CQ Reviews:

The Swan Model 500C Transceiver

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THE Swan Model 500C Transceiver is an updated version of the Model 500 which is one of a series in the popular Swan line.

Since we have not previously reviewed the Model 500, we'll give a complete run-down on the 500C. The features common to both models are: full coverage on the 80-10 meter amateur bands; s.s.b. operation with essentially 1/2 kw p.e.p. input on either l.s.b. or u.s.b.; c.w. operation; compatible a.m. operation using a single sideband with 125 watts carrier-input power; wide-range adjustable Pi-network for matching loads of 15-500 ohms; p.t.t. operation or v.o.x. (with accessory unit); a.l.c.; two-speed v.f.o.-tuning drive; frequency calibration in 5 kc steps, except 20 kc ones on 28 mc band; dial-set for indexing calibration; built-in 100 kc crystal calibrator; provisions for split-frequency operation using external v.f.o. accessory. Power is obtained from an external source.

The basic differences found in the Model 500C over the provisions in the Model 500 are: use of 6LQ6 tubes in the p.a. instead of 6HF5's, providing 520 watts p.e.p. input rather than 480 watts; 15- and 20-meter band coverage changed to 21-21.45 and 14-14.45 in place of 21-21.5 and 13.85-14.35 mc; relative output-power meter readings provided in addition to signal-level and p.a. cathode-current indications; 6JH8 substituted for the 7360 balanced modulator; vacuum-tube carrier oscillator replaced with transistorized type; c.w. keying now possible through v.o.x. accessory for v.o.x.-type break-in, manual c.w. switching still available when the accessory not engaged; c.w. sidetone monitor; transmitter-frequency offset for c.w. operation; carrier-level control for c.w.; improv noise-limiter operation; nominal i.f. of 55 kc instead of 5173 kc.

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Technical Features

A block diagram for the 500C is shown fig. 1. Single conversion is used througho This minimizes the possibility of many spu ious responses and lessens the chances non-linearity that might otherwise be intr duced by additional mixers.

The i.f. is nominally 5500 kc. The sid band filter used employs crystals for a 6 bandwidth of 2.7 kc. At 60 db down it 4.6 kc, resulting in a 1.7:1 shape factor. T bandwidth is 8.3 kc at 100 db down w ultimate rejection outside this passband rat at greater than 100 db.

Since there is only one conversion, t frequency range of the v.f.o. is altered f the various bands as indicated at Table

Sidebands are changed by switching ca rier-oscillator crystals. A 5500 kc crystal employed for the "normal" sideband; that the one usually used on each amateur bar The "opposite" sideband carrier frequency 5503.3 kc.

The carrier frequency for the normal sid band permits passage of only the *upper* sid band through the sideband filter, but with t 80- and 40-meter bands the end result transmission of only the *lower* sideband, b cause the receiver i.f. is obtained by t v.f.o. frequency *minus* the signal frequenc rather than the *signal* frequency *minus* t v.f.o. frequency as is the case for the 2(15- and 10-meter bands.

On transmit, a similar inversion occu because on 80 and 40 meters the generat s.s.b. signal and the v.f.o. frequencies a

See page 110 for New Reader Servi

The Swan Model 500C Transceiver shown with the Model 117XC A.C. Power Supply and Speaker Console.

ıbtractively mixed; while on 20, 15 and 10 eters they are additively mixed as shown at able I.

Changing sidebands on any one amateur and also requires retuning the v.f.o. 3.3 kc. his is not an automatic shift, thus necessitatg manual retuning; however, to facilitate ıch operation, there are two fiducial hairnes. They are identified by LSB and USB. ne indicates the frequency when the lower deband is engaged; the other similarly is sed for the upper sideband.

V.F.O.

The v.f.o. is a solid-state job with two ansistors. Q_1 functions as Colpitts oscillar in a common-base circuit with the various nges obtained by switching inductors and ssociated padders. Q_2 is an emitter follower at provides isolation between the oscillator d the 6EW6 vacuum-tube amplifier for the f.o. signal, thus minimizing loading effects by the amplifier and thereby aiding in ensuring stability.

A negative operating potential of 10 volts is obtained for the v.f.o. setup from the transceiver bias supply and it is regulated by a Zenner diode, further contributing to stability particularly during line-voltage or power-supply variations.

