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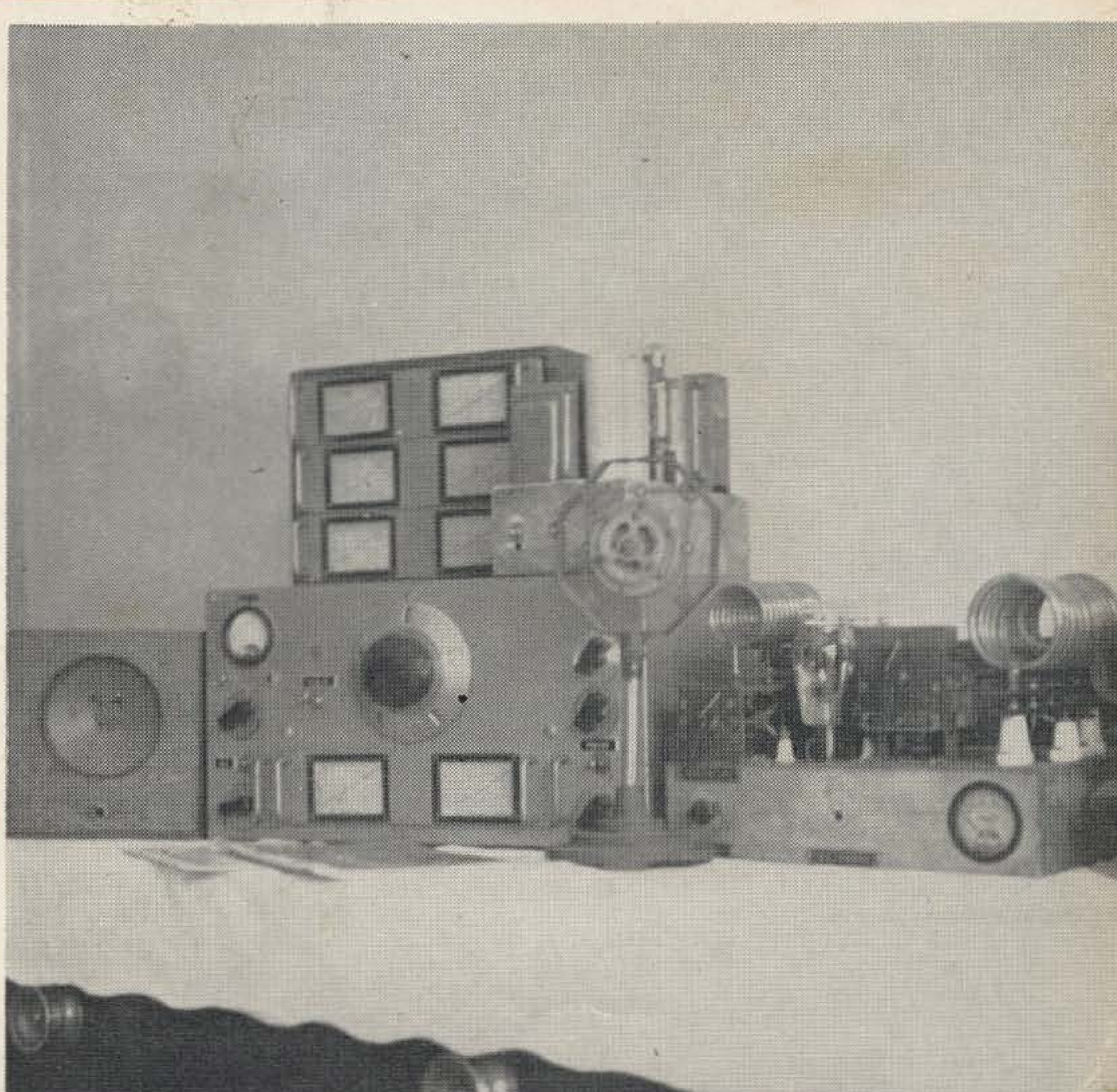

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Wayne Grenee, W2NSD
Editor, etcetera

April, 1963

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Leonard Tamulonis, WIMEL

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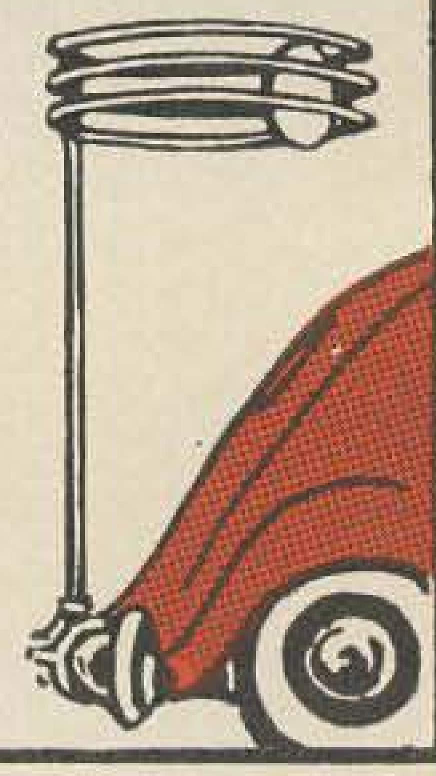

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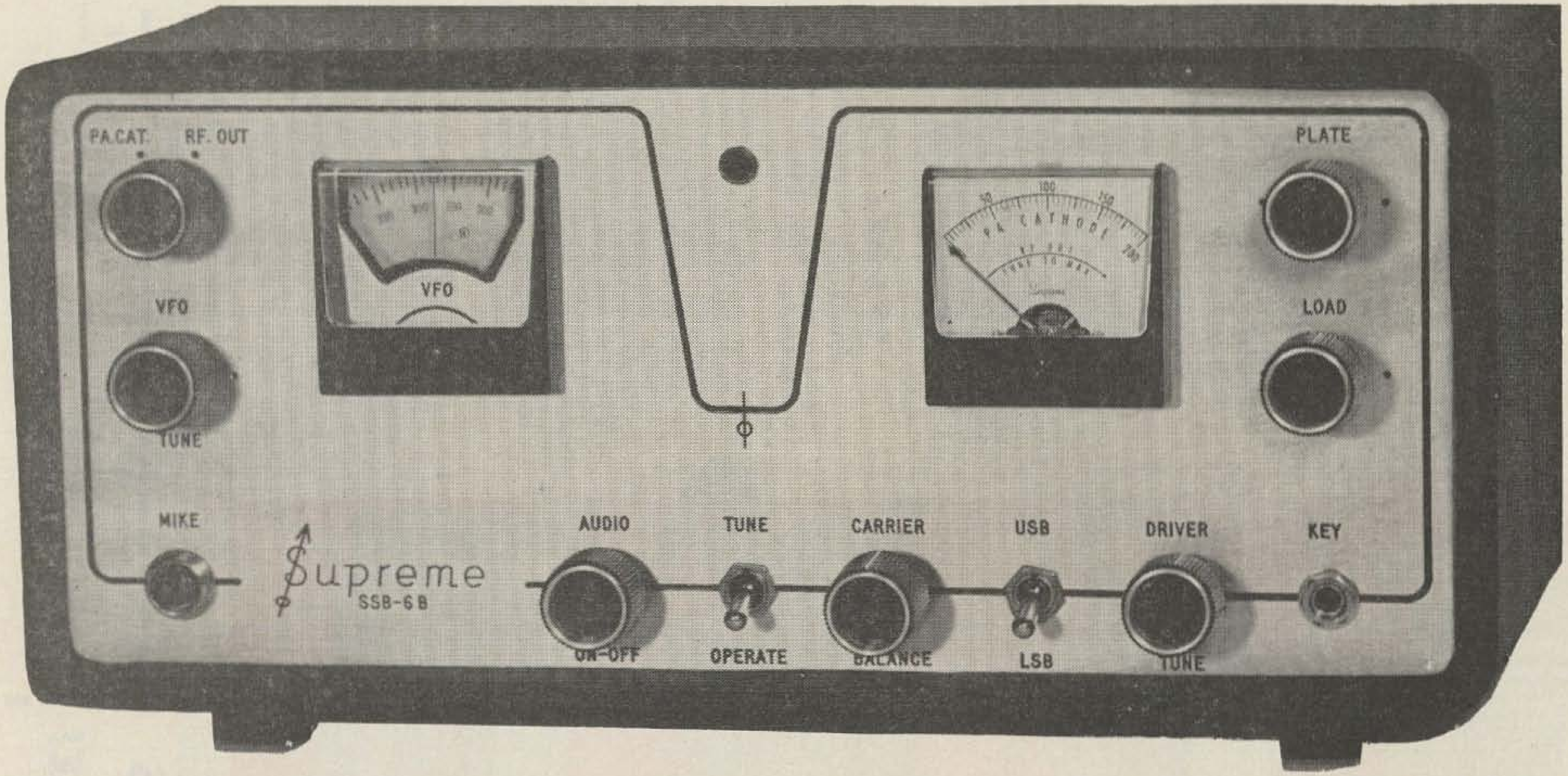

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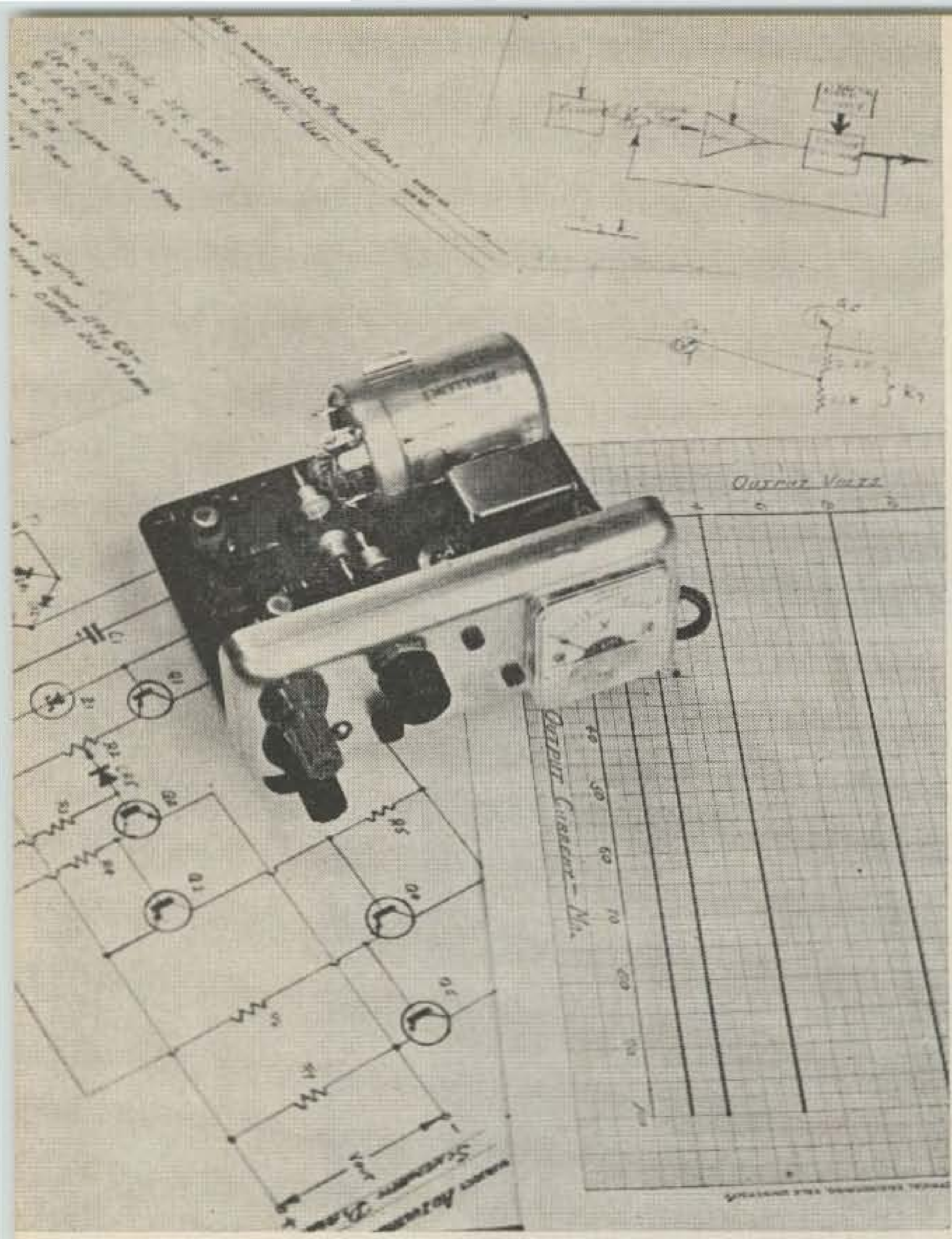


This unit is available in a 73 kit because we know that any of you who have been doing any transistor experimenting are probably awfully tired of using batteries by now and know darned well that you have to have one of these.

An Adjustable Regulated Power Supply

Charles Miller W1ISI
General Radio Company
West Concord, Massachusetts

Interest in applying the transistor to both new and older circuit designs has grown at an ever increasing rate in the last few years. Their commercial application has required increasing the quality and the quantity of the output of transistor manufacturers. This has caused the prices of transistors to fall at a rapid rate. This is one vicious circle that has worked to the advantage of the average individual as cost appears to be the major barrier to be surmounted in most construction projects.

One of the problems associated with the design of transistor circuitry is the power supply. That is, most transistor circuits must be operated at low voltages and higher current levels. The average vacuum-tube supply is unsuitable because its output voltage is normally many times higher than the transistors can stand. A vacuum-tube supply may be used with a voltage divider, but this type of supply is useful for only low-level circuits because of the power wasted as heat. Batteries are seldom desirable, owing to their cost and relatively short life, and because their voltage is not adjustable. The usual "cheap and dirty" solution is to use a low-voltage transformer with silicon rectifiers and a simple capacitor-output filter, then use a voltage divider or a simple series power transistor to provide adjustment. These solutions have the disadvantage that even though adjustable, the output voltage will fluctuate with changes in load current and line voltage.

General Considerations

The design of a transistor supply, the output of which is both adjustable and regulated, presents many problems.

Fig. 1 is an elementary diagram illustrating the "series-regulator" technique. It is applicable to both transistor and vacuum-tube power supplies. The unregulated supply consists of an ideal voltage source V_S with an associated internal resistance R_i. The load R_L is connected to the supply through the series resistance R_S. It may be seen that all components are shown to be variable except R_i. This allows us to consider:

a) the adjustment of the value of V_O.
b) the effects on V_O as R_L (and thus I_L) varies.
c) the effect on V_O as V_U varies.

Since from Ohm's Law

$$V_O = I_L R_L \quad (1)$$

and

$$I_L = \frac{V_U}{R_L + R_S}, \quad (2)$$

$$V_O = V_U \frac{R_L}{R_L + R_S}. \quad (3)$$

Thus if V_U is assumed constant for the moment, the value of V_O for a given value of R_L is determined by the value of R_S. Under these conditions then, V_O depends only on the setting of R_S. If R_S is zero (short circuit), equation 3 becomes

$$V_O = V_U \frac{R_L}{R_L + 0} = V_U \quad (4)$$

and

If R_S equals infinity (open circuit), then

$$V_O = V_U \frac{R_L}{R_L + \infty} = 0 \quad (5)$$

Referring again to equation (3), if the value of R_L is changed with V_U and R_S constant, V_O will change. However, a new value for R_S may be found such that

$$\frac{(\ R_L\ )}{(R_L + R_S)_1} = \frac{(\ R_L\ )}{(R_L + R_S)_2} \quad (6)$$

leaving V_O unchanged.

Variation of V_S is due essentially to fluctuations of the line voltage into the supply. For a fixed load, from equation (1), V_O can be constant only if I_L is constant. But

$$I_L = \frac{V_S}{R_L + R_S + R_i} \quad (7)$$

Thus R_S must be varied as V_S varies to maintain I_L constant.

Although each phase of the circuit operation was taken individually, complications arise in a practical supply. Of particular importance are the three "corners" of the region of operation indicated in Fig. 2. At low voltage and low current, for example, R_S must be a virtual open circuit. At high voltage and high current, however, its resistance must be extremely low, as the indicated I_L must drop only the voltage *between* the V_U and V_O curves at that point. Perhaps the point of greatest importance though is the condition of low V_O and large I_L. This is the point at which the voltage across and the current through R_S is maximum. Since

$$P = (E_{R_S})\ (I_L) \quad (8)$$

R_S thus dissipates a maximum amount of power in the form of heat. As the function of R_S is to be performed by a transistor, the ability of the transistor to satisfy the indicated criteria must be carefully considered.

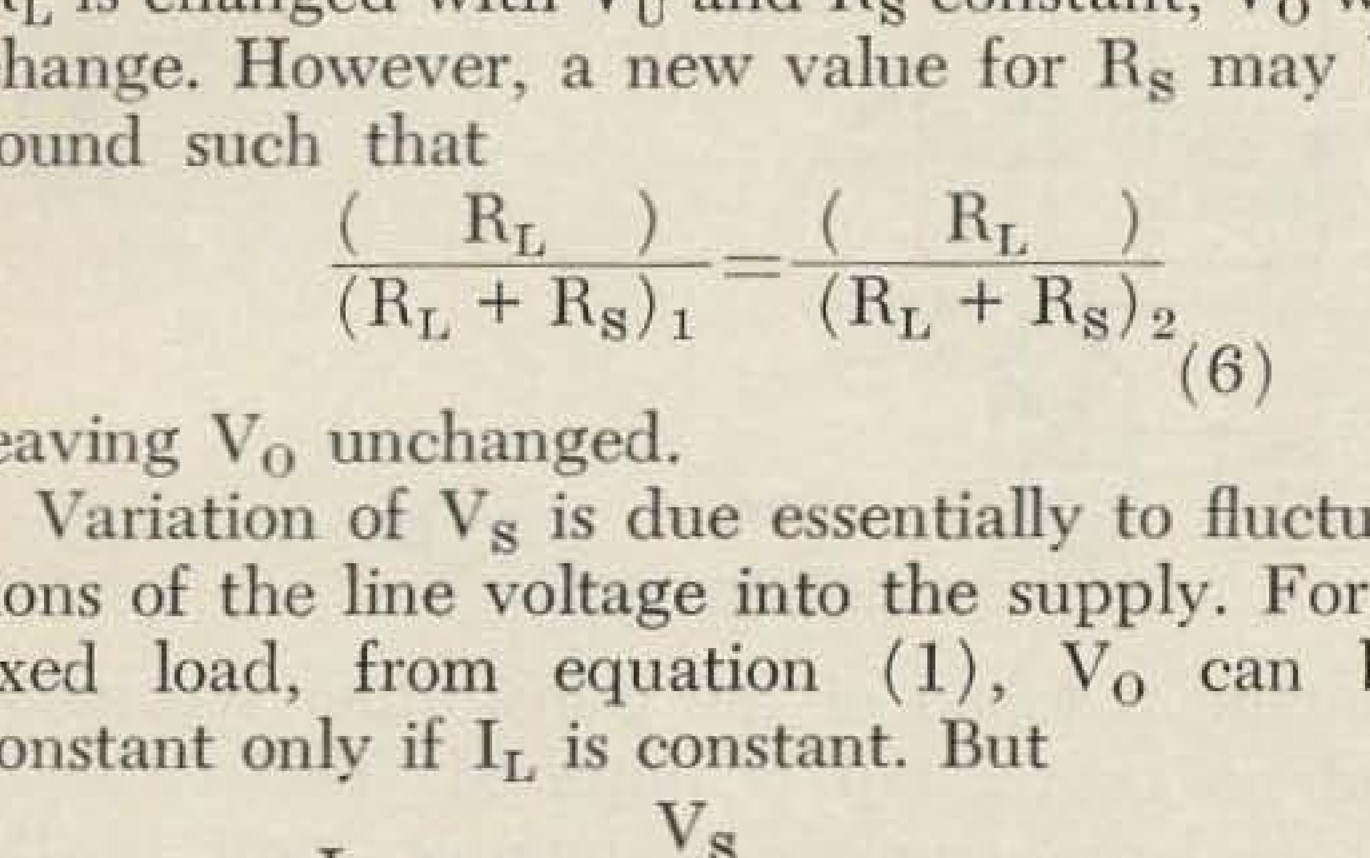


FIG. 1

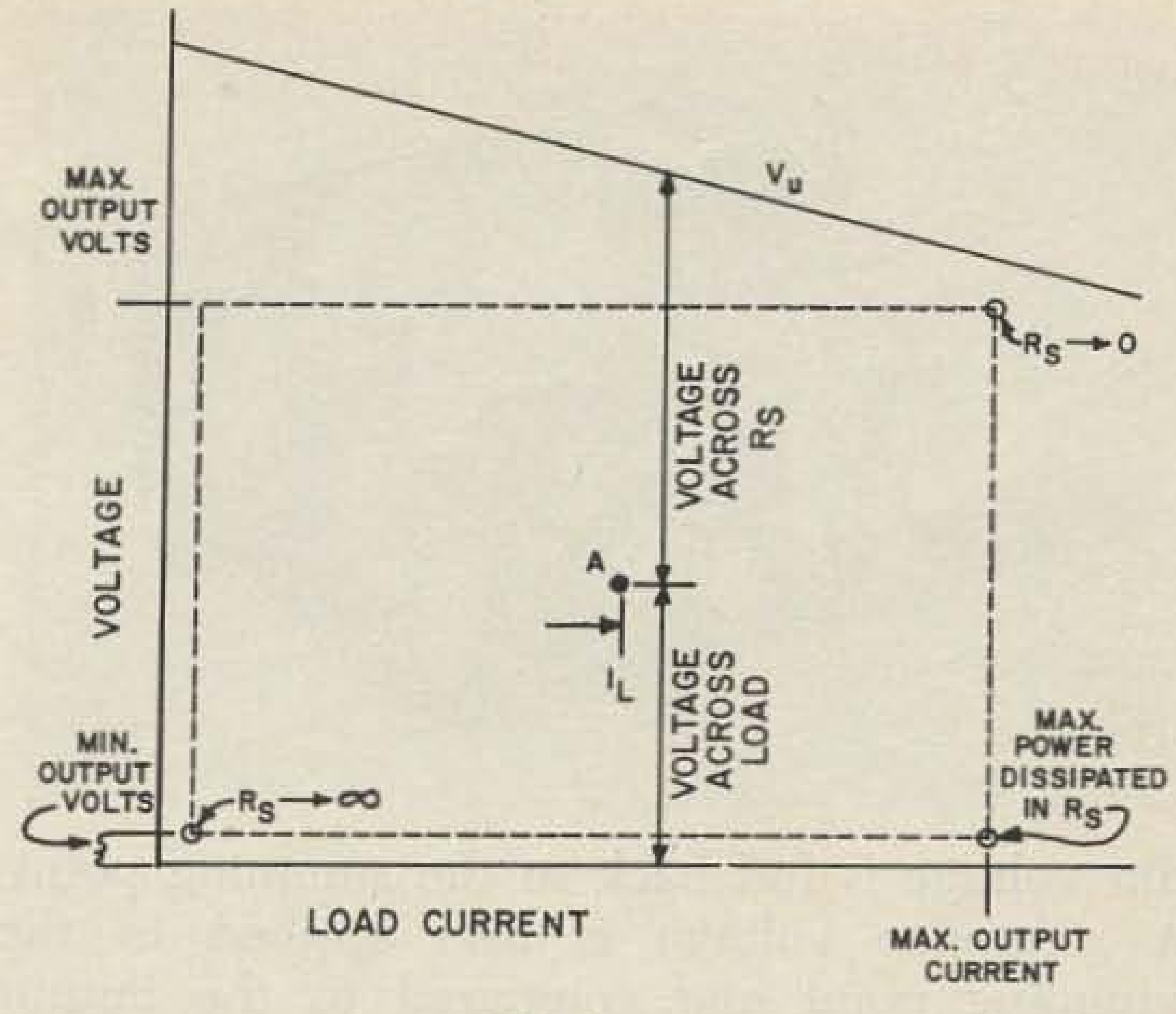


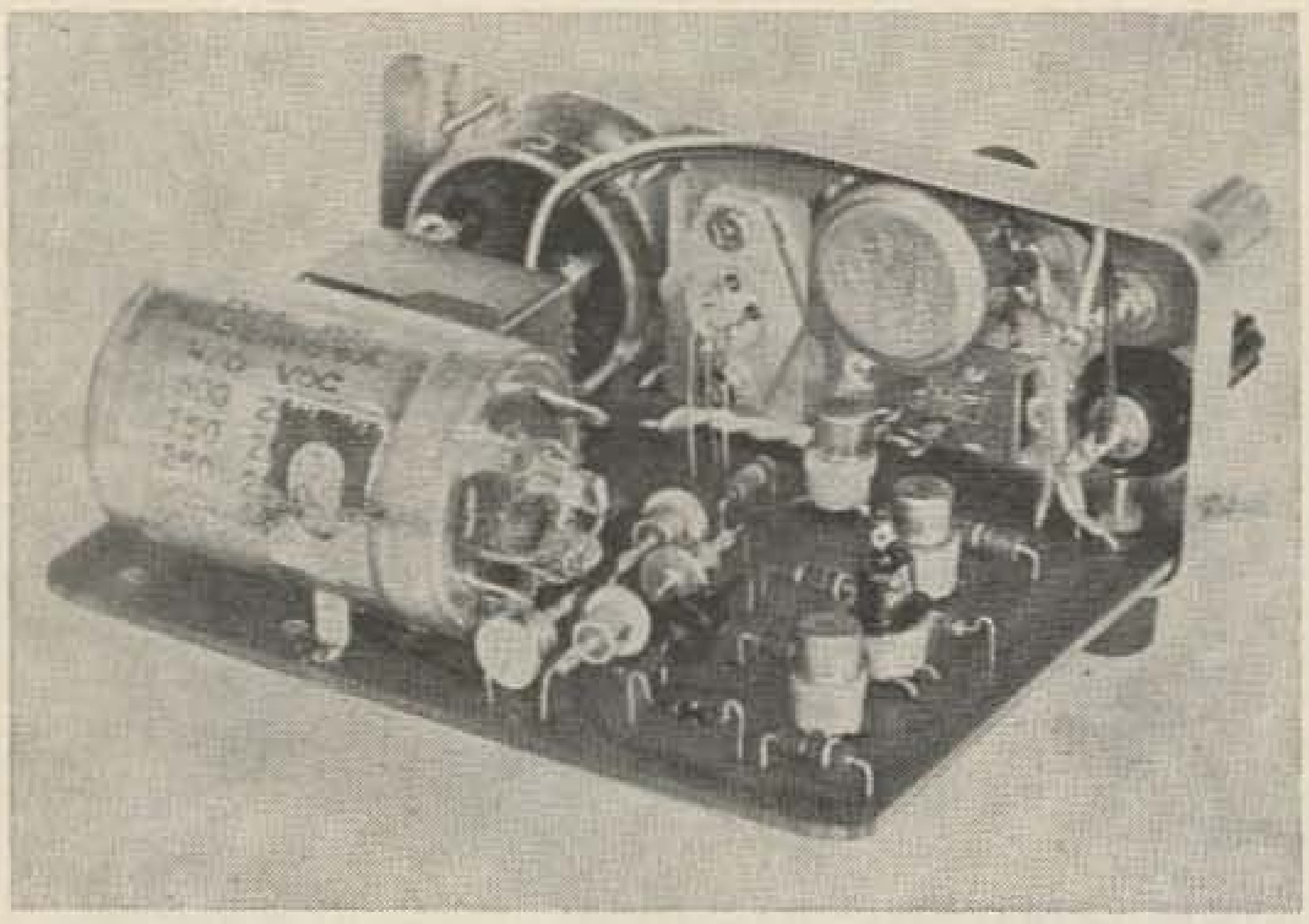
FIG. 2

Operating Conditions
Symbols refer to Fig. 1.
Operating Region of the Supply. Any value of voltage or current within the rectangle may be obtained. Note that the drop across the series element R_S is the difference between Vo and Vu at any output current, as at point a.

