addressed stamped envelope.

A reduced view of the United States Operating Regulations for 160 meters. Much larger copies are available from either CQ or W2EQS. An s.a.s.e must accompany your request.

each state, Canadian province or foreign country worked.

5. Final score: Total QSO points multiplied by total multiplier.

6. Exchange: RST report plus a progressive three contact number starting with 001 for the first contact, followed by your sate or province. (It is not necessary for DX stations to send their country, that's quite obvious.)

7. Disqualificaions: Violation of the rules and regulations pertaining to amateur radio in the country of the contestant, or the rules of this contest, or unsporsmanship conduct, or taking credit for duplicate contacts in excess of 3 percent of the total number made, will be deemed sufficient cause for disqualification.

8. Awards: Certificates to the top scoring station in each state, Canadian province and foreign country. 2nd and 3rd place àwards will be made if the score or participation warrants.

'Hawaii and Alaska will be considered "foreign countries" for QSO and multiplier credit. The District of Columbia counts same as Maryland. And don't forget, VE1 is divided into three provinces, Nova Scotia, New Brunswick and Prince Edward Island.

Log sheets and United States Operating Regulations for 160 may be obtained from *CQ* or W2EQS upon request. A large s.a.s.e. must accompany your request.

Mailing deadline for logs is February 28th and they go to: Contest Chairman, Charles M. O'Brien, W2EQS, 48 Prospect Ave., Westwood, N.J. U.S.A. 07675.

Arkansas QSO Party

Starts: 2200 GMT Saturday, January 24
Ends: 0400 GMT Manday, January 26

This is the fifth QSO Party sponsored by the North Arkansas ARS. The same station may be warked once on each band and each mode for QSO points.

Exchange: QSO nr., RS/RST and QTH; county for Ark. stations, state, VE province or country for all others.

Scoring: For Arkansas, I point per QSO, multiplied by numbed of states, VE provinces and DX countries worked. Out-of-state stations, 5 points per each Ark. QSO, multiplied by number of Ark. counties worked. (max. of 75)

Frequencies: C.W.–3560, 7060, 14060, 21060, 28060. SSB–3960, 7260, 14300, 21360, 28560. Novices–3735, 7175, 21110.

Awards: A certificate to the highest scoring station in each state, VE province and foreign counry. (min. of 100 points)

Mailing deadline is February 5th and logs go to: North Arkansas A.R.C., Att: J. K. Fancher, Jr., W5WEE, 407 Skyline Terrace, Harrison, Arkansas 72601.

Editor's Notes

Its rather anticlimatic to be writing about our DX contest at this late date. By the time you will be reading his column both events will be over.

However we do anticipate another record return, especially in the Phone Contest. George Jacobs indicated that we would have conditions equal to those experienced last year, and they were terrific in the '68 phone week-end.

As for the c.w. section we will again be happy if we can hold our own in that one. Now that the FCC has held off on the additional frequency cut-backs anticipated on Nov. 22nd, we have a better chance to meet this challenge.

Keep hose logs coming fellows, but keep 'em neat and all scored. Remember, we have almost 3000 to check, you only have one, your own.

Here its another year and the Holidays will soon be here. All the best to you and yours for the Christmas Season, and may the New Year bring you many Blessings.

73 for now, Frank, W1WY

See page 104 for New Reader Service

Q AND A

BY WILFRED M. SCHERER,* W2AEF

More Notes on TXI

In last month's discussion on TXI an account was given of W6WZK's unsuccessful attempts in obtaining satisfaction from a prominent manufacturer of entertainment appliances in regard to a TXI situation. We are happy to report that in contrast to this, most helpful assistance in finding a solution to a recent TXI problem was provided through the cooperation of a different manufacturer and his local service representative. Detailed information on this case will be given in a future column.

Also, one of the TXI preventitive measures suggested last month was the use of shielded leads for external-speaker connections. It has since been found that where such leads are of appreciable length, they could aggravate the situation. In such cases the shield functions as a grounded-base r.f.-pickup antenna tuned near the frequency of the interfering transmitter, inducing r.f. into either the inner lead or the equipment itself. This might be cured either by altering the lead length to detune it or by connecting the speaker-end of the shield directly to a good ground.

Another situation is that TXI could more readily be involved when the transmitting antenna is a vertical one instead of a horizontal job, a condition that was commonly experienced with BCI in the days before TVI, due to the vertical polarization, low radiation angle and the omnidirectional characteristics of vertical radiators.

Even with a horizontal antenna, a vertical-radiation component could exist due to antenna currents on the shield of a coax feedline. Under such conditions, a balun at the antenna-end of the line (as suggested last month) should minimize the possibility of a vertical component that could create a substantial enough r.f. field to cause TXI that might not otherwise be experienced. A low s.w.r. also should be maintained.

*Technical Director, *CQ*.

V.F.O. Problems

QUESTION: I am using a Galaxy V with the remote v.f.o. (RV-1). Both the remote v.f.o. and the inboard one have developed problems, as follows:

The inboard v.f.o. remains exceptionally stable as always, but when tuning across a signal, I get a tremendous frequency warble. When I stop the physical tuning, whatever frequency the v.f.o. is then at is a constantly stable one. The gear mechanism seems as firm as always and there do not appear to be any mechanical problems.

The outboard v.f.o. has a different problem. There is no warble, but every minute or so the frequency suddenly jumps 300-500 c.p.s. both on receive and transmit. This unit, as well as the other, has been re-tubed. Voltages and resistances check okay and the VR-tube output voltage remains constant when the shift occurs. Got any ideas on solutions?

ANSWER: The frequency warble on the internal v.f.o. for the Galaxy V probably is due to poor ground contacts at the capacitor rotor. Make sure the ground wipers are tight. Sometimes these get loose and require a corner or two to be soldered to the capacitor frame. It may be that those in the Galaxy unit are spot welded to the frame, but check them anyway. Also, squirt a good contact cleaner on the bearing surface of the wipers. We generally use Spray Kleen put out by GC (General Cement Co.).

Dirty or loose multiple ground paths also can cause trouble. Make sure all ground connections (or points where the capacitor frame makes ground contact) are tight. One such ground path may be through the drive mechanism, so look for dirt here too that requires cleaning out.

As for the frequency jumps in the outboard v.f.o., this may be due to a loose connection or a bad contact at the tube socket which is affected by heating cycles. Another likely cause, and one rather difficult to pin point, is a defective fixed or trimmer capacitor. We don't know what the "innards" of this v.f.o. constitute, but a mica, ceramic or temperature-compensating capacitor (at the tuned circuit or for coupling) may be bad. If a switch is involved, check this over for dirt, a bad detent, contact, etc. If the v.f.o. has its

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own amplifier or buffer, the trouble could be here, since changes in loading by this stage could affect the v.f.o frequency.

Dirt in Equipment

While we're on the subject of dirt in certain equipment, it might be well to point out some precautions against such conditions that may affect not only v.f.o.'s, but also tuning capacitors for r.f. circuits as well as other components. Yes, dust will even seep into potentiometers. Besides causing noisy operation, accumulations of dirt or dust with a mixture of moisture can eventually create undesirable leakage paths, cause voltage breakdowns or other difficulties.

A good preventive measure against dirt buildup, particularly where the equipment has a perforated cabinet or open back, is to keep the gear covered with paper, a plastic-bag material or lint-free cloth when it is not in use.

This may not be practical with some mobile installations, where dirt accumulation is most apt to occur; but if it is not so, an alternative would be to remove the gear when it is not expected to be used over a particular period of time. If either expedient is not suitable, it would be well to at least periodically remove the gear temporarily, remove dust or dirt with a small brush and then wipe sections clean with a cloth. A pipe cleaner often will be handy for removing dust from between variable-capacitor plates. Periodic cleaning also should be considered for home-station gear.

Appeal for Manuals

Morrow Receiver Model MBR-5
Morrow Transmitter Model MB-560A
Morrow Power Model RTS-600S
Hallicrafters Panadapter Model SP-44
P & H Linear Amplifier Model LA-500

If any of our readers have any technical data on these items, we'd appreciate receipt of such to enable Zerox'ed copies to be made for forwarding to those concerned. Unless otherwise specified, all material will be returned to the sender. Thanks.

Hum on NCX-5 Incremental Tuning

QUESTION: I get hum in the receiver of the NCX-5 when the incremental tuning is used. How can this be cured?

ANSWER: Hum on the NCX-5 incremental tuning can be cured this way:

At the incremental-tuning control, disconnect the two resistors and capacitors from the ground lug held by the control. Connect these ends of the resistors and capacitors to a new ground lug to be installed directly on the chassis below. This will eliminate an a.c. ground loop through the panel caused by the pilot lamp circuits.

Grid Current on SB-200 Linear Amplifier

QUESTION: Your comprehensive and excellent review on the Heath SB-200 linear amplifier was most gratifying. I have the following question on it:

While using the amplifier, driven by a Drake TR-4, a drastic drop in grid current is experienced when the amplifier is tuned for maximum output and with a plate current of about 600 ma. Will the amplifier be harmed when the load is reduced to 500 ma where the grid current then comes up?

ANSWER: The drop in grid current when the amplifier is fully loaded is a normal condition. Tune up the amplifier as outlined in the review or as you have done for maximum *output*. If the amplifier is lightly loaded, it will easily be overdriven and high grid current will be indicated. The overall result will be ready susceptability to flattopping and undesirable distortion.

The lower you can keep the grid current for a given power level, the better the linearity or quality of the signal. The grid current indicates that you have r.f. drive for the specified power level, but when the grid current goes down on full tuneup, some of the driving power is absorbed by the load and thus is transferred to it.

Year-End Thoughts

This month marks the end of the second year for the present Q & A Column. As in the past, we again thank those who have submitted questions, provided helpful information for others or who have patiently waited for replies, many of which are still delayed due to the huge backlog of mail which just seems to grow larger day by day.

We are also grateful for the complimentary letters, those with words of encouragement and particularly those expressing appreciation for our efforts in finding solutions to the individual's problems. These make our task more rewarding.

And now—may the joy and peace of Christmas be with you, always!

73, Bill, W2AEF

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Propagation

BY GEORGE JACOBS,* W3ASK

DURING December and January, propagation conditions in the high frequency amateur bands between the United States and Europe, the Far East, Central America and the northern half of Africa are expected to remain at about the same level as during this past October aNd November. Conditions on paths between the USA and central and southern Africa, South America, Oceania and parts of south and southeast Asia are expected to decrease somewhat as a result of seasonal changes within the ionosphere.

Good-to-Excellent openings are forecast to most areas of the world on 10 meters from shortly after sunrise through the late afternoon hours. Excellent openings are also expected on 15 meters from shortly after sunrise through the late afternoon and early evening hours. During most of the daylight hours it will be a toss-up between 10 and 15 meters for DX propagation honors.

Good-to-excellent DX propagation conditions are also forecast for 20 meters. The band should open at sunrise, and remain open to one area of the world or another through the daylight hours and into the early evening. To some areas of the world, 20 meters may remain open during the hours of darkness as well. Optimum DX conditions generally occur on this band during the sunrise period and again during the late afternoon and early evening hours.

DX propagation conditions to most areas of the world are usually at their best on the lower frequency bands during the winter months. Static levels on these bands should be at seasonally low values during December, and signal levels are expected to be stronger than at any other time of the year. DX openings on 40 meters should begin during the late afternoon hours, with the band opening first to Europe and to other areas in a north-

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

LAST MINUTE FORECAST

Dec. 1 through Jan. 15, 1970

	Forecast Rating & Quality			
	Days (4)	(3)	(2)	(1)
Above Normal: Dec. 1, 7, 15, 18, 28, 31. Jan. 10, 12.			B-C	C
Normal: Dec. 2-3, 5-6, 8, 11-14, 16-17, 19-22, 26-27, 29-30. Jan. 1, 3-5, 7, 9, 11, 13-15.	A-B	B-C	C-D	D-E
Below Normal: Dec. 4, 9-10, 23, 25. Jan. 2, 6, 8.	C	D	D	E
Disturbed: Dec. 24.	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.; 500 watts s.s.b., or 100 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 December 15, 1969 through February 15, 1970, and are prepared from basic propagation data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

easterly direction. The band should remain open to one area of the world or another through the hours of darkness and until shortly after sunrise, when conditions to Oceania and to areas in a generally westerly direction are expected to peak.

Fairly good 80 meter DX openings to many areas of the world are forecast during the

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hours of darkness, at times with exceptionally strong signal levels. Some fairly good 160 meter openings are also likely to take place during the same time period. DX conditions on both 80 and 160 meters usually peak when the transmission path is entirely in darkness, or when part of the path is in darkness and the other in either twilight or dawn.

V.H.F. Ionospheric Openings

There is a slight possibility that some transcontinental F-layer openings may be possible on 6 meters during December. Some openings may also be possible between the continental USA and Hawaii and between the USA and South America. The best time to check for F-layer 6 meter openings is about an hour or so before noon, and during the early afternoon hours.

Two significant meteor showers are expected during December, during which time meteor-scatter openings may be possible on the 6 and 2 meter bands. *Geminids*, a major shower, should take place during the second week of the month, peaking on December 13. *Ursids*, a less intense shower, is expected to last for about two days, peaking during the *daylight* hours of December 22. Most meteor showers peak during the night, usually just before dawn; Ursids is the exception.

TE, or trans-equatorial scatter openings on 6 meters are expected to fall off a bit in the northern hemisphere during December, but some should be possible between the USA and South America. TE openings take place during the evening hours, peaking between approximately 8 and 11 P.M. at the path mid-point.