The carrier oscillator, which is transistorized using a Pierce circuit, also is powered from the same regulated source.

C.W. and Tuneup

During tuneup a carrier is obtained by unbalancing the modulator which employs a beam-deflection type tube. One of the deflection plates is automatically grounded at this time.

For c.w., the carrier is obtained and its level is adjusted by varying the carrier-balance control as needed for the desired output. Normally, the carrier crystal is 300 c.p.s.

Band (mc)	V.F.O. (mc)	Xmt-Mix	I.F. Sig. (mc)
3.5-4.0	9.00-9.50	Diff.	5.5
7.0-7.45	12.50-12.95	Diff.	5.5
14.0-14.45	8.50-8.95	Sum	5.5
21.0-21.45	15.50-15.95	Sum	5.5
28.0-29.7	22.50-24.20	Sum	5.5

ıble I—Band-to-band frequency setup used in the 500C. On receive, the difference mixture etween the input signal and the v.f.o. frequencies is used to produce the 5.5 mc i.f. On transmit, the ıtput signal is produced either by the difference or sum mixture of the v.f.o. frequency and the 5.5. mc s.s.b. generator signal as indicated at the Xmt-Mix column.

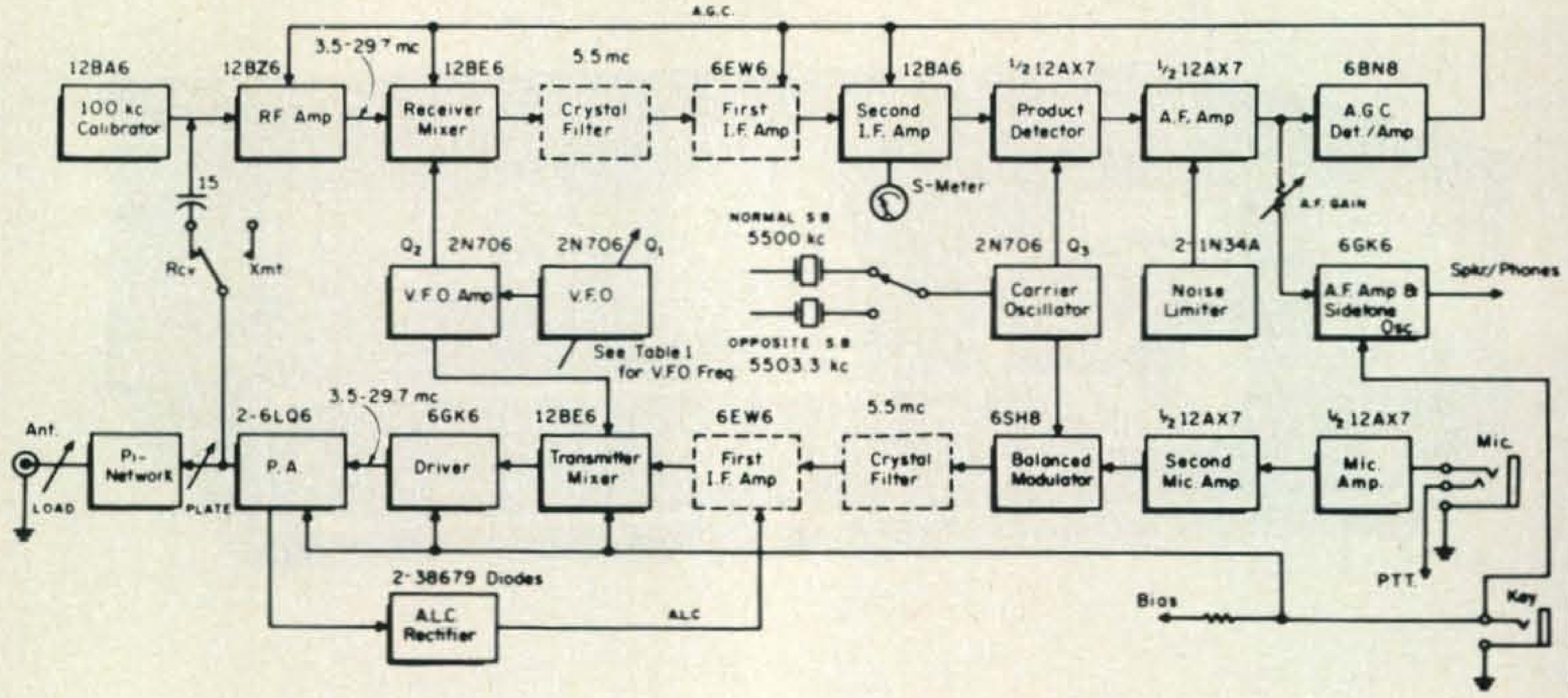


Fig. 1—Block diagram for the 500C. Salient technical details are given in the text. Circuit elements in dashed lines are common to both transmit and receive.