It was felt that a lower voltage limit of zero would be desirable. However, experience has shown that in general the minimum supply voltage required in circuit development may be as high as one volt. The maximum supply voltage required is normally 10 to 30 volts. Current requirements for low-level circuits are quite moderate, normally being a few milliamperes per stage.

Circuit Description

We have to this point ignored the method by which the value of R_S is set. A block diagram of the power supply is shown in Fig. 3. The unregulated voltage is applied to an emitter-follower stage. This transistor acts as variable resistor R_S in series with the power supply and R_L and maintains the output voltage at (approximately) the voltage ON ITS BASE. The out-



put voltage is fed back to the summing point. A reference voltage is also applied to the summing point and compared to the output voltage. If the output voltage is not the same as the reference voltage, a difference, or error voltage appears at the input of the amplifier. The error voltage is amplified and applied to the base of the emitter-follower with such polarity as to cause the output voltage to approach a level equal to the reference-voltage level. This should immediately be recognized as a negative-feedback amplifier with the reference source acting as the input signal.

The summing point may be treated either as a voltage or as a current summation. Unfortunately, current summing at the amplifier input requires the reference and output voltages be of opposite polarity so that in equilibrium, the sum of the currents into (or out of) the amplifier-input terminal equals zero. There are some definite advantages to be gained by this technique, but a second power supply is required. Voltage summing is employed as it requires no extra supply. As an added advantage, the voltage-summing circuit employed provides some gain for the error voltage in addition to that provided by the amplifier.

The amplifier is necessarily a dc amplifier, and as such, is subject to drift. This condition is made worse by the fact that high gain is

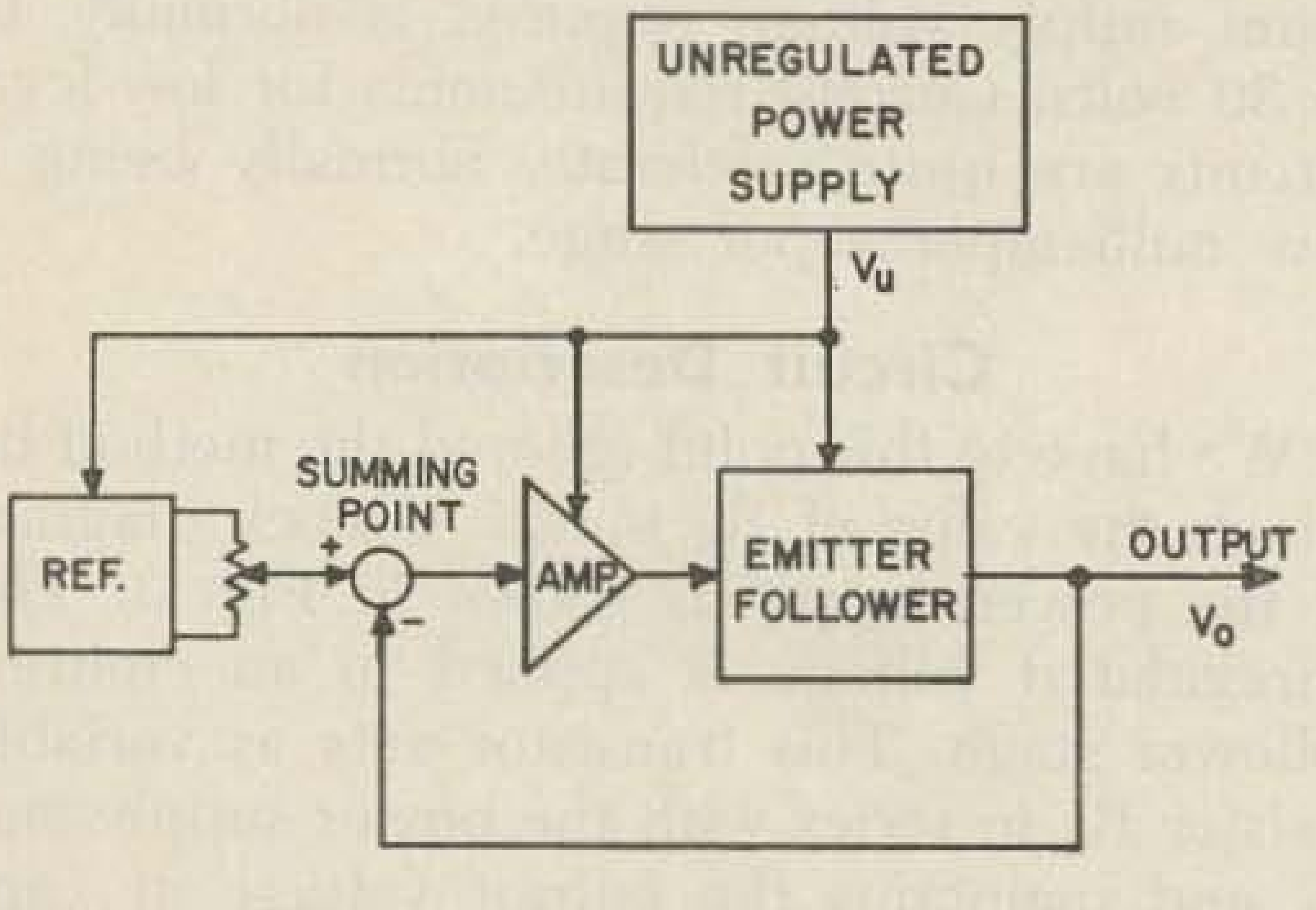
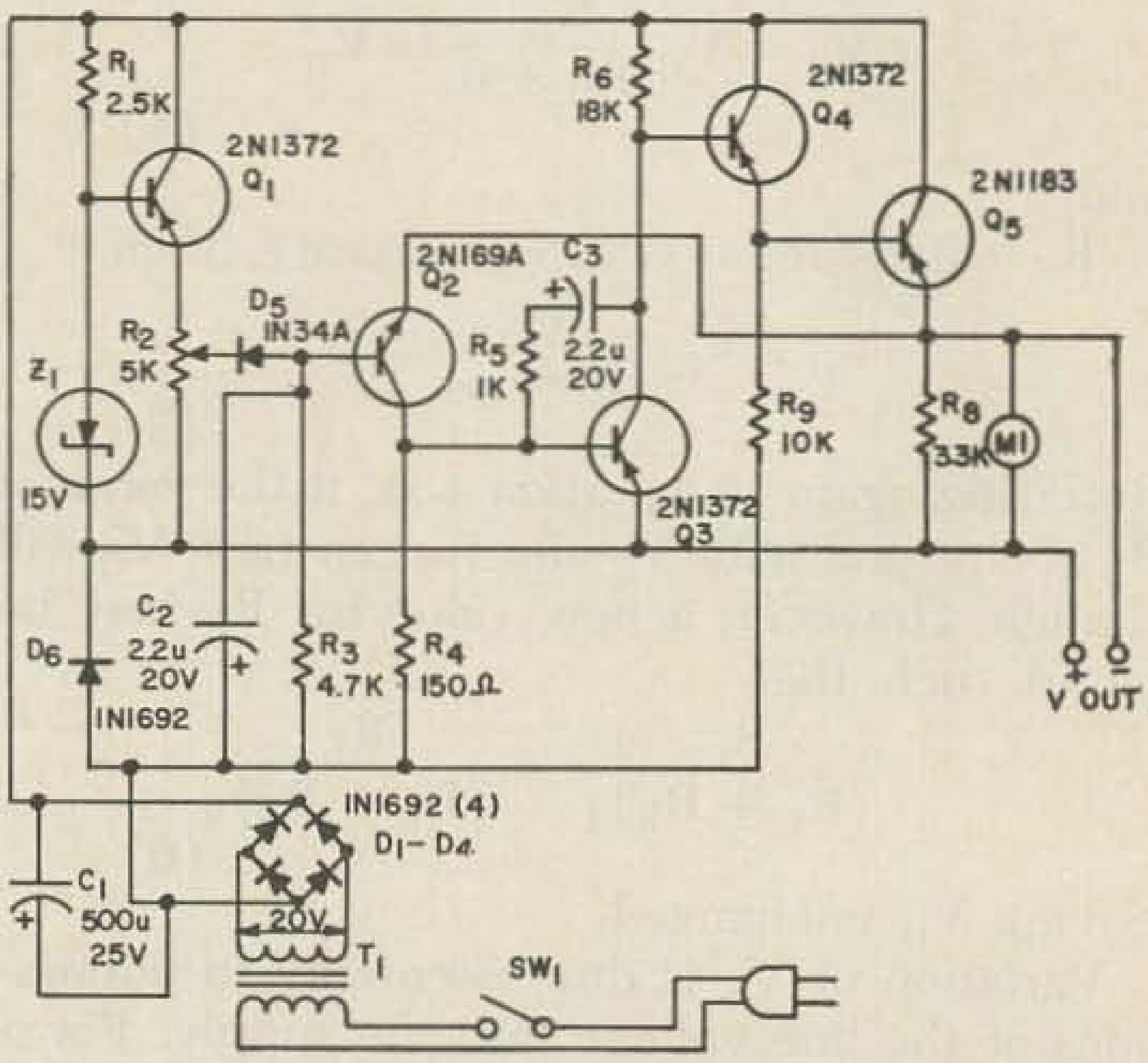


FIG. 3

necessary for good regulation of the output voltage as load current changes. The amplifier is stabilized by large amounts of feedback. Simply stated, although the amplifier has a large gain, the ratio of the output-to-input voltage is one. The only point not stabilized by the dc feedback is at the input of the summing point, and this has been stabilized by an additional compensating circuit. Ac feedback is employed to maintain stability and regulation with capacitive loads and during load transients.

The circuit diagram appears in Fig. 4. An unregulated power supply is formed by T1, CR1-CR4, and C1. The rectifiers form a bridge circuit to full-wave rectify the transformer secondary voltage. With this circuit full ad-

FIG. 4



vantage is taken of the transformer secondary and no center tap is required. The value of C1 is large enough to remove most of the ripple. It will be noted that its value is smaller than that normally associated with low-voltage/high-current supplies. Remember that the output voltage is tied closely to the value of the *reference*. Thus, if the reference-voltage ripple is low, the output ripple will also be low. If the power supply is poorly filtered and contains appreciable ripple but the regulator output does not, the regulator has *electronically* removed a great deal of the ripple, just as if a huge capacitor had been employed for filtering. C1 may be thought to have been electronically multiplied by the regulator circuit, in this case to a minimum value of about 50,000 μf.

The reference source is composed of R1 and Z1. If a maximum degree of regulation is desired, with voltage summing, the reference voltage must be as large as the highest output

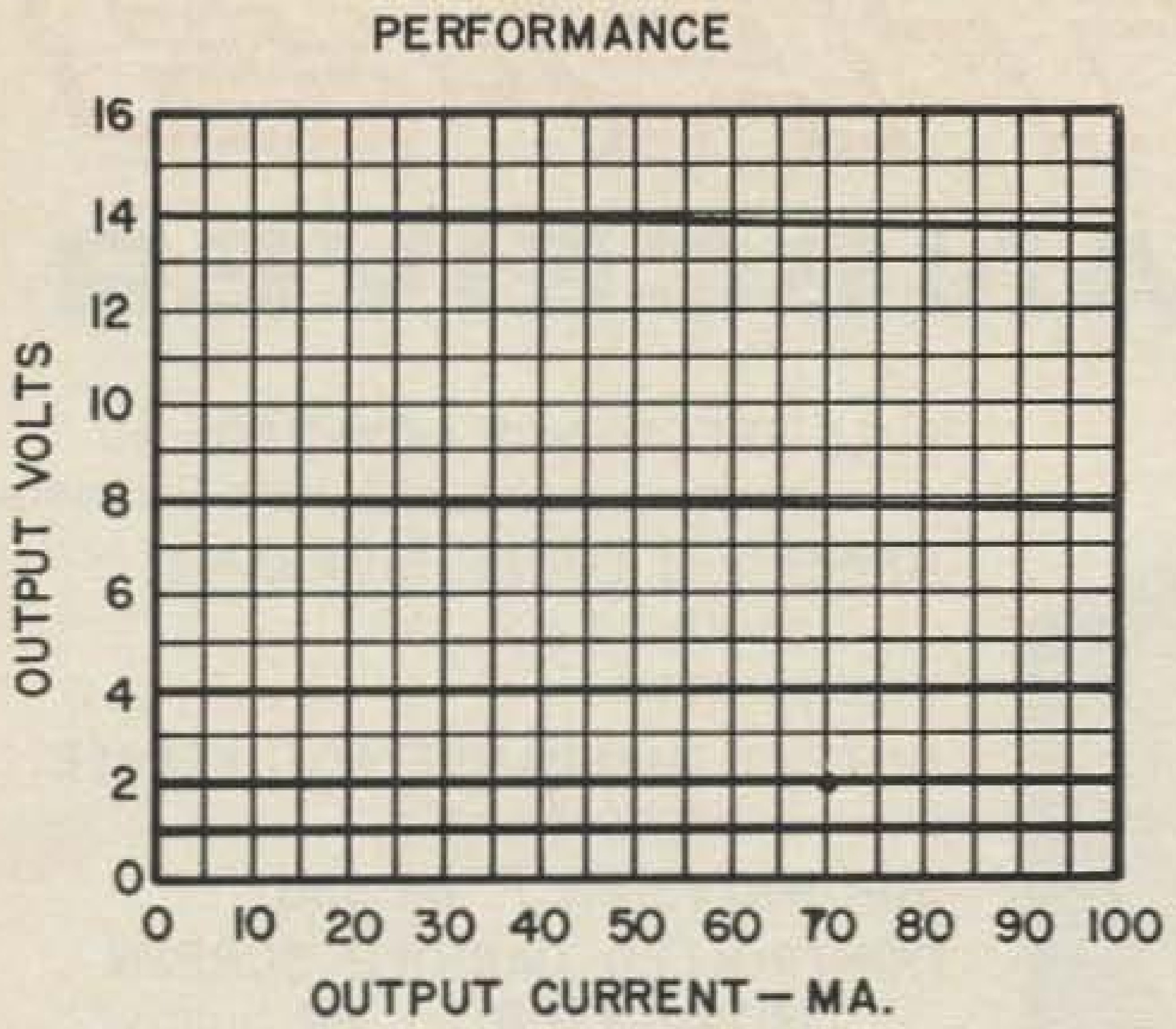


FIG. 5

voltage desired (remember the 1/1 ratio!). The use of a zener diode holds the voltage at the base of Q1 constant. An emitter-follower stage, consisting of Q1 and R2 maintains a constant-voltage output almost equal to that of Z1 across the potentiometer R2, the output-voltage control. Summation is accomplished by Q2. This circuit is novel in that it has no vacuum-tube equivalent. That is, it employs a transistor of polarity opposite to that of all the other transistors in the circuit. This allows the reference voltage as tapped off by R2 to be applied to the base and the output voltage to be applied to the emitter. Any difference between the two voltages is an error signal which is amplified in the collector circuit and applied to the base of Q3, a grounded-emitter circuit. The signal developed across the collector load resistor, R6, is directly coupled to the base of Q4.

The inclusion of R7 assures the ability to adjust the output voltage to the lowest possible minimum value. The actual regulation is the function of Q5. A minimum load, or "bleed" is provided by R8. Drift of the output voltage, which would be caused by changes in temperature of Q2 by altering the base-to-emitter voltage drop, are compensated for by CR5 and R3. Diode CR5 is forward-biased by R3, but its small forward drop is in opposition to the V_{be} of Q2. As the temperature of CR5 and Q2 is raised, both forward drops increase by approximately the same amount, and the voltage between the output and reference remains constant. Returning R3, R4, and R7 to a point slightly more positive than the positive output terminal also helps reduce the lowest minimum output voltage obtainable. The use of a silicon rectifier at CR6 operated in the forward-biased condition provides a small but constant voltage for this purpose.

In a sense, it is an economical low-voltage zener diode.

The noise on the output is reduced by the additional filtering of the reference voltage by C2. As with any feedback amplifier, instability may be a problem. The combination of R5 and C3 stabilize the loop by providing degeneration which increases with frequency, necessary when the supply is used with reactive loads.

Operation

With the components specified this supply will deliver 100 ma continuously from its minimum output voltage of 0.35 volts, to its maximum voltage of 15 volts. Fig. 5 illustrates the output-voltage current curves obtained at various values of V_0. The design of this circuit allows considerable latitude in the choice of components. Transistor Q5 may be a higher or lower powered type, though in any case care must be taken that the supply is not operated in such a manner as to exceed the collector-temperature limitations due to excessive current at low output voltage. Proper heat-sinking is absolutely essential. The choice of types for the other transistors is dictated primarily by the voltage supplied from the unregulated power supply (and proper polarity, of course). It is well to be on the safe side and select types which have collector-to-emitter voltage ratings which are approximately 1.4 times the ac voltage appearing across the secondary of T1. Transistors of higher β should make little improvement in regulation, though lower β units for Q2 and Q3 will degrade the regulation. The detectable changes of V_0 are due to changes in the zener voltage. This is due partly to the simple reference circuit employed and partly to the dynamic resistance of the zener diode. The zener voltage of Z1 may have any value lower than that given though the use of a lower reference

(More on page 14)

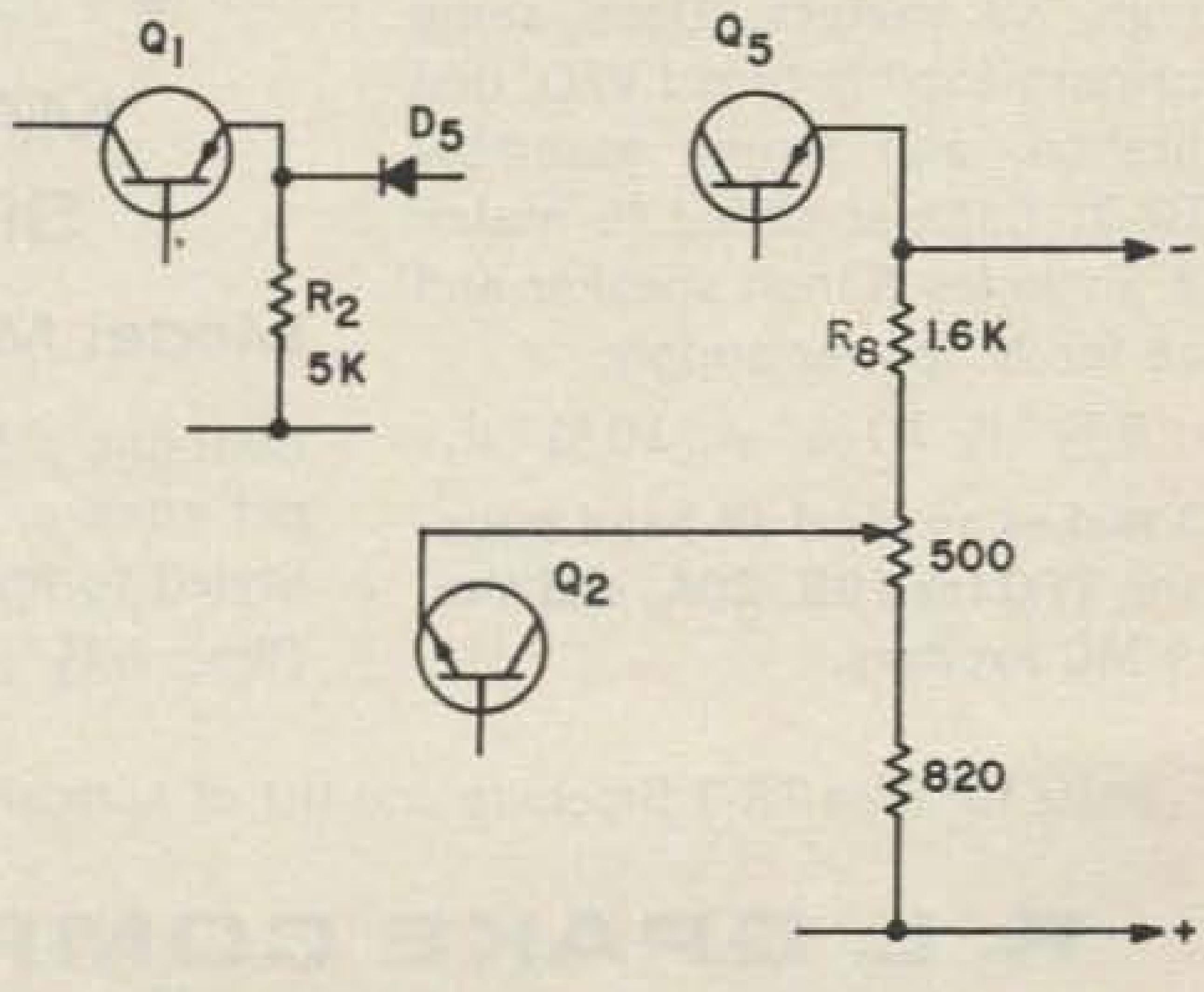
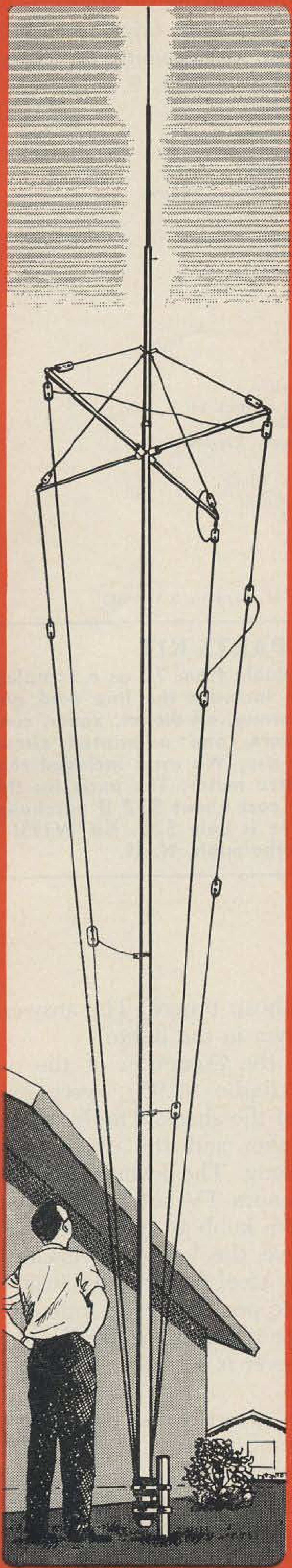


FIG. 6



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Impedance.....50 ohms nominal
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Ground Plane Req. .Copper Plated 6' Ground Rod (not supplied)

Mechanical Specifications:

Max. Wind Survival..40 MPH Self Supporting (100 MPH Guyed)
Construction...........2" to 7/16" Aluminum 6063 T832 Alloy
Wire Elements.......7-24 Copper Clad Steel
Insulators..........Ceramic and Injection Molded Plastic
Overall Height......36'6" Phone; 38' CW
Net Weight..............30 lbs.
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voltage degrades the regulation somewhat. A diode in the 5- to 6-volt range may be employed to take advantage of the almost zero temperature coefficient. In this case, R8 must form a voltage divider with the emitter of Q2 returned as shown in Fig. 6.

Construction

The photographs illustrate the power supply built by the author. The parts listed on the schematic were selected primarily on the basis of size so that they might be "shoehorned" into an available box. As a consequence, several special parts were made, such as the heat sink for the power transistor. Similar boxes are made by Zero Manufacturing Company, Burbank, California, but construction would be simplified by the use of a larger case. No details of the etched board are shown as each individual will undoubtedly make some parts substitutions. Some of the obvious ones include the use of a heavier power transformer and/or filter capacitor, and a transistor at Q5 capable of dissipating more power. Remember that adequate heat-sinking is of prime importance. No other form of overload protection is provided. If higher output voltage is desired, the technique illustrated in Fig. 6 may be employed, but the secondary voltage of T1 must also be increased. In the event that circuit voltages are changed (and with some transistor substitutions), it will be necessary to alter some of the resistance values in order to assure operation anywhere within a rectangle (output voltage-output current) similar to that shown in Fig. 2.

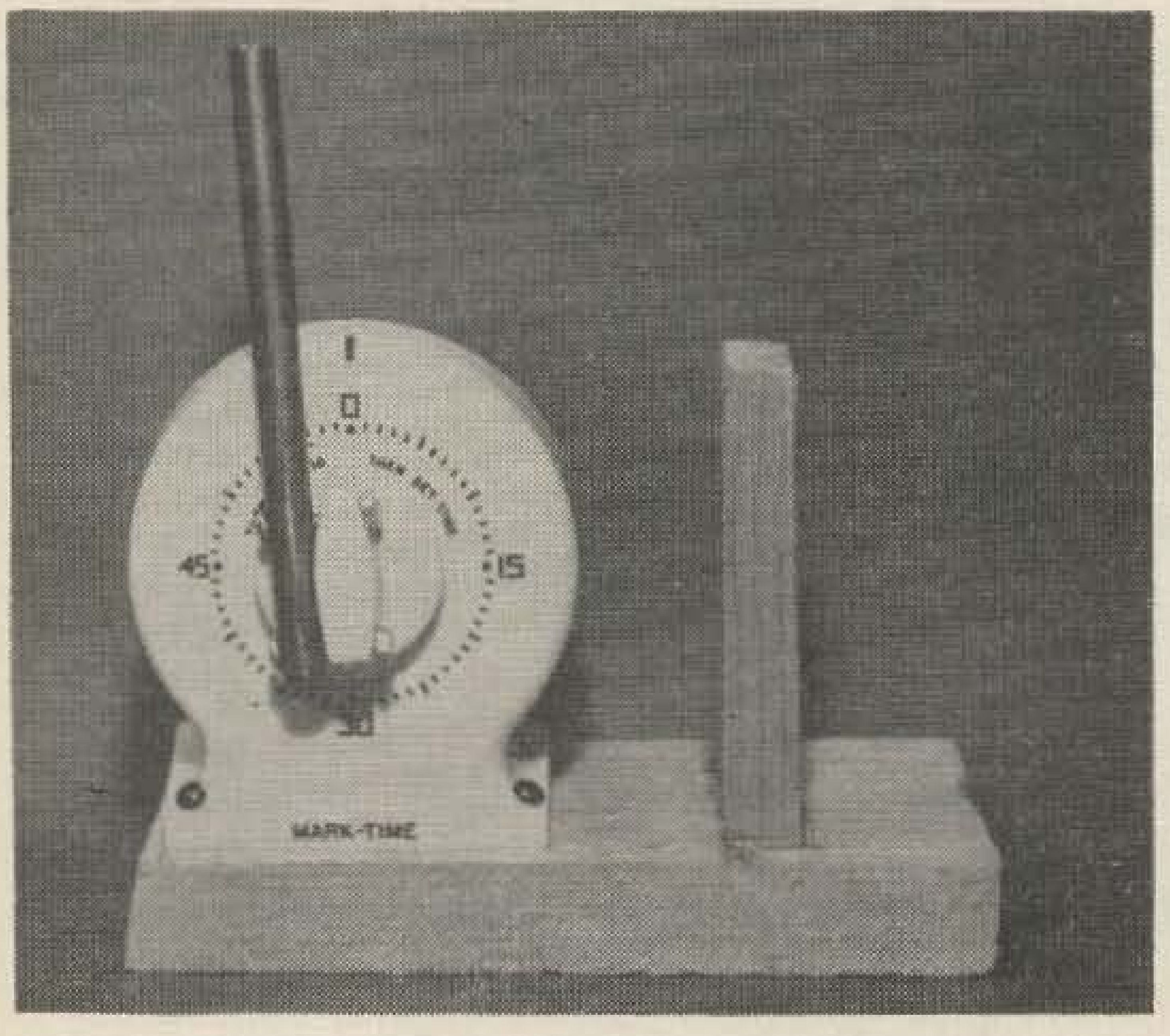
. . . W1ISI

Parts List

C1—500 μfd., 25V Elec.
C2, C3—2.2 μfd., 20V Elec.
CR1, CR2, CR3, CR4, CR6—IN1692
CR5—IN191
R1—2.5K
R2—5K Linear Taper Pot.
R3—4.7K
R4—150 ohm
R5—1K
R6—18K
R7—10K
R8—3.3K
SWI—S.P.S.T. slide switch
T1—Power Transformer, Input 110V, 60Cy Output 20V, 140 MA
(Magnetic Circuit Elements, Inc. OB62CT29
Address: 3722 Park Place
Montrose, Calif.
Z1—Zener Diode, 15 V.
Q1, Q3, Q4—2N1372
Q2—2N169A
Q5—2N1183
M1—0-15 VDC Meter (Lafayette TM-100)

Ten Minute Timer

Why not operate legally? Why not keep on the good side of the FCC? Why not buy a ten minute timer for those SSB QSO's? Timers are expensive, so I asked myself (desiring to consult the most astute person on this problem) "Why not build a cheap timer?" The answer to this problem is shown in the photo.