A secondary seasonal peak in sporadic-E propagation is expected during December (the major peak occurs during the summer months). This should result in a number of short-skip openings, between distances of approximately 800 and 1400 miles, on 10 and 6 meters. Although the early evening hours are generally favored for such openings, they may occur at any time.

Some auroral-type v.h.f. ionospheric openings are also likely to occur during December, especially when ionospheric conditions on the h.f. bands are below normal or disturbed. Check the "Last Minute Forecast" at the beginning of this column for the days that are most likely to be in these categories during the month.

Sunspot Cycle

The Zurich Solar Observatory reports a monthly mean sunspot number of 81 for September, 1969. This was the lowest level of solar activity observed since September, 1967. September's sunspot activity results in a smoothed sunspot number of 106, centered on March, 1969, as the present cycle continues to decrease slowly. A smoothed sunspot number of 97 is forecast for December, 1969.

This month's column contains DX Propagation Charts valid from December 15, 1969 through February 15, 1970. Short-Skip Propagation Charts valid for December appeared in last month's column.

The Editor of this column would like to take this opportunity to extend his warmest wishes to everyone, everywhere, for a Merry Christmas and a very Happy New Year.

73, George, W3ASK

December 15,–February 15, 1970

TIME ZONE: EST (24-Hour Time)

EASTERN USA TO:

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

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

TIME ZONES: CST & MST (24-Hour Time)

CENTRAL USA TO:

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

[*Continued on page 82*]

A MUST FOR EVERY DXER

DX AWARDS LOG

This fabulous book sells for $3.95 anywhere in the U.S. and is available for immediate delivery from the CQ Technical Library. However, with any subscription to CQ you can obtain a copy of the *DX Awards Log* for just $1.50 (a $2.45 savings). To obtain your DX Log at the discount price it must accompany a subscription order to CQ, but that order can be for renewals or extensions as well as for new subscriptions.

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☐ New Subscription ☐ Renewal ☐ Extension

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Propagation [*from page 79*]

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

TIME ZONE: PST (24-Hour Time)

WESTERN USA TO:

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

See page 104 for New Reader Service

VHF TODAY

BY ALLEN KATZ,* K2UYH

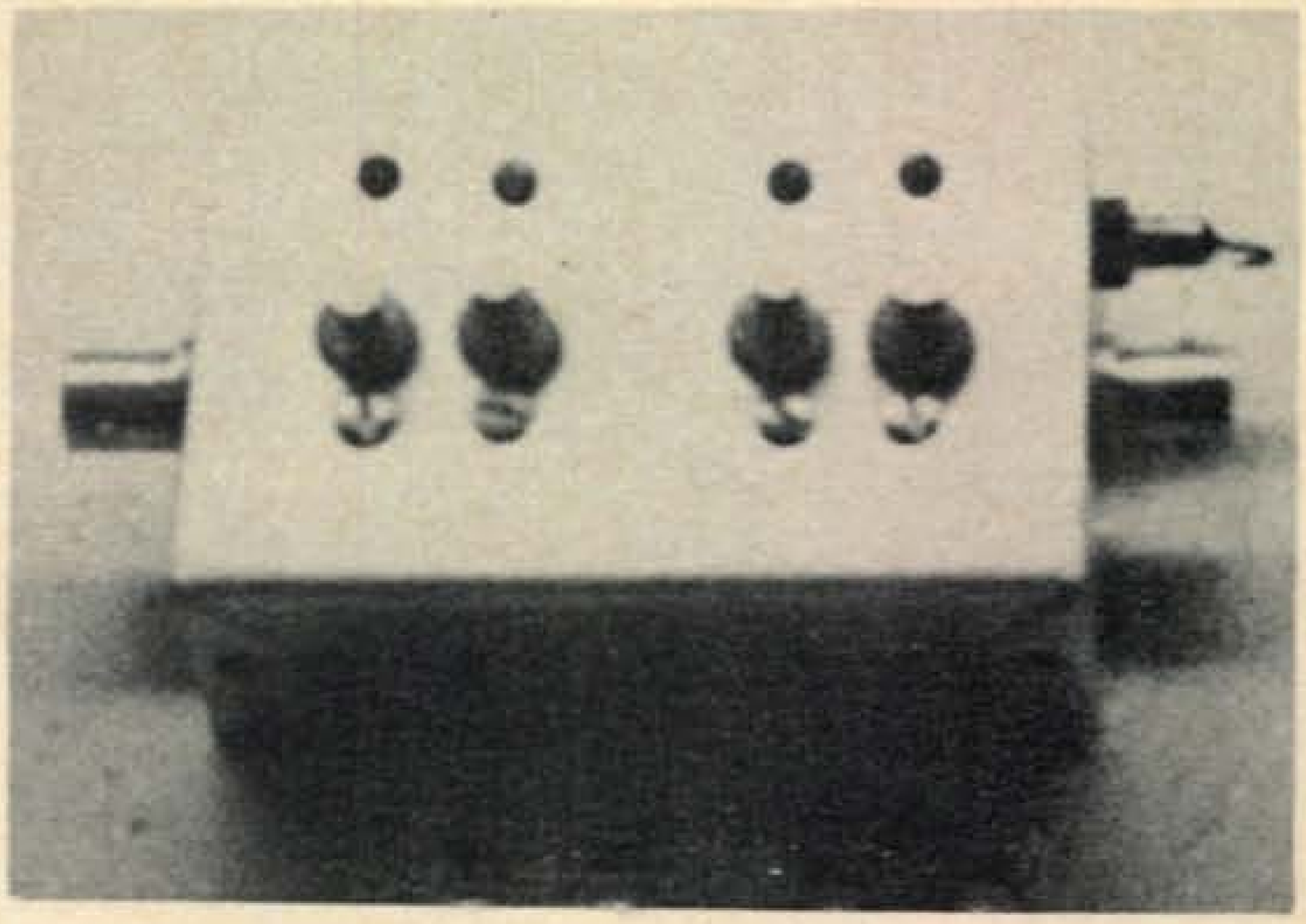
How would you like to possess a little box which could be inserted anywhere in your receiving system to obtain a gain of 30 db or more. Such a device would have been in the realm of fantasy several years ago, but today in the solid state age it is practical and the subject of this months column.

10 to 500 Mc

The device we are talking about is a broadband transistor amplifier, the schematic of which is drawn in fig. 1. It has a gain of about 30 db from just under 500 mc to just above 10 mc. And it can have a noise figure below 3 db even at 432 mc when constructed of really hot transistors.

We first ran across the circuit for this unusual amplifier at a talk given by Bill Ashby, K2TKN, on VHF Transistor Circuits at the HARC Convention in October of 1968. The circuit shown is actually that of two amplifiers in cascade. Any number of the basic two transistor amplifier units may be cascaded to obtain as much gain as desired. The secret of the amplifier's flat broadband response is the negative feedback provided by the 220 ohm resistor—10 mmf capacitor combination in the emitter lead of the second transistor.

*66 Skytop Road, Cedar Grove, N.J. 07009.



Top view of the broadband transistor amplifier.

The low frequency cutoff may be decreased at the expense of high frequency characteristics by increasing the size of the emitter bypass capacitors and the corresponding coupling capacitors.

Applications

We keep our broadband amplifier mounted near the v.h.f. converters. Most of the time it is in use between the output of one of our v.h.f. converters and the 28 mc input of our noise (radar) blanker. The broadband i.f. noise blankers described in the ARRL's *VHF Manual* and *Radio Amateur's Handbook* are great devices. When working properly they can completely cure radar and ignition noise problems. Unfortunately, most v.h.f. converters do not have enough output to fully drive these blankers. Hence, much of the weaker radar pulses and ignition noise gets through. One solution to this problem is to have an extra high gain amplifier between your converter and the blanker, as we do.

Another place we frequently use our broadband amplifier is between our low noise 432 mc preamp and our ATV converter. Our 432 mc preamp does not have enough gain to completely override the high noise figure of the converted u.h.f. TV converter we use for amateur TV operation. Putting the broadband amplifier in between, completely cures this problem.

[*Continued on page 90*]

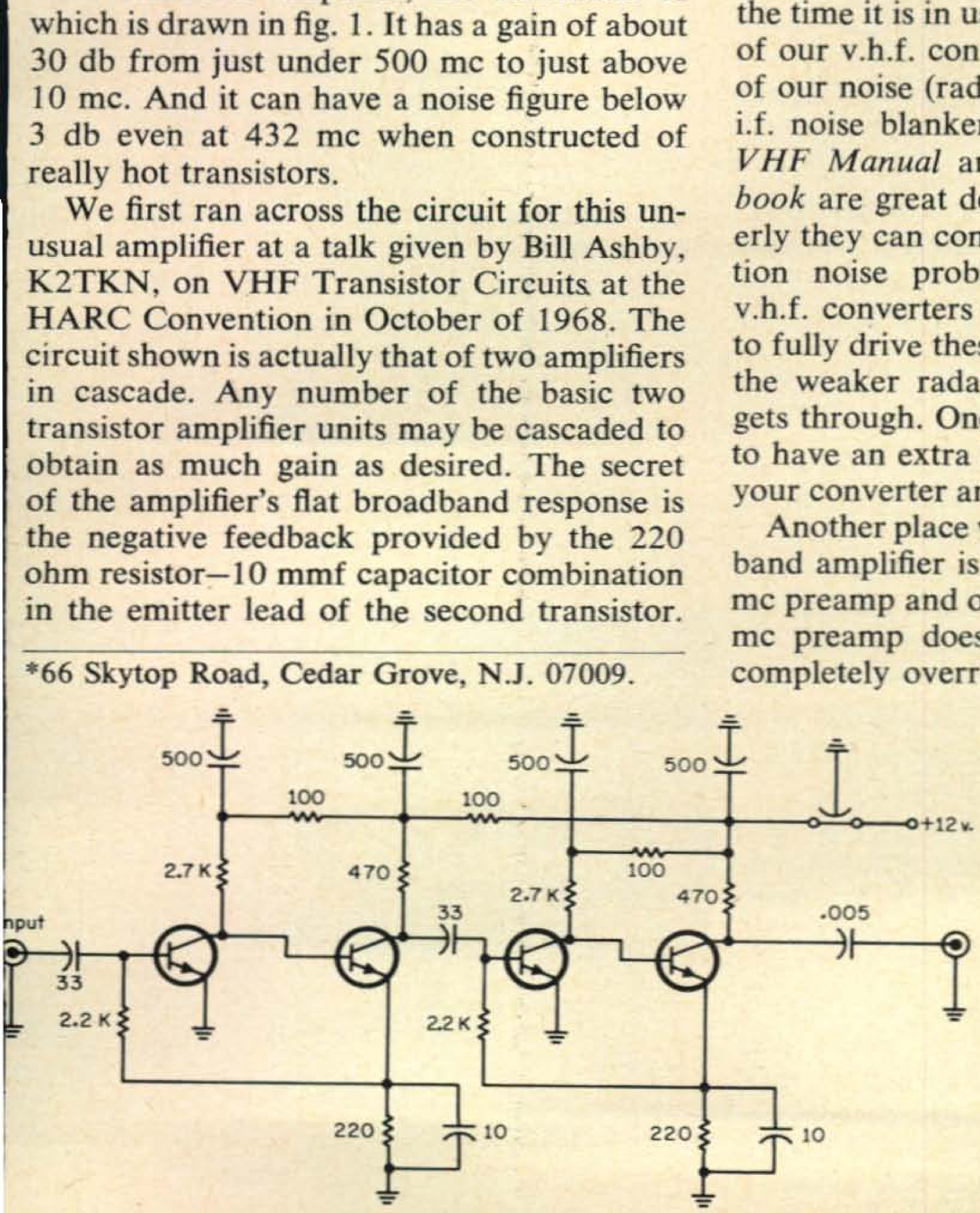


Fig. 1—Schematic diagram of the 10-500 mc broadband amplifier.

THE awards PROGRAM

BY ED HOPPER,* W2GT

THE December, "Story of The Month", as promised, about Eddie Palmer, K4LSP, after this data.

Mixed USA-CA-3000 awards went to Bill Todd, K4ISE; Ben Harris, K5DRF; and Don Birch, K7NEQ. Don, K7NEQ also received a 2500 award endorsed All 14 mc and USA-CA-2000, 1500, 1000 and 500 awards endorsed All 14 mc 2 × SSB. Bob Disbrow, WB2ZSO qualified for Mixed USA-CA-2000, 1500, 1000 and 500 awards. John Robertson, W5OB (ex-W5BUK) was issued a Mixed USA-CA-1500 award. Mixed USA-CA-500 awards went to LeRoy Ferguson, WA2RQH; Winky Merick, WA5UUB (ex-WA4NBT); and Andrew Lovelace, K4BXU. Charles Secrest, WA8ASV and John Kroll, WA8-TDY were recipients of USA-CA-500 awards endorsed All SSB.

USA-CA HONOR ROLL

3000		2000		1000	
K5DRF	26	WA5OCG	78	K7NEQ	175
W7NEQ	27	K7NEQ	79	WB2ZSO	176
K4ISE	28	WB2ZSO	80		
2500		**1500**		**500**	
WA5OCG	55	K7NEQ	110	WA2RQH	742
K7NEQ	56	WB2ZSO	111	WA5UUB	743
		W5OB exW5BUK	112	K7NEQ	744
				K4BXU	745
				WB2ZSO	746
				WA8ASV	747
				WA8TDY	748

John E. (Eddie) Palmer, K4LSP

Eddie was born and attended school in Kingsport, Tennessee and later graduated from the University of Tennessee.