outside the passband of the sideband filter. For c.w. operation and tuneup, a "rubbering" padder is automatically switched in the crystal circuit of the carrier oscillator to shift the frequency of the 5500 kc crystal 800 c.p.s. higher, so that it falls well into the filter passband. This permits the carrier to pass unattenuated for full output.

It also provides an 800 c.p.s. frequency offset between receive and transmit as is desirable for c.w. work. Also at this time, the 2nd speech amplifier is disabled to prevent accidental modulation from the microphone.

Sidetone Monitor

Grid-block keying is used for c.w. along with a sidetone monitor that is a unique affair whereby the receiver a.f. output amplifier is automatically converted to a tone oscillator as shown at fig. 2.

A.G.C.

The a.g.c. is the audio-derived type with a slow release time provided by a suitable R/C combination in the a.g.c. line. The r.f. gain also may be manually controlled by a potentiometer that furnishes a fixed bias to the a.g.c. line for setting the overall gain as desired.

Noise Limiter

The noise limiter employs two back-to-back diodes shunted across the output of the 1st a.f. amplifier with circuitry similar to that often used for s.s.b. at an i.f. transfor mer. In the Model 500 the noise limiter i installed ahead of the a.f. amplifier, but i the 500C it *follows* the amplifier. This allow it to function at a higher signal level, thu making its performance more effective. Th a.n.l. also prevents noise peaks from captiv ating the a.g.c. Its circuitry is shown at fig.3

R.F. Circuits

The same tuned-r.f. circuit for each ban is used for both the receiver-mixer input an the transmitter-mixer output. This circui is gang-tuned with a dual capacitor alon with the transmitter-driver output and thu constitutes the *P.A. Grid Drive* control. I peaks up the circuits both on receive an transmit.

The receiver r.f.-stage input is tuned b the transmitter Pi-network to which it i coupled by a 15 mmf capacitor. On transmi this capacitor is disconnected by the change over relay.

Transmitter

The Pi-network for the p.a. has two ad justable loading controls. One cuts in or ou fixed capacitors for *course* loading, the othe operates a varible capacitor for *fine* loading As stated earlier, this allows proper matchin to a wide range of loads. This feature, whic is seldom found in tranceivers, enables oper ation under various antenna or transmission line conditions not otherwise possible withou