The parts, with the exception of the oven timer (Layfayette Radio $2.95), were found lying on the floor of the shack. The base measures 5½ by 2½ inches and the upright lever stop is 3¼ inches long. The lever itself is a 4 inch piece of aluminum TV antenna element.

When drilling the knob to attach the lever it is best to remove the knob to check that the holes miss the steel leaf spring inside. I found it necessary to pound a small indentation in the lever to make it accommodate the shape of the knob. The lever is attached to the knob with 4-40 screws.

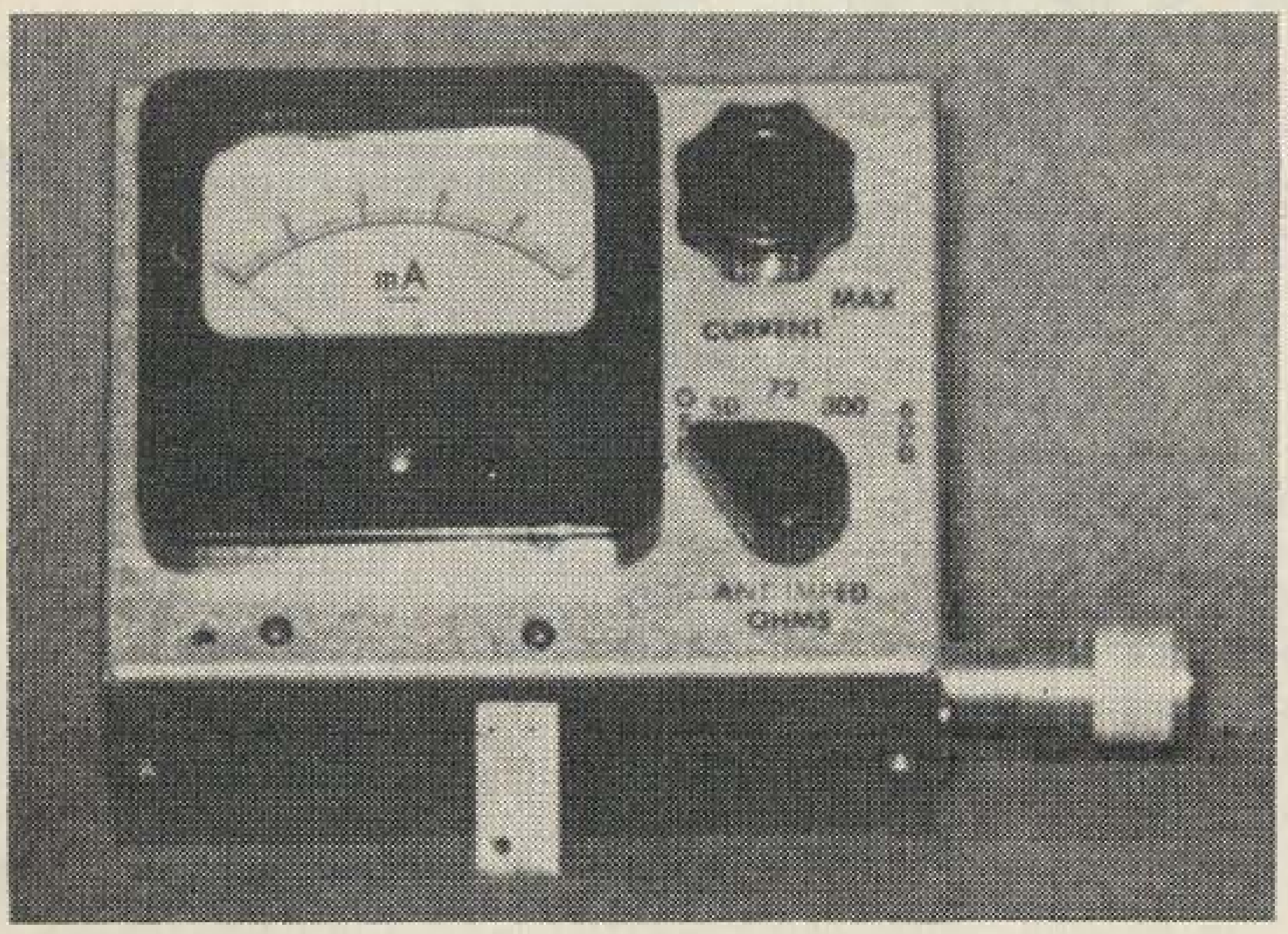
The lever stop is glued to the base approximately 2½ inches from the axis of the knob. It is best to use a slow drying glue since the lever stop will need to be moved back and forth a bit before the exact position for a ten minute run of the timer is found.

. . . W8LWS

Temperature Limited Diode Noise Generator

73 Parts Kit Available . . . see end of article.

F. L. Thomas
7 Park Street
Belleville 9, N. J.



Recently I was confronted with the necessity for a good noise generator. All of the noise generator designs available in any of the amateur publications at hand were of the crystal diode type. The disadvantage of this type of instrument lies in the fact that the current through the diode has no simple relation to the noise output. Unless expensive calibration equipment is on hand this type of generator is useful only on a comparative basis. Consequently it was decided that a temperature limited diode noise generator would be built.

The noise output of a temperature limited diode noise generator is simply related to the current flowing through the diode.[1] The noise figure of a receiver may be calculated directly from the magnitude of the current by the following equation:[2]

Noise figure in db.=10 log (20 I R)−(1)

Where I=current through temperature limited diode required to make the noise output power of the receiver double the value it was with no current through the diode.

R=antenna impedance

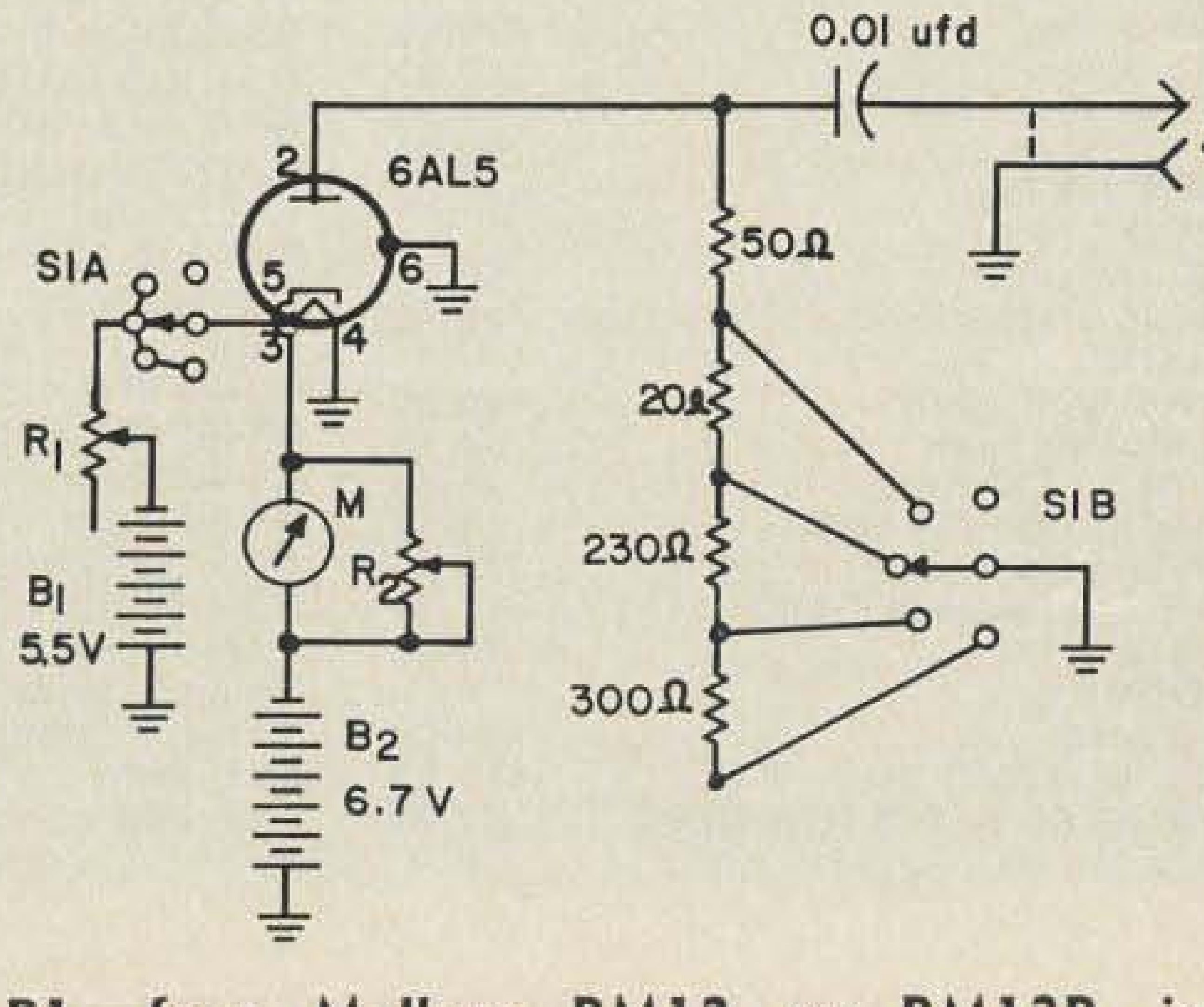
The actual noise generator is quite simple, consisting of half a 6AL5 with a milliammeter in the cathode leg and the appropriate resistance for the antenna circuit connected to the plate by means of a selector switch. The heater current is controlled by a 20 ohm potentiometer in series with the heater. The unit is battery operated for convenience. High current capacity, small sized mercury cells are used throughout. The whole unit is contained in a 3″ x 4″ x 5″ Minibox.

Construction

The resistors are mounted on the switch, making the leads as short as possible. The tube socket is mounted on a small bracket screwed onto the side of the chassis, placed so that the distance from the switch is a minimum. The meter calibration potentiometer and the heater supply battery holders are mounted on another bracket placed over the meter as shown in the photograph.

Operation

To use the generator it is connected to the receiver antenna terminals, the AVC is turned off, and the audio output is measured with the

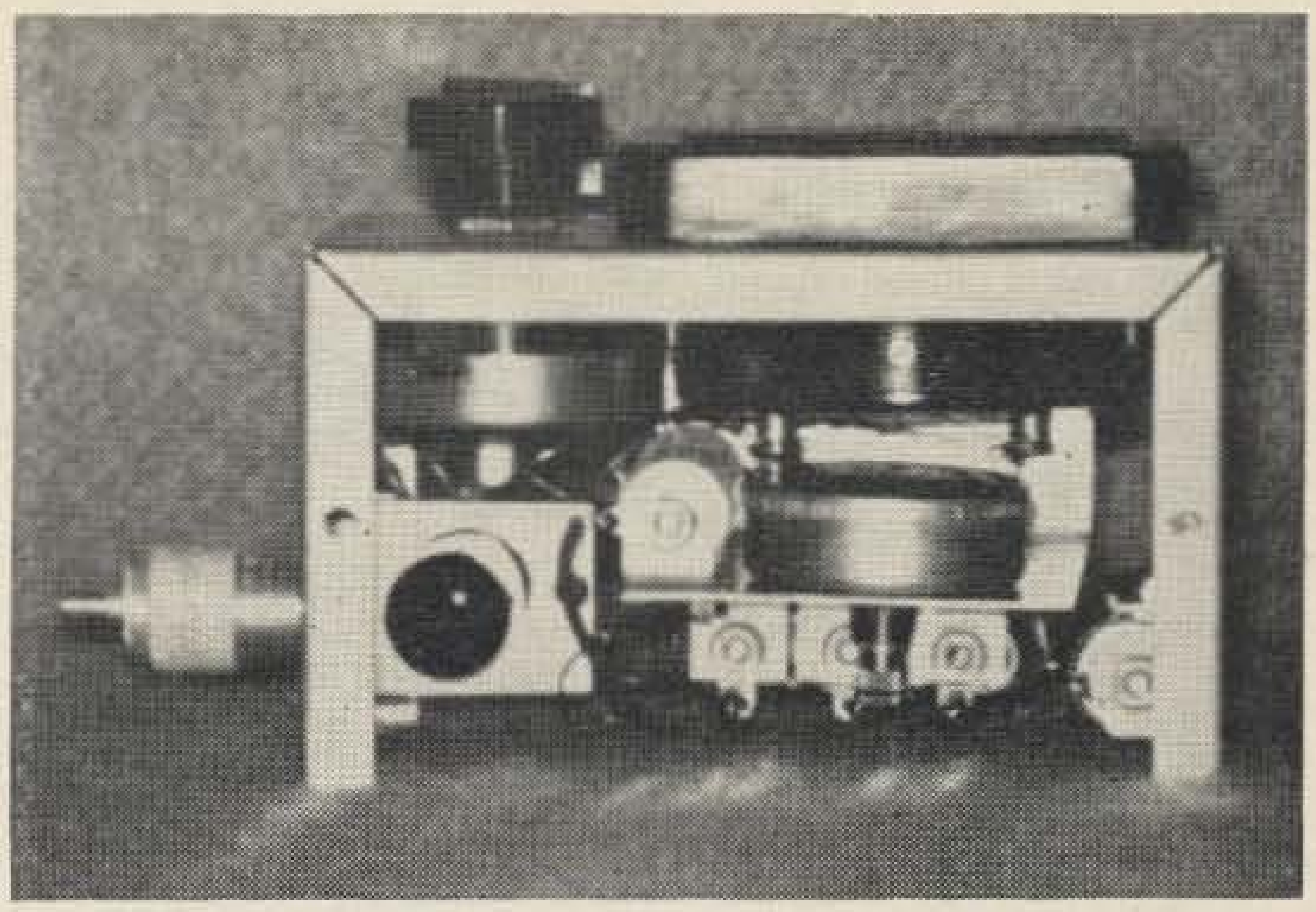


B1—four Mallory RM12 or RM12R in series (lifetime of this circuit should be greater than 10 operating hours)
B2—Mallory TR-135R
M—0-1 ma (Lafayette TM-60 or equivalent)
R1—20 ohm potentiometer
R2—20 ohm Potentiometer
J1—coax connector
S1—DP 5 pos miniature rotary switch

generator off. The generator is then turned on and the current through the diode is increased until the power output is double what it was before. At this point the voltage output will only be 1.41 times the original. The current necessary to give this noise increase is noted and the noise figure calculated according to equation (1), or estimated from the figures given in Table I.

Noise Figure in db.	Current, ma., for antenna impedance of: 50Ω	72Ω	300Ω	600Ω
2	1.40	1.15	-	-
4	2.25	1.80	0.42	-
6	3.55	2.85	-	-
8	5.65	4.50	1.05	0.53
10	8.85	7.15	-	-
12	14.2	11.3	2.65	1.32
16	-	-	6.65	3.30
20	-	-	16.6	8.42

The unit described is useful for noise figures up to 13 db at 72 ohms. For higher noise figures a higher current capacity diode and a higher heater voltage and current supply is required, necessitating an ac operated power supply. With a suitable power supply a 6X4 may be satisfactorily operated up to a noise figure of about 22 db. In both cases the maximum noise is obtained by passing more



than the allowable average current through the diode. Consequently readings at these extremes should be made and the current lowered again in only a few seconds, or damage to the diode will result.

Table I shows the current readings for various noise figures with different antenna impedances.

The generator will operate satisfactorily up to at least 50 mc, and probably considerably higher.

REFERENCES

1. **Radiotron Designers Handbook**, fourth edition, page 1307, reproduced and distributed by RCA Victor Division, Radio Corporation of America, Harrison, N. J., 1953.

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Letters

Att. Wayne Green, Editor??

I have been a ham for 36 yrs. and I have never seen any article published as stupid as the one you published by W3PHL. I will not spend any more money for your magazine.

. . . G. V. Lichtenfels W3AQT

Aha, the book-burners rear their ugly heads. While several fellows did write in protesting, none of them quite so obviously had not read the article . . . or even the magazine. The others used our current address and not the one we stopped using over six months ago. Many letters of compliment have come in about this article from the more competent engineers in our readership, and a handful of grumbles have been received, though not one of them took any issue with any part of the article. The complaints against the article seem to be that PHL has a wickedly broad signal on 75 meters and that he has been suspended in the past during a battle with the FCC. I have suffered the judge and jury treatment by the FCC in past years and the mere fact of suspension doesn't necessarily indicate guilt to me any more than Perry Mason considers his clients guilty because they are in prison. We are wide open for more articles on DSB to clarify or confuse matters. I can see some points where PHL missed, though most of the article seems unassailable.

Dear Wayne:

Reference page 86 of the February issue, W7ATK claims there should have been a 2.5 mh rf choke tied to the second plate of his converter rf stage, as illustrated in enclosed, amended diagram. It is true that without one all the intelligence will arc to ground and the pipes will bust, but I draw no conclusions from this or from the other fact that the caption under the "73 Mixer" circuit belongs under a photo of my own dandy converter (omitted). My grandmother always said that simplicity is an unrewarded virtue. She was terpischorean in the grind and bump tradition and at the end of her act she would load her navel with a small marble and pop a balloon at twenty paces. From the collapsed balloon a white dove would fly up into the wings training a satin streamer on which was printed the cryptic comment: "Half the fun is getting there." I believe this has been taken up as a slogan by Cunard. Be that as it may, my grandmother made the bucket one night in Boston for putting out street lights as a result of a wager and soon retired. Please send me whatever certificate is appropriate and enclose a dollar to help cover costs of administration of this program.

. . . Ken W7IDF

Selected Circuits

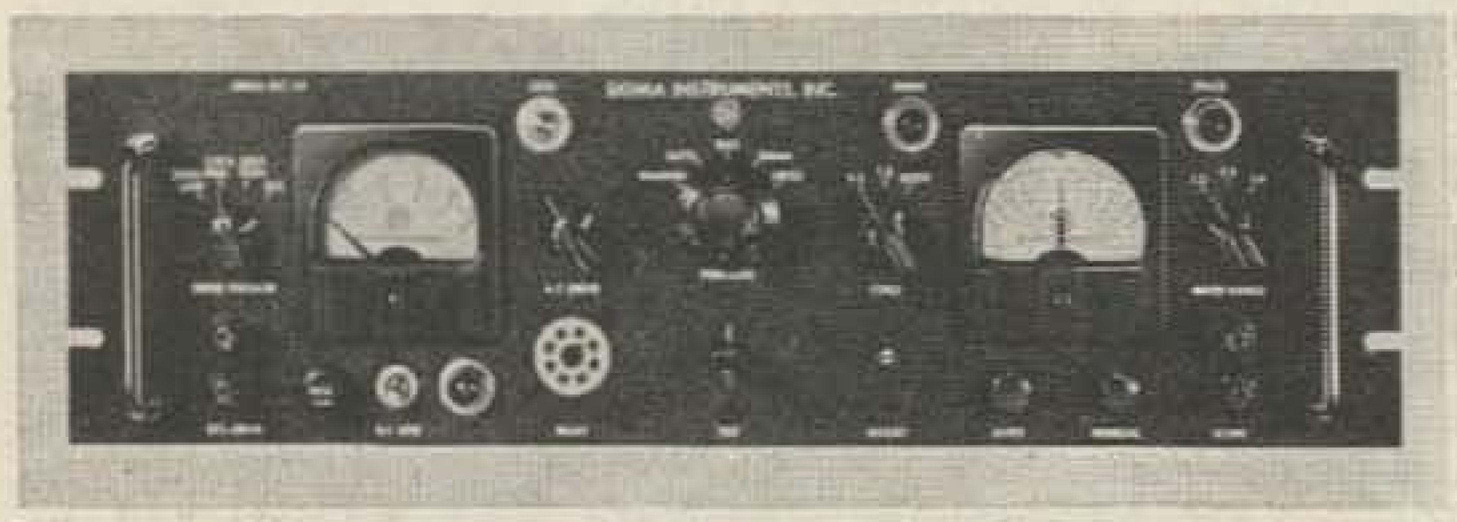
Sigma Series 4500 Polar Relay Test Set

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Polay relays are widely used in teletypewriter applications to provide isolation between various equipments, effect conversion between modes of keying and as repeaters to permit operation of several equipments from a low current signal source. There are very few amateur RTTY installations that do not use one or more of these versatile devices.

The operating requirements imposed on telegraph signalling relays are quite stringent and the present compact, efficient and reliable devices are the result of many decades of development. These relays must accurately repeat the high speed signal impulses without introducing appreciable distortion and must continue to do this on a day in and day out basis.

When we consider that a teletypewriter relay on a 60 word per minute circuit operates several million times per day, the problem becomes apparent. For example, the rated life expectancy of many utility type relays is far less than 1 million operations. Contact materials used in teletypewriter service must be capable of carrying substantial currents and, despite the use of exotic materials, contacts are subject to wear which eventually causes the relay to fail. Since polar relays are expensive, precision devices, the obvious answer is to make them maintainable. Field adjustments are provided and the relays may, *by using proper test equipment*, be easily cleaned and adjusted, restoring their original performance.



Front panel view of the Sigma Series 4500 Polar Relay Test Set.

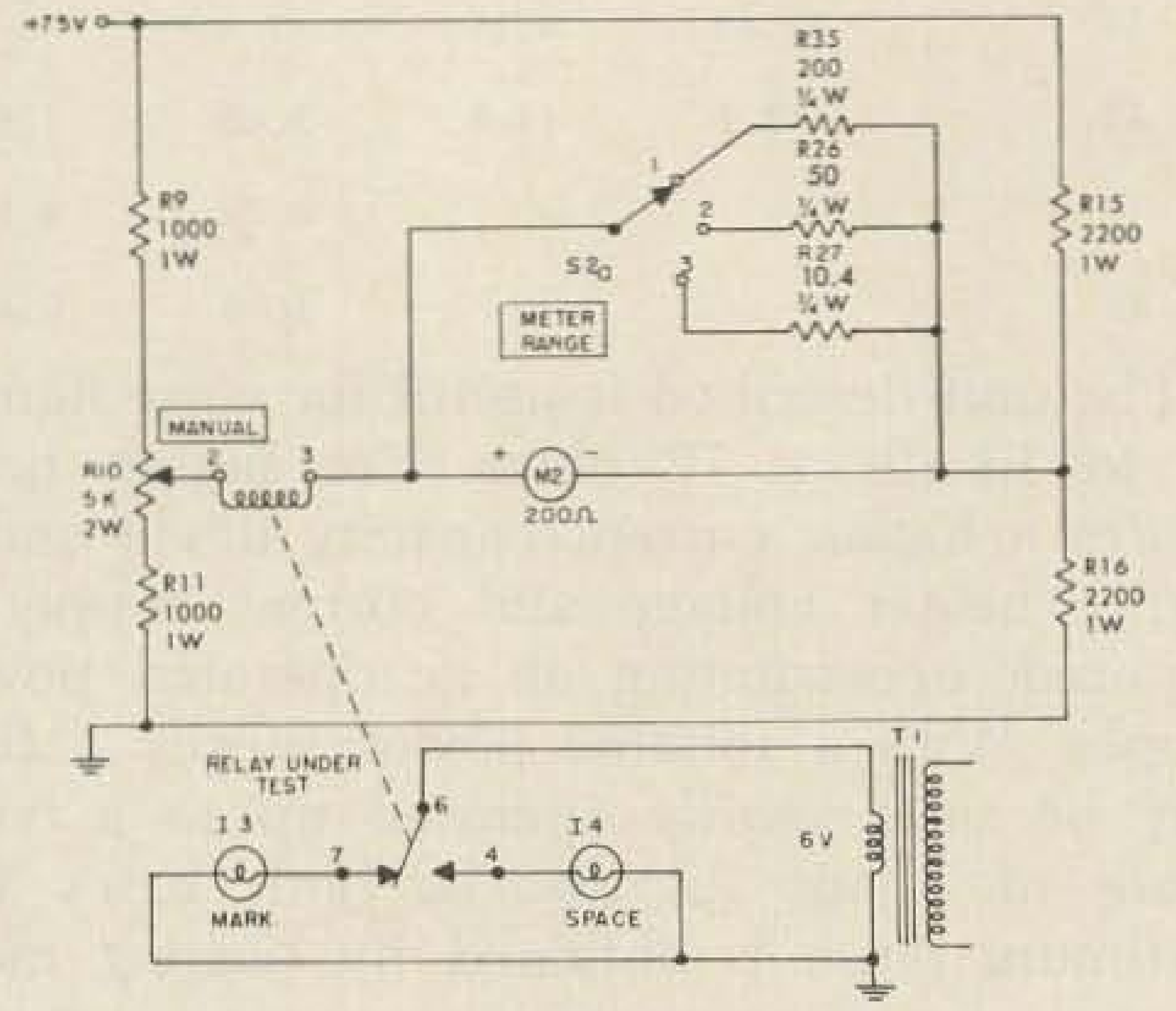


Figure 1: Schematic diagram of the Sigma Series 4500 Relay Test Set MANUAL SENSITIVITY test circuit. Meter multipliers provide ranges of 1.0, 2.5 and 10 MA. Relay terminal numbers refer to Sigma Series 7 and Series 72 relays.
C3 Capacitor, electrolytic, 100 mfd, 110 volt ac.
M2 Milliammeter, dc, .5-0-.5 ma basic range, 200 ohms resistance.