An interest in amateur radio blossomed while running some electrical experiments while attending the seventh grade.

The Novice test was passed in 1955 and six months later the Conditional ticket was obtained. Last year, after much code practice, an Advanced license was obtained.

In the past five years, much work has been done in building and operating different antenna systems. Most of the work has been with multi-element wire beams on the 80 and 40 meter bands.

Eddie became interested in county hunting in 1964 when he happened to tune across the 40 meter band and heard K8CIR and WØMCX making contact with W4BPC in Eddie's own county. Soon Eddie was regularily checking into the net.

At that time, operating hours were limited, but in late 1964, Eddie joined a sales agency for industrial instrumentation and thus started traveling.

During the past five years, K4LSP has given out 1500 different counties including 5 different provinces of Canada.

To quote Eddie, "It has been lots of fun working for the County Awards. I have met and made many friends. Now that I have ALL-3079-Counties, I hope to rework them ALL on the 20 meter band, ALL SSB". Good Luck, Eddie.

Eddie Palmer, K4LSP.

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

See page 104 for New Reader Service

FLASH!
John M. Sulak, W8UMR
Has Qualified for #14
USA-3079-CA All Counties Plaque!

FLASH #2
Paul H. Newberry, Jr. W4YWX
Has Qualified for #15
USA-3079-CA All Counties Plaque!
SEE W4YWX FOTO/STORY
NOVEMBER '69 CQ

Letters

Joe Skutnik, W2JWK, writes: " I finally made the grade of all 3079 USA Counties. When I started County Hunting in October of 1964, I thought I could never make the grade.

'As I recall, my initial contact was with "Big George", K8VSL/M for the start of my county hunting and I wound up with Ruth, WA8FSX/M7, in Douglas County, Washington. It took 4 years, 9 months and 20 days to do it, but what went on during that time could fill an oversize issue of *CQ* Magazine.

'Within that scope of time, many lasting friendships were made, places were visited, awards and credits gained, assists in emergencies, loss of some well known mobile and fixed operators and you might say the whole gamut of life was staged through a single voluntary but well coordinated activity, *County Hunting*.

'I bow with difference to all those mobile operators who have made all of this possible. They sacrificed their time, money and efforts on our behalf. Some were and still are outstanding mobileers by the way they can peel off stations in the pile-ups. It would give me pleasure to name a few, but to do so would only slight those that were unmentioned and there are just too many of them. All are deserving of praise, however, let it be known that my gratitude goes beyond anything that I could put into words, and those that know me well enough will individually perceive the thanks due them.

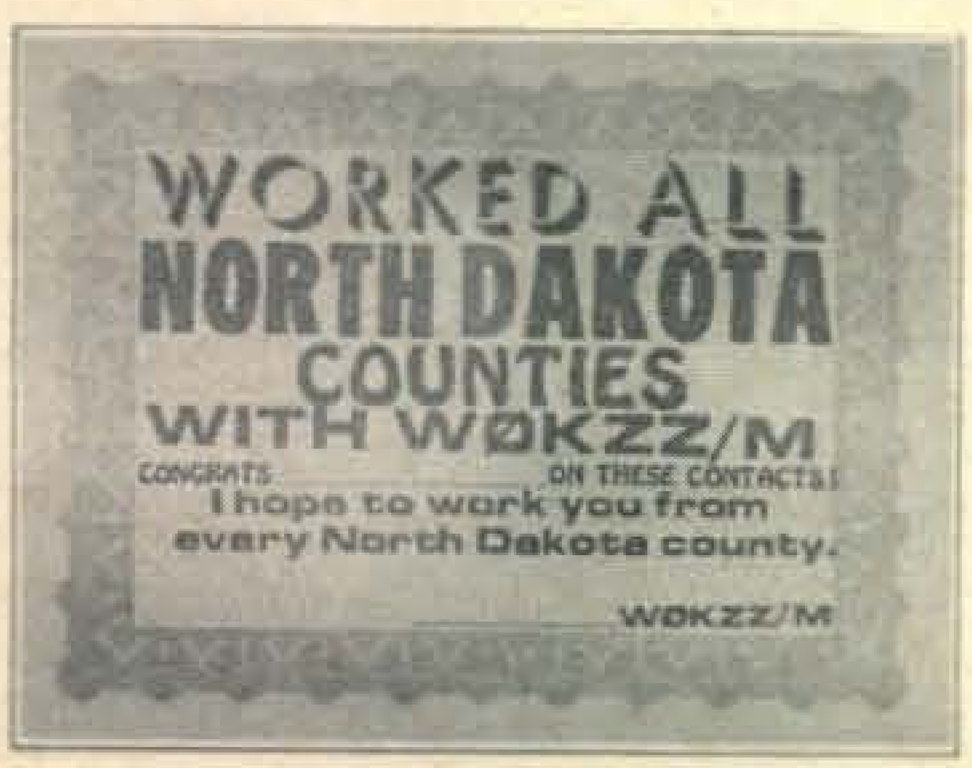
'Ed, your column in *CQ* is gaining additional participants in county hunting and once they hear the boys in action, they hop on the bandwagon. Here's hoping that through your able guidance and with the editorial contributions of all active county hunters, the column continues to grow in stature and prominence. I'll be hearing you and the gang on the Net".

W4UC Five Flags Award: This certificate is being offered by The Five Flags Amateur Radio Association Inc., 248 West Garden Street, Pensacola, Florida 32501. Issued for two way communication with five (5) amateurs in the Greater Pensacola area–they do NOT have to be club members–or for contacting the club station *W4UC* once. Send log data and $1.00.

Paul Newberry, Jr., W4YWX, writes: "The end finally came this week! The last three were really scattered–#3077, WØBK/M, Lake of the Woods, Minn.–#3078, W5DAU /M, Catron, N.M.–#3079, K4ZLE/M, Pamlico, N.C.

'Now, guess I can concentrate my efforts toward helping some of the others finish. It would really take the rest of the week to list all the stations that have gotten me counties that completed states, filled in holes, *etc.*, but I just couldn't feel right without mentioning a few like: WØYLN (who completed 3 states for me), WAØWOB (who finished N. & S. Dakota for me the same day), WA5-TJO, W5DAU, WØKZZ, K4ARF, W7GKN, WØGV, K7NHV, WA7EGL, WA4LMR, W9HGO/HFF, WAØJRZ, WAØEVO, WAØ-KGD–(looks like a WHO's WHO among the County Hunters). There are many others, but you know who they are first hand, Ed.

[*Continued on page 89*]



WØKZZ/M N.D. Counties Award.

303 Award.

See page 104 for New Reader Service

SURPLUS sidelights

BY GORDON ELIOT WHITE*

ONE of the classics of the World War II surplus era, the Navy LM Crystal Frequency Indicator, is still with us. The LM, and its Army counterpart, the better-known SCR-211 (BC-221) are commonly found in most surplus stores and are often seen at hamfests. These little units were well enough designed back in the late nineteen-thirties that they are still very useful, and they were so ruggedly built that the years have taken very little toll on their accuracy. Light in weight and easy to use, they can hold their own with frequency meters costing far more today.

Fig. 1 is a photo of the LM front panel. The BC-221 is similar, though slightly larger. The Navy version was accompanied by a separate a.c. power supply, while the BC-221 had space in the case for batteries, and, later, for an optional a.c. power unit.

Figure 2 is the LM schematic. All of the LM models through LM-18 are quite similar, with the changes from model to model so slight as to be unnoticeable for the most part. The LM and LM-1 were designed for slightly lower plate voltages, and the units from LM to LM-9 had low-frequency fundamental tuning range of 195-400 kilocycles. Starting with LM-2 a voltage regulator circuit was added, and plate voltages of 260/475 were used. Numbers starting with LM-10 had a low frequency range of 125-250 kc. All the LM units had a high frequency fundamental range of 2 to 4 megacycles.

The "odd" LM numbered units were provided for use with external battery power supplies, while the "even" numbers had an a.c. power unit provided.

Accuracies closer than two kc may be obtained at the upper end of the 20,000 kc high band, down to 25 cycles per second at the 125 kc point. Substantially better accuracy can be realized if the unit is left turned on constantly in a permanent position, so that it becomes stable. Since the accuracy is largely determined by the stability of the calibration crystal built in to the unit, trim-

*5716 N. King's Highway, Alexandria, Virginia 22303.

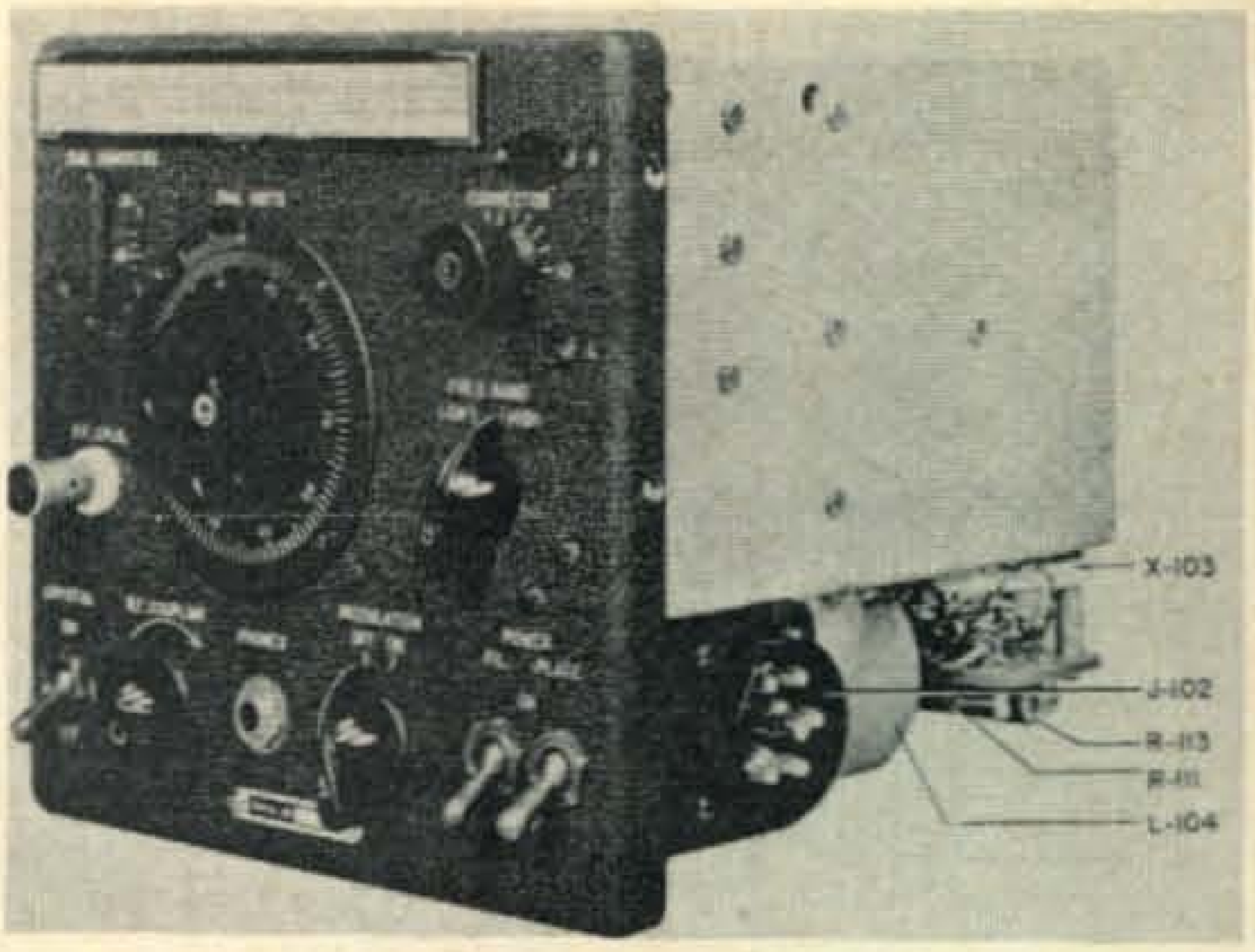


Fig. 1—A drawing of the LM front panel.

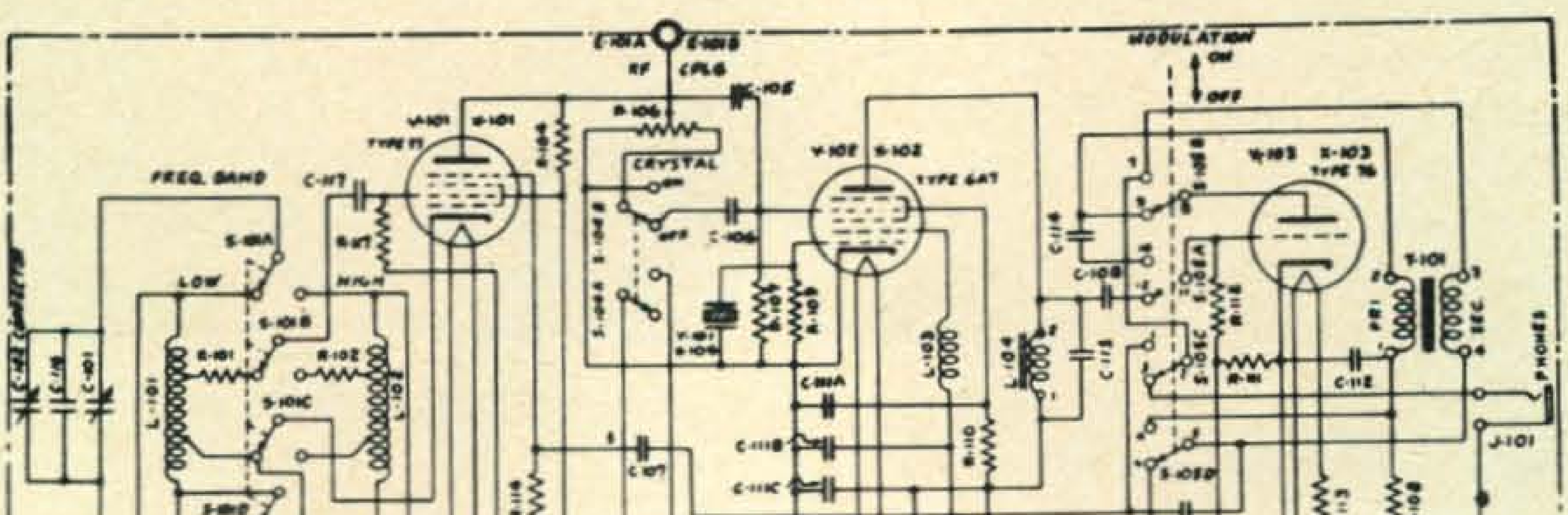


Fig. 2 Schematic diagram of the LM Unit.