See page 110 for New Reader Servic

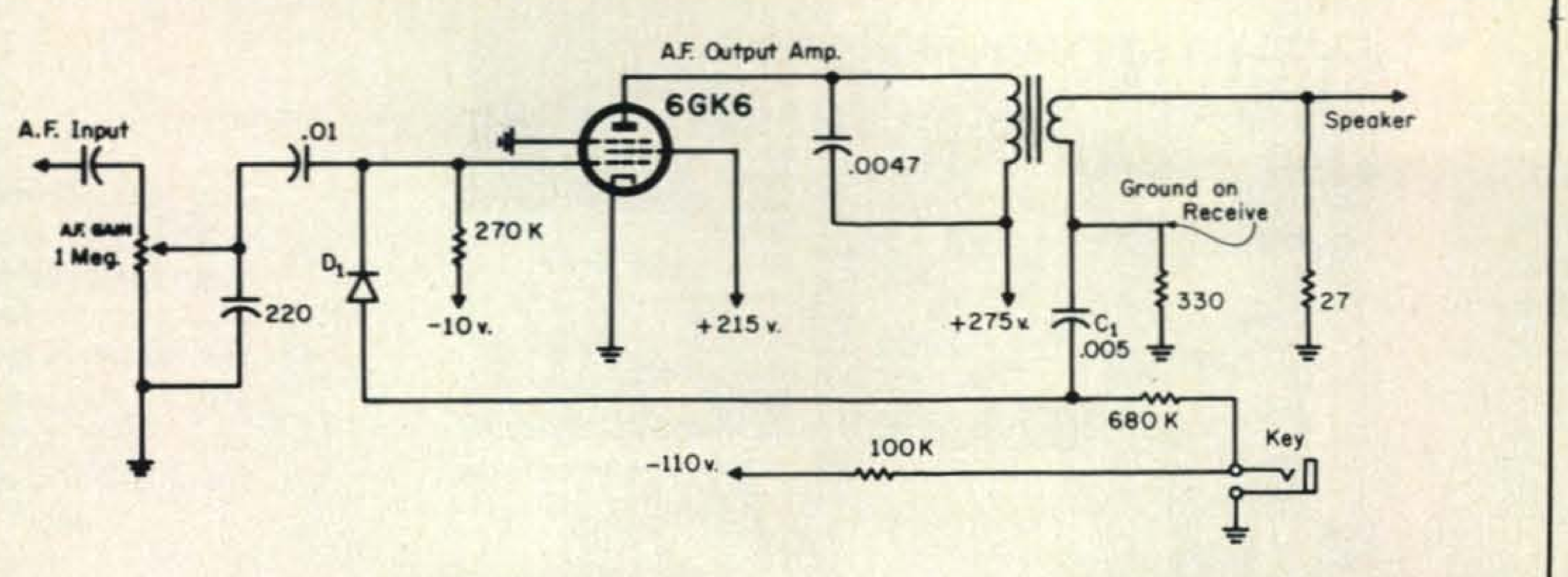


Fig. 2—Sidetone-oscillator setup used in the 500C. A feedback loop consisting of C_1 and D_1 is connected between the output and the input of the a.f.-output amplifier. The overall circuit constants are such that this causes the amplifier to oscillate and produce an audio tone of about 800 c.p.s. D_1 is a diode switch that disables the feedback loop on receive or activates it for tone with c.w. transmit.

the use of external coupling or matching devices.

Neutralization

Excellent overall stability is achieved by neutralization of both the driver and the p.a. using the capacitance-bridge method in each case. This is augmented in the p.a. with different value fixed capacitors for each band that are switched in or out of one branch of the circuit to counteract circuit strays through the band-switch wiring. Proper neutralization is thereby maintained on all bands with one setting of the customary varible neutralizing capacitor in the plate branch. In addition, on the 10-meter band, a separate variable capacitor is switched in to enable precise neutralization for this band where the circuit values usually become more critical.

A.L.C.

The a.l.c. is the conventional type using a solid-state voltage doubler to rectify the a.f. component that appears at the p.a. grid. when grid current tends to flow.

Meter

The S-meter operates from the a.g.c.-controlled 2nd i.f. On tuneup, it is automatically transferred to indicate relative power output. Included is a sensitivity control. On s.s.b. and c.w. transmit, the meter automatically indicates p.a. cathode current.

Tuning Dial

The drive for the v.f.o. has an inner knob that provides fast-speed tuning for quick excursions across the range with five turns required for such coverage. Slow-speed or vernier tuning with an outer knob covers 15-20 kc per revolution on all bands, except for 28 mc where it covers about 60 kc.

There are three scales on the dial: one for the 3.5 mc band, one for 7, 14 and 21 mc, and one for 28 mc. On all scales the incremental calibrations, as noted earlier, are spaced about 3/32″ apart.

Indexing the dial calibrations against the fiducial hairline, referred to the calibrator marker signals, is done electronically by adjusting a small knob which slightly varies the v.f.o. frequency as needed. The l.s.b. and u.s.b. hairlines thus always remain centered at the dial window.

Equipment Connections

Transfer between transmit and receive is handled by two relays. Included on one is a