Relay manufacturers who are concerned with long term customer satisfaction must make available maintenance concepts and procedures, repair parts and suitable test equipment for field adjustment of their relays. One of the foremost relay manufacturers, Sigma Instruments, Inc., has done just this in support of their extremely fine Series 72 polar telegraph relay. The Sigma Relay Test Set, Series 4500, is a compact instrument that incorporates test circuits for the rapid, convenient and accurate measurement and adjustment of all the important characteristics of polar relays designed for communications service.

The Instruction Book for the Series 4500 Relay Test Set is much more than a set of instructions for an item of hardware. This 32 page booklet defines terms, analyzes in detail the essential operating characteristics of polar relays and then describes the parameters for the various tests required to verify these characteristics. Simplified schematic diagrams are given for each of the many tests that may be performed with this versatile instrument. Separate tests are provided for manual measurement of sensitivity, automatic measurement of sensitivity, contact circuit bias in percent, contact circuit break time in percent and leakage current measurement with 500 volts applied between contacts and coils.

Fig. 1 shows the circuit used for manual measurement of trip current or relay sensitivity. One relay coil and the zero center milliammeter, shunted for various current ranges, are series connected between the junction of the voltage divider, R15 and R16, and the contact arm of R10. Thus one end of the series circuit is established at half the supply voltage of 75 volts while resistor R10 allows the other end of the series circuit to be adjusted equally above and below this potential. Assume that the relay contacts are in the MARK position and the arm of R10 is near the center of its adjustment. No voltage difference exists across the relay and metering circuit and no current flows. Advancing the arm of R10 toward R9 will result in current flow from left to right through the relay coil and meter, increasing until the relay armature "trips," closing the circuit to the SPACE indicator light. Moving the arm of R10 toward R11 will result in the reverse condition and the

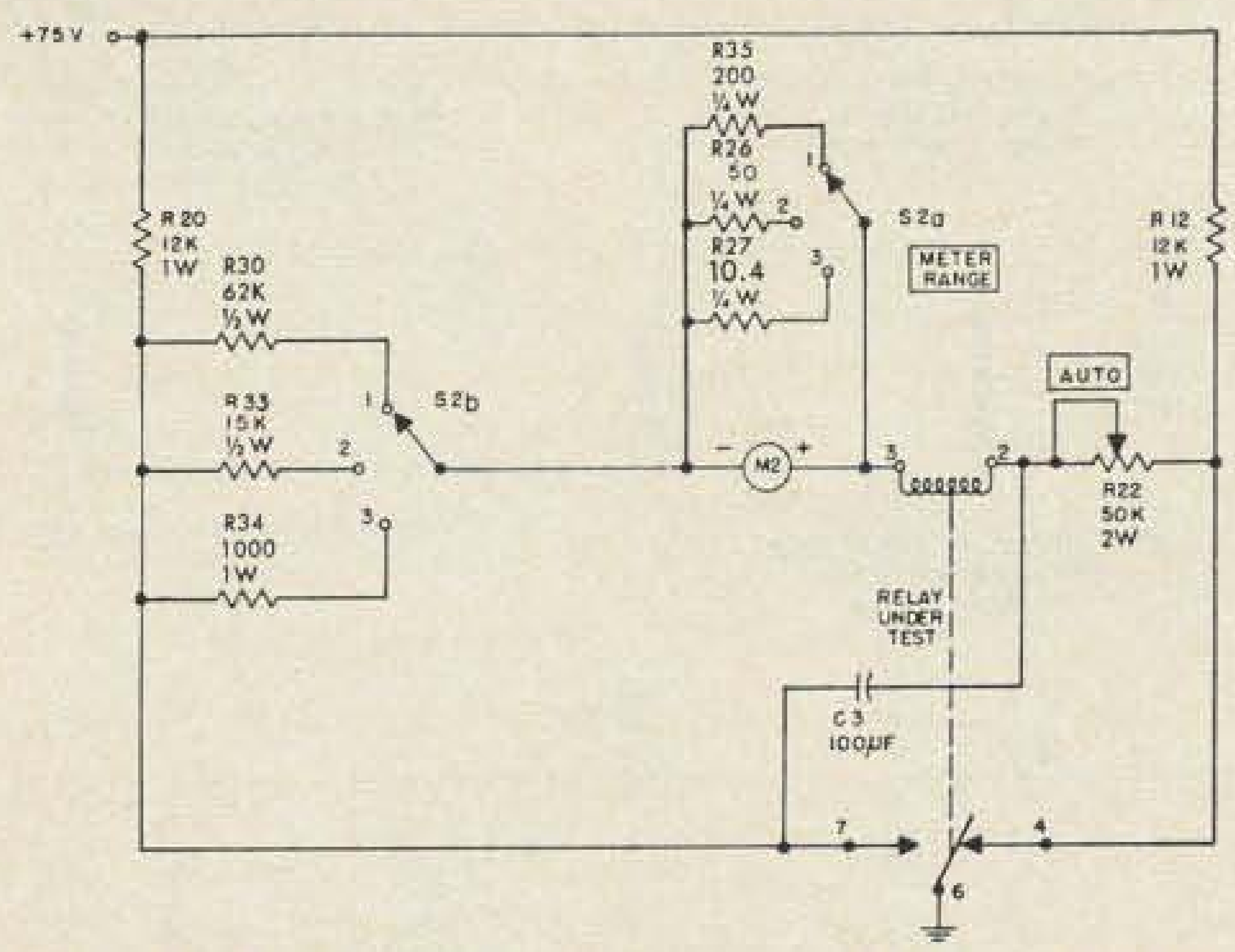


Fig. 2: Schematic diagram of the AUTOMATIC SENSITIVITY test circuit used in the Series 4500. Meter multipliers provide the same ranges as in Fig. 1. The elaborate multiplier network prevents changes in switching speed, determined by R22, when the meter range is changed. Note that C3 is a non-polarized unit.

M1 Milliammeter, ac, 0-5 ma, rectifier type.

M2 Milliammeter, dc, .5-0-.5 ma basic range, 200 ohms resistance.

T1 Transformer, auto, secondary taps at 50, 117 and 250 volts; 117 volt 60 cps primary.

SERIES 72:

Resistance Ohms Each Coil	Turns Each Coil	TS Adjustment Ma. DC	TG Adjustment Ma. DC
		Trips either direction, current in one coil.	
10	600	2.4 — 5.6	9.6 — 14.4
160	2,400	.6 — 1.4	2.4 — 3.6
400	3,700	.39 — .91	1.6 — 2.4
1,000	6,000	.24 — .56	.96 — 1.44
2,500	9,600	.15 — .35	.6 — .9
4,000	12,000	.12 — .28	.48 — .72
SERIES 7:			
150	2,375	3.00	
1,000	——	1.10	
3,100	10,250	0.72	

TABLE I: Standard trip values for Sigma Series 7 and 72 polar relays. Relays of other manufacture, with similar coil resistances, should perform fairly closely to these specifications. Note that the series 7 relays have an extra coil of a few turns between Pins 3 and 5. This coil should be short-circuited to prevent contact bounce.

relay armature will trip to the MARK state. Relay adjustment should be made for the desired sensitivity consistent with equal MARK and SPACE trip currents.

"Hold the relay firmly in the test socket and simultaneously make the MARK and SPACE adjustments, manipulate the appropriate switches and observe for proper meter readings." The answer to the question of where all of those hands come from is found in Fig. 2. In this automatic sensitivity test circuit, the relay is automatically switched from MARK to SPACE condition at a rate slow enough to permit accurate meter readings. This frees both hands to accomplish the required relay adjustments. Regardless of which contact of the relay is closed, the circuit is unstable and the current increases through the relay coil in the direction required to move the armature to the opposite contact. Initially, capacitor C3 is discharged and the charging current of the nonpolarized capacitor holds the voltage across the relay coil to a level insufficient to trip the relay. As the capacitor charges, the current through the relay coil increases and the relay trips. The relay contacts reverse the polarity of voltage applied to C3 and the relay coil. The cycle repeats as long as voltage is applied. Resistor R22 provides an adjustment of switching speed. Table I gives the standard sensitivity test conditions for various relays of the Sigma Series 7 and 72 lines. As noted, this data is generally applicable to relays of other manufacture having similar coil resistances.

Fig. 3 shows the bias test circuitry used in the Series 4500 Relay Test Set. Low, medium and high 60 cycle drive voltages are available to accommodate relays with a wide range of

Sigma Relay Type	Drive Voltage	Full scale of AC Milliammeter	AC Drive Current Bias & Break
72—10TS	LOW	50	30*
72—10TG	LOW	50	20*
72—160TS	LOW	50	15
72—160TG	LOW	50	10
72—400TS	MED	50	10
72—400TG	MED	50	6.5
72—1000TS	MED	50	6
72—1000TG	MED	50	4
72—4000TS	HIGH	5	3
72—4000TG	HIGH	5	2
72—2500TS	HIGH	5	3.8
72—2500TG	HIGH	5	2.5
7—150T	LOW	50	20
7—1000T	MED	50	8
7—3100T	HIGH	5	4

TABLE II: AC drive values for bias measurement of the Sigma Series 7 and 72 polar relays. As in the sensitivity tests, these values should be applicable to relays of other manufacture having similar coil resistances. Values, except as indicated by *, are based on drive applied to only one coil.

coil resistances. In all cases, the minimum drive voltage is used to accentuate relay bias during adjustment so that bias will be minimized in working circuits employing a healthy drive. Table II gives bias test conditions for relays having various coil resistances. M1 is a 5 ma ac milliammeter which is shunted as required to monitor the various ranges of drive current. The bias indicator circuit uses a zero center scale milliammeter in conjunction with the simple divider network shown in Fig. 3B. The resistances are arranged so that equal and opposite currents flow through the meter for the

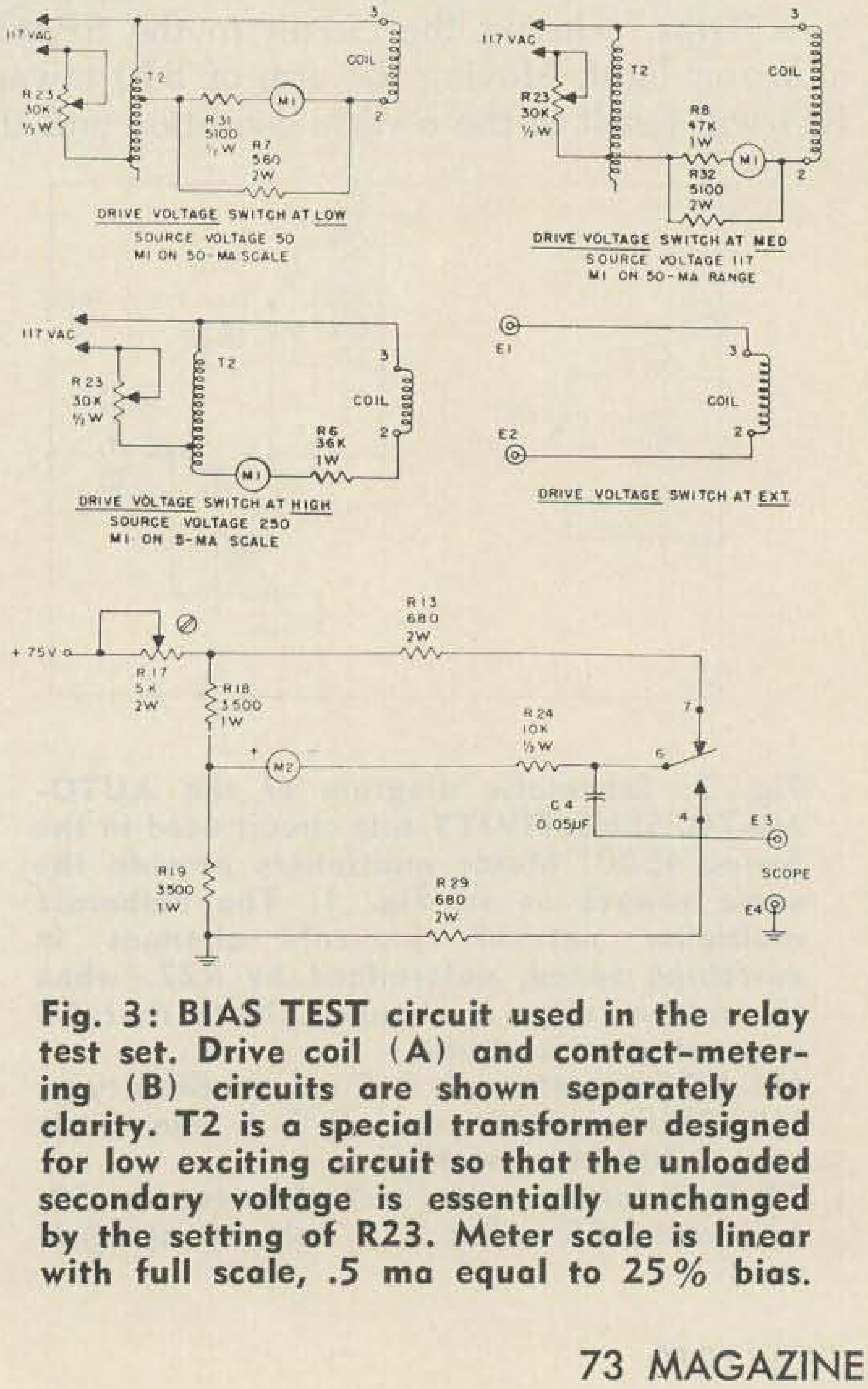


Fig. 3: BIAS TEST circuit used in the relay test set. Drive coil (A) and contact-metering (B) circuits are shown separately for clarity. T2 is a special transformer designed for low exciting circuit so that the unloaded secondary voltage is essentially unchanged by the setting of R23. Meter scale is linear with full scale, .5 ma equal to 25% bias.

MARK and SPACE contact conditions. Using circuitry not shown, the supply voltage dropping resistor, R17, is adjusted for a static meter current of 2.0 ma in both the MARK and SPACE conditions. When drive is applied to a relay which introduces no bias, the meter pointer vibrates around the zero center point on the scale. Bias in the relay under test is indicated by an off-center deflection of the meter. The .5-0-.5 ma meter is calibrated linearly 2.5-0-2.5 and bias in percent is the reading of this scale multiplied by 10. Deflection to the left of center indicates MARKING bias and deflection to the right of center indicates SPACING bias. The relay under test should, of course, be adjusted for zero bias.

Fig. 4A shows the base diagrams of the Sigma Series 7 and 72 relays. This will assist in understanding the other drawings which are keyed to these pin connections. The only difference between the wiring of the Series 7 and 72 relays is that the Series 7 relay has an additional coil, normally short-circuited externally, connected between pins 3 and 5. Incidently, many amateurs have purchased the older Series 7 relays through surplus channels. As a point of information, the oldest of these, the 7JOZ-160T Model D, is the exact equivalent of the 7JOZT-150T. The S425-1 Relay Test Fixture will accommodate the Western Electric 255A relay. The diagram of this unit, shown in Fig. 4B, permits convenient comparison of the terminal connections for the two relay types.

This article has attempted to present the basic circuitry required for the proper adjustment of polar relays used in teletypewriter serv-

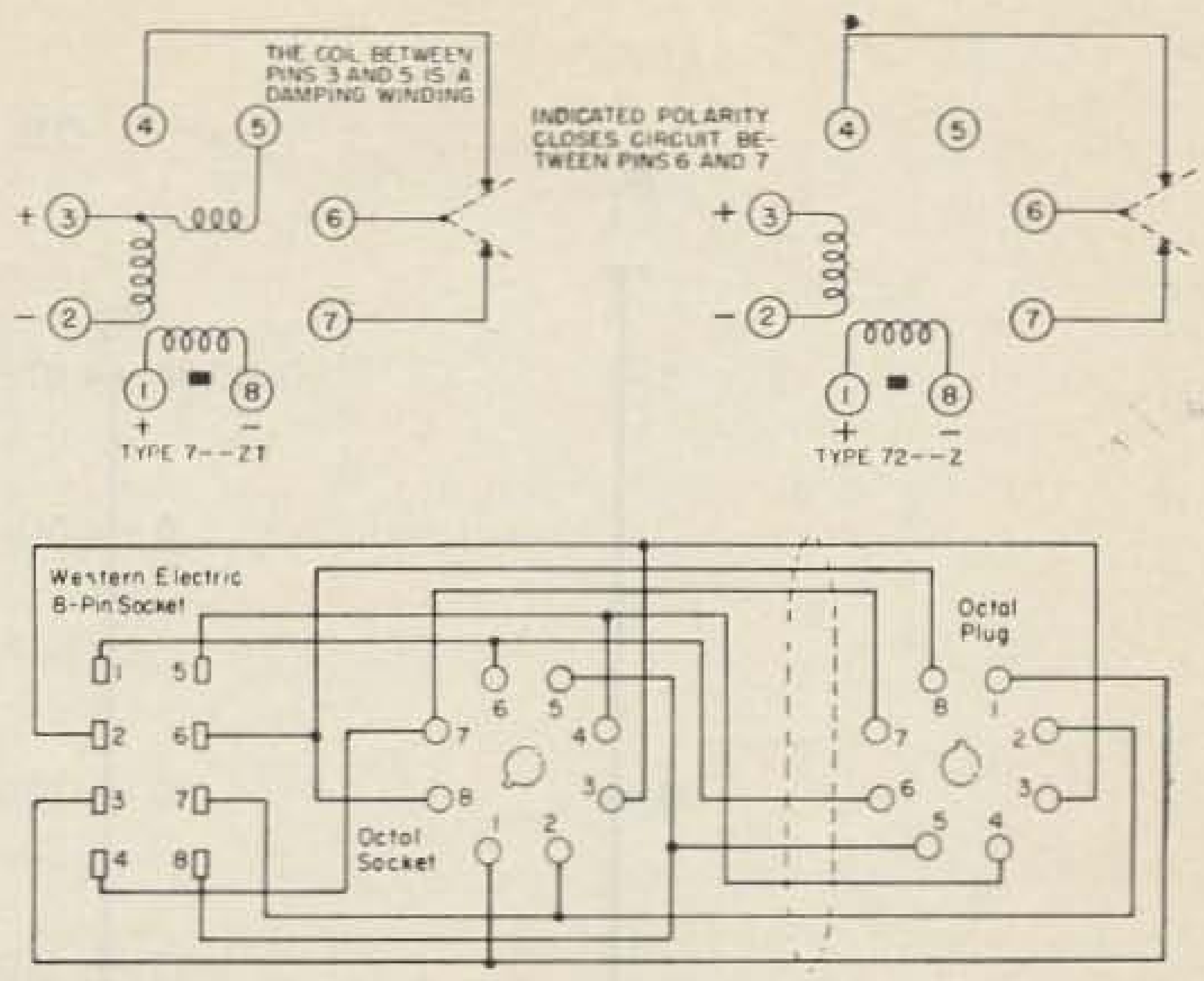


Fig. 4: Schematic diagrams of the Sigma Series Fixture. This unit plugs into the Series 4500 Test Set and, in addition to serving as a jig for adjustment, serves as an adaptor for the Western Electric 255A relay.

ice. Information and drawings from the Instruction Manual for the Series 4500 Polar Relay Test Set have been used with the permission of Sigma Instruments, Inc. This manual, written by W1BIY, contains such a wealth of additional information that it should be in the hands of every amateur with a serious technical interest in RTTY. Arrangements have been made with Sigma to supply single copies of this booklet to amateurs at the cost price of $1.00. Address your requests directly to Sigma Instruments, Inc., Sigma Division, 170 Pearl Street, South Braintree 84, Massachusetts, attention: Advertising Manager.

. . . W4WKM

Decibels?

It's a cinch

Carlos Robertson K1MRK
39 Gleason St.
Framingham, Mass.

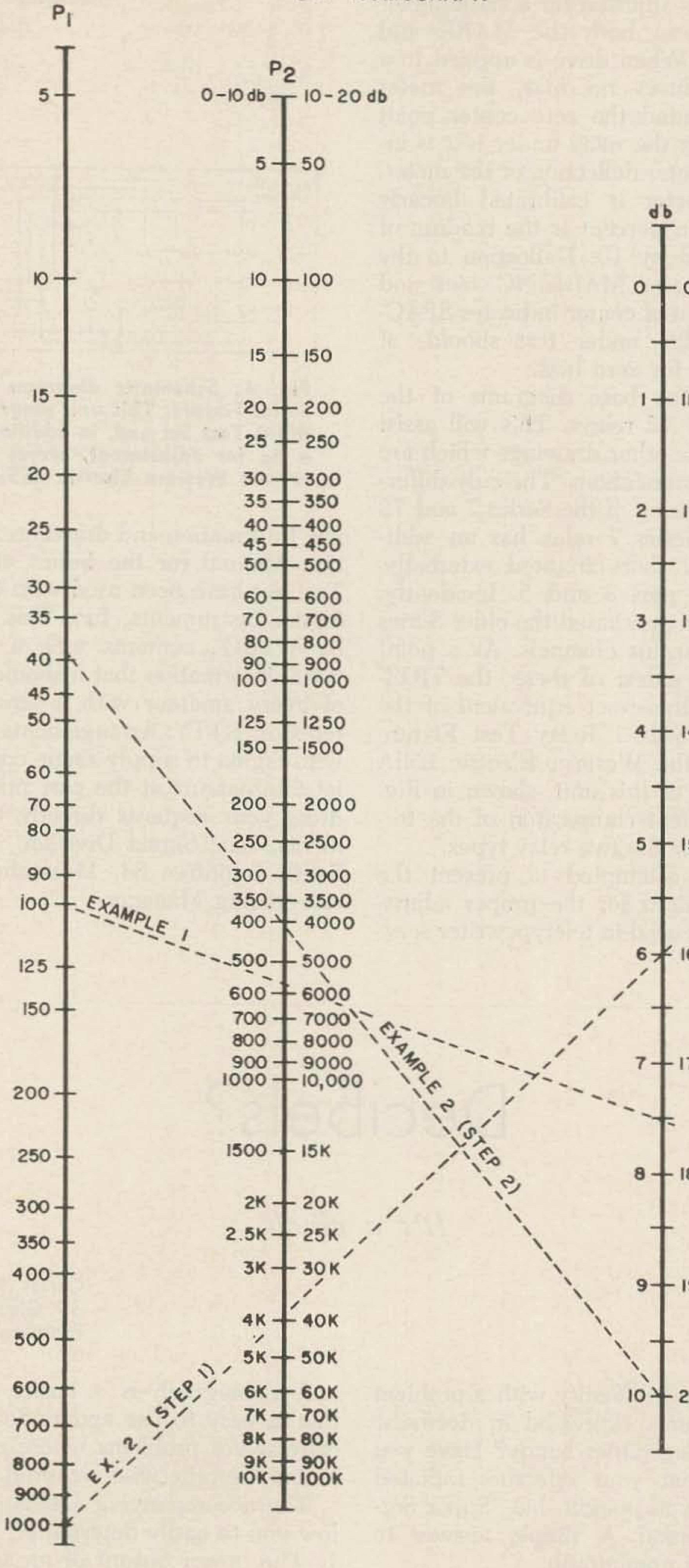
Have you ever had difficulty with a problem involving power ratios expressed in decibels? Did you have the log tables handy? Have you ever wondered what your *effective* radiated power would be if you bought that "Super Signal Squirter" antenna? A simple answer to these problems is a nomograph.

A nomograph is a basic, convenient chart that is easy to use and understand. It graphically solves problems where mathematical formulae are otherwise required.

The accompanying DB Nomograph will allow you to easily determine:

1. The power output of an antenna (knowing

DB NOMOGRAPH



the input power and the antenna gain in db).
2. The power radiated off the back of an antenna (knowing the input power, the forward gain, and the front-to-back ratio).
3. The required input power for a given output power (knowing the gain available in db).
4. The gain, in db, of an antenna (knowing the power input and output).
5. The gain required, in db, for any circuit or device (knowing the power input and the required power output).

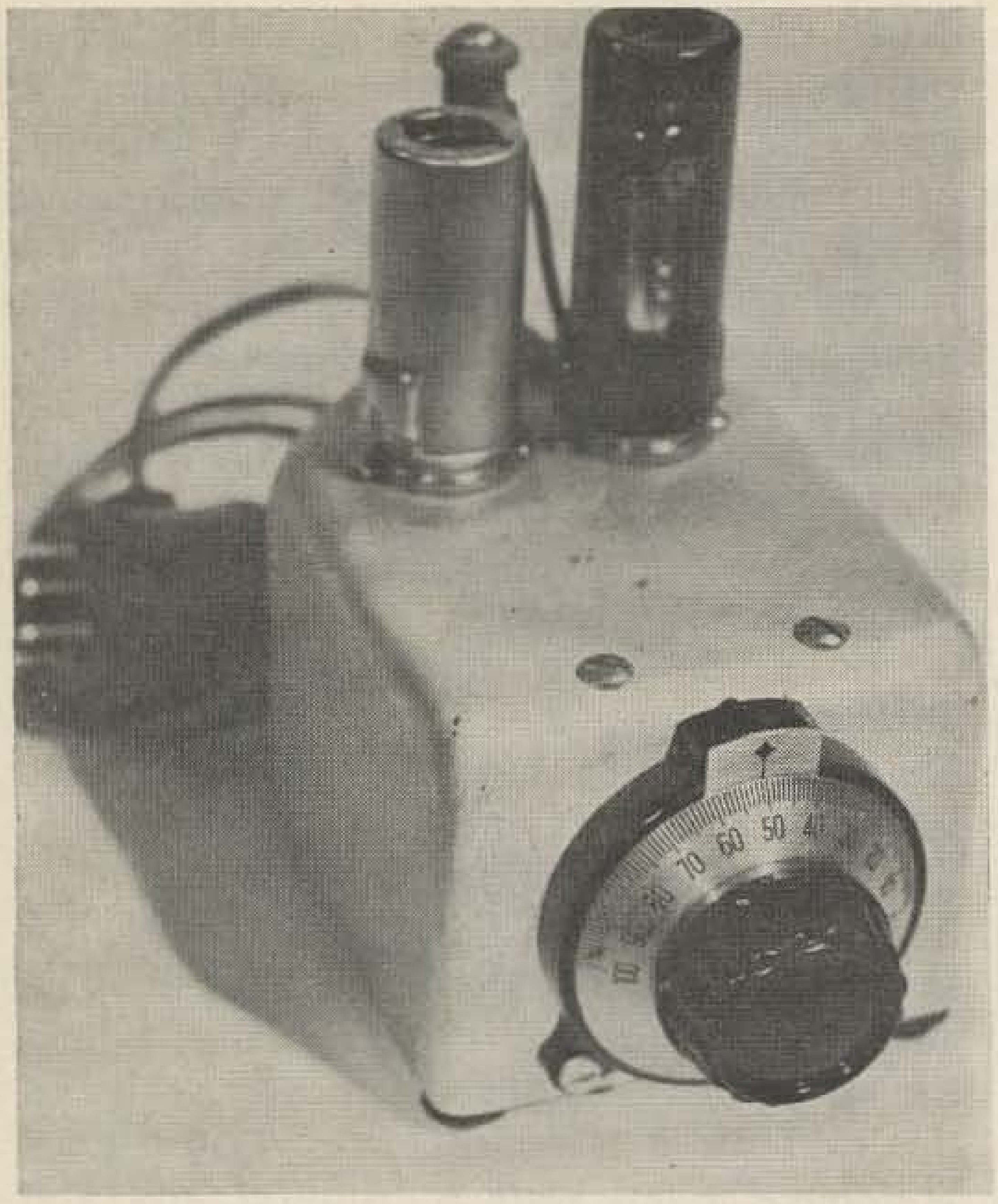
These are but a few of the problems that can be solved by the nomograph. Undoubtedly the average amateur will find many additional applications.