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See page 104 for New Reader Service

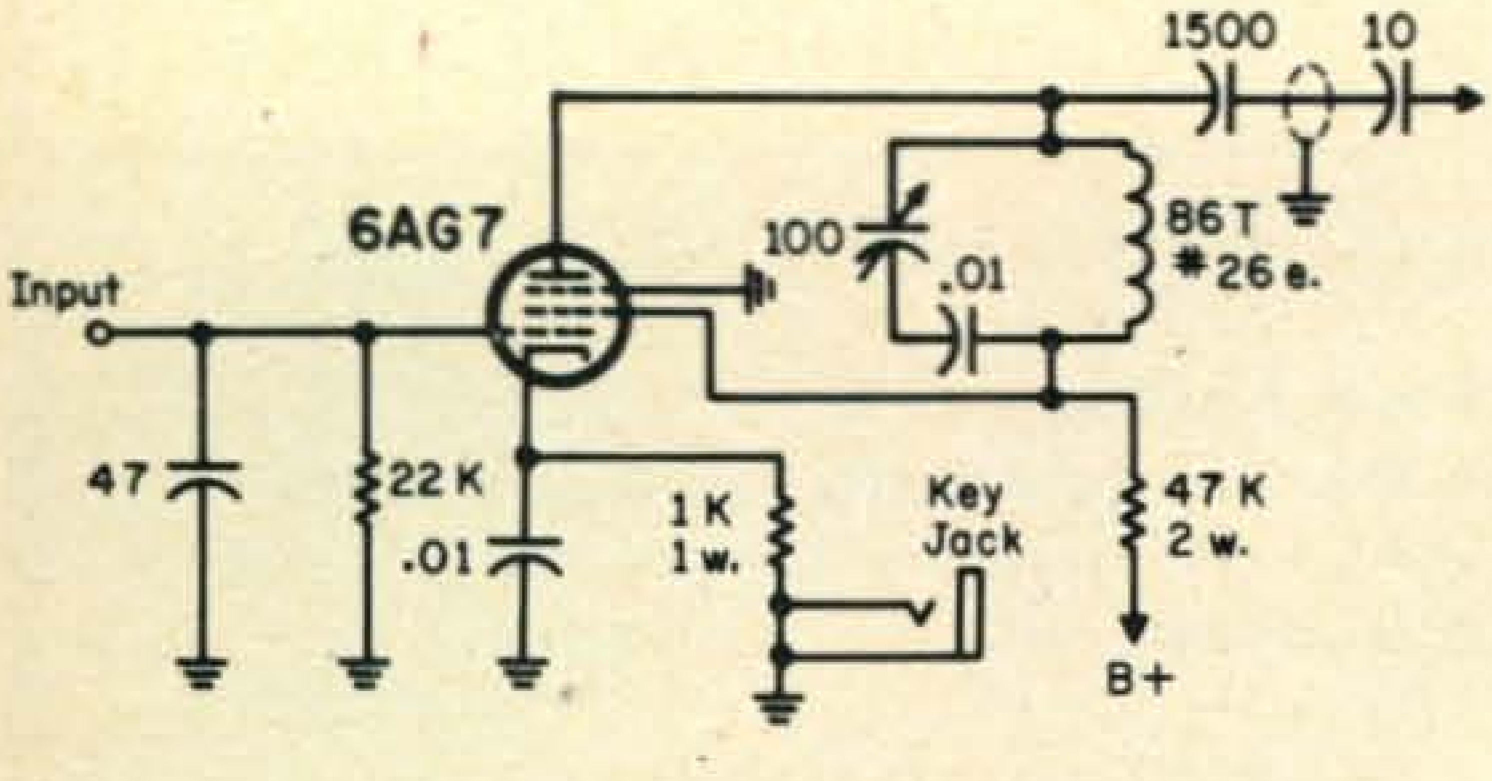

Fig. 3—A buffer stage for the LM frequency meter when it is used as a v.f.o.

ming of the crystal to zero-beat with WWV can essentially remove nearly all error.

There has been quite a bit written about the LM in the amateur literature, with the more significant articles appearing in *CQ*, October, 1965, covering calibration improvements, and April, 1956, covering the SCR-211. In *QST* there have been articles on the LM as a v.f.o., March, and January, 1950; as an audio generator, February, 1950, and as an injection oscillator for single sideband work, March, 1958. In *73* there was a power supply article in June, 1964.

The LM and SCR-211 lend themselves readily to use as a v.f.o. Generally it is well to add a simple buffer stage between the LM output and the transmitter, using, say, a 6AG7. Fig. 3 shows one suggested buffer circuit for this use. You may arrange to key this stage, allowing a constant-running oscillator for stability, with break-in keying. (The LM is well-enough shielded that it may be left running while receiving)

Figure 4 shows a circuit to add an eye tube for greater ease in determining zero beat. When a weak signal cannot be heard, the 6E5 will usually still show the zero point.

The signal to the 6E5 may be taken directly from the 'phones jack on the front panel of the LM, and the plate and filament power "stolen" from the unit itself. Tap the B+ ahead of the voltage regulator tubes so as to get a full 250 volts.

A couple of notes about the LM and SCR-211 that might be made here: the LM has audio modulation on all models, while several versions of the SCR-211 do not. Some LM models have a "crystal" switch position that shorts the r.f. output. Most of the SCR-211 units are found with their calibration books still attached, since they are screwed to the lid. Many LMs are found without the book, since it was fastened by a short piece of chain, and merely slipped into a clip under the unit when not in use, and over the years the books have often been lost.

The calibration books are vital, of course, to using the LM as a frequency meter. It is possible to find a blank calibration book and calibrate the unit yourself, but the amount of patience required is beyond most of us. I tried that route, and was finally stymied by the fact that when I would come back after taking a break the small amount of thermal drift would have "lost" my signal, and I was never quite sure how to find it again without losing track of where I was in the calibrating process. My unit was worse than most, and my shack was drafty, but even under the best conditions, home calibration is a task for a masochist.

It should be possible to do a job of calibrating an LM sufficient to use it as a v.f.o. over a narrow band, or to spot band edges, if you find one in uncalibrated condition. Generally the meter will sell for a lot less without the book, for it is worth next to nothing to most buyers that way.

The associated power unit, CKB or CRR-10121, may be used with a.c. power mains that deliver from 100 to 130 volts, by using the compensating switches. Headsets to be used with the LM should be the common military low impedance type.

The manual on the LM sets through LM-18 is *NavShips 900, 002*.

In addition to the compensating switches on the power unit, there are links in the meter itself which may be set to allow for the voltages supplied. Markings on these are self-explanatory.

When using the LM, you will not hear beat notes from the crystal oscillator when the modulation is turned on.

The CORRECTOR control is used to set the v.f.o. in the LM precisely to frequency with the crystal oscillator, at a major calibration point. It compensates for temperature

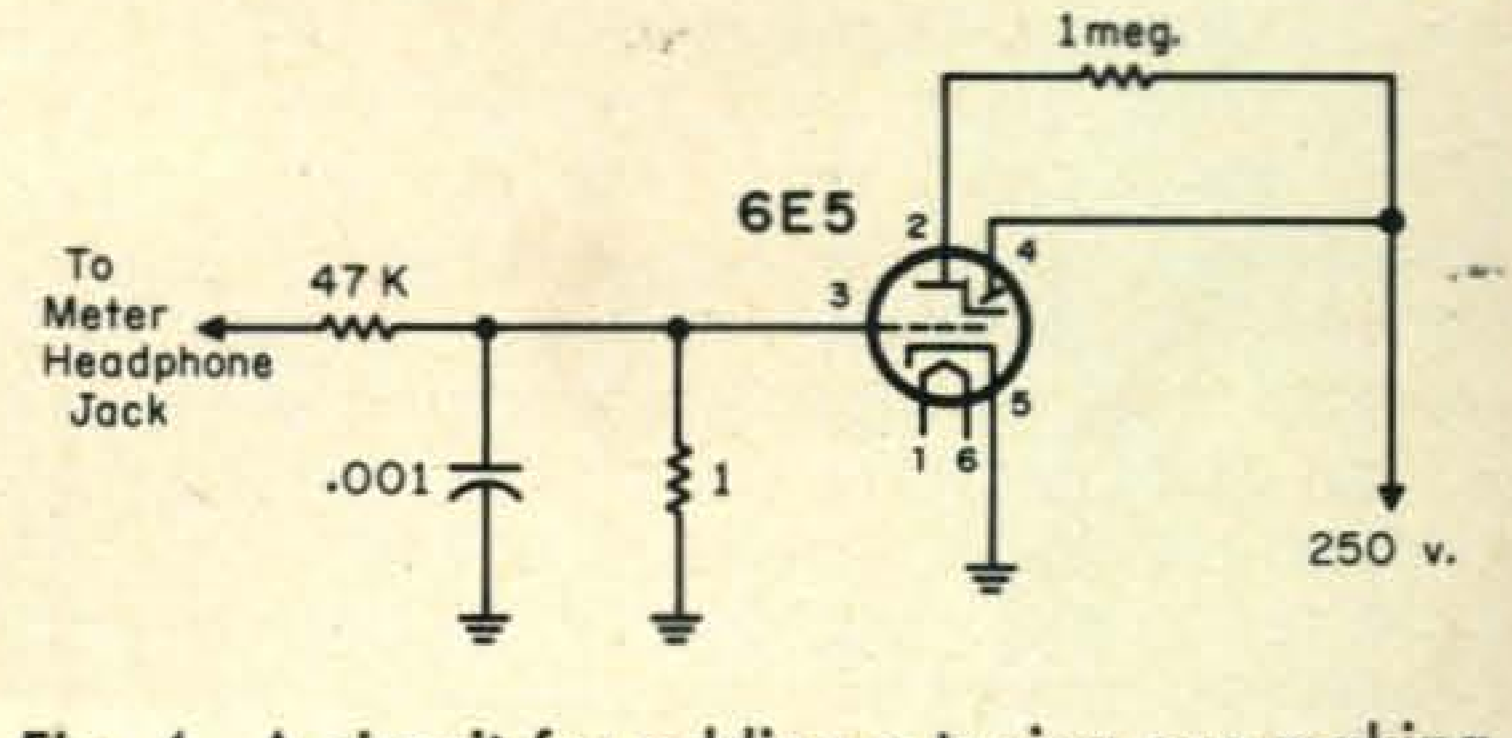

Fig. 4—A circuit for adding a tuning-eye making zero beat determination easier.

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changes, and tube aging.

In use as a frequency meter, the LM is loosely coupled to a transmitter, and the transmitter is turned to give zero beat as heard in the LM headphones. To set a receiver, the LM output is coupled into the receiver, which is then tuned to pick up the frequency meter output. ■

USA-CA [*from page 85*]

Of course, wouldn't want to leave out ole K8YGU.

'It is truly a fine group of people on 14.336 and it has been a rare treat to have been associated with them and with Mr. W2GT.

'See you from some county soon that I hope is a new one for you. P.S. Concerning my YWX-100 Georgia County Award, if anyone works me in *all* 159 Georgia counties I will send them an engraved plaque (NO charge). Endorsement stickers still available for 125 and 150. K1WQU got #1 for 125".

Awards

WØKZZ/M North Dakota Counties Award: Basic Award issued for working WØKZZ from 33 North Dakota Counties. Send 50¢ and GCR List. Seals for 38, 43 and 48 Counties, just send list and s.a.s.e. The first 10 to work WØKZZ in all North Dakota Counties will receive an engraved Plaque. There are NO date nor band limitations. Apply to: Carl W. Reed, Jr., WØKZZ, 1422-12th Street North, Fargo, North Dakota 58102.

303 Award: This unusual Award will be issued to anyone who had a contact with any of the many mobiles who were enroute to-at-or enroute from The County Hunters Convention, Mountain Home, Arkansas, July 4th Weekend (See foto and Story October *CQ*). Send data and 25¢ to: Cleo J. Mahoney, WAØSHE, 6001 Blue Ridge Cutoff, Raytown, Missouri 64133. This unusual Award has on it the signatures of 37 of the County Hunters who attended the convention.

Notes

I want to apologize for the fact that I have a big backlog of Awards/Award Data due to space limitations, I will get to your Award as soon as possible.