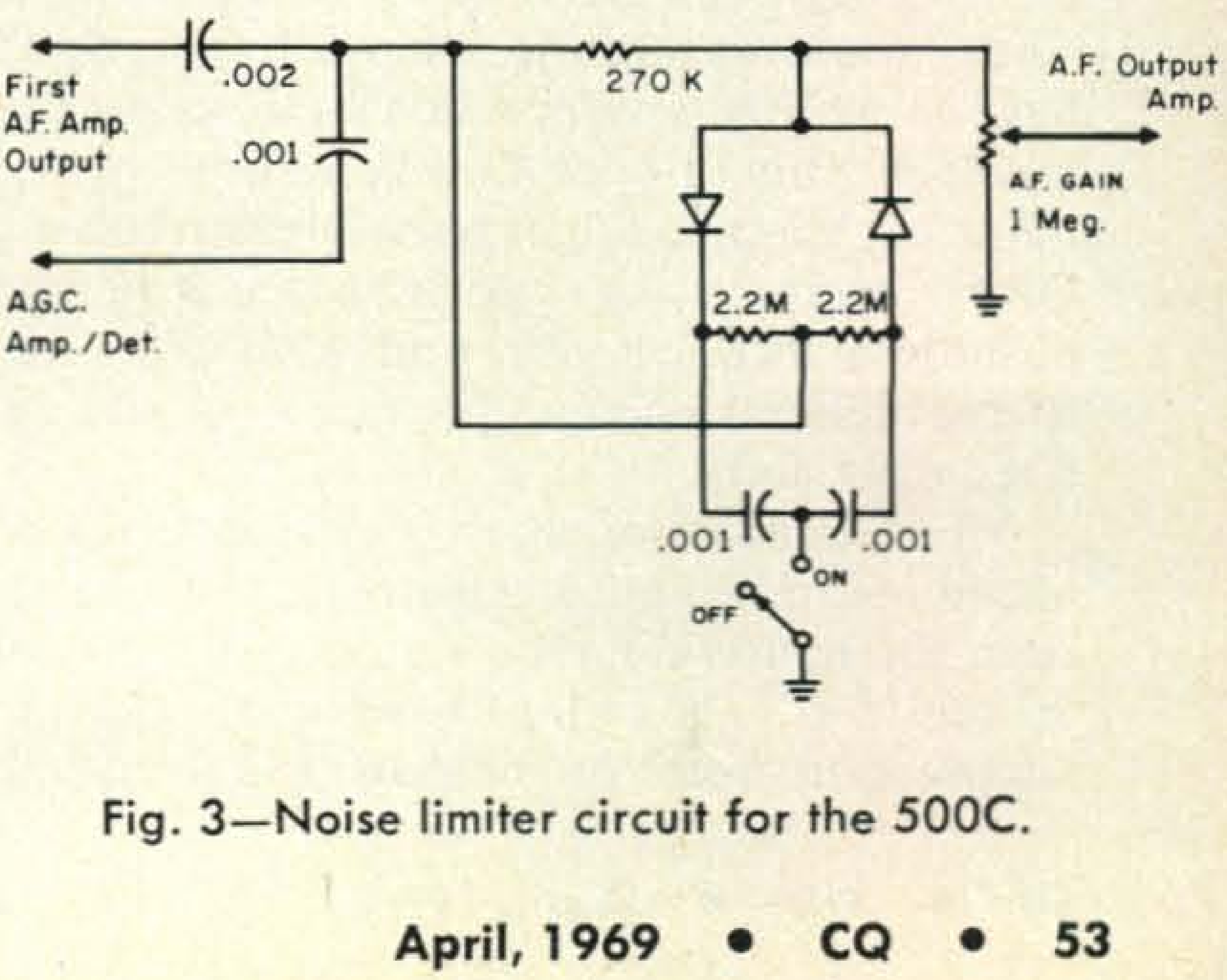
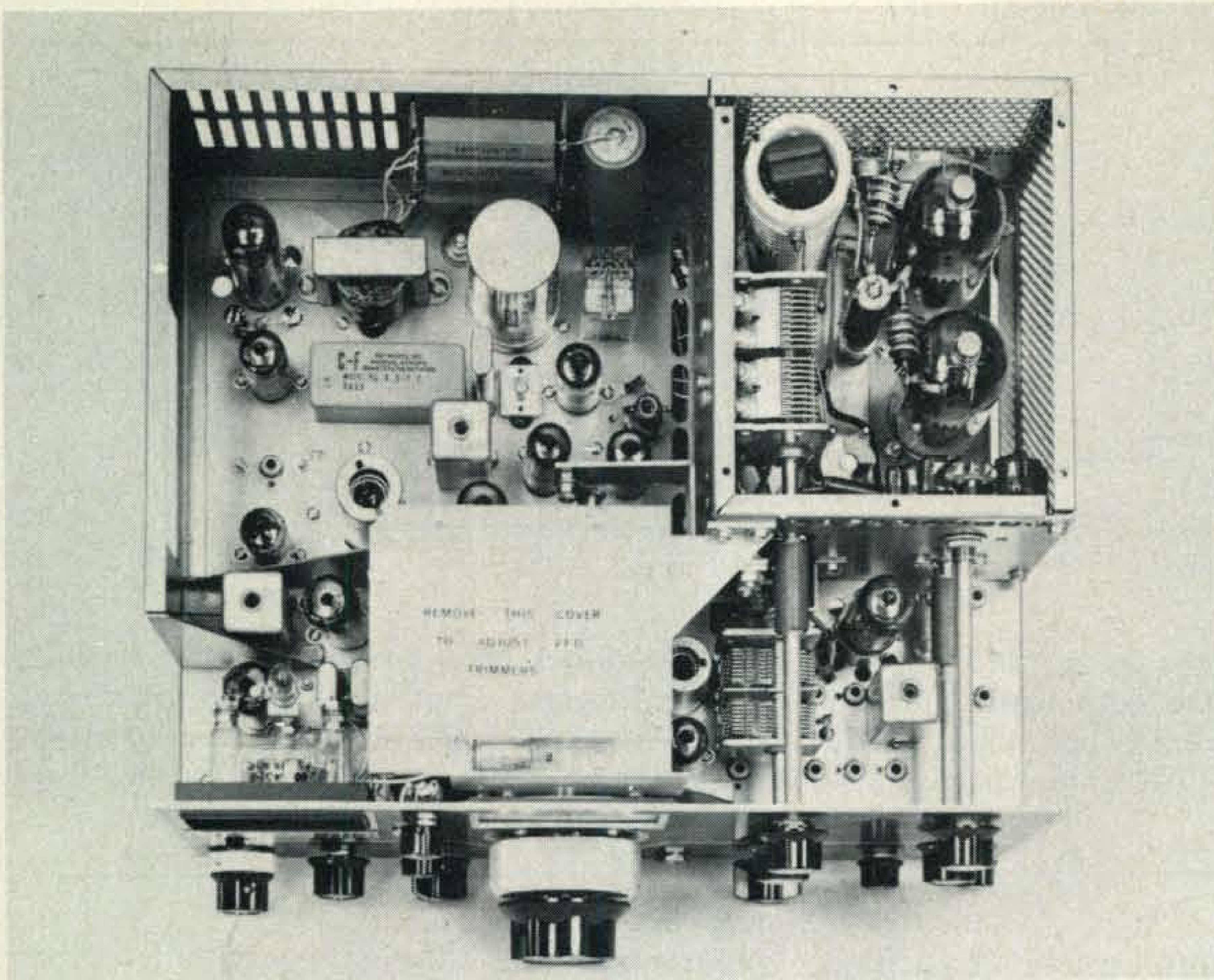