The use of decibels to express a ratio between two quantities is convenient and becoming much more common. You will find that by using this nomograph you will have as much understanding of the use of decibels as you now have in the use of volts and amperes.

Here are some examples in the use of the nomograph:

1. To find the effective power output of a new antenna you will need to know the power delivered to the antenna and the specified gain of the antenna in db. Assume representative values for the example of 100 watts of power delivered and an antenna gain of 7.5 db. Place a straightedge on the nomograph so that it intersects 100 watts on the P_1 scale and 7.5 db on the db scale. The actual effective power output is read on the P_2 scale where the straightedge crosses it. In this example it is 560 watts. In other words, your 100 watter will sound like a half gallon if you connect it to an antenna with 7.5 db gain.
2. Suppose your power output is 1 kw and your antenna has a front-to-back ratio of 20 db with a forward gain of 6 db. You want to know the effective rearward radiated power. Step 1, as in example 1, is to find the forward effective radiated power. Place a straightedge on 1 kw on the P_1 scale with the other end of the straightedge on 6 db on the db scale. The straightedge will inintersect the P_2 scale at 4kw or 40 kw. Since the forward gain of the antenna is between 0-10 db we read the 0-10 db side of the P_2 scale, or the 4 kw point. Step 2 is to place the straightedge so that it connects 20 db (the front-to-back ratio) and 4 kw on the right hand of the P_2 scale. (Again, be careful to use the appropriate side of P_2; the left hand side applies to ratios of 0-10 db and the right hand side applies to ratios of 10-20 db.) The answer is 39.8 watts, read on the P_1 scale. This is the actual effective power radiated off the back of the antenna.
3. You want to determine what power input is required to provide an effective radiated output power of 3.0 kw. You know that your antenna has a forward gain of 9.0 db. Place a straightedge so that it connects 9.0 db on the db scale and 3.0 kw on the 0-10 db side of the P_2 scale. Read the power input required on the P_1 scale. In this example it is 375 watts.
4. Suppose you have determined that your antenna system makes your 200 watts sound like your friend's 1 kw rig. You want to know the gain of your antenna system in db. Place the straightedge so that it connects 200 watts on the P_1 scale with 1.0 kw on the 0-10 db side of the P_2 scale. The gain of your antenna system is read where the straightedge intersects the db scale. In this example it is approximately 7.0 db.
5. You have a 5.0 watt transmitter and you want to install a new antenna system that will provide an effective radiated power of 300.0 watts. Place the straightedge so that it connects 5.0 watts on the P_1 scale and 300.0 watts on the 10-20 db side of the P_2 scale. If you had tried to use the 0-10 db side of the P_2 scale the straightedge would not intersect the db scale. The gain required of the new antenna as read on the 10-20 db side of the db scale is 17.9 db. We read the 10-20 db side of the db scale because we used the 10-20 db side of the P_2 scale.

Although the examples illustrate the use of the nomograph by comparing antenna characteristics, the nomograph is not limited to solving problems in power ratios related to rf energy. Any quantity of power, be it commercial household power, audio, rf, etc., can also be related in terms of decibels by using the nomograph. . . . KIMRK



Edwin Cole W7IDF
P.O. Box 3
Vashon, Washington

Vector VFO

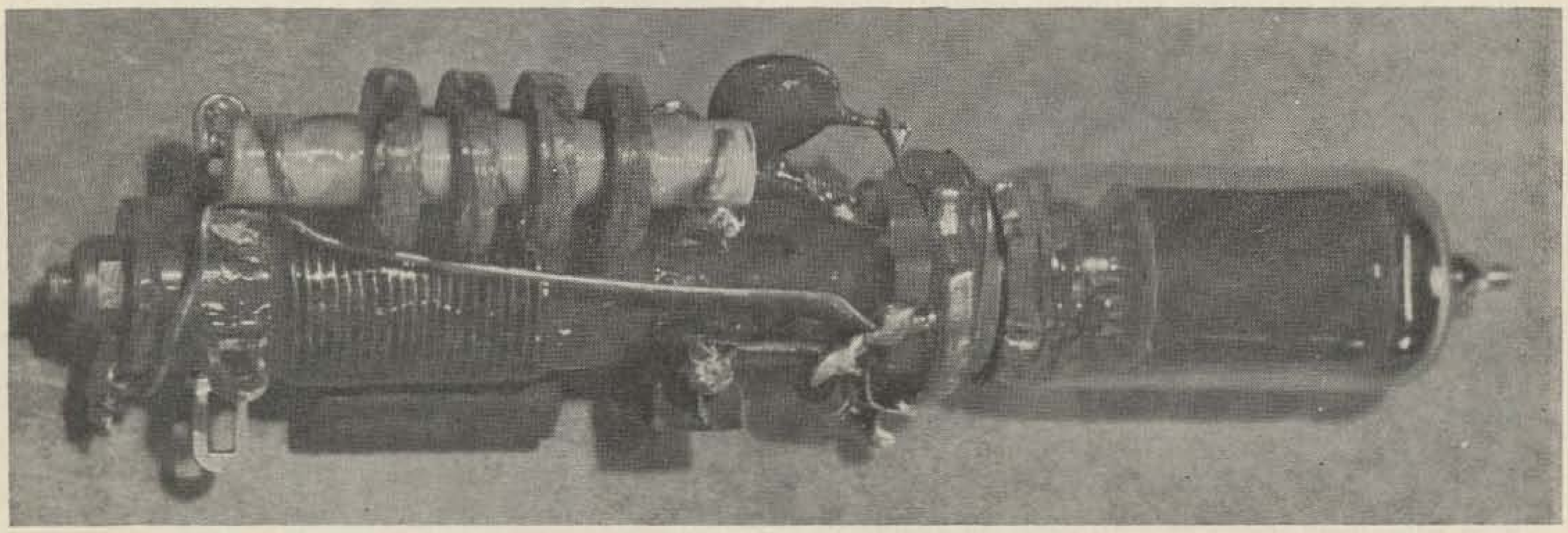
73 Parts Kit Available . . . $6.50

Take one Vector seven-pin turret socket, wind nineteen and one-half turns of Belden #20 Nylclad cathode-tapped at six turns, coat generously with low-loss dope, pad to frequency and serve with DX-60.

It's almost that simple. The only components not mounted on the socket are the tuning variable, the output mica and the plate rf choke. (When the last two are soldered to the plate pin they should be dressed away from the turret to avoid degenerative feedback.) You may prefer to juggle the padder and variable values for junk-box or bandspread considerations but with a 250 mmfd variable the VFO tunes from 3350 to 4050 kc. This range obviously means very little spread on the high bands, but I read my frequency on the receiver dial and it takes only a moment to check calibration before going on the air. The variable I used is a broadcast midget picked for four virtues: double bearings, short shaft, rigid frame, compactness.

The coil and circuit component values are products of eclectic empiricism.* As it happened, the first try was successful. This was suspicious so a duplicate unit was put together, with the same results. Operation for the past

* Cut and try



MODEL 5CIV84 40 and 80 METER

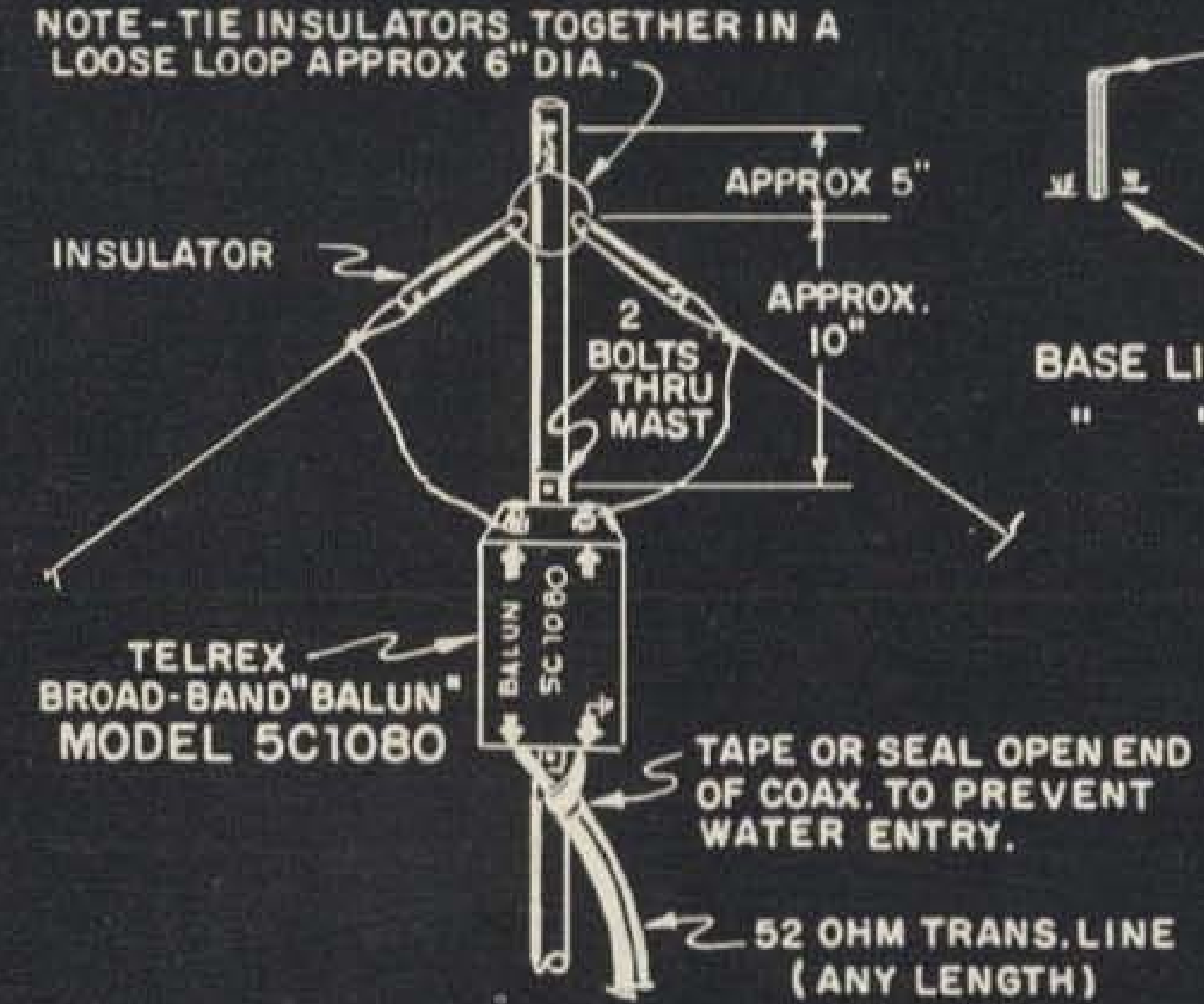
"DUO-BAND"
"BALUN"-FED INVERTED "V" ANTENNA KIT
INSTALLATION and ASSY. INSTRUCTION SHEET

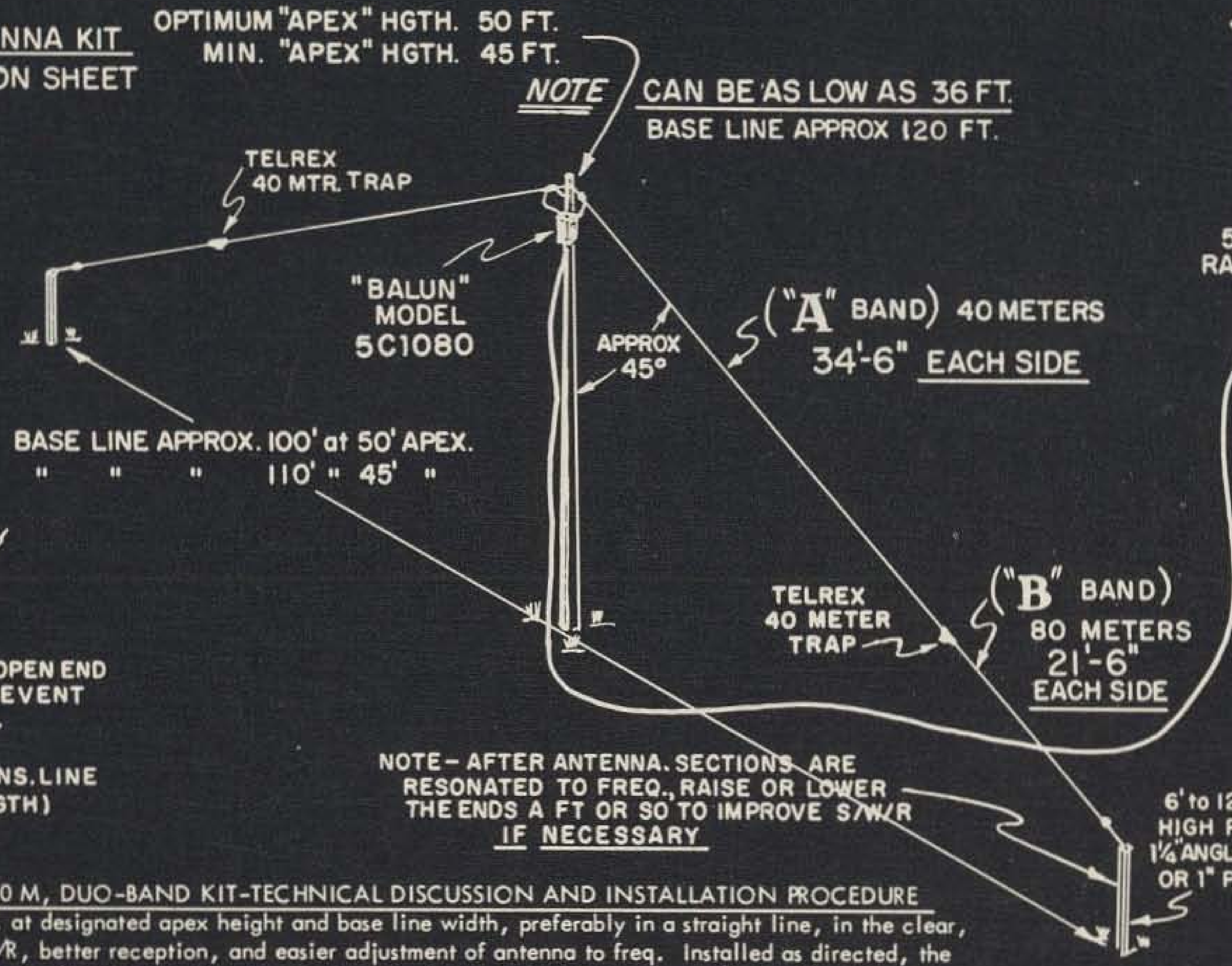
$24.95

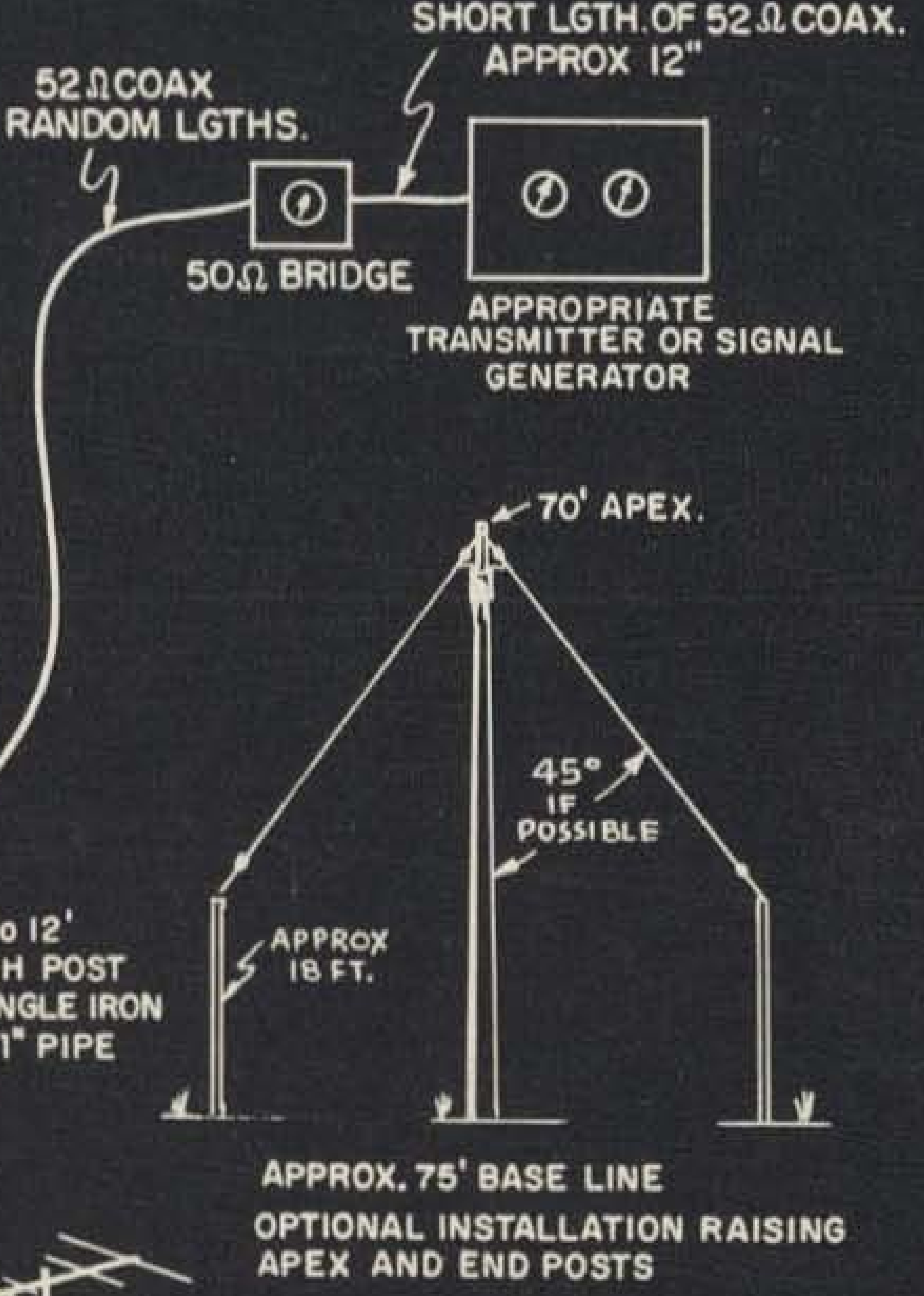
(RATED 1 KW P.E.P.)

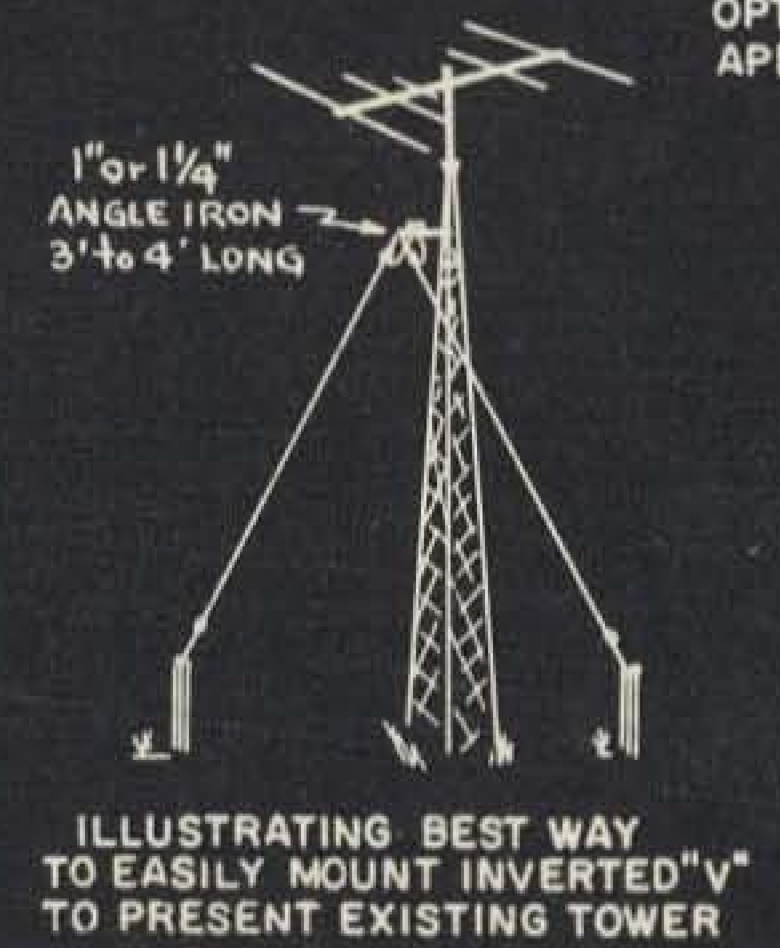
KIT COMPONENTS SUPPLIED

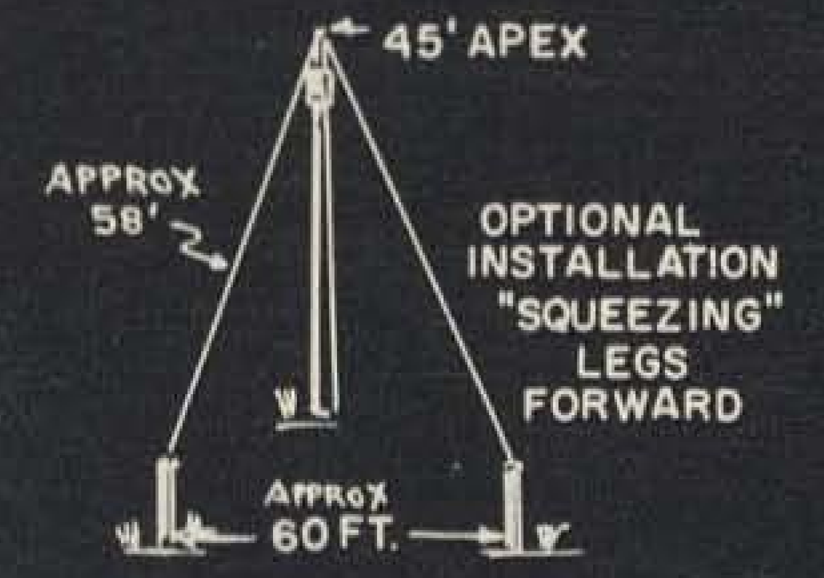
1 - TELREX BROAD-BAND "BALUN"
4 - HIGH GLAZE INSULATORS
130' No. 16 COPPERWELD WIRE
2 - TELREX 40 METER TRAPS











TELREX "BALUN" FED INVERTED "V", 40 & 80 M, DUO-BAND KIT-TECHNICAL DISCUSSION AND INSTALLATION PROCEDURE

Install antenna support structures (wood or metal), at designated apex height and base line width, preferably in a straight line, in the clear, away from power lines, etc., to assure min. S/W/R, better reception, and easier adjustment of antenna to freq. Installed as directed, the "Balun" fed Inverted "V" will provide the best match, because the "legs" approximate a 45 degree angle from the vertical, thus effecting an input imped. of approx 52 ohms, automatically at most sites, without fuss or bother. However, the Telrex "Balun" fed Inverted "V" lends itself to considerable variation from these definite recommendations, although greater difficulty may be experienced to "cut" antenna to freq. and to reduce the S/W/R to a usable minimum.

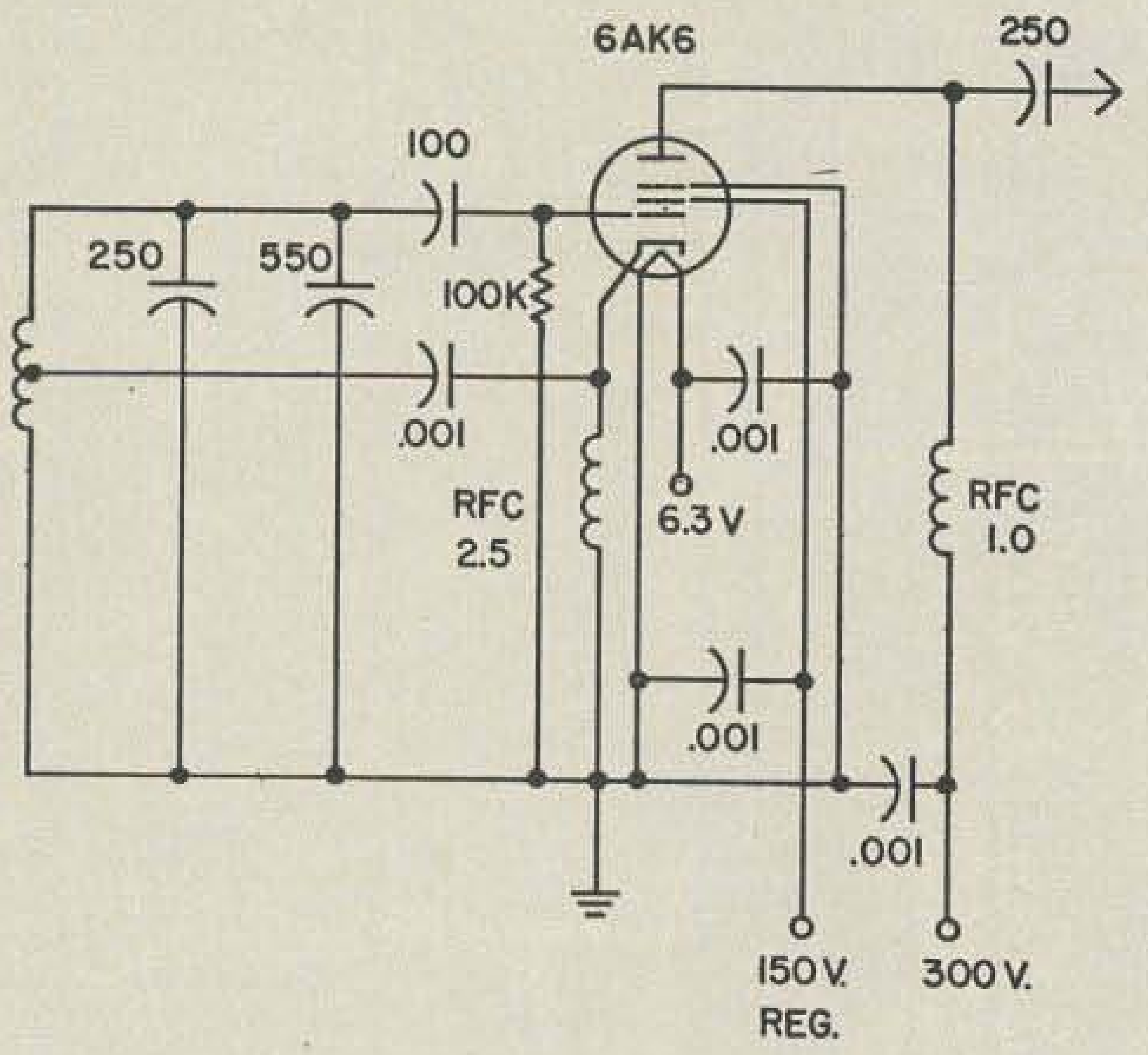
Performance---Properly installed and resonated to freq., a Telrex "Balun" fed Inverted "V" 40, 80 M, duo-band, will outperform the usual horizontally installed doublet, or vertical antenna and provide a S/W/R of under 2/1 for approx 3% freq. bandwidth, (about 250KC on 40M; about 125 KC on 80M). The pattern is primarily Omni-directional with nulls off the ends of approx 6 DB, and the radiation is hi-performance, low-angle, irrespective of ground conductivity!