Many thanks to Jim Fisk, Editor of *Ham Radio* and also to Tom, JA1HNO for sending me that very fine *Award Manual For Radio Amateurs,* published by *CQ Ham*

Radio of Japan which has fotos and rules of some 145 Awards issued by different Clubs, Societies and Amateurs of Japan. Unfortunately my knowledge of their language is *Nil,* and I have not had time to have it translated.

Sorry to report a fire destroyed all equipment, records, QSL's certificates/awards and home of Howard S. Bradley, W2QHH, "Mr. Certificate". Hope that property and equipment damage was covered by insurance, but his records, QSLs and certificates can never be replaced. Fortunately no one was hurt, even though the fire occurred in the middle of the night. (W2QHH "Story" *CQ* 9/66).

This December column completes FIVE years of writing/talking to you and they have been wonderful years I have greatly enjoyed. Your help, cooperation, many letters and total support have made it a successful period. It is most rewarding to work a station (or receive his letter) in any spot in the USA or the world and have him (or her) say, "Ed., I enjoy your column each month in *CQ*". I would like you all to know that *if* at anytime should circumstances, beyond my control, change this–it will not be my choice. Again thanks for everything!

Sure hope Santa brings you all the things you desire, Merry Christmas and A Happy New Year. How was your month? 73, Ed., W2GT.

VHF [*from page 83*]

We have also used the amplifier as a preamp on 144 mc and 220 mc on several occasions. However, when using a broadband amplifier as a preamp, you should have a filter in front of it, since it will amplify all signals within its bandpass equally. A strong signal, completely out of the frequency range you wish to listen to, could thus overload your front end.

Construction

Amplifier construction is truly simple. With no tuned circuits, the layout is not critical. The amplifier shown in the photos was built in a 2″ × 3¼″ × 1″ mini box. Transistors used were of the KMC K-5000 series, although almost any transistor which is usable as an r.f. amplifier on 432 mc will do (TIM 10's for example). Of course, as noted earlier, the better the transistor, the better the noise figure. Once the amplifier is built, just check the wiring, apply voltage and you should be in business.

73, Allen, K2UYH

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Screen Switch [*from page 67*]

This circuit can handle up to 35 ma of screen current with ease. At the screen voltages specified this means approximately 10 watts can be fed to the screen. This should be adequate for most tubes that require about 300 volts on the screen.

Key Clicks

The waveform at the screen will be the same as that at the key. If the key voltage changes rapidly when the key is opened, the screen voltage may be removed too soon. This will cause clicks to develop in the output of the transmitter. To correct this, a capacitor can be connected across the key line. The value of the capacitor can be adjusted to eliminate the clicks.

If a series screen resistor is required it should be inserted between ttransistor Q_2 and the screen. If the dropping resistor's value approaches that of R_4 the screen voltage will be lower than required even though the circuit is working properly. Resistor R_4 will then have to be increased to bring the screen voltage up to normal. If R_4 is made too large, however, the $R_4 C_1$ time constant will become too long and the screen voltage will not drop to zero between dots and dashes.

Construction

The circuit can be constructed on a single terminal strip or a small piece of perf board and placed in any convenient location inside the transmitter. Lead lengths are not critical since all control lines are usually bypassed for r.f. Be sure to keep the cases of the transistors away from ground, since they are connected to the collectors which are above ground.

After having used the transistor screen switch for several months, no problems have developed, even though the transistors are being operated near their maximum voltage ratings. This is no doubt due to a transient free B+ and key voltage source. I would like to thank Herb S. Brier, W9EGO for his help and criticisms. ■

50 MC Monitor [*from page 31*]

but you might peak T_8 and T_9, which may be a little detuned by the diode reversal. The unshaded cans are those in the a.m. circuitry. The modified Guardian has proven entirely satisfactory for its intended purpose, monitoring *strong local* signals ■

See page 104 for New Reader Service

DX [*from page 71*]

Guglielmo Marconi and the outbreak of World War I. By 1915 there were dozens of Italian hams, but when Italy entered the war that year they were promptly put off the air.

Between 1918 and 1922 the hams gradually got back on the air and were acknowledged by the government. In 1923, Ernesto Montu, I1RG, one of the best known Italian radio pioneers, founded the country's first radio magazine, *Il Radio Giornale (The Radio Journal)*. At that time there were two different associations, the A.D.R.I. (Association of Italian Radio Amateurs) and R.C.N.I. (National Radio Club of Italy).

On Jan. 24, 1924, two months after the first transatlantic QSO between EF8AB (Deloy) and NU1MO (Schnell), the first such contact involving an Italian amateur took place between Adriano Ducati, I1ACD, and Schnell himself. Shortly afterward Ducati took a round the world trip on a ship of the Italian Navy to study propagation.

After many attempts, Mario Santangeli, I1ER, who is still on the air, made the first QSO with New Zealand on May 31, 1925.

In 1926 Ernesto Montu issued his first book on radio transmission, and in 1927 A.D.R.I. and R.C.N.I. combined to form the A.R.I. (Associazione Radiotecnica Italiana) with Montu as president and founder. He continued as president until 1948. In 1927, Adriano Ducati published his handbook for Italian hams.

Shortly afterward the Facist government came to power in Italy and the hams gradually went off the air when license renewals were not permitted. During the 1930's there were only about 50 OM's operating in Italy, and all of these were on a clandestine basis. A.R.I. headquarters was at Montu's home in Milan, and Montu himself assigned calls and kept a secret list of the active stations. During this period the Swiss amateurs were very helpful.

A very important problem for the hams of this period was the concealing of antennas. Many resourceful OM's located them inside the chimney's of their houses. Even in those years the annual meeting was held. It took place secretly at the Milan fair.

In 1940, with the outbreak of World War II, Montu sent a letter to every Italian ham instructing him to cease his activity and put away his antennas. Many compiled, but some

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remained active and contributed to the war.

After 1945 Montu again organized the amateurs who were rapidly increasing in number due to the great amount of surplus gear on the market. A.R.I. was divided into sections in 1946, and in 1948 Ernesto Montu stepped down as president, and *Radio Rivista* became the official journal.

One of the I-land hams greatest opportunities for public service occured in 1951 during the Polesine flood. A great help was rendered through amateur communications.

In 1954 the government initiated compulsory examinations for the amateur license as had been decided at Atlantic City. This created a mild crisis and the number of hams decreased. A second crisis occurred in 1963 when the government levied a 10,000 lire ($16.00) tax to be paid by each licensee each year, with beginners paying double that or 20,000 lire. A.R.I. fought the measure, and the tax was reduced to 1000 lire.

The summer of 1965 produced the first formal emergency network, the C.E.R., Corpo Emergenza Radioamatori (Amateur Radio Emergency Corps). This organization was very effective during the November, 1966 floods in Tuscany (Florence) and Veneto (Venice). The Postmaster-General sent a telegram of thanks to A.R.I. Other occasions of service were the January, 1968 earthquake in Sicily and the November, 1968 flood in Piemonte.

The present A.R.I. membership is 4500 and the number of new licenses being issued is increasing each year. The Italian hams are striving hard to get government permission for a larger band on 80 meters, restoration of the 430 mc band, Mobile stations (it is presently illegal to have a transmitter in the car), and a reciprocal license agreement.

Examinations for the license are held twice each year, usually in May and October. They consist of a written test plus c.w. transmitting and receiving at 40 letters per minute. There are 3 classes of license. The first class for up to 75 watts power cost $6.50; the second class for 75-150 watts costs $8.00; and the third class for 150-300 watts costs $11.50. Italian citizenship is required and the applicant must be at least 16 years old and of good moral behavior.

The 10, 15, and 20 meter bands are the same for Italian amateurs as in the U.S., but on 40 meters only 7000-7100 kc may be used, and on 80 meters only 3613-3627 and 3647-

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WANTED: Electronic Keyer, Vibro, KWM-2 and P.S.-A, XE 1 NE, P.O. Box 2807, Mexico City, Mexico.

SOUTHERN ALBERTA AREA: FOR SALE: D.X.-100 Xmtr $125. C. Kropi, NAK, VE6UP, 513-19 Street, North Lethbridge, Alta, Can.

SELL OR TRADE: HT-37, excellent condition, $175. Tech troner, 514 AD scope, Ameco 2 and 6 meter converter w/supply. K2HDU, 7 Johnson Ave., Plattsburgh, N.Y.

PLATE XF,R: 3kv/2KV, CT, 110V PRI. Thordarson T1?6. 450 watts CCS rating. $35 or best offer. WA1JYU, 27 Blue Ribbon Drive, Westport, Ct. 06880.

SELL: DX-6OA, HG-10 VFO, DK60-G2C antenna relay, $85. W4RNL, 245 Morning View Drive, Athens, Ga. 30601.

SELL OR TRADE: VCS-300 VAC. Variables — $25; Variacs Walkie-Talkies, digital counter parts, meters. SASE brings large list. G. Trammell, 1507 White Oak Ct., Martinsville, Va. 24112.

MANUAL WANTED: for SP-600 JX-1 (Army #R274-AFRR,) manual #TM11-897. W. F. Montgomery, KZ5FN, Box 27, Gatun. C.Z.

FOR SALE: Viking 500 like new. from Johnsons Company year 1968, cost me $425.00. Make offer. Write W8WSC, Stryker, Ohio 43557.

ANTIQUES—RADIOS: 2 Atwater Kent radios model 30 and model 40, make offer. Stan., W8QKU, 2748 Meade, Detroit, Mich. 48212.

WANTED: Collins 399C-1 external VFO. Any condition ok. Mike Ludkiewicz. 143 Richmond Road, Ludlow, Mass. 01056.

FOR SALE: Elmac PMR-6A, NC-60, Hallicrafters 538A, and much more. Send S.A.S.E. S. Bryant, Star Rte., Center Bridge, N.Y. 12035.

SSB Filters 3 KHZ at 64KHZ 8 xtal full lattice units by W. E. includes in/output xfmrs in filters. $10 pp. W9FTE, 8800 W. Clovernook Ct., Milwaukee, Wisc. 53224.

TRANSFORMER DATA, Size of wire, turns, cross section of core for any transformer. Complete Data, $2.00. W4GO, 3087 Carnes Ave., Memphis, Tenn. 38111.

FOR SALE: Teletype model 19 complete A1 condition $150.00, also Teletype model 15 $90.00. Prefer local dealer, W2GJJ, Chris Vinson, Larkspur Street, Yorktown Heights, N.Y. 10598.

WANTED: Both large and small front panels for an Apatche TX-1 transmitter. Also various other small parts. Also want good ART-13 around this area. Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741.

FOR SALE: Complete model 19 TTY, plus 14 typing reperf, W2JAV, TV, loop supply. Pick up. $150.00. WA8CKT, 662 W. Lincoln Caro, Mich. 48723.

SELL: Like new Model 99-5015 Lafayette RF Signal Generator $17.50. W. C. Holder, 1000 West Alden Ave., Valdosta, Ga. 31601.

HALLICRAFTERS SR400 xcvr & P500 pwr/spk $649; SX117 rcvr $215; all excel. cond.; Bill Bode, 13241 Eton Pl., Santa Ana, Calif. 92705.

1 KWMBL all new SB34, Mike, mtg plate, Spitfire LA500 final, 12V Spitfire sply. $400. W9EWB, Kohlhagen, 818 Oakley, Elgin, Ill. 60120.

ANTIQUE OMNIGRAPH 14 Morse Code discs (Spaced caracters) Running order. Make offer. Joe Brand, K6OJC, 1250 Val Vista, Pomona, Calif. 91766.

TRADE: July 1945 CQ, perfect condition, for June 1945 CQ. Want all 1946 CQ. G. E. Perrine, W9KOI, 212 Crystal Lake Dr., Urbana, Ill. 61801.

SELL OR SWAP: DX60B, HR-10B, AM2, 11 xtals, Key, cables. T/R SW manuals. $150.00. 30 day guarantee. WA1JFG, 120 Oak Tree Dr., N. Kingstown, R.I. 02852.

HALLICRAFTERS HA-2 w/P-26 Pwr. supply, Voltage Reg, w/AMECO Preamp installed. $175; much excess VHF/UHF gear sell/trade, SASE. W4API, Box 4095, Arlington, Va. 22204.

COLLECTORS ITEMS: Radio Catalogues 1920's & 1930's — "Harpers Wireless Book", Verrill 1913 — K5ENL, Ed Block, Grandview, Texas 76050.

SWAP for CW, Xmtr: Goodies for Gentlemens' Gallon. 4-1000As, PS, Socket, Chimney, Rack. SASE to WICZM, Rt. 3, Main Dunstable Road, Nashua, N.H. 03060.

W3OK Delaware-Lehigh Amateur Radio Club meets monthly 7:30 PM. Sell field Bethelem Pa. Everyone welcome.

SELL: Heath Sixer $30; DX-40 $25; VF-1 $10; Heath Balun $5; Dow Relay. DKCTRM-1 $5. Need Vibroplex Bug. K9MNT, 607 Ann Street, Joliet, Ill. 60435.

FOR SALE: HW12-7000, L. W. Richter, 131 Florence Dr., Harrisburg, Pa.

BRAND NEW Hallicrafters HT-44 w/as new PS-150-AC in speaker console, orig. cartons & warranty card $229. Vy gd HT-30 xmtr, SSB/CW/AM, built-in PS, $89. Excellent P&H 400C linear, 800 PEP, extra set finals, $85. All w/manuals. FOB B. Lindblom, 512 Grandview, Chillicothe, Mo. 64601.