Fig. 3—Noise limiter circuit for the 500C.



Top view of the Swa 500C. The cover ha been removed from th p.a. compartment a the upper right. Th job is ruggedly bui and well braced t resist twisting or warp ing.

set of s.p.d.t. contacts with terminals at the rear of the set for control of external gear. There also is a Jones 12-terminal power connector, an 8-pin octal socket for the v.o.x. accessory and a 9-pin octal-type socket for other accessories such as an external v.f.o. The c.w.-key jack also is on the rear. A 3-way mic jack is on the panel.

Operation and Performance

Operationally, one of the nice features that is characteristic of the Swan gear is the two-speed tuning drive for the v.f.o. Its performance is velvet smooth at either speed and it is conveniently manipulated by easy-to-grip knobs. No backlash was detected on the model made available to us.

Another convenient arrangement on the set is that the sideband-selector switch has one position marked *normal* for providing the sideband normally used on each band. Thus, when bands are changed, you don't have to manually switch sidebands as needed therefor. Should operation be desired on the other sideband, as might be helpful in dodging QRM, you flip the switch to the sideband position marked *opposite* and retune the v.f.o. to the fiducial hairline provided for the related sideband.

Measurements of receiver performance on all bands indicated a sensitivity 6 db better than the manufacturer's rating of 0.5 μv for 10 db S+N/N ratio. Unwanted-sideband suppression both on receive and transmit, rated at more than 50 db, was −42 db a 500 c.p.s. and −58 db at 1 kc, indicatin better-than-usual attenuation and very stee filter skirts.