INSTALLATION PROCEDURE---Cut copperweld wire supplied into designated lengths. Assemble to insulators and "Balun" as illustrated. Connect a 52 ohm coax trans. line (any length), to input side of "Balun", then raise the antenna to its prepared supports for resonant checks. With a S/W/R bridge (and signal gen.) connected as illustrated, locate the resonant freq. of "A" Band (40 meters), it should resonate low in freq., perhaps outside the low end of the 40 meter band. To correct, shorten each "leg" approx 1 ft. or so, then recheck resonant freq. Repeat (shorten or lengthen) if necessary, until antenna resonates to your desired "A" Band (40M) sector. Note! The antenna must be raised to its intended final apex and end post height each and every time resonant freq. and/or S/W/R readings are taken and---Only After "A" Band has been properly resonated to freq., should you proceed to resonate "B" Band (80M) as instructed for "A" Band. Note! When "B" Band has been properly resonated, recheck and correct "A" Band to freq., if necessary. In conclusion---If further info or assistance is required, please write Department H and please supply S/W/R readings, a rough sketch, and a stamped addressed envelope so that we can respond quickly and easily.

MFD. UNDER TELREX PATENT No. 2,576,929

ANTENNAS SINCE 1921 **Telrex** LABORATORIES Communication and TV Antennas ASBURY PARK NEW JERSEY U.S.A.

TELREX EQUIPMENT AVAILABLE THRU THE BETTER AMATEUR DISTRIBUTOR. IF NOT IN STOCK, PLEASE ADVISE. WE WILL BE PLEASED TO SHIP FROM OUR FACTORY



With the exception of filament disc by-pass all fixed capacitors are silver micas.

six months has been completely satisfactory, with one possible exception. Drive on all bands is more than adequate except on ten phone, where it is about a milliampere short at the 6146 grid. If you find it necessary this could probably be most easily remedied by peaking the slugged coil in the DX-60 or by tuning the plate circuit of the VFO to pick up the second harmonic. Speaking of harmonics at this point, let's remind ourselves that working ten with an eighty meter VFO requires extra attention to the output frequency.

The original plan, as you may have guessed, called for mounting this unit inside the DX-60, but I simply couldn't find a spot where the oscillator wouldn't be subjected to heat and/or mechanical modulation by transformer hum; perhaps someone else will. The chassis shown in the photo is surplus, cast-aluminum and small enough to provide a maximum of rigidity without crowding. An OA2 with its six thousand ohm, ten watt resistor take up some of the extra space on top—where all good heat producers belong.

After warm-up, drift was checked at less than one hundred cycles in an hour. On-the-air requests to a reliably cynical local ham for critical appraisal confirmed the performance as clean and stable. That long axial machine screw looks out of place in the center of a VFO coil, but it doesn't mean you can't use a turret socket to achieve stability in a simple and compact package. . . . W7IDF

Wee Birdcage

The ultimate in limited space antennas

Terrence Banks K3LNZ
426 Orange St., S.E.
Washington 20, D. C.

How would you like a three-element beam for 80- or even 160? Sounds like a pipe dream, of course. But you *can* have an antenna, for somewhere between $5.00 and $20.00, depending on the band, that you can put together yourself, that will occupy no more than a 17 foot turning radium on 160 and correspondingly less on other bands, and that finally will give you a marked improvement over a full size dipole. Just how much improvement will be explained later, but it's well worth the little amount of trouble involved.

The solution is nothing radically new—it is simply an application of someone else's good engineering that went by practically un-noticed several years ago. I am referring to the G4ZU "Birdcage" antenna which appeared in one of the other amateur radio journals in April 1960,

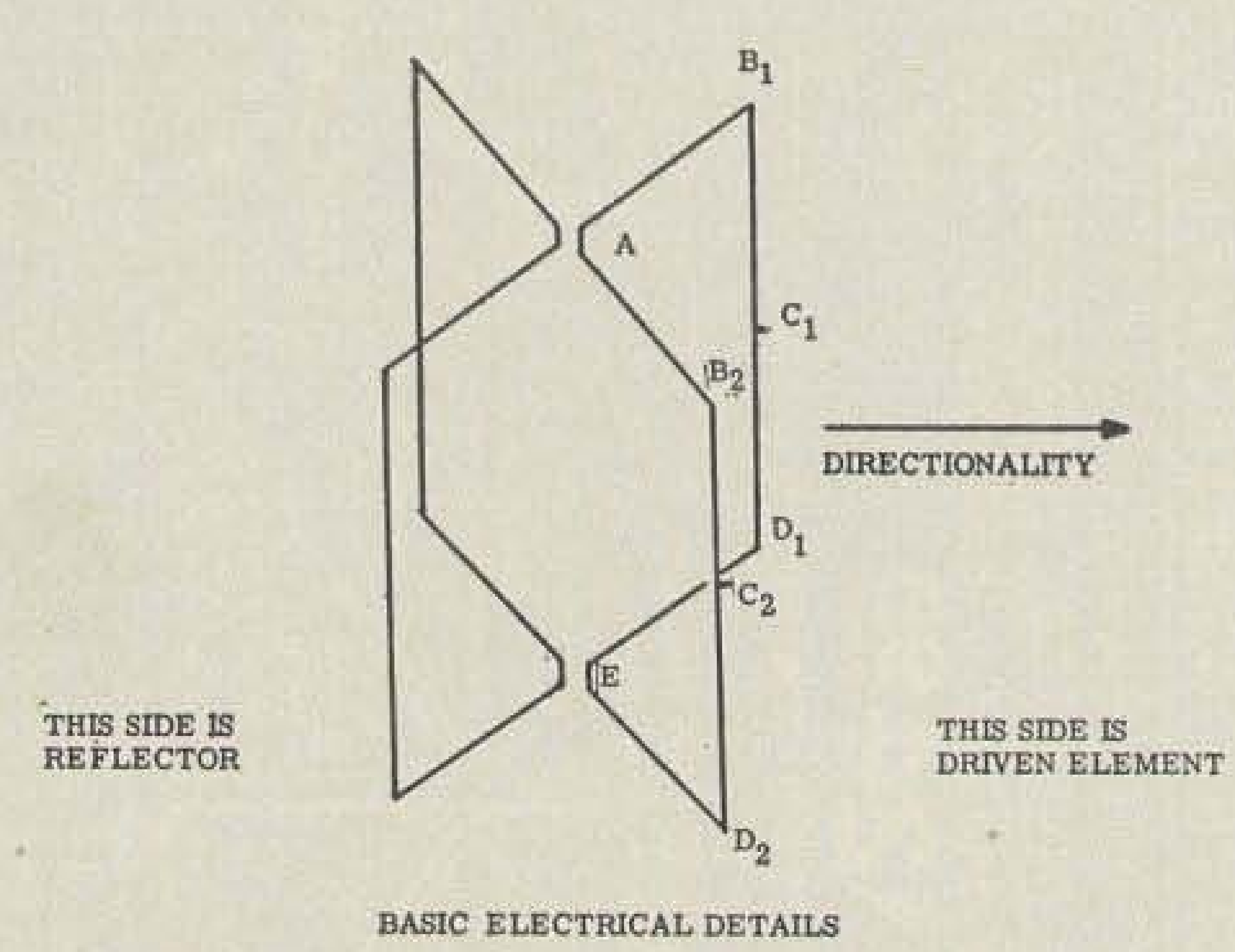


FIGURE 1

plus the additional information that one will work when cut to one-quarter of its original size. This author therefore claims no credit for anything more than sitting at the typewriter and presenting the facts (verified, on the air) and figures.

The basic principle of the Birdcage is shown in Fig. 1. A pair of V dipoles have center points at A and E. One dipole runs from C_1 through B_1 to the centerpoint A, and then on through B_2 to C_2. The other dipole goes around the other way through D_1, E, D_2 and back to C_2. These may look like funny dipoles, but they are merely bent toward the other dipole at B_1 and B_2 and at D_1 and D_2, and are connected together where the tips meet at C_1 and C_2. Assuming A is the feedpoint, if we follow our way around the circuit, we will find that we have one full wave before we get back to A again. This obviously will load up very well on the frequency for which it is cut. The theory behind it is that the inner portions of the two dipoles will radiate in a horizontal plane, and the portions that are bent up or down to connect to the opposite pieces serve merely as a voltage feed, so that one dipole can be fed at its center and then will end-feed the other one. Addition of a reflector constructed in the same manner balances it out mechanically, and gives us additional gain over that obtained by stacking the two dipoles.

When G4ZU's original article appeared, the writer took a quick look at the claimed gain (10 db) and what the size would be when scaled down to six meters, and went looking for materials. Results were very good without even bothering to measure SWR or feedpoint impedance. We just tuned the reflector for maximum forward gain and proceeded to work all the new signals we were hearing. About this time, we made the acquaintance of Skip W3CYT who was also intrigued by the original article. However, he had gone a step further and experimented around with half and quarter size models. Comparing notes revealed that less gain, but otherwise similar results, were obtained in the miniature models. Although no actual figures on gain were ever arrived at, comparison with standard dipoles showed definite improvements in signal strength, and an estimated figure of 4 db does not sound out of line. Fig. 2 shows the physical size of one element (A to B_1, or etc.) for the various bands, both in quarter-wave and full-wave models. It is obvious from this that a full-wave 40 meter model will work as a quarter-wave on 160, and likewise for other possible frequency relationships, up to the quarter-wave

Band	Full-Wave	Quarter-Wave
2 meters	10-5/16"	2-5/64"
6 meters	29-3/4"	7-3/8"
10 meters	4'-4"	13"
11 meters	See Note #1	See Note #1
15 meters	5'-10"	17-1/2"
20 meters	8'-8"	2'-2"
40 meters	17'-4"	4'-4"
80 meters	34'-8"	8'-8"
160 meters	See Note #2	17'-1"

Note #1: Details supplied upon request to other countries. Residents of U. S. need not bother asking.

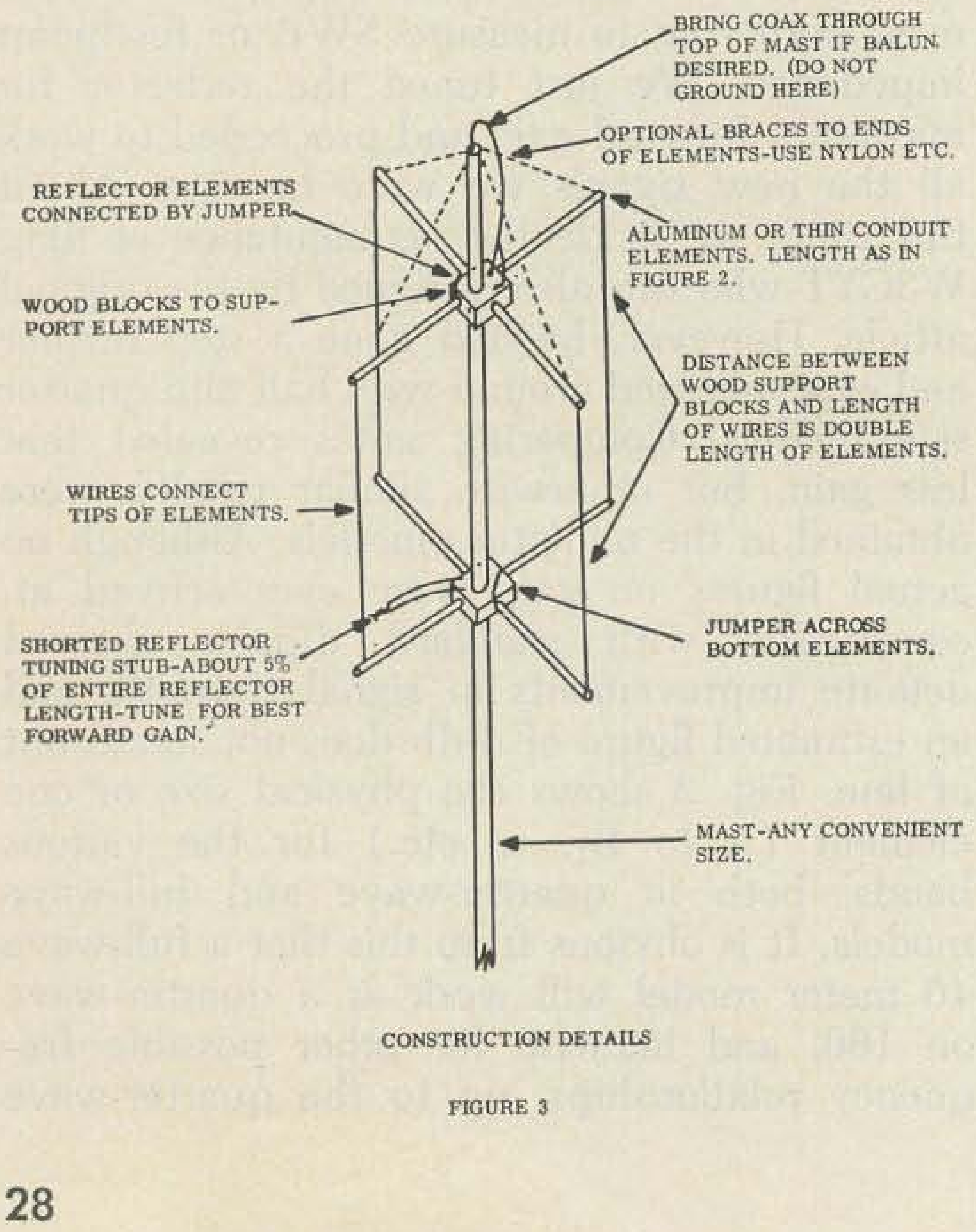
Note #2: Anyone this ambitious won't have any trouble calculating his own figure.

All lengths given are for one element (8 required), and also represent the turning radius of the antenna. All are given for the low edges of the bands.

Fig. 2—Sizes for Various Bands

six meter model which has a radius of less than 7½ inches!

The mechanical details are shown in Fig. 3. Simply obtain two suitable sized hunks of hard wood. Bore holes for the size of mast you wish to use, and mount them exactly twice the length of one element apart (either a quarter wave for the full-wave model or a sixteenth wave for the quarter-wave model). Next, bore holes for whatever diameter of material you have selected for the elements, which is simply whatever you have around or can purchase cheaply, such as half-inch inside diameter thin-wall conduit. The elements should come close to, but not touch, the center support, and should be fastened in with machine screws in such a way that adjacent elements can be connected electrically by jumpers. See Fig. 4 for details. In most quarter-wave models, no extra support is needed for the elements, nor will any be needed on the higher band full-wave models. However, if you think the elements will have a tendency to droop, simply run the mast a bit higher than the top wood block and run nylon, glassline, or what have you down to the ends of the top elements for support. Finally, connect vertical wires between the tips of the top set of elements and those directly below. These wires may be any size convenient or mechanically desirable, as they carry no current. Likewise, there is no appreciable rf voltage present at the wooden mounting blocks, so no special pains are required to use low-loss material at these points. Finally, element thickness, while theoretically tending to control bandwidth, is so much greater than any wire that might be used in a standard dipole that mechanical size alone should be the deciding factor.



CONSTRUCTION DETAILS

FIGURE 3

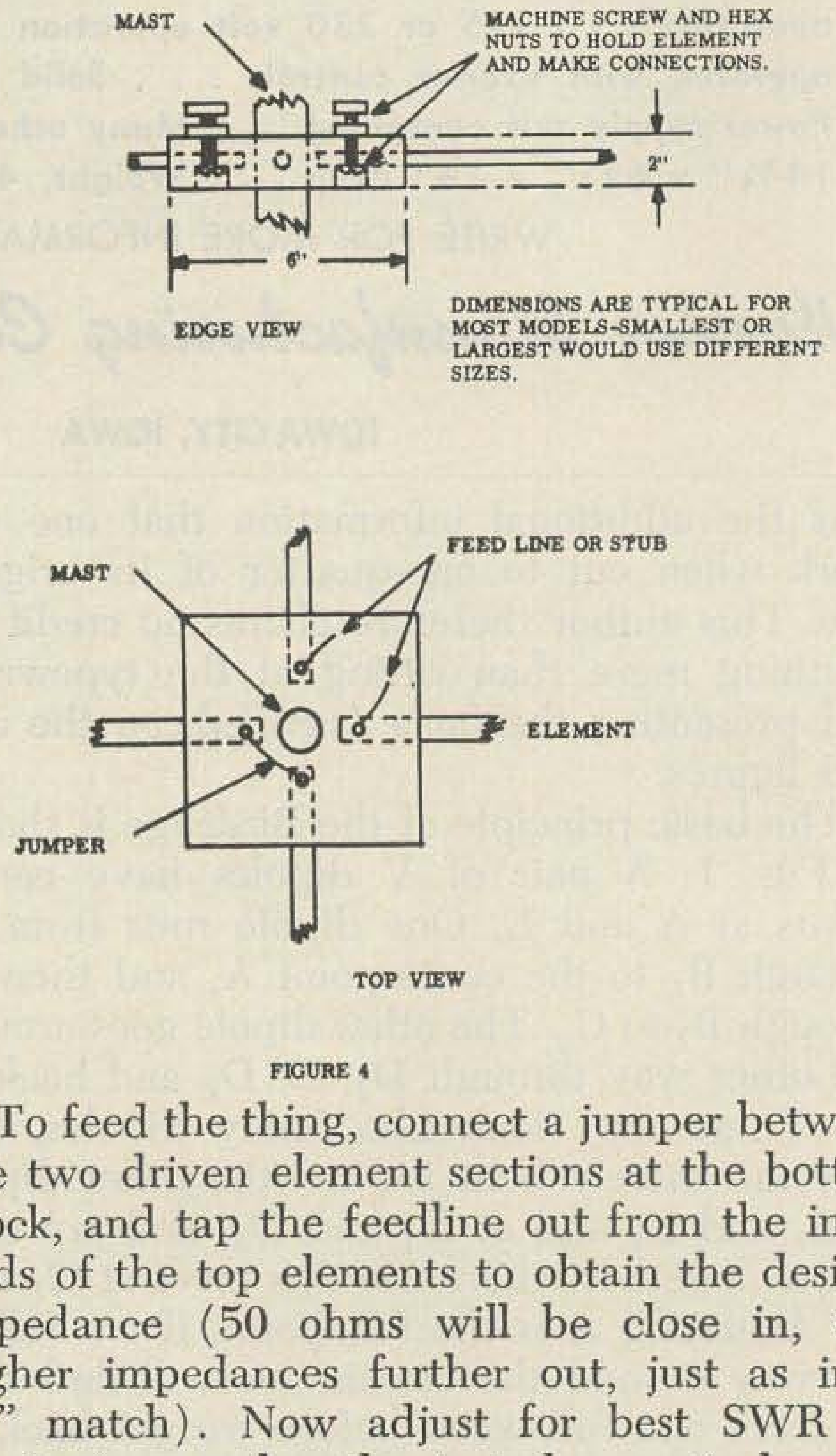


FIGURE 4

To feed the thing, connect a jumper between the two driven element sections at the bottom block, and tap the feedline out from the inner ends of the top elements to obtain the desired impedance (50 ohms will be close in, and higher impedances further out, just as in a "T" match). Now adjust for best SWR by shortening or lengthening the vertical wires slightly. At this point, it would be best to mention that a balanced feed is required. This can be obtained through the customary half-wave loop of coax if 200 or 300 ohm feed is desired. It can also be obtained by using the mast as part of a 1:1 ratio "balun." Run the coax into the mast, grounding the braid as you do, at a point exactly one-quarter wave below the top of the mast. This will be the same

SB 33

"BILATERAL"

Transistorized Circuitry

KEY FEATURE IN THE BIG SB-33 VALUE

Bilateral! Space-age word, key to one of the biggest SSB transceiver values ever! Exclusive SSB Bilateral amplifiers and mixers (pats. appd. for) operate in two directions—avoid needlessly-idle stages in either transmit or receive. This eliminates a boxful of components—simplifies wiring—reduces equipment size—provides savings in cost that reflect in a lower selling price. **There is no compromise!** The compact SB-33 package includes **everything** essential for the brightest state-of-the-art SSB performance—features a **Collins mechanical filter that is used in both transmit and receive!** And add—as further cost-reducing innovations, new SBE overtone techniques for a unit using only three quartz crystals! Advanced solid-state techniques are skillfully applied throughout SB-33 to take full advantage of lower power consumption and superior heat rise properties of transistors and diodes. Equipment is more effective—smaller in size. Stability is inherent, VFO drift extremely low. Both VFO and I-F are gang-tuned on the nose. No critical bandpass circuits.

4-Bands: 80-40-20-15 meters.

Power input: 135 watts P.E.P. maximum (speech waveform).

Receiver sensitivity: Better than 1 uV for 10 db signal/noise ratio.

Sideband selection: Upper or lower sideband selectable by panel switch without change in frequency.

Tube and semiconductor complement: 2—PL-500 beam power tetrodes. 1—12DQ7 driver. 20 transistors. 13 diodes, 1 zener diode.

Power supply: Built in 115VAC supply.

Loudspeaker: Built-in.

Size: 5½"H, 11¾"W, 10¼"D. 15 lbs.

389^50

SB-33 Special inverter, 12V DC/115V AC	59.50
SB-33 Deluxe VOX/Compressor	39.50
SB-33 100 Kc crystal calibrator	27.50
SB-33 Mobile mounting base, locking type	12.50
SB-33 Carrying case, luggage type w/accessory compartment	29.50
SB-33 accessory adaptor for rear of transceiver	1.95

Faust Gonsett, W6VR, Pres.

SBE Sideband Engineers Inc. Rancho Santa Fe, Calif.

distance as between the wooden support blocks for a full-wave model, or four times this distance in a quarter-wave model. Do not ground the coax anywhere above this point. Separate the braid and the inner conductor where they come out the top, and you will have a balanced feed at the same impedance as the transmission line.

Now connect a jumper between the two top elements of the reflector, and insert a stub of twin-lead the same length as an element between the two bottom reflector elements. This gives us one-sixteenth, or about 6%, of the total reflector length, which we know is too much as 5% is the theoretical figure for how much longer than the driven element it should be. Prune this stub, keeping the far ends shorted, until maximum forward gain is achieved. You can now go back over the two adjustments (driven element and reflector stub) as many times as it takes to make you happy with the SWR and FB ratio if you are of a mind to squeeze out the last milliwatt of power, although the average guy will probably be contented to let things as they are after the first basic adjustments, and won't lose an awful lot by doing so, either.

Several things that should be borne in mind when using this arrangement are that two-band operation is quite practical, as long as there is a 4:1 frequency ratio—that is, operating quarter-wave on 80 and full-wave on 20, or etc. Also the elements can be cross-connected (both halves in series) to make a half-wave (or is it really full-wave?) bi-directional model on the "in-between" band (40 in the last example) although the gain is no better than with quarter-wave operation due to neither side being larger than the other, and neither serving as a reflector. Finally, either the feedpoint or the reflector tuning stub can just as well be either top or bottom, whichever suits your convenience. If you use open line, bottom feed would obviously be more convenient than coming up through the mast as with coax.

As stated before, several of these antennas were built and tried out on six meters. Results were, as close as can be "guesstimated" with nothing but S-meter readings and comparison with dipoles, close to G4ZU's claim for the full-wave model, and a conservatively estimated 4 db gain for the quarter-wave miniatures. Results on receiving tend to back up these figures rather closely.

Lastly, do not expect either (1) a sharp directional pattern, or (2) a large front-to-back ratio. After all, one driven element and one reflector wouldn't give you these in beam configuration either. The side nulls are deep, however, and overall performance is well worth the small effort and expense required to construct one. . . . **K3LNZ**

Protect Your Investment

Roy Pafenberg W4WKM

ANY amateur who desires to pursue his avocation and at the same time is interested in keeping his kids in shoes and a few cold ones in the box must necessarily be concerned with the trade-in or resale value of his gear. This applies equally to commercial and converted surplus equipment. In order to avoid an expensive turnover of the station with each real or claimed state of the art advance, many amateurs find it desirable to modify their commercial equipment to gain the advantages of new techniques. Of course, extensive modifications are the rule in most surplus conversions.

How do you modify and still not lower the value of your equipment? The Golden Rule applies in this area and results in a very tangible increase of cash in pocket. The potential buyer of your equipment probably desires what you yourself would want. This boils down to new appearance and performance along with detailed instructions and service information. This is a tall order but it can be filled.

A few simple precautions, religiously followed, will insure top market value of modified commercial and converted surplus equipment:

1. Make the minimum modification required to gain the desired performance objective. Plan the modification so that the equipment may be restored to the original condition if things don't pan out. It is sometimes difficult to accomplish the desired modification without punching additional holes in the panel of the equipment. In this connection, new components can be of great value. See "Versatile Control Techniques" in the Aug. 61 issue.

2. First impressions are important and appearance, internal and external, should be up to par. The quality of workmanship in the modification or conversion should at least meet the same standards to which the equipment

was designed and manufactured.

3. Maintain *complete* data on all your equipment.

Of these points, the last is possibly the most important and by far the easiest to goof. While a scrawled sketch on the back of an old bill may satisfy your requirements at the time the work is done, this is rarely true of the prospective buyer of the modified equipment. He wants, and deserves to get, the most complete data you can give him.

Manila file folders are a good binder for individual equipment information. This is especially true of surplus equipment where the manual, if available, may not cover the actual application. File such information as you can get in the folder. If the conversion is described in a magazine article, clip and file. Schematic diagrams, in particular should be neat and legible, showing all details of the conversion or modification.

Entering changes on schematic diagrams of complex equipment is, in itself, a problem. Stencil correction tape, as pointed out in the blurb in the Aug. 61 issue, can be used to block out sections of the original schematic and corrections and changes entered directly on the tape. It is often detsirable to make copies of diagrams, either from borrowed publications or to pass on. Commercial photostats are ideal but can be quite expensive. In these modern times, many offices are equipped with photographic transfer type duplicating machines. Probably the most popular of these is the Kodak Verifax. Drawings may be duplicated on these machines and the results are quite professional. Maximum size is 8½" x 14" and the cost of materials, per copy, is pennies.

After you complete the equipment file on your modification or conversion, you may feel it is of sufficient value to pass on to other amateurs. If so, you have already completed the hardest part of preparing an article on your project. Duplicate your material, tie it together with some prose and send it to 73 Magazine. You may have a winner.

All in all, time spent on keeping the equipment library current pays off in personal satisfaction and means dollars in your pocket when you dispose of the gear.

. . . W4WKM

A Comparative

W2NSD/1 . . .

Our little survey back in February indicated that over 20,000 of our readers are planning on going sideband mobile this year. This is not illogical for a great many of us have been waiting rather patiently for the manufacturers to bring out reasonably priced units so we could operate sideband from our cars. The way the fellows with the KWM's have been working out has been an eye opener. I know that I've talked with Antarctica while driving through the streets of New York City.