PRINTING PRESS WANTED: Hand operated. 5 x 8 or 6 x 10. HF Smith, 4N180 Ridgewood, Bensenville, Illinois. 60106.

DRAKE TR3-RV3-AC3 excellent condition. Will ship. $425. J.M. Kootsey, 1511 James Street, Durham, N.C. 27707.

WANTED: Drake T-4B, T-4XB, TR-4 or Swan 500 with power supply. E. C. Elker

WATERS phone patch with compressor $5 and Waters Channelator model 349—$30 (both unused) or trade both towards Collins 312B-5. G. Clark, MD, W6GAW, 1741 La Coronilla Dr., Santa Barbara, Calif. 93104.

FOR SALE: BC-221AE $35.00; New 3" 500 ma dc and 5 amp RF meters, $3.00; SCR 522 $15.00. W4TKD, J. Wingfield, 344 Linda Lane, Ft. Walton Beach, Florida 32548.

FOR SALE: Drake TR3, AC-3, MS4, Collins Patch Two mils, foot switch 40+ spare tubes, molike Ant $450.00. WA7BCK, 107 Magnolia Ave., Everett Wn. 98201.

See page 104 for New Reader Service

FOR SALE: Atwater-Kent Tuned Radio Freq. Type L Chasis BCB Ser. #6386484. Best offer U pay shipping. Contact Steve Bradke, WA2GMC, 11 Francesca Drive, Oyster Bay, N.Y. 11771.

NEW: Ham M Rotator and Gonset Tri-Bander with new type element supports, never used $150. Pick up. George Nolan, Water Mill, L.I., N.Y. 11976.

SELLING: Heath HW-100 xcvr, HP23-A/SB-600. Factory tuned and aligned. With receiver incremental tuning. (July CQ) Beautiful! Shipping prepaid. Highest bidder. WB4KQV. A. H. Shrago, 805 Burton St., Rocky Mount, N.C. 27801.

LINEAR: CE 600L, Broadband no tune! 6 Bands incl. 160M only 20w. drive $190. J. Taylor, W2OZH, 1257 Wildflower, Webster, N.Y. 14580.

WANTED: Swan VOX unit VX-1 or VX-2. Will buy or trade for my 3el 15 meter beam. Don Rubin, WA3JRA, 3919 Bancroft Rd., Balto., Md. 21215.

WANTED: Weagant value with ext. grid year 1912, UV204 with sperieal bulb. W9LGH, 610 Monroe Ave., River Forest, Ill. 60305.

AMECO R5 Receiver used very little, mint $85.00 or will trade for a good Drake WV-4 RF wattmeter. K3YMN, 2185 Sampson Street, Pittsburgh, Pa. 15235.

FOR SALE: Ameco CN-50 $20.00; CN-144 $17.00; DX-60A $55.00; HW-29A with Mobile Pwr. Sup. $30.00. WA8ZJN, R. Allen, Rt. #6, Zanesville, Ohio 43701.

HEATH SB-100, 200, 300, 400. Swan 240 with mobile p.s. New 4-100 tube, 3KW, HV xformer. W0FGB/6, 4453 Via Pinzon, P. V. Estates, Calif. 90274.

ANY ACTIVE HAMS interested in starting good radio club for this area? L. Briggs, W3MSN, 5400 Boulder Road, Oxon Hill, Md. 20021.

SELL: Heath Two Meter Twoer $35.00. So. Calif. only. K. C. Jones, W6RLN, 6172 Gumm Dr., Huntington Beach, Calif.

SELL: EICO 753 SSB Xcvr. 751 AC supply, Bug. Vy Gd. $100.00. You pay shipping. W9RQR, 204 S. 11th Street, Belleville, Ill.

RMW6900 $140, RME4350 $75; Vibroplex Blue Racer $13, 10D Mike $13, Art Ford, 6 Stoothoff Rd., East Northport, N.Y. 11731.

5 in. Model 553 Dumont scope $40, HB pp 813 KW, $50; HB 90W am-cw, $25; 1925 RCA loop ant, $10; W2RUZ, 33-45 172 Street, Flushing, N.Y. 1358.

SELL: Assortment of variable and fixed resistors Wire wound and carbon. From 1/2 watt up to 150 watts. SASE for complete list. Ken Maas, Burlington, Wis. 53105.

SWAN 410 VFO WANTED: Also need Feb. 63; May 64; Sept., Oct., Nov., Dec. 66; All 67 CQ. K0RNZ, 4830 North Glendale, Wichita Kansas 67220.

COLLEGE: Collins D.C. supply MP-1 and mobile. Mount 351D-2 $117.00. Postage paid. Write: K1CMI, Mercedes Street, Chipcopee Falls, Mass.

COLLEGE: 4CX1000 $40.00; new variable inductor 13.5uh Johnson 226-3. $13.00. Tube tested and postage paid. Write John, 28 Mercedes Street, Chicopee Falls, Mass.

SELL: Collins 32S-1 and 516F-2 AC supply in matching cabinet w/spkr. $425. 75S-3 $375. All for $775. W6DQ, 8 Surrey Lane, Rollings Hills, Calif. 90274.

SWAP new 4CX250B or pair 416-B tubes for BC-312, BC-348, TCS, BC-652, ARB or equal receiver. Swap my SCR-522 for TCS rcvr. or xmtr. HAL, Box 103, Sherborn, Mass. 01770.

SELL: New Heath Mohican factory aligned used 15 hr. $80. W1OTU, 72 Laurel Crest, Madison, Conn. 06443.

FOR SALE: Hickok 600A Dynamic mutual conductance Tube tester $40 and Precision E200C RF Generator $40 plus shipping. R. M. Terrill, 3706 Alta Vista, Tex. 75229.

BTI LK2000 s/n 1924 absolutely mint. low hours, factory cartons & manuals. Certified $695 check, FOB E. Stolz, 3738 Robertson Ave., Sacramento, Calif. 95821.

FOR SALE: TA-36, HAM-M $175.00. Firm. Not enough room at QTH to swing 24 ft. boom. Pick up only, no shipping. Milo Boz, Rt. 2, Salem, Ohio 4460.

FOR SALE: 432 MC transceiver from handbook $25. Model 19 TTY, 14 Typing Reperf, W2JAV, TV complete. $150.00. WA8CKT.

COLLINS 75S1 with noise blanker, 32S1, and 516F-2, $775. Egbert, W0MMM/6, 17333 Tramonto Dr., Pacific Palisades, Calif. 90272.

WANTED: Mint CE 200V with 160 meter factory coils. State details. W2CVW, 13 Robert Circle, S. Amboy, N.J. 08879.

BATTERY FOR SALE: 24 Volt. 30 amp for 8 hours. (240 amperehour). 12 large plastic cells 77 lbs. each. Like new $250.00. Howard S. Long, Box 11155, Denver, Colo. 80211.

SWAP—Have 7.5 HP Sears outboard motor A1—for Heath SB610 scope or similar. Lewis, 37939 10th Street E., Palmdale, Calif. 93550.

WANTED: SB200 mint condition, Give data—Age finals, etc. Your letter, Geo. Earl, Box 366, Ridgeway, Ont.

NATIONAL NC-200 xcvr, AC-200 pwr. supply, manuals. Factory cartons, will ship. Best offer. Klima, 15 Floral Street, Bath, Maine 04530.

SELL: Swan 120 with HP-23 supply $125.00. Also 10 new instructograph tapes $8.50. WBGV, Phil, 11820 Engleside, Detroit, Mich. 48205.

FOR SALE: Collins 30L-1 Serial #15000 $350.00. SP-600, JX-17 like new $300. Need 75S-1. Mike Ludkiewicz, 143 Richmond Road, Ludlow, Mass. 01056.

WANTED: Heath SB-610 Signal Monitor or Heath HO-10 monitor scope. W0TDH, 4201 Colvin Dr., St. Louis, Mo. 63123.

WANTED: RTTY Model 401 receiving tape printer, must have Sync. motor and 60W. P.M. gears. Also need other RTTY gear. Bob WA8IWX, 23016 Schafer Drive, Mt. Clemens, Mich. 48043.

HAMMARLUND SUPER—Pro BC-779A Mint with older power supply, instruction manual Rcvr. never modified or repaired. $90.00. W1BGW, 28 New Haven St., Boston, Mass. 02132.

NOVICE XTALS: 1-80M, 2-40M, 1-15M $6 p.p. or $1.75 each p.p. A.M. Fox, Box 895, Greeley, Colo. 80631.

SELL Heath Hybrid Phone patch HD19, like new, for $19.00, with book. Cal Enix, W8EN, Box 474, White Pigeon, Mich. 49099.

BRASS POUNDERS: If you ever earned your living as a radio operator, commercial, or Navy, join Society a radio operator, commercial, or Navy, join Society of Wireless Pioneers, P.O. Box 530, Santa Rosa, Calif. 95402, de W6BLZ.

FOR SALE: Complete Amateur station like new. S.R. 500 complete with AC Power Supply P.S. 500 AC, Mike, & Inverted & Antenna with 50 ohm from feed line, Complete $300.00. Ralph Paxton, 108 N. 2nd Ave., Chula Vista, Calif. 92010.

SELL: Three 7038 Vidicons. Broadcast pullouts. $10. each p.p. W0YOY, B. Sasek, 3030 Shirley Court, Lincoln, Neb. 68507.

WANT: Swan 250C and 117 xc. Must be reasonable. O. Dion, 21310 1st W. Bothell, Wn. 98011.

SELL: Lightning Bug, HT-40, HQ-105-TR, B&W Grid Dip, misc. items. Send stamp for details. WA5MYR, 1704 Glenn, Ft.Worth 76131.

ATTN: Coin collector Hams—U.S. & *Canada Types*—buy or trade equipt. For info.—S.A.S.E. W9TAL—15309 Oak Street, Oak Forest, Ill. 60452.

See page 104 for New Reader Service

FOR SALE: HT-41 Linear Amplifier, All bands $175.00 or best offer and 1960 & 61 & on QST and CQ & some 73 magazaines at 25¢ each by years only. L. M. Covey, K1JAR, 238 Jenness St., Lynn, Mass. 01904.

DRAKE TR4 & AC Supply. Exc. condx. $500. Also selling Nikormat Ft. camera. Wilcox, 2605 Wards Rd., Lynchburg, Va. 24502.

SELL: Hammarlund HQ110AVHF Rcvr. $225, new Eico 720 Xmtr $75, take both with xtras for $275, all in mint condition. J. Siegel, 97 Erie Ave., Rockaway, N.J. 07866.

MANUAL WANTED for SP-600 JX-1 (Army #274A/FRR), manual #851. W. F. Montgomery, KZ5FN, Box 27, Gatun, Canal Zone.

SELL: QST, CQ, 73's magazines, send your requirements. E. D. Guimares, Jr., WA1BFD, 17 West End Ave., Middleboro, Mass. 02346.

SELL OR SWAP 120 and 140 both excellent performers. Need SR42A or 22er W2OFB, Box 138, Adelphia, N.J. 07710.

FOR SALE: NCX-3 w/ps $260, Gonset II 2m $100, both in good condx. A. Steingart, WB2MZE, 3356 Frederick Street, Oceanside, N.Y.

FOR SALE: Hallicrafters HT44, SX117, PS150—$140.; BC779—$35.; Kngiht T150A—$50.; cert. ck & ship. T. Yocom, 1530 Country Club Dr., Marion, Ia. 52302.

FOR SALE: DX-60B xmtr, only 6 months old, with manual, $70 postpaid. WA0YAK, Chan Shippy, Rt. 2, Colome, So. Dak. 57528.

WANTED: KW amp parts including amply rated transformers. Give full details. W0JX, 7765 Fontana, Prairie Village, Kansas 66208.

FOR SALE: Old issues of CQ, QST, 73, FM, and Ham Radio available at a nickel per copy, plus shipping costs. Write to LERC, Amateur Radio Club, (W6LS), 2814 Empire Avenue, Burbank, Calif. 91504.

FOR SALE: Johnson Valient, excellent condition. $100. Come and get it. W2RQ, 212-456-7755.

SELL: Johnson Viking KW Match Box, New, No SWR Meter, $60.00. Electro-Voice Microphone Model 644, $30.00. Chet Angstadt, R.D. #3, Box 450, Fleetwood, Pa. 19522.

SELL: Globe Scout 65w 80-6 AM-CW $30 or best offer. WA7DOK, R. Harker, 2711 Kincaid, Eugene, Or. 97405.

FOR SALE: Hallicrafters SX-28A with spkr. and manual, $50 or will trade for ?? W9BXJ, 4341 Sheridan Road, Racine, Wisc. 54303.

FOR SALE: Henry 2K-2 (Near-new), $900. KWM-1, 516F-1 $225. KWM-2, 516F-2, 312B-5; $1,025. 75S3-B #85530. $575. 312B4 (new). $175. James Craig, W1FBG, 29 Sherbourne Ave., Portsmouth, N.H. 03801.

SB-200 1200w Linear professionally wired, unused, $200. cash. H. L. Greene, 211 Circuit, Hanover, Ma. 02339.

CQ 1946-1968. 20¢ each. State needs or SASE for list. E. Halton, W1QWU, Providence College, Providence, R.I. 02918.

WILL BUY. Power supply RA-20 for BC314. State Price. W9UDY.

FOR SALE: Drake TR-6, 3 mo. old, all accessories. $750.00. & Shipping & insurance. J. D. Gysan, W1VYB, 53 Lothrop Street, Beverly, Mass.

WANTED: Heath H010 or SB610. Also want QST, CQ, and 73 Binders plus coax relay. Tom Dornback, K9MKK, 19W167 21st Place, Lombard, Illinois. 60148.