Only two internal spurious responses wer found. These were out of the amateur band at 4001 and 7330 kc and were less than 0. μv. The i.f. signal rejected measured 44, 52 54, 66 and 60 db on the 3.5, 7, 14, 21 an 28 mc bands respectively. Image rejection fo the same respective bands was 85, 76, 72 80 and 74 db.

The a.g.c. characteristic was quite flat wit only a 3 db a.f. output change with 20 d r.f.-input signal changes of 1-10 μv. This i unusual in that with most receivers there i much less a.g.c. control in the low-micro-vol region. For a 60 db r.f. input change of 10 10,000 μv the a.f. output variation was 7 db

The a.g.c. release time was found to b good for eliminating pumping effects o strong signals, but the attack time appeared t be a bit on the slow side, inasmuch as i sounded hard with a tendency to slightly plop at the start of strong-signal transmissions.

The S-meter readings were quite generou ranging from 32 μv for an S-9 indication o 3.5 mc to 5-10 μv for S-9 on the other bands This also indicated a band-to-band gain var iation of 6 db, except for 3.5 mc where it i somewhat lower to a larger degree.

Insertion of the noise limiter slightly drops the a.f. level and the h.f. response, but its use was quite effective in providing gooc

See page 110 for New Reader Servic

nal readability not otherwise possible der adverse noise conditions.

Frequency Stability

Since the v.f.o. operates on a different nge for each band, frequency-stability runs re taken at the midpoint of *each* band and re conducted separately the first thing on fferent days at the same morning-ambient 65° F.

Under these conditions, the drift during the st 30 minutes ranged from 100 to 500 .s., with a 100-150 c.p.s. drift the next 60 nutes and 50 c.p.s. or less per hour there- ter on all bands. This is exceptionally good pecially in view of the act that the v.f.o. nctions at comparatively high frequencies indicated at Table I.

Line-voltage variations of ±10% produced frequency shift of less than ±5 c.p.s. nging the transceiver cabinet created no verse effects on the frequency.

Transmitter

As usually is the case when TV sweep- pe tubes are used in a p.a., tuneup must be nducted carefully and quickly for reson- ce to avoid tube damage.

On transmit the *output* power under tune- or c.w. conditions was 275 watts on 3.5, and 14 mc; 250 watts on 21 mc and 225 atts on 28 mc. *Peak-output* power on all nds with voice modulation was 20% gher. With a two-tone test on s.s.b., the stortion products were equivalent to the ting of approximately 30 db down.

C.W.

We did not have the v.o.x. accessory, so nnot comment on its operation, partic- ary for c.w. break-in. Without it, transfer tween receive and transmit for c.w. must conducted by manually shifting the mode itch. P.t.t. operation is otherwise available r s.s.b. and a.m.

The c.w. keying was good and in spite of a irly steep wavefront on the make, no ad- rse clicks were evidenced with on-the-air eration. The break trails off gradually, so problems were expected here. A slight irp appeared during keying on the 28 mc nd. This was not experienced on the other nds.

The frequency offset on c.w. places the ansmitter frequency 800 c.p.s. *lower* than e receiver frequency on the 3.5 and 7 mc nds; while on 14, 21 and 28 mc it is 800 p.s. *higher* than the receiver frequency. This must be kept in mind when band-edge operation is conducted.

The sidetone monitor is set at a fixed level, but it may be altered by changing an internal resistor as prescribed in the manual.

On a.m., the carrier output power is about one-quarter that noted above for tuneup. A.m. transmissions are made using only one sideband. There is no envelope detector for receiving a.m., so such signals must be de- modulated by zero-beating the carrier and listening to one of the a.m. sidebands.

The size of the 500C is 5½" x 13" x 11" (H.W.D.) and it weighs 17¼ pounds.

Power requirements are: 800 v.d.c. at 550 ma peak; 275 v.d.c. at 150 ma; –110 v.d.c. at 100 ma; 12.6 v. a.c. or d.c. at 5 a.; 12 v.d.c. at 250 ma for relay.

These voltage may be had from a variety of Swan power supplies for operation from 117-230 v.a.c. or 12-13.5 v.d.c. There also is an external v.f.o. accessory, Model 410C, that may be used either for on-frequency transceive operation or for split-frequency work. Data on these units may be obtained by writing to the manufacturer.