Transceivers seem to be finding a place in the hamshack too. A great many hams don't feel it is necessary to buy both a receiver and a transmitter when a transceiver does the whole job and takes up a lot less space . . . and ends up costing a lot less.

Even the relatively high price tags of some of the transceivers won't be much of a deterrent for many amateurs are now buying on those old easy terms, which means that a $600 package will probably only cost you about $12.50 per month for three years, plus carrying charges, and you end up with something worth $200 to $400 when you go to trade it in. The fellow who drives to work can figure that his rig is costing him 50c a day. If he has to drive any distance this is well worth it not only for the relief of boredom, but for the friends that he will make through these twice-daily contacts on the bands.

I've tried to give you all of the factors for general comparison on the big chart. There are many other features of each unit that you will want to investigate too, which will send you not only to the paragraph under each photo which has been prepared by the manufacturer, but also on a perusal of their advertising claims.

The field is obviously quite competitive and you'll find that the manufacturers all give excellent value for the investment you make. None of them are overcharging for what you get. Some are able to give a bit more through sophistication of design. Several units keep their cost down by eliminating functions that are not absolutely necessary for sideband mo-

Survey of TRANSCEIVERS

bile operation, though they usually offer either kits of parts to add these omitted functions or else instructions for modifications.

In making your choice of a transceiver you probably will not really look for much in the way of CW or AM capabilities if you are planning on using the rig solely in the car. You may well be able to do without the ten and fifteen meter bands for the next few years while old Sol recovers from his spot-blight. Ops planning on shack use of the transceiver may well consider ten and fifteen of importance, as well as complete coverage of the CW bands, etc.

MARS members should remember that almost all transceivers can be moved out of the bands a bit by the changing of a heterodyne crystal, with the only loss being in calibration.

Look 'em over. Decide whether you want one of these inexpensive Heath one-band jobs to keep you in touch with the gang as you drive around, or perhaps a super delux all-band transistorized Hallicrafters FMP-200.

Transceiver Com

	Date Released	Price	Final Tubes	Input PEP	80M	40M	20M	15M	10M	WWV & 6M
Collins KWM-2	10-59	$1150	(2) 6146	175	3.4-4.0	7.0-7.4	14.0-14.4	21.0-21.6	28.5-28.7 [1]	14.8-15.0
Davco DT20/DR30	6-63	535±	(1) 6146	70	3.55-4.05	7.0-7.5	14.0-14.55	21.0-21.55	28.0-29.55	9.5-10.0
Drake TR-3	4-63	495	(3) 12JB6	300	3.5-4.1	7.0-7.6	13.9-14.5	21.0-21.6	28.0-29.7	50.0-51.5
Elmac ATR-4	5-63	750±	(2) 6146	180	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-30.0 [2]	
Hallicrafters SR-150	11-62	650	(2) 12DQ6B	150	3.5-4.0	7.0-7.35	14.0-14.35	21.0-21.45	28.0-29.7	
Hallicrafters FPM-200	8-62	1995	(2) 6146	150	3.5-4.0	6.8-7.3	14.0-14.5	21.0-21.5	27.7-29.7	9.7-10.2
Heath HW-12	6-63	120±	(2) 6GE5	200	3.8-4.0 [5]	7.2-7.3 [5]	14.2-14.35 [5]			
National NCX-3	3-63	369	(2) 6GJ5	200	3.475-4.02	6.980-7.315	13.875-14.42			
SBE SB-33	3-63	389.50	(2) PL500	135	3.8-4.0	7.15-7.35	14.2-14.4	21.25-21.45		
Sonar Four Bander [7]	5-63	495	(2) 6GJ5	360	3.795-4.005	7.095-7.305	14.195-14.405	21.295-21.505		
Swan SW-240	2-63	320	(1) 6DQ5	240	3.780-4.020	7.050-7.320	14.130-14.370			
Tranceivers S3B	4-63	299	(1) 6DQ5	240	3.78-4.02	7.05-7.32	14.13-14.37			
WRL Galaxy 300	3-63	300	(2) 6HF5	300	3.8-4.0	7.050-7.350	14.2-14.4			

[1] Can tune other 200 kc segments with crystal change.

[2] Choice of 28.0-28.5 or 29.0-29.5 and 28.5-29.0 or 29.5-30.0 mc.

[3] Power supply for xmtr still not firm. Receiver power supply includes speaker, Q-multiplier and ac supply.

[4] Rig provides normally used sidebands for each band. Extra crystal available for opposite sidebands as an accessory.

[5] Heath HW-12 covers 80M only. HW-22 covers 40M; HW-32 is for 20M.

I've tried to include just about all of the specifications which will be of general interest in comparing the various makes of transceivers. All of these figures are the best that I could round up. There may be some variation, particularly in units which have not yet been released . . . and the prices obviously are subject to minor fluctuations as indicated by plus-minus signs.

You'll find the first release of information on some units soon to be unveiled on the chart and in the following pages. With the exception of the Sonar units and the Transceivers, Inc. units from whom we were unable to get sufficient information by presstime, I believe that we have covered the sideband transceiver field rather thoroughly.

Keep in mind that the writeups under the photographs were prepared by the manufacturers with the idea of supplimenting the info in this chart.

With the exception of the SBE unit which has the loudspeaker built in, all transceivers require either an external speaker which is normally built in the ac supply or else they depend upon your using the regular car radio speaker.

The exact frequency coverage is given here in detail for those fellows who might be influenced by the ability of a unit to cover MARS channels, or other frequencies adjacent to our ham bands.

Almost all transceivers have provisions for turning a linear on and off when the unit is used in the shack.

Three of the units are largely transistorized, the Hallicrafters FPM-200, the SBE SB-33 and the Davco combo. Tubes are used only in the higher power rf stages. Since transistors are more efficient than tubes these units are naturally a bit more efficient than tube units, though they may not make any difference to

parison Chart

Sidebands	I.F.'s (mc) 1st Conv.	I.F.'s (mc) 2nd Conv.	Size H	Size W	Size D	Weight	VOX	100 kc Calib	S Meter	Sideband Generation	Bilateral [8]	Dial (kc) Calibration	Mtg Bracket	AC Power Supply	DC Power Supply	Total Rig, MB, AC&DC P.S.
both	2.8-3.1	.455	7 3/4	14 3/4	13 1/4	18	inc	inc	yes	455 kc mech	no	1	$120	$115	$198	$1583
both	1.95-2.5	.455	7	8	5 3/4	11	inc	inc	yes	455 kc mech	yes	10 [9]	inc	36 [8]	? [6]	571+
both	9.0		5 3/8	10 3/4	14 1/4	12	inc	inc	yes	2-9 mc xtal	±1kc	10 [9]	inc	80	130	705
both			5 1/2	15 3/4	9 5/8	19	inc	inc	yes	2.7 mc xtal	±1kc	5	— [6]	— [6]	— [6]	950±
both	6.0-6.5	1.65	6 1/2	15	13	17	inc	inc	yes	1650 kc xtal	±2kc	5	40	99.50	109.50	859
both	2.1		5	16	11	26	inc	inc	yes	2.1 mc xtal	yes	1	inc	inc	inc	1995
S	2.3		7	13	11	12	inc	$8.95	yes	2.3 mc xtal	no	2	inc	HP-23 [6]	HP-13 [6]	? [6]
SX [4]	5.2	5.2	6	13 5/8	11 5/8	20	inc	acc [6]	yes	5.2 mc xtal	no	5	inc	110	120	599
both	2.282	.455	5 1/2	11 3/4	10 1/4	13	$29.50	$27.50	no	455 kc mech	no	10	12.50	inc	59.50	449
both	2.959-3.155	.455	5 3/4	11 3/4	11 3/4	11	inc	inc	yes	455 kc mech	no	5	8	134	154	763
SX [4]	5.175		5 1/2	13	11	12	no	no	no	5.175 mc xtal	no	5	inc	95	115	530
SX [4]	5.175		5 1/2	13 1/4	11	10	$39		yes	5.175 mc xtal	no	5	inc	99.50	99.50	500
both	9.1		7	15	13 5/8		$19.95	no	yes	9.1 mc ph	no	10	15	80	120	515

[6] No price yet set.

[7] Sonar also is producing a set of monobander transceivers which cover any 200 kc segment of the 80-10 meter bands. These units are very similar to the Four Bander except for frequency coverage and a lower price of $395.

[8] Bilateral operation, in the sense intended here, has to do with being able to tune the receiver separately from the transmitter. CW ops and SSB DXers sometimes find this of advantage.

[9] Plus one kc calibration on tuning knob.

your car's electrical system.

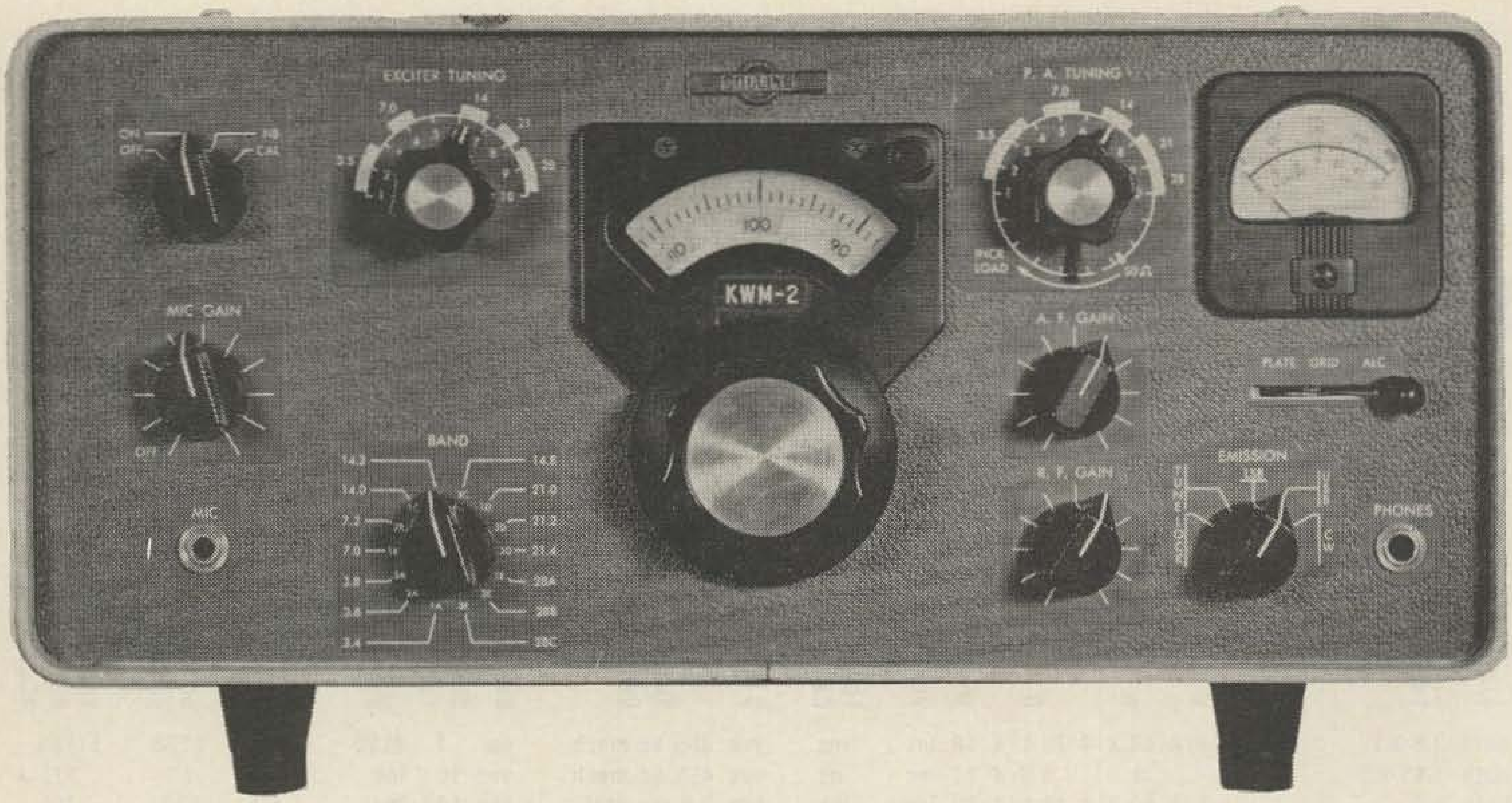
As an old-time mobileer I have been waiting for these transceivers just as much as you have. I used to enjoy keeping in touch with the gang around New York on 20 meters back when the sun spots were in their last low. As DX improved I found mobiling more and more frustrating with AM and I decided to wait until low cost sideband was here. Now it's here and I'll be mounting one of the rigs in my little Porsche and you'll be hearing me putting around up here in the wilds of New Hampshire Porsche-Mobile.

There really is nothing like having a rig in the car to make trips more enjoyable. Even with a car that is as much fun to drive as mine I find myself shying away from avoidable one to two hour trips unless I am able to use the time to make a few contacts, in which case the trip is over before I know what's happened.

In this day of multi-band transceivers it might be a good idea to put a little sign up in the back window of the car telling what band you are on so the ham that passes you or is behind you can give you a call. It is a lot of fun to drive along talking to another fellow that you've just happened to meet. I drove all the way from New York up to Northampton, Mass. one time talking away happily with a chap I chanced to be following. We stayed about a mile apart to keep from blocking each other.

Your mobile rig is a key to any town you visit too. I have frequently been able to work up spur of the moment midget hamfests by breaking in on a local group as I drove into town. Mobile operation is one of the facets of our wonderful hobby that gives rich rewards, so get yourself rigged up and gas up.

. . . W2NSD/1


EXCITER TUNING
P. A. TUNING
KWM-2
MIC GAIN
MIC
BAND
A. F. GAIN
R. F. GAIN
EMISSION
PHONES
PLATE GRID ALC

The MULTI-ELMAC Model ATR-4 Transceiver provides complete coverage of the 80M through 10M Amateur bands. Upper and lower sideband operation with excellent carrier and sideband suppression marks the basic design, but AM (USB with carrier) and CW with adjustable sidetone completes the requirements of the most versatile amateur. The features, to mention a few, include VOX, manual keying, break-in CW, 100kc calibrator, and adjustable VFO dial drag. A unique PTO with a tuning ratio of 20kc/turn is nearly linear and is mechanically superior in design. An overload indicator that measures final amplifier grid current provides a positive visual indication of flat-topping and simplifies adjustment of the mic gain for optimum clean output. The indicator aids the tune-up procedure and shows the 100% modulation level for AM operation.

The sideband generator has good long term carrier suppression requiring no field adjustment. Sideband rejection and additional carrier suppression is obtained with a 5.420mc crystal filter containing six crystals. The audio characteristics are shaped to provide a high intelligence power level and a crisp sound on-the-air. The final amplifier contains a pair of 6146's in parallel operating into PI network with adjustable antenna loading.

The receiver utilizes a product detector and optimum AVC characteristics for SSB operation. Receiver shift control provides a plus and minus 1 kc tuning of the received frequency independent of the transmit frequency.

ATR-4

Elmac

21470 Coolidge Hwy.

Oak Park 37, Mich

$750±

FPM-200

Hallicrafters

Chicago 24, Illinois

$1995

The Hallicrafters Model FPM-200 Transmitter-Receiver/Transceiver is a complete, compact, self-contained radio station of advanced design. The versatility of the Model FPM-200 permits it to be operated as a fixed, portable, or mobile equipment. The unit is of the hybrid type using a combination of 41 transistors, three vacuum tubes, and two gas tubes. The power supply, the receiver circuits, and the low-level transmitter stages are completely transistorized. The high power stages of the transmitter use three vacuum tubes to develop the required power for transmitting and two gas tubes to regulate the screen voltage for the final amplifier stage. The Model FPM-200 equipment provides for amplitude modulated (AM), continuous wave (CW), and single-sideband (SSB) transmission and reception on the 80, 40, 20, 15, and 10 meter bands. An additional range is provided in the receiver for the reception of station WWV on 10 MC. Each tuning range is 500 KC, readable directly in kilocycles.

Two tunable oscillators (VFO's) are provided with selection to permit the equipment to operate as an independent transmitter and receiver on different frequencies within a given band, or to operate as a transceiver on one frequency—both functions being controlled by one oscillator.

A built-in, 100-KC crystal oscillator permits a front-panel adjustment for calibration of the VFO kilocycle dials.

SR-150

Hallicrafters

Chicago 24, Illinois

(See cover two)

The Hallicrafters Model SR-150 Transceiver is a precision-built, compact, high-performance radio equipment of advanced design. This transceiver utilizes 19 tubes and a dual conversion IF to provide for the transmission and reception of single-sideband (SSB) and continuous wave (CW) signals on the 80, 40, 20, 15, and 10 meter bands.

The versatility of SR-150 equipment permits it to be operated as a fixed station or as a mobile equipment. A 117-volt, 50/60-cycle, AC power supply, complete with speaker (Model PS-150-120), is available for fixed-station use; a 12-volt DC power supply, Model PS-150-12, and a mobile mounting rack (Model MR-150) are available when the transceiver is to be used in a mobile configuration.

An advanced feature of the SR-150 equipment is the Receiver Incremental Tuning (RIT) control. This control enables the operator to unlock the receiver frequency and tune the receiver approximately two KC either side of the transmitter frequency. Flipping the RIT switch OFF automatically returns the equipment to the transceiver condition.

$650

HW-12

Heath Company

Benton Harbor, Mich.

$120 ±

Here in a single, neatly styled unit are provided complete transmitting and receiving facilities suitable for either "mobile" or "fixed" station operation. The only other accessories required for immediate "on-the-air" operation are the Heathkit HP-13 DC or HP-23 AC power supply, a PTT microphone such as the Heathkit GH-12 ($6.95) and an antenna.

Features include a deluxe fourteen tube heterodyne circuit, 200-watts peak envelope power input to the final amplifier, a highly stable low frequency VFO, crystal-lattice filter for SSB generation, automatic level control for greater talk power, built-in PTT and VOX circuits and provision for operation with a linear amplifier. Provision is also made for a plug-in 100 kc crystal calibrator for accurate band-edge marking at 100 kc points, Kit HRA-10-1, $8.95.

Assembly of the HW-12 is easy with over 90% of the components mounted on a heavy-duty circuit board. A pre-cut, cabled wiring harness and easy-to-follow instructions further simplify assembly. The rugged one-piece steel chassis is welded and braced for rigidity and stability. Gimbal mounting bracket included. Average construction time is 15 hours.

NCX-3

National Radio Company

Melrose, Mass.

(See cover four)

$369

National's NCX-3 transceiver is a rugged, handsomely styled unit designed for high performance fixed station use as well as for portable or mobile operation. In order to meet this requirement of dual application, the NCX-3 covers both phone *and* CW portions of the 80, 40, and 20 meter amateur bands (one of the few transceivers which do so), and incorporates *built-in* VOX and break-in grid block keying. VOX sensitivity, delay, and anti-VOX are adjustable, as well as CW break-in release time. The NCX-3 has an automatically switched S-meter/PA cathode current meter, and is the only SSB transceiver on the market with separate AM detection for full AM compatibility. The variable Pi-network final amplifier uses two 6GJ5 pentodes for a *conservative* 200 watt PEP input with only 700 volts B+, and the 40 watts of plate dissipation available is almost twice as high as in some other transceivers with similar PEP ratings.

Operation is on lower sideband on 80 and 40 meters, upper sideband on 20—a different carrier oscillator crystal may be installed should operation on the infrequently used "opposite" sidebanks be contemplated. Fast attack, slow decay, RF-derived AGC is provided for "thumpless" gain control on SSB and CW, which together with product detection and a 45:1 splitgear/planetary drive allow effortless tuning of signals. SPDT relay terminals are incorporated for control of an external linear amplifier, and a gimballed, positive-lock mobile mount is provided with the NCX-3 at no extra charge. The NCX-3 uses 18 tubes and six diodes, and measures only 6 1/16" H x 13⅝" W x 11⅝" D. Matching NAXA AC supply/-speaker console for fixed station operation and NCXD DC supply for mobile provide all necessary operating voltages. The NCX-3 and its accessory power supplies are being delivered now, and are warranted by National's one-year guarantee.

SB-33

Sideband Engineers Inc

Rancho Santa Fe
California

(See page 29)

$389.50

The SB-33 Single Sideband Transceiver, produced by Sideband Engineers Inc., Rancho Santa Fe, California, provides selectable single sideband operation on the 75–, 40–, 20–, and 15–meter amateur phone bands. A 2.1 kc Collins mechanical filter used in both transmit and receive, gives exceptional selectivity. All circuitry is solid-state, with the exception of the high level stages (driver and power amplifier). Bilateral stages which operate in one direction on receive, and in the other direction on transmit, eliminate duplication of circuitry, and permit selection of upper or lower sideband without carrier shift. An a-c power supply and speaker are included in the basic package, resulting in a complete fixed station installation in less than one-half cubic foot. Mobile operation is possible through use of an inexpensive d-c to a-c inverter which is furnished as an accessory. A VOX-audio compression unit is also available as an accessory.

SPECIFICATIONS

Frequencies—3.8 to 4.0 mc, 7.15 to 7.35 mc, 14.2 to 14.4 mc, 21.25 to 21.45 mc.
Receiver Sensitivity—Better than 1 uv for 10 db signal to noise ratio
Tube and Semiconductor—3 tubes, 20 transistors, 14 diodes
Complement Power Consumption—Receive 35 watts, Transmit 165 watts
Dimensions—5½ in. high, 11¾ in. wide, 10¼ in. deep
Weight—15 pounds, approximately

SW-240

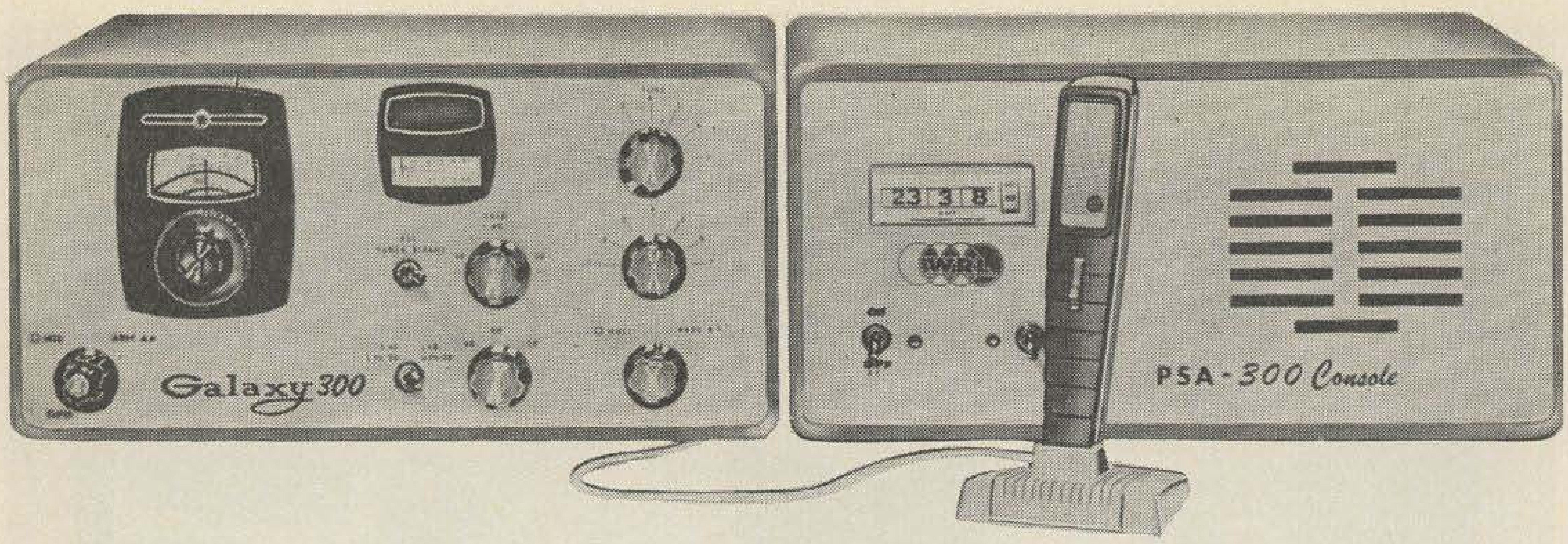
Swan Engineering Company

Oceanside, Calif.

(See page 6)

The SW-240 three band SSB Transceiver retains the same basic design, quality and craftsmanship which made the single band Transceivers such an unqualified success. Without the overwhelming acceptance of these Transceivers by radio amateurs throughout the world, the dramatic growth of Swan Engineering would not have been possible. It is our sincere intention to continue providing the radio amateur and the communications field with equipment of the highest quality and performance at reasonable cost.

$320



Galaxy 300

World Radio Labs

Council Bluffs, Iowa

(See cover three)

$300

As active hams, we here at World Radio feel that the major advantages of the Galaxy 300 over other available rigs are:

1) The conservative 300 watt power level, PEP . . . by using a pair of the new G.E. Compactron 6HF5's, a tube similar to the 6DQ5, but with increased plate and screen dissipation, smaller and with better high frequency performance.

2) You have a choice of sidebands with no carrier shift since the VFO is shifted an amount equal to the difference in crystal frequencies. This means you don't have to retune when you shift sidebands.

3) Automatic Load Control keeps the average talk power up.

4) Outstanding receiver performance. This is a combination of the super-smooth dial, a combination of planetary and spring loaded anti-backlash gearing gives a two-speed dial with a choice of 72:1 or 12:1 for slow and fast tuning. There is no dial cord to slip or wear and no detectable backlash. Adjustable hairline for minor calibration shifts. The 9.1 mc crystal filter results in 2.7 kc selectivity at the 6 db points and 6.5 kc at 50 db! S-meter is calibrated in S units and db over S-9. Audio derived AVC is remarkably smooth. 2½ watts of audio output, plenty even for the noisiest cars.

5) Stability. The VFO is completely boxed in 16 gauge steel.

6) There are dozens more features to the Galaxy 300, but the best one of all is the price which is possible only because we sell "Direct to the Ham," thus passing along the middleman savings.

MONEY SAVING! SPACE SAVING! QSO SAVING!

Just $279.00
Amateur Net

Features the sensational Eimac 3-400Z high-mu Triode. No Grid or Screen Bias Needed. Low Distortion!

THE DESK TOP

Loudenboomer

MARK II RF LINEAR AMPLIFIER
by RADIO INDUSTRIES, Inc.

There's something about the MARK II Linear Amplifier that reminds you of the good old days!

Perhaps it is the husky, conservatively rated components—that loaf along without strain. It may be the straightforward layout that makes all components easy to reach. Or, it could be that Total Look of sturdy reliability. Or—the low, low price!

Rest assured, though . . . with all its old fashioned appeal, the MARK II is as modern and advanced as tomorrow! The smart two-tone gray enamel cabinet measures just 14⅛" x 12⅞" x 7⅛". . . fits nicely on your operating desk. And the crisp performance of your MARK II will give you consistent QSO successes on even the most crowded bands.

Visit your Dealer soon and examine the great new LOUDENBOOMER MARK II LINEAR AMPLIFIER.

HERE ARE A FEW OF THE MANY MODERN FEATURES:

1. Zero-bias Eimac 3-400Z requires no screen and grid power supplies. 400 watts of plate dissipation.
2. Full legal input power on CW and SSB, 600 watts AM —80 through 10 meters.
3. 45 watts of drive for full input.
4. Grounded grid circuit for improved linearity. No neutralization.
5. Fully metered for grid current, plate current, plate voltage *and* relative power output.
6. 50 ohms input through wide band Ferramic transformer.
7. Adjustable Pi tank output; nominally designed for 50 ohms unbalanced load.
8. Requires just one power supply—2500 to 3000 VDC at 350 MA.*
9. Circuitry supplied for controlling power supply from MARK II panel.
10. 50 C. F. M. blower and self-contained filament transformer requires 115 VAC, 60 cycles. Both front-panel fused.

*NOW AVAILABLE: Matching Power Supply for the MARK II Linear Amplifier. Supplies 3000 VDC at 350 MA Continuous. Transformer Primary for both 115 VAC and 230 VAC. Size, 12" x 14" x 8½". Weight 75 lbs. AMATEUR NET, $159.59.

Write for illustrated Data Sheets.

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RADIO INDUSTRIES INC

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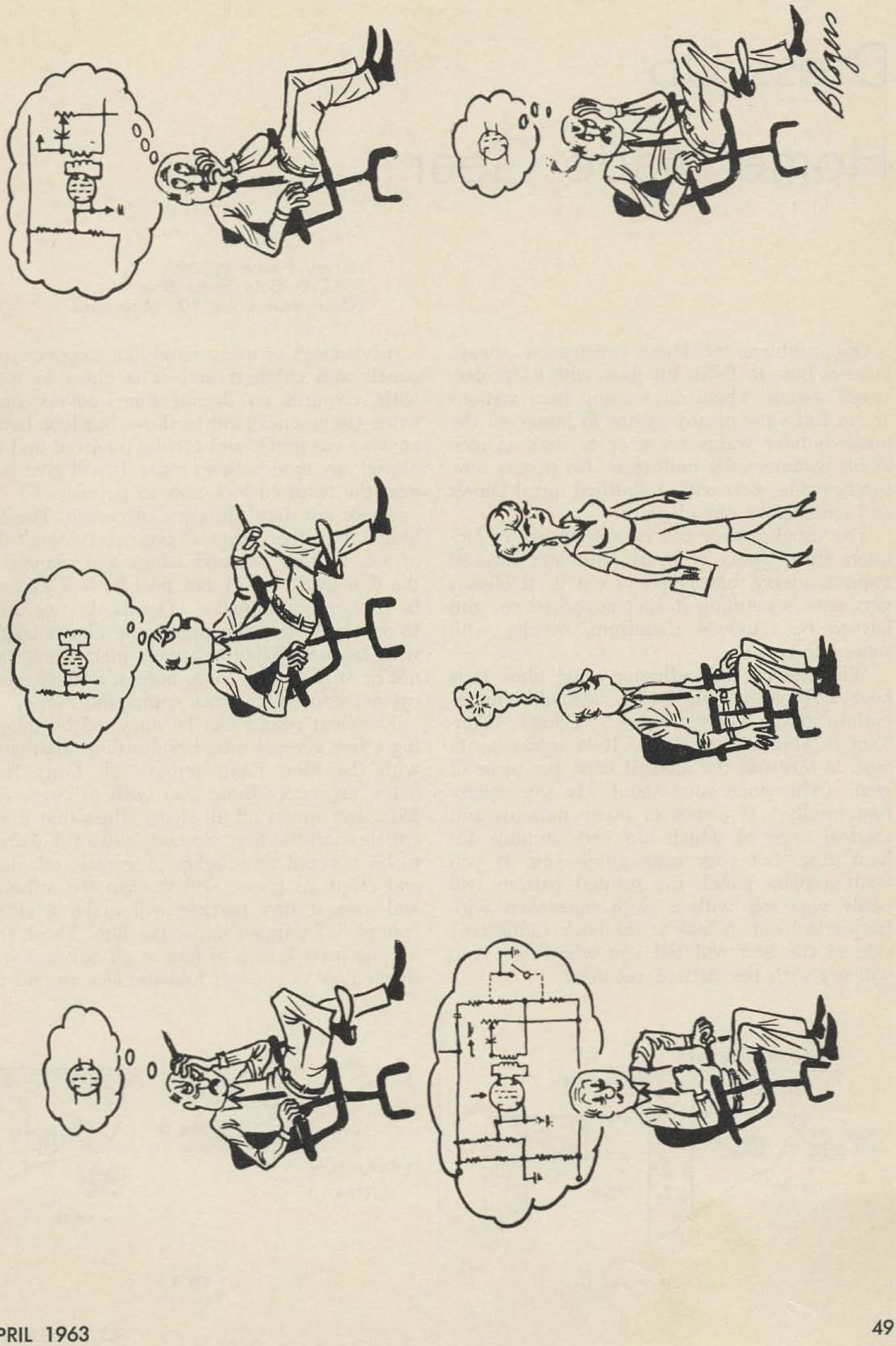
DXDC COUNTRY LIST

Here is the official U.N. Country List which is being used as the basis for credit for membership in the very exclusive DX Decade Club (see page 2, Feb. 63 issue of 73).

YA Afghanistan
ZA Albania
FA Algeria
LU Argentina
VK Australia
OE Austria
ON Belgium
CP Bolivia
PY Brazil
LZ Bulgaria
XZ Burma
9U5 Burundi
UC2 Byelorussia
XU Cambodia
FE8 Cameroun
VE Canada
TL8 Central African Rep.
4S7 Ceylon
TT8 Chad
CE Chile
BV China
HK Colombia
TN8 Congo (Brazzaville)
9Q5 Congo (Leopoldville)
TI Costa Rica
CO Cuba
5B4 Cyprus
OK Czechoslovakia
TY2 Dahomey
OZ Denmark
HI Dominican Rep.
HC Ecuador
YS El Salvador
ET3 Ethiopia
9M2 Fed. of Malaya
OH Finland
F France
TR8 Gabon
9G1 Ghana
SV Greece
TG Guatemala
7G1 Guinea
HH Haiti
HR Honduras
HA Hungary
TF Iceland
VU India
PK Indonesia
EP Iran
YI Iraq
EI Ireland
4X4 Israel
I Italy
TU2 Ivory Coast
VP5 Jamaica
J Japan
JY Jordan
XW8 Laos
OD5 Lebanon
EL Liberia
5A Libya
LX Luxembourg
5R8 Madagascar
TZ Mali
5T5 Mauritania
XE Mexico
JT1 Mongolia
CN Morocco
9N1 Nepal
PA Netherlands
ZL New Zealand
YN Nicaragua
5U7 Niger
5N2 Nigeria
LA Norway
AP Pakistan
HP Panama
ZP Paraguay
OA Peru
DU Philippines
SP Poland
CT1 Portugal
YO Romania
9U5 Rwanda
HZ Saudi Arabia
6W8 Senegal
9L1 Serra Leone
6O Somalia
ZS South Africa
EA Spain
ST Sudan
SM Sweden
YK Syria
5H3 Tanganyika
HS Thailand
5V4 Togo
VP4 Trinidad & Tobago
3V8 Tunisia
TA Turkey
5X5 Uganda
UB5 Ukraine
U USSR
SU United Arab Rep.
G United Kingdom
KW United States
XT2 Upper Volta
CX Uruguay
YV Venezuela
4W1 Yemen
YU Yugoslavia



Dress Up Home Made Gear

Harvey Pierce W0OPA
5372 E. Bald Eagle Blvd.
White Bear Lake 10, Minnesota

One problem the home constructor always faces is how to finish his gear with a "professional" touch. These days many ham stations are in full view of any visitor to home, so the home builder wants his gear to look as nice as his commercially built gear. No matter how neatly made, gear with unfinished metal panels and cases looks out of place.

The usual answer is a can of enamel or lacquer, either spray or brush. But let's face it! Paint is messy, however you use it. It *always* gets onto something it isn't supposed to, and has to be removed therefrom, usually with some effort.

Why not use self-adhesive vinyl film? It is neat and clean, and widely available under various trade names, such as "Cling," "Con-Tact," "Magic-Cover," etc. It is moderate in cost, in terms of the amount used per piece of gear. (The price runs about 11c per square foot locally.) It comes in many patterns and shades, some of which are very suitable for ham gear. Let your taste guide you. If you want a plain panel, the printed pattern will easily wipe off with a cloth moistened with lacquer solvent. A look at the back (adhesive) side of the film will tell you what color you will get with the pattern removed.

Advantages of using vinyl film to cover your panels and cabinets are,—it is clean to work with, requires no drying time, covers small holes (large ones tend to show, but look better anyway covered), and can be removed and renewed any time without muss. It will give your gear the textured look now so popular.

There are disadvantages, of course. The adhesive is of the "contact" type and doesn't dry or set, so that exposed edges and corners of the film tend to curl and peel back if exposed to rubbing or abrasion. Decals do not seem to adhere to the film unless the film is coated with lacquer. Being relatively inelastic, it cannot be stretched to cover bulges, formed round cabinet corners or other compound curves.

Excellent results can be obtained by following a few general rules besides those that come with the film. First, remove all burrs from holes, especially those you wish to cover and hide, and round off all sharp edges that might cut through the film. Second, clean the surface to be covered thoroughly of grease, oil, dust, and chips, as grease will weaken the adhesive and even a tiny particle will make a visible "pimple" if trapped under the film. Third, fold over at least ¾ inch of film at all edges. Fig. 1 shows how to cut and fold the film around the

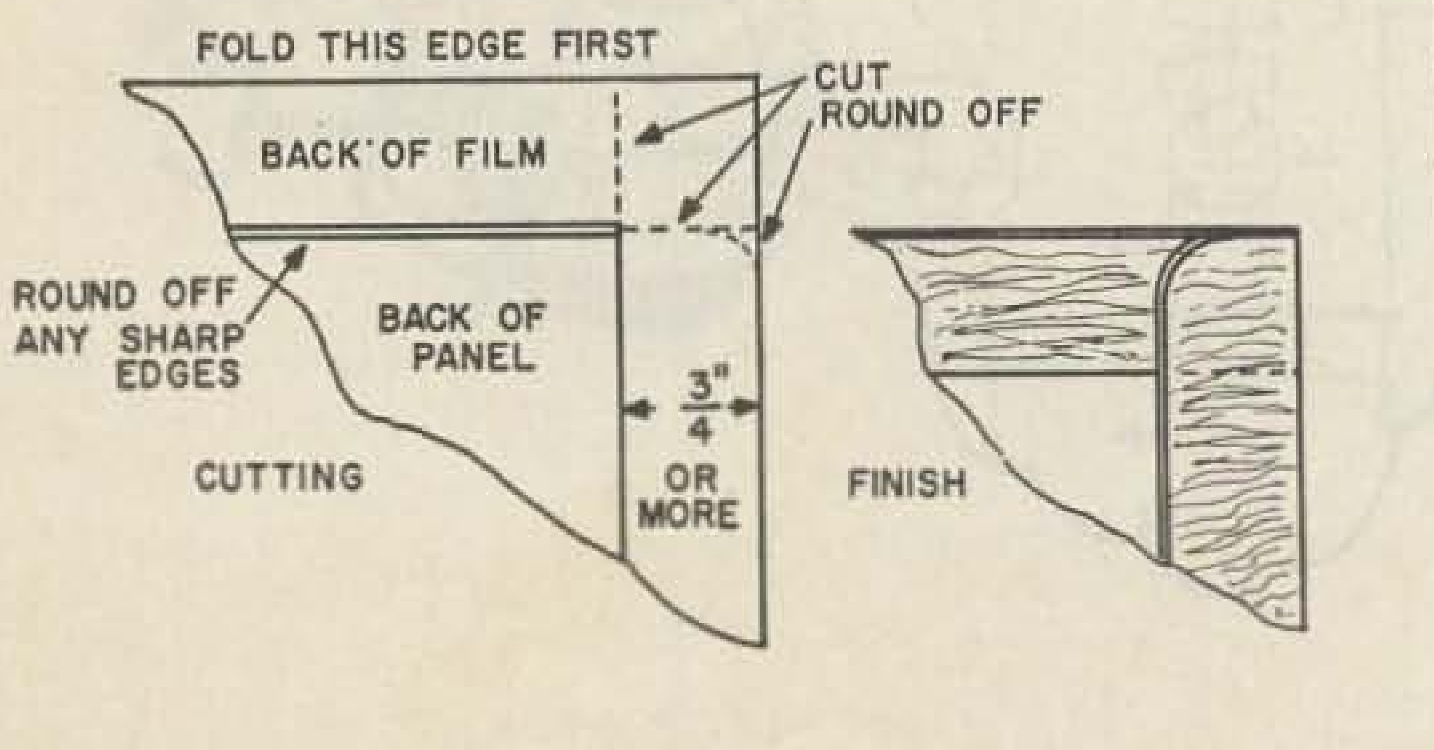


FIG. 1

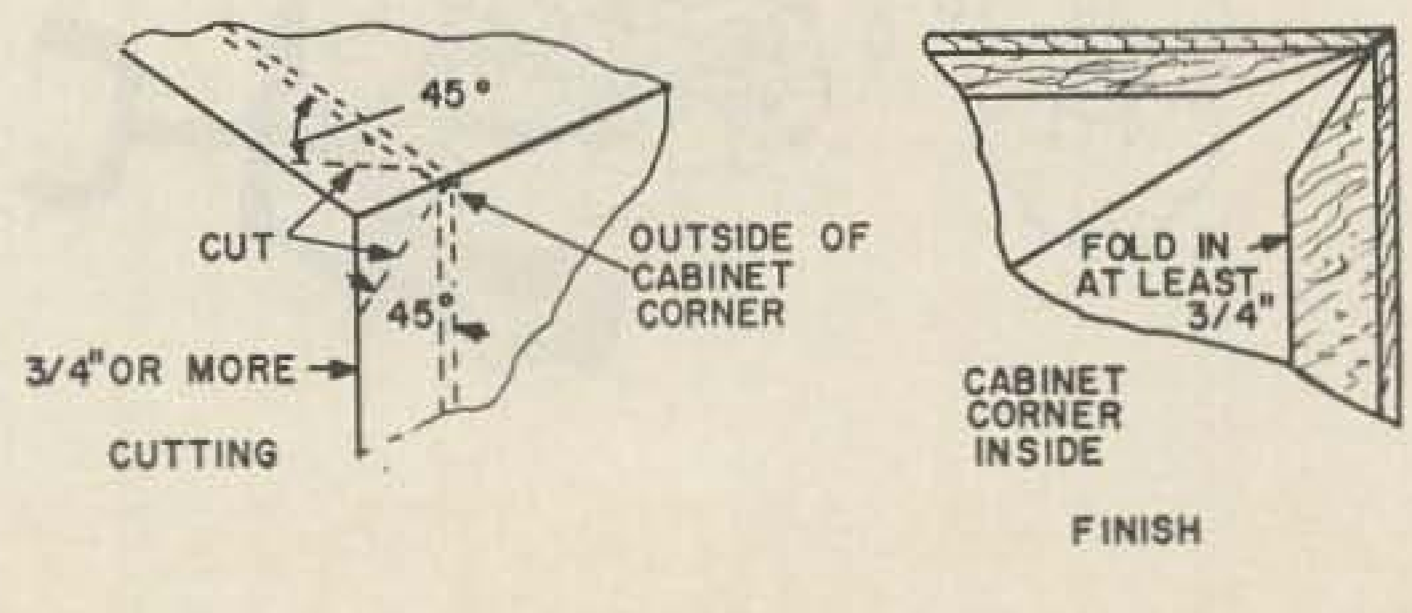


FIG. 2

edges and corners of a panel or other flat sheet. Note that the corner folded on top is rounded to prevent curling. Fig. 2 suggests how to treat an open cabinet corner. Fourth, keep your fingers clear, as any dirt or grease on your fingers will weaken or even "kill" the adhesive where you touch it. Fifth, on all but small pieces remove the paper backing from the film as you smooth it on. It is easier to avoid air bubbles and wrinkles this way, and the adhesive has less chance to pick up dust and dirt.

While holes can be drilled after the film has been applied, it is better to have the holes all drilled before covering. Small holes can be opened thru the film with a sharp awl or icepick or larger ones cut thru with the point of a sharp knife. Be sure to use smooth washers under all screw heads and nuts, to avoid drawing and wrinkling the film while tightening them. Ventilating holes should be finished with eyelets as it is impossible to put a small clean-looking hole thru both film and backing.

In removing the pattern to obtain a plain film, be very careful with the lacquer thinner. Do not apply it to the film directly, but moisten a small pad of cloth and rub on a small area at a time and allow to dry immediately. Do not let the solvent get to the adhesive backing, as through a hole or slit, and do not permit the film to stay wet with the solvent. Be sure you have adequate ventilation, and DON'T SMOKE!

Because this vinyl film is as easy to remove as it is to apply, you can experiment to your heart's content with two-tone combinations, different patterns, and so on. Don't overlook the possibilities of various decorative tapes, foils, and adhesive letters. Maybe you can't quite equal the spraybooths and silk screens of the manufacturers, but you can certainly improve the looks of that bare metal panel and box, and without muss, too. . . . W0OPA

Find the Common Ground

Dick Baldwin K4ZQR
409 Kaelin Dr.
Louisville 7, Ky.

It was in March of 1960, and the sun spots had not slid down the slope of cycle 19 quite so far as they have now. I had tuned the Valiant up around 21300 kc and called CQ DX with the beam toward Europe. I announced that I was listening, first on my frequency, and then in the foreign part of the band. Nothing unusual about this—a routine DX call on a Saturday afternoon. Little did I realize it would or could culminate in a friendship that has grown over the months and has done its bit, I hope, toward contributing to international good will.

To get on with the story, I got an answer on my frequency, and of course, it was a constant battle with the stateside QRM to make out even the call and the handle. It turned out to be I1BAK whose handle was Giuliano in Rimini, Italy; and for a few minutes we had the frequency clear—long enough for Giuliano to find out I was using a quad antenna and to tell me that he was using one also, and would appreciate some help on its dimensions and tuning. Maybe it was the quad that established the common ground between us, or maybe it was the fact that here was a chance to do something besides exchange RST's and QSL's, but after we signed I made a copy of some of the Handbook text on quads, described and diagramed my own setup and enclosed it with my QSL.

Back came a letter of thanks and a request for the mailing of an Heathkit Grid Dip Meter, an instrument which he could not purchase in Italy. I said okay and he sent the money in advance through a New York bank. During the past year we have corresponded regularly, and every once in a while I'd mail him a bit of surplus—a relay—a tube—or some small part I didn't need and he in turn would send us a piece of handicraft—perhaps a box or a tray, since Italy is short on electronic gear but long on the arts.

Of course we made schedules, but only one other resulted in a contact and that was brief. Either the QRM moved in or the band shifted, never a solid contact after that first one.

Through the mail, however, and by means of some tapes we exchanged; we got well acquainted with each other and our families. Giuliano is an electrical engineer with the equivalent of a Ph.D. in engineering. He works for the Italian State Railways. Me, I'm at that stage in life when the children are married and you begin to wonder if you are ever going to get back to Europe to see what has happened since the War 20 years ago. We couldn't really afford it, but the XYL and I decided to go while we could still navigate without crutches and before any more shooting started. I was going to show her Paris, London, and all those far away places she had heard me tell about these many years.

With three weeks of vacation we decided the best bet was a canned tour. Even though it wouldn't retrace all of the route I'd taken with Patton's Third Army, I could still show her London, Paris, Luxembourg, and parts of France and Germany. Italy, too, was on the tour and while I had seen no part of it while in the service, we got an unexpected dividend in the form of an overnight stop in Rimini—the home QTH of my Italian friend. My wife was all smiles as she told me this as I came home from work the evening after the itinerary of the trip arrived.

This was in March of 1962 and our day in Rimini was not until August 19th, almost five months later; but I could hardly wait to send off an air mail to Giuliano and tell him we would have an eyeball QSO in August. He practically went into orbit and told us to arrive "destitute" (he meant hungry) as we would get a "stuffing."

Finally the big day came. I had written that we should arrive in Rimini about 4:00 pm in the afternoon. Actually we got in about 3:30 pm and after freshening up we came down to the lobby of our hotel at 3:55 pm to phone my friend. He and his wife were waiting there for us because we had a scheduled meeting at 4:00 pm!

What did we want to do? The town was ours. Well, first of all I said I'd like to see his shack and of course this pleased him just as it would please any other ham, here or abroad. Italians have a tough time acquiring equipment. Only one firm, Geloso, makes amateur equipment and while their stuff is excellent, it is limited in scope to VFO's and receivers, and it is not cheap. You can buy Heathkits over there but at fantastic prices. He had an AR88 for a receiver, and a transmitter constructed from a Geloso VFO and parallel 6146's that I'd sent him. We discussed mutual problems for a few minutes and then the XYL's broke it up by suggesting we go for a drive around Rimini.

We wound up in San Marino, which is a tiny republic surrounded by Italy on a mountain top. It's one souvenir shop after another, and while there I met M1D, the only ham in San Marino and Giuliano's first contact as a ham. He is no longer active or I would have made a schedule then and there as I could use another country toward that DXCC.

Back to Rimini for the "stuffing" which consisted of the Italian equivalent of a New England Shore Dinner. Rimini is on the Adriatic Sea, and the fish is excellent, especially when eaten in a romantic restaurant where the ceiling is a grape arbor and where you wash down each course with the juice of the grape.

Finally it was time to part, and we took our presents and said goodby as they dropped us off at the hotel. Of course we gave them presents too; some nylon things for his XYL, a doll and dresses for Monica, his daughter, and some radio parts for Giuliano. As for our gifts, we now have a beautiful miniature marble statue of Pauline Bonaparte (Napoleon's sister) on our mantle, a pair of beautiful gold frame 17th century style pictures on the wall, and one of the best bottles of after-dinner cordial I ever tasted safely stowed down the hatch. Plus, of course, the best gift of all—the fond memories of an evening spent in cementing international relations that neither the XYL nor I will ever forget.

The XYL, normally no more enthusiastic about ham doings than any average XYL, remarked afterward that she wished we had other spots on our tour where we could visit hams I'd contacted. Hmm—maybe I should have written that French ham I sent a copy of "My Old Kentucky Home" to on request.

DX contacts are brief and often difficult, but find the common ground if you can; whether it be your gear, families, work, hobbies, or what have you. Find it—and you find a friend, not just a contact. . . . K4ZQR

Controlled Carrier Screen Modulation

Terrence Banks K3LNZ
426 Orange St., S.E.
Washington 20, D. C.

One of the problems confronting either the home constructor or the kit or commercial equipment buyer is the recent popularity of the controlled-carrier method of screen-grid modulation. Judging from the on-the-air discussions I have heard about this system, some of the basic facts are being ignored by those interested, either pro or con, and the advertising claims of several manufacturers serve only to add more confusion to the issue. It is the intention of this article to present the basic facts in such a way that they can be considered minus the prejudices and misconceptions usually brought up.

First, let's set our ground rules so we will know what we are talking about and, equally important, what we are not talking about. By screen modulation we mean only the controlled carrier variety. Without this feature, screen modulation requires much larger tubes than would normally be used for the same power level, and is best left for those with large tubes and small power supplies. By plate modulation we mean the standard transformer-coupled modulation of the plate (plus screen grid in tetrodes and pentodes) of a Class C final amplifier. Linear amplifiers, sideband, etc., are not under discussion. Neither is audio quality which Heath and several other companies have proved can be excellent with screen modulation.

Let us use the popular type 6146 tube as a guinea pig. We will supply adequate grid drive and run 600 volts on the plate. First we will take a typical set of screen-modulated conditions, and then will compare the corresponding maximum ratings with plate modulation. We will then discuss the relative output obtainable, the ease and economy of applying the two methods, and finally some operating considerations.

Power-wise, most manufacturers will rate their 6146 transmitters as "90 watts input on CW and 90 watts peak input on phone." Translated into English, this means that the maximum plate current readings obtained on voice peaks are equal (150 ma) to the key-down CW conditions. However, no meter yet produced will keep up with the variations in the human voice, so meter readings of 150 ma actually mean that the peaks are running in the neighborhood of 250 ma, or about 70% higher. This is about the highest they can run without the opposite peaks driving the screen so negative that cut-off of the tube (and therefore splatter) occurs. Presuming peaks of 250 ma and the opposite peaks of slightly above zero, we have an average input to the final of about 125 ma, which at 600 volts will give us 75 watts.

In a plate modulated final, the meter will read a steady 112 ma for the maximum rated phone input of 67½ watts, whether modulated or not. However, the secondary of the modulation transformer will have an audio (ac) voltage across it, and therefore in series with the dc plate supply voltage, exactly equal to our 600 volt plate voltage. This gives us a voltage varying from zero to 1200 volts. We assume the modulating impedance, which is the combined resistance of the final tube, tank coil and other circuit components, to remain the same (about 5500 ohms) so our plate current actually varies from zero to double the average meter reading. This gives us peaks of four times the unmodulated input, as the voltage and current both double at the same time. 67½ watts times 4 is 270 watts on peaks, which would make us think the average input is one-half of that, or 135 watts. Due to factors we won't discuss here, this is not the case and the average power input under these conditions is about 37% of the peaks rather than 50%. We could prove this mathematically, or by instruments, but it's simpler to add our dc input to the final, 67½ watts, and the audio power supplied by the modulator, or about 33 watts, which gives us an average input under modulation of just over 100 watts. Thus we see that our input, and therefore output, is about 33% higher (100 versus 75) when using plate modulation instead of screen modulation with the same tube.

Turning next to ease and economy of construction, we find that a 6SL7 speech amplifier and 6SN7 modulator will handle our 6146 quite easily. Other components required are small and few, so on a 2 x 4 minibox we can build, or purchase, a suitable screen modulator for about $12.00. If our transmitter cost us $50.00, we pay 82c per watt of input.

A plate modulator for the same rig will use 2 6L6 or larger tubes, plus speech amplifiers, a driver stage, interstage transformer, modulation transformer, and a power supply at least as large as the transmitter uses. On an 8 x 10 chassis we build, or buy, a modulator for about $40.00 and pay 90c per watt of input power.

However, if we add the other accessories necessary to put the transmitter on the air, such as microphone, crystals, antenna, etc., we find that as soon as our accessories reach a total of about $45.00, our cost per watt becomes equal for either type of modulation and then proceeds to favor plate modulation from this point on.

Finally, we come to operating factors. The difference between a 75 watt transmitter and a 100 watt transmitter is approximately one-third of a unit on the S-meter, so for good band conditions or local work, there is no appreciable difference. However, under weak signal conditions the steady carrier of the plate modulated transmitter pays off slightly better. This is because the controlled-carrier type of signal will drop off and allow bursts of noise to intrude between syllables, making copy difficult. There is also the minor, but nonetheless present, inconvenience of having to put the screen modulated transmitter in the CW mode for tune-up, whereas it is quite feasible to zero-beat an incoming signal with the VFO only and then dip the final of the plate modulated transmitter while calling.

In conclusion, the screen modulated transmitter is neither the monstrosity its opponents claim, nor the low-priced powerhouse its advocates would have us believe. It sounds well, is simple and economical, and gets almost, but not quite, as much signal out of a tube as plate modulation. For the amateur who does not have money to throw away it represents an excellent means of getting a phone signal on the air with little investment, and can then be put aside for emergencies, sold, or dismantled for parts when plate modulation is later installed as an improvement.

A Compact VFO Dial

Roy Pafenberg W4WKM