SELL: Swan 350 (late), 117xc, power supply, spare finals and tubes; SWR; A-1 condition. Best offer. WB2YRU, Al Povol, 3538 Centerview Ave., Wantagh, N.Y. 11793.

WANTED: GE Progress Line, other FM equipment. R. C. Wallenburg, 4911 Western, New Orleans, La. 70122.

SELL: Oscilloscope, Sencore 5", mint condition, wide band—$150. No shipping. WA0WCJ, Eddy Horan, 3803 Humphrey, St. Louis, Mo. 63116.

FOR SALE: Hy Gain 6 mtr 6 ele. beam. $19.95, AR 22 rotor with 100 ft. wire $19.95. Both good condition. Geffner, 48 Park Ave. E, Merrick, L.I., N.Y.

SB-34 Transistorized Transceiver, with SB-2 mike, and manual, $240.00. Alan Rutz, WA9GKA, RR2, Box 410, LaPorte, Ind. 46350.

SELL: CQ's, QST's, Handbooks, and call books. One or a hundred. Erv Rasmussen, 164 Lowell Street, Redwood City, Calif. 94062.

FOR SALE: Elmac AF-68 like new xtra clean and power supply. $60. W5AQN, Box 1316, Rockport, Tex. 78382.

WANTED: Ham transmitting and receiving accessories for cash. D. R. Droege, 281 Jenny Lane, Dayton, Ohio 45459.

GONSET 4-$2..0.., VFO $60.00, Both $250.00 Ameco Receiver $40.00. WA2OHN, Phone after 8:30 P.M. 516 791 7481.

SELL: HA-10 $120; Seneca VHF-1 $100; Drake 2-B $150; Tecraft 50 Conv. $27.50; Ameco PT $30. All perfect with manuals. FOB. Glenn H. Pickett, 1106 Jefferson SE, Albuquerque, N. Mex. 87108.

FOR SALE: Collins S-Line 75S3B-32S3-516 F2-312B-4. Exc. con. WA0GON, 231 So. Jasmine Street, Denver, Colo. 80222.

WANTED: YL CW skeds with Oregon North Dakota, Arkansas, and Tennessee for WAS-YL. W1DMD, 298 Taunton Street, Lakeville Mass. 02346.

FOR SALE: Drake 2-C 2-CS, A-AC. Perfect condition. $210.00. Write WA2IAK, 54 High Point Drive, Springfield, N.J. 07081.

LETS TRADE: Japanese various commemorative stamps for 4CX25OB's sockets & chimneis K. Ishikawa, 62 Kinjo, Nisho City, Aichi 445, Japan.

MERCURY RELAYS, Clare HG series, good, some new $1.75 each pp. WB6KFI, 30646 Rigger Rd., Agoura, Calif. 91301.

COLLECTORS ITEMS Riders "Perpetual Trouble Shooters Manuals". Complete set 1930's—Gernsbach "Official Radio Service Manual" 1930 make offer K5ENL, Ed Block, Grandview, Texas. 76050.

WANTED: Schematic Diagram for Iron Horse Reperforator RTTY unit. F. Gilmore, K0JPJ, 560 S. Warren Ave., Springfield, Missouri, 65806.

WANTED TO BUY: CW helix of 1920s' vintage. W6-AKM, 1289 Glen Eyrie Ave., San Jose, Calif. 95125.

RTTY—For Sale—28ASR-Electrom-F.S.C. and tone keyer. M. Cohen, 400 Brookhaven Rd., Wallingford, Pa.

COUNTER: 100KC, Berkley Eput model 7150 BDK, Excellent condition. $200. FOB. John Link, 1081 Aron Street, Cocoa, Fla.

LINEAR BUILDERS: Send for low price. List of High Power Ports. Be delighted R.D. Mace, 8600 Skyline Dr., Los Angeles 90046.

FOR SALE: Collins 75A4 original condition. Used very little. SN-4052 best offer. W6ULC, 2878 No. Bailey Dr., Anderson, Calif. 96007.

FOR SALE: Drake R4A, T-4X, MS-4, AC-4 excellent condx. $730.00 Will consider best offer or sell seperate. WA1KZI, D.J. Burke, Meadowcrest Dr., RFD 5, Bedford, N.H. 03102.

FOR SALE: 4-400's, a pair never used. $20 each. 4X250's used but tested $7 each.N.W. Roscoe, W1CIX, 80 Columbus Ave., Bridgewater, Mass. 02379.

FOR SALE: Heath HW-16 with HG-10 VFO, $105. HR-10 receiver, $45. PPD. Want Drake 2B, 2BQ. W. G. Brown, W2TPV, 4128 Barrett Dr., Newburgh, N.Y. 12550.

See page 104 for New Reader Service

WANTED: Old battery operated radios of the early 1920's. Need not be in working condition. Also want early wireless gear, CQ and QST binders. State your price. D. McKenzie, 1200 West Euclid, Indianola, Iowa. 50125.

WANTED: One Heathkit HQ-13 Ham-Scan scope in kit form in the factory sealed box. Bill Jacobs, K3RYA, 208 Sleepy Hollow Road, Pittsburgh, Pa. 15216.

FOR SALE: Brand new Swan 500C and power supply—speaker in excellent condx., $500. 14 AVQ and gnd wire, $10. Bug, $5. Ant. relay $10. Pkge—$510. Sri, you must pick up. Jay Friedman, 484 First Street, Elmont, N.Y. 11003.

SELL: CQ Mag, June 1948—Dec. 1949 complete plus a few 1947 Good condx. W2OKO, R. Mendelson, 27 Somerset Place, Murray Hill, N.J. 07971.

FOR SALE: E-Z Way model RBS-40G Galvanized, Two-section, 43 foot crank-up tower. Rotator Head accepts Ham-M Rotator. Wall attachment bracket included. Price—$125 F.O.B. Contact: F. Duran, W9KRU, 910 E. Waverly Drive, Arlington Heights, Ill. 60004.

HAVE 813 and 810 tubes, never used. Will trade or sell. What have you to trade? Need 3-1000Z tube. R. W. Field, K4IV, RR#2, Owensboro, Ky. 42301.

TOWER GUY WIRE: A-1 Galv. 1/4" made up with insulators. Turnbuckles, etc. Complete 18¢ per foot. Govt. surplus. Details Fred WA1ECV, RD 1, W. Redding, Conn. 06896.

INTEGRATED CIRCUITS: uL914 and uL923—50¢ each PPD. Ken-Morey, 803 West Sixth, Pittsburgh, Kansas. 66762.

FOR SALE: HR-10B receiver, calibrator. Will ship-good cond. $50. Geo. Ritter, 607 Shaker Drive, Medina. Ohio 44256.

CANADIAN: WANTED: Sideband Adapter B&W51SB or SB10, advise to condition and price. Seymour Harrison, VE1ABM, 91 Harbour View Drive, Sydney, Nova Scotia.

SELL: 240 copies QST & CQ 1955 thru 1967. extra 73 & CB free. The works $40.00. W2PYB, 72 Rumford Street, Depew, N.Y. 14043.

FOR SALE OR TRADE: BC-221 with AC supply, Knight VFO, make offer. Norman S. Ince, 3240 Dartmoor Drive, Dallas, Texas. 75229.

WANTED: KW Matchbox. Gutman, W2VL, 491 Rebecca Lane, Oceanside, N.Y. 11572.

B&W 5100 and 51SB $160.00 crated FOB Wichita Falls, Tx. Write WA5CMC, 2309 Bullington Street.

WANTED: Westrex Fax recorder almost any condx. Halicrafters Mariner ditto. G. Wickens, 297 Nahunt Rd., Nahunt, Ma. 01908.

ALL COMPONENTS 720 V. Pwr. supply. $8.95: 1320 V. Pwr. supply, $10.95: other ham gear. E. Tischler, 58 Carey Ave., Wilkes-Barre, Pa. 18702.

LIKE NEW: Galaxy V, AC 35, Calib., speaker, $275.00. Shipped. Rea prepaid in 48. D. P. Crowell, 314 E. Main, Ada, Okla. 74820.

WANTED: HW-26 will trade or pay money. Will pay reasonably. E. Baznik, 20931 Tracy Ave., Euclid, Ohio. 44123.

FOR SALE: T-4XB, R-4B, MS-4, AC-4, mint condx. Manuals and cables, $800.00. Plus shipping. WA9WEC, 852 W. Hawley, Mundelein, Ill. 60060.

WANTED: SR-150 any condition. All letters answered. H. Avary, 3204 Tamworth Court, Modesto, California. 95350.

HALL. HT-40 xmtr-not a kit. Like new-$50.00. A. E. Wilson, East Brewster, Mass. 02640.

FOR SALE: Collins 51J4 mint, original condition, no modifications, 1, 3, 6 Kc. mechanical filters, cabinet, $575 FOB. W7QCN/0, 1610 Shaster Drive, Colorado Springs, Colo. 80910.

DRAKE R4B 4 mo. old $310. Hammarlund HQ170 AVHF $250 Johnson Invader 2000 $400 Intercepter $225. George Misic, 37370 Windy Hill Drive, Solon, Ohio 44139.

NC-200 National xcvr, pwr supply, manual. 200w SSB, AM, CW $275 or offer. Also RME-69 rcvr. WA2-FEZ, 186 West Ave., Pitman, N.J.

SELL: NC125 rcvr w/speaker, manual, .56-35 MH, FOB, $60. Pat Crowley, 7 Racoon Drive, Hazlet, N.J. 07730.

40 Mc. tapetone converter $20. 6 meter tunaverter $20. 80 meter mobile xmtr $25. W2EWL, SSB Xmtr $25. Marty Feeney, K1OYB, 38 Howard Street, Portland, Maine. 04101.

MAINE HAMS! The Portland Amateur Wireless Association meets each Tuesday at 7:30 P.M., at 227 Spring Street, Code and Theory lessons given.

WANTED: 2 meter FM rig, $60 or under. Chicago area only. D. Ralston, 230 S. Lincoln Way, North Aurora, Ill. 60542.

FOR SALE: 19 Set Teletype CV-57 CV-89 all good condition. WA0KLC, 315 E. 20 Street, Grand Island, Nb. 68801.

MOTOROLA 80D-150 MC FM transceiver, w/control, mike, cables. Rec. is T-powered $75. K6KZT, 4434 Josie Avenue, Lakewood, Calif. 90713.

COLLINS Crystal Filters: Centerfrequencies 219 to 271 KHz; BW 400Hz-3db, 750 Hz-10db, 3KHz-30db, 5KHz-40db; 4.74 KHz channel separation, some pairs. $3.75 ppd. W0KPZ, Box 1038, Boulder, Colo. 80302.

MOTOROLA 80D-150 MC FM transceiver, w/control, mike cables. Rec. is T-Powered. $75. K6KZT, 4434 Josie Avenue, Lakewood, Calif. 90713.

SAROC Fifth National Fun Convention, Stardust Hotel, Las Vegas, Nevada, February 4-8, 1970. QSP SASE for details, SAROC, Box 73, Boulder City, Nevada. 89005.

FOR SALE: SX-96 rcvr with xtal cal. and speaker, DX-20 xmtr with xctals and key—$135. Mike, 340 S. 2nd, Street, Central Point, Oregon.

INTERESTED IN QRP? New QRP Net on 7080 at 0100 GMT Friday evenings. Check in and QSO other QRP fanatics. Try out the new QRP rig. I am on usually every nite and will be glad to sked Clay City, S.D., for QRP. Adrian Weiss, K8EEG/O, Rt. 1, Box 3, Meckling, S.D. 57044.

SALE: Elmac AF 67—AC supply—Exc condx. Best offer; HQ 170—w/clock, spkr—mint condx. $175. W2ASI, 15 Kensington Oval, New Rochelle, New York. 10805.

I WILL PAY $4 plus shipping for your burned out but unbroken 4-1000A or other similar sized tube. H. Trautmann, Deerfield Academy, Deerfield, Mass. 01342.

H.W. 12 and Ham built ps and mike in good condition. $80 pick up or will deliver in 100 M.L. Bill Mott, WA7IIR, Rout I, Box 97, Toppenish, Wash. 98948.

4D32 tubes, brand new, unused, (6). $25.00/ea., 2/$45.00 postpaid. W1YRC, 30 Rocky Crest, Cumberland, R.I. 02864.

EP2CB (CHUCK) going QRT Oct. 69. Tnxs to all for a memorable experience. QSL Via WA6GZZ.

WANTED: Instruction book for 2" scope TS34A/AP. It is TM11-1067A or AN16-35TS34-4 or NavShips 95343 or TO33A1-13-27-1. Jordan, 2334 W. Mulberry, San Antonio, Tex. 78201.

WANT TO BUY Swan 350C, 500C, or other good SSB rig in top condition. WA7GYL, Rt. 1, Box 45, Hamilton, Montana. 59840.

WANTED: Linear systems Commander PS manual, borrow or swap for HW-100 manual. K7LYK, 116 Stewart Street, Seattle, Wash. 98101.

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FOR SALE: Communicator III Six Mtrs. Excellent condition. $80.00. Regency MR-10 Monitor Radio two months old $55.00. WA8LTJ, 131 Pepperidge Lane, Battle Creck, Mich. 49015.

FOR SALE: Heathkit TX-1 $100, Hallicrafter S-40B $50. Rex McCollough, RR1, Box 63, Idabel, Okla. 74745.

EICO 753 and 751 late version with calibrator $165. W2CHK, 39 Sunset Blvd., Pittsford, N.Y. 14534.