The Swan 500C Transceiver is priced at $520. A matching 117 v.a.c. power-supply console with built-in loudspeaker is avail- able at $105. These are products of Swan Electronics, Oceanside, California 92054.

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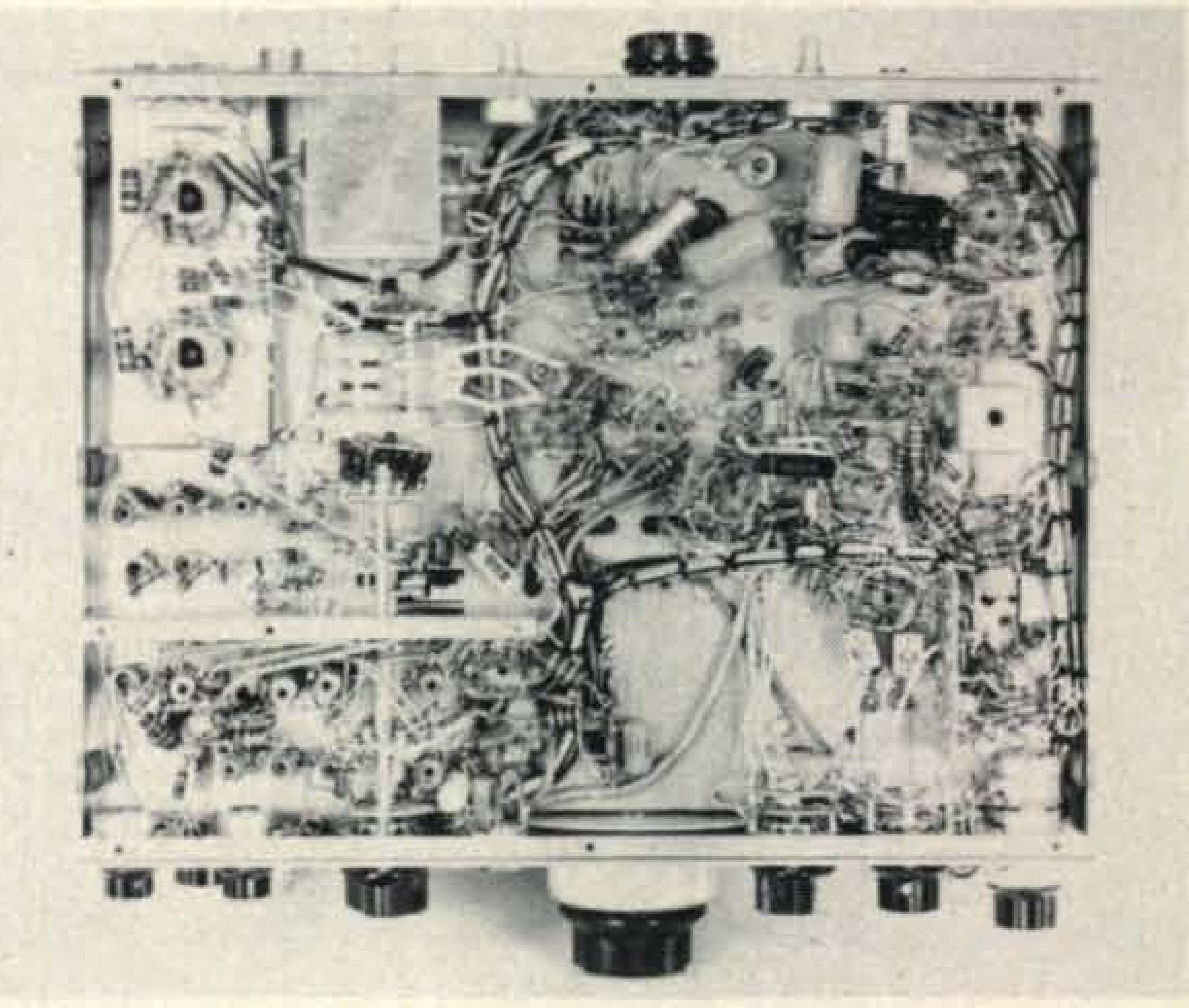

Bottom view of the Swan 500C. To minimize the possibility of TVI, the power-supply leads go through a copper box (left of upper center) where they are bypassed with feedthrough-type capacitors. The r.f. inductor cores for each band may be adjusted through access holes in the bottom cover where they are clearly identified.