FOR SALE: Swan 175 make offer. K8EKG, Joe Turkal, 1020 4th Street, S.W., Massillon, Ohio. 44646.

CASH FOR KWM2, give serial and condition also quick cash acceptable. W0BNF, Box 105, Kearney, Nebr. 68847.

SX-140 in good condition, $75. Pick up deal only. Teddy Leonrad, Box 261, Welcome, N. Carolina. 27374.

RCVRS: RBA w. p/s-$55, RAL-$29, RBS-$47, RBO-$28 TCSXMTR-$27, BC-1000 FM Xcvr-$24. Prefer pickup. G. Gray, 636 Hollywood, Monroe, Mi. 48161.

SELL: Johnson Valiant II and SSB Adapter with FSK connections ready for operation. $350.00. Schwartz (914) 668-3534 (day); (914) 668-3677 (evening).

FOR SALE: Lafayette HE35 6 meter transceiver AC and 12VDC Pwr $35., 19 Teletype $150. C. Vinson, WZGJJ, 2796 Larkspur Street, Yorktown Heights, N.Y. 10598.

WANTED: 500 to 1000w Linear. Prefer factory wired Johnson Thunderbolt or Courier. Must be in good condx., 606 Buckeye, Vacaville, Calif. 95688.

TRADE: FM tuner, MPX converter, stereo amp. for ham gear. Value about $45. W2ELV, 6 Tuscarora Ave., Geneseo, N.Y. 14454.

YOUR USED POSTAGE STAMPS can help finance disabled hams' club. Any quantity from any countries, please, to: A. Herridge, G3IDG, 96 George Street, Basingstoke, Hants, England.

FOR SALE: Model 15 Teletype complete with stand, converter, v.g. condition, $100. WA8QAA, Box 88, Globes, Mich. 49055.

SELLING: Complete working ARC 5 station 3-7.4 megs. 70 watts, am, cw, mike TR switch, etc. Howard Morse, 13 Tanglewood Estates, Keene, N.H. 03431.

COLLINS KWS-1/75A4. Vernier knobs all filters, etc. Perfect. Will deliver. BOB. 703-524-2398. 4423 N. 17th Street, Arl., Va. $1000

FOR SALE: Heath Kompact-KW matching A.C. supply. $150. Will ship. WA0QQR, 1314 Lincoln, Longmont, Colo. 80501.

SELL OR TRADE: GR unit oscillator, 900-2000 mc. APR 4, all TUs. Complete file CQ. Want RTTY back issues. W4NYF, Box 8873, Ft. Lauderdale, Fla. 33310.

COLLINS 75A-4 receiver. Low noise mixers, vernier knob, new P.T.O. excellent condition. $400.00. Pick up only. W2HC, 129 Harvard Street, Westbury, N.Y. 11590.

FOR SALE: Collins 75A-2 $215, 32S-1 W/PS $400, 75S-38 Mechanicals 2.1 kc $20; 0.5kc $40; Johnson Ranger $90 K8VQP 15746 Bradner, Plymouth, Mi. 48170.

SELL: Hammarlund HQ-110 rcvr 160-6 meters $95, Globe Chief Deluxe 90 watts CW 80-10 mtr xmtr $27, WA3JBN, 316 Donnell, Lower Burrell, Pa. 15068.

SAROC Delegates meet Alice, Billie, Bob, Hal, and Jim at SAROC advance registration desk, Stardust Hotel Convention, Las Vegas, Feb. 4-8, 1970.

SOUTHERN NEVADA ARC. INC. Box 73, Boulder City, Nevada 89005 hosting Fifth SAROC National Convention Feb 4-8, 1970. QSP SASE for details.

SAROC cocktail parties hosted by Ham Radio Magazine SWAN and GALAXY Stardust Hotel Convention Center, Las Vegas, Feb. 4-8, QSP QSL for details.

FOR SALE: Northern FSK, VMO. Power supply and manuals. 710 Grid Dip meter, SP600JX. Make offer for all or one. K7UWG, Rt. 2, Box 240, Mascoutah, Ill.

FOR SALE: AR 88 receiver $75.00., Johnson Ranger $90.00, NC 300 receiver, xtal Cal., speaker, $150.00. Swan 350 transceiver, 117 X/C power supply/ speaker, vox, $375.00. Gonset 2 meter transceiver $100.00. W3WYN, 2123 Armstrong Ave., Morton, Pa. 19070.

FOR SALE: Nikon "F", f1.4 50 mm, case, flash; $350. SW-240, VFO Console (vox, calibrator) USB/LSB: $250. James Craig, W1FBG, 29 Sherburne Ave., Portsmouth N.H. 03801.

FOR SALE: DX-35 xmtr with built-in antenna relay 65 watts CW, 45 watts fone. 80, 40, 20, 15 & 10 meters. $35.00. James Blumenfeld, Belmont Drive, Monticello, N.Y. 12701.

SELL: Model 90905 Millen monitor $25; Heath GR-64 receiver $20; EMC 214AR supply 100 V. 1 amp $20; Robert Ireland, Pleasant Valley, N.Y. 12569.

SELL: Trade NCX-5 MK II late model, NCX-A supply, XCU-27 calibrator, mint condition $435. Don Burns, 4410 Reading Rd., Dayton, Ohio. 45420.

COLLECTORS ITEM FOR SALE OR TRADE: National Agsx. Stamp for details. T.A. Herrmann, W7AOI, 2327 S.E. 72nd Ave., Portland, Oregon. 97215.

WANTED: Donations of any type of gear to help start a high school radio club. Contact Drew Wolfe, WA3-KLK, Randallstown High School, Offut Rd., Randallstown, Md.

SELL: 2 4065 tubes new $16.00, 2 4-150A tubes new $18.00; 2 4-250A used but A1 $30.00 W1ODQ, 299 So. Main Street, Mansfield, Mass. 02048.

WANTED: Eddystone geared Slo-Motion Drive 110:1 #898. Also good Gen. Coverage Rec. B. Weitermann, K9ISI, 4549 North 38, Mil., Wis. 53209.

MY JUNQUE Box runeth over, Request list of bargains W. C. Holder, 1000 West Alden Ave., Valdosta, Calif. 31601.

WANTED: SB:34 and Hustler Mobile Antenna. State price and condition. Roy Waterman, Box 186, AFRES, Robins AFB, Ga. 31093.

HELP SOS North Wildwood A.R.C. WB2DVB needs RTTY gear. Please donate your used dust collectors. Will pay shipping or haul. 118 E. Columbine Rd., Wildwood, N.J. 08260.

FOR SALE: Best offer, Hallicrafter SX-110, R-47, HT-40K. Turner Model 200. Robert Partridge, P.O. Box 18, APO Seattle. 98731.

LOOKING FOR COLLINS 312B-4 or 312B-5. State condition and price; G. K. O'Brien, 8401 N. Atlantic Ave., B20, Cape Canaveral, Fla. 32920.

WANT: Swan 406B. Sell; 3 mo. old Dynaco PAT/4A Trans. Stereo Preamp. Shure V-15/2 Cart/ and Mol. Preamp. K7Kca. 2601 Swan, Tucson, Ariz. 85716.

HEATH AA-50 stereo amp, Heath PT-1 FM AM deluxe tuner, $80 for both, or trade for VHF FM gear. W9TKR, 505 South Elmwood, Waukegan, Ill. 60085.

BERKELEY MODEL 510 electronic counter. Eleven digit readout. $150. SASE for info. Trade for late model VHF FM gear. W9TKR, 505 South Elmwood, Waukegan, Ill. 60085.

WANTED: Inst. or sch. or Mfg. address for Mar's EK-20 keyer. Will borrow or buy. R. Nicodemus, WN3-MST, RD#8, Greensburg, Pa. 15601.

AMECO CN-144-146 & 146-148 in; 28-30 mhz. out. PS-1 power supply. All brand new. Cost $73, all for $40. Both xtals incl. WA2DDR, 104 Woodhill Lane, Manhasset, N.Y. 11030 516-627-7797.

FOR SALE: Wheatstone 15/32" oiled perferator tape. P.L. Lemon, W6DOU, 3154 Stony Point Road, Santa Rosa, Calif. 95401.

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SAVE $75!

Herbert Gordon Company is pleased to announce availability of a limited number of brand new, factory fresh Clegg 66'ers, at only $175.00 FOB Harvard.

Now you can obtain a high efficiency modern 6 meter AM transceiver with 22 watts input and a dual conversion superhet with a built-in speaker, for less than the price of most used rigs.

In demand by Civil Defense Organizations, this fine piece of equipment is a worthy successor to the famous old 99'er. A built-in dual power supply enables you to operate mobile or from the regular house mains. Compact, efficient and with very pleasing audio quality, the 66'er is the ideal set for the new technician. Or even for we old timers who want to get on this fascinating band.

The 66'er features high level plate modulation, built-in push-to-talk operation, a spotting switch, very low drift 8 khz selectivity, adjustable squelch, switchable noise limitation and coverage of 49.9 to 52.1, which includes VHF, MARS frequencies. The sensitivity of the set is better than a half microvolt for 10 db signal plus noise-to-noise ratio. This has a dual IF receiver with the lower IF being 456 khz for modern monitoring.

The size of the unit is 12½" wide × 12" deep × 7¼" high. It weighs only 19 lbs and accepts standard 8 mhz FT 243 crystals.

Get on the band-wagon and order one of these today.

HERBERT W. GORDON COMPANY

Woodchuck Hill, Harvard, Mass. 01451

Telephone 617-456-3548

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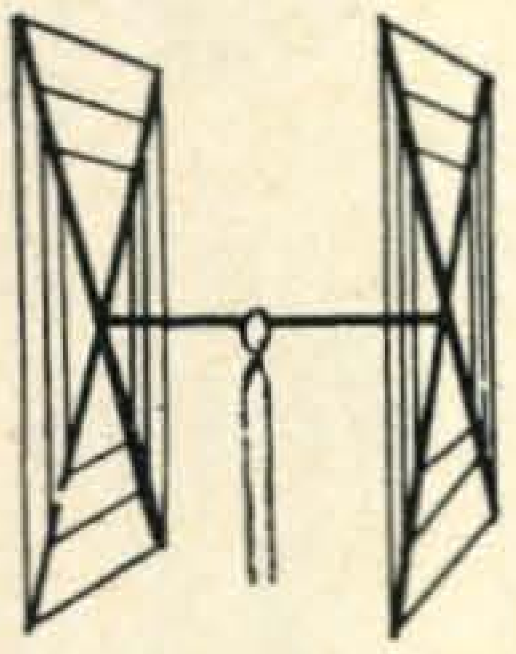
AHA! YOU THOUGHT GOTHAM

had a 47 story factory with 16 beautiful receptionists and 87 research technicians. No! No! No! Gotham is just two brothers making thousands of antennas in a 15' x 35' store, at prices that reflect the low, low, low overhead.

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	$35.00
10-15 CUBICAL QUAD	30.00
15-20 CUBICAL QUAD	32.00
TWENTY METER CUBICAL QUAD	25.00
FIFTEEN METER CUBICAL QUAD	24.00
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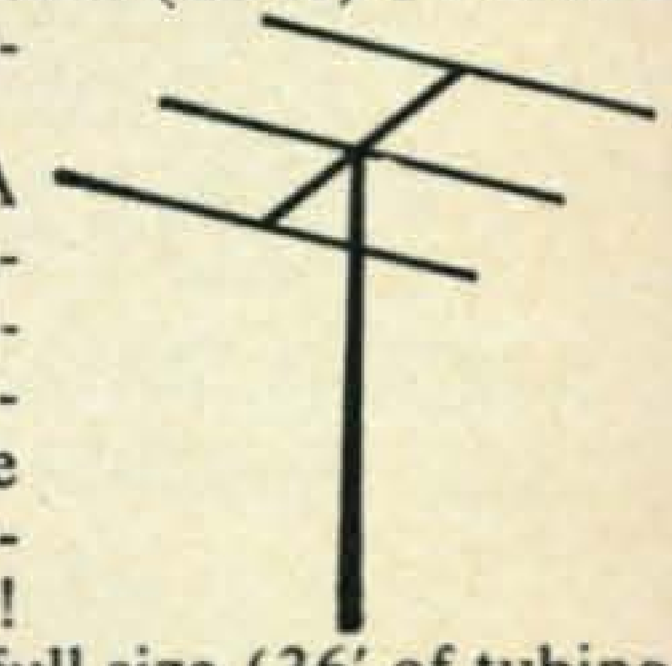
(all use single coax feedline)

GOTHAM
1805 Purdy, Dept. CQ,
Miami Beach, Fla. 33139

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	$19	4 EL 10	$18
3 EL 20	25	7 EL 10	32*
4 EL 20	32*	4 EL 6	18
2 EL 15	15	8 EL 6	28*
3 EL 15	19	12 EL 2	25*
4 EL 15	25*	*20' boom	
5 EL 15	28*		

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, T12FGS, 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

HOW TO ORDER: Send money order. We ship immediately by REA Express charges collect. Gotham ham and CB antennas are available for pick-up in: Rockford, Ill.; Orange, Calif.; Cleveland, Ohio; Daytona Beach, Fla.; Calgary, Canada; Hannibal, Mo.; Indianapolis, Ind.; South Bend, Ind.; Oklahoma City, Okla.; Leavenworth, Kansas; Dallas, Texas; Brockton, Mass.; Ellwood City, Penna.; and in the Benelux Countries and Australia. Write for name and address of franchised distributor. Other cities open.

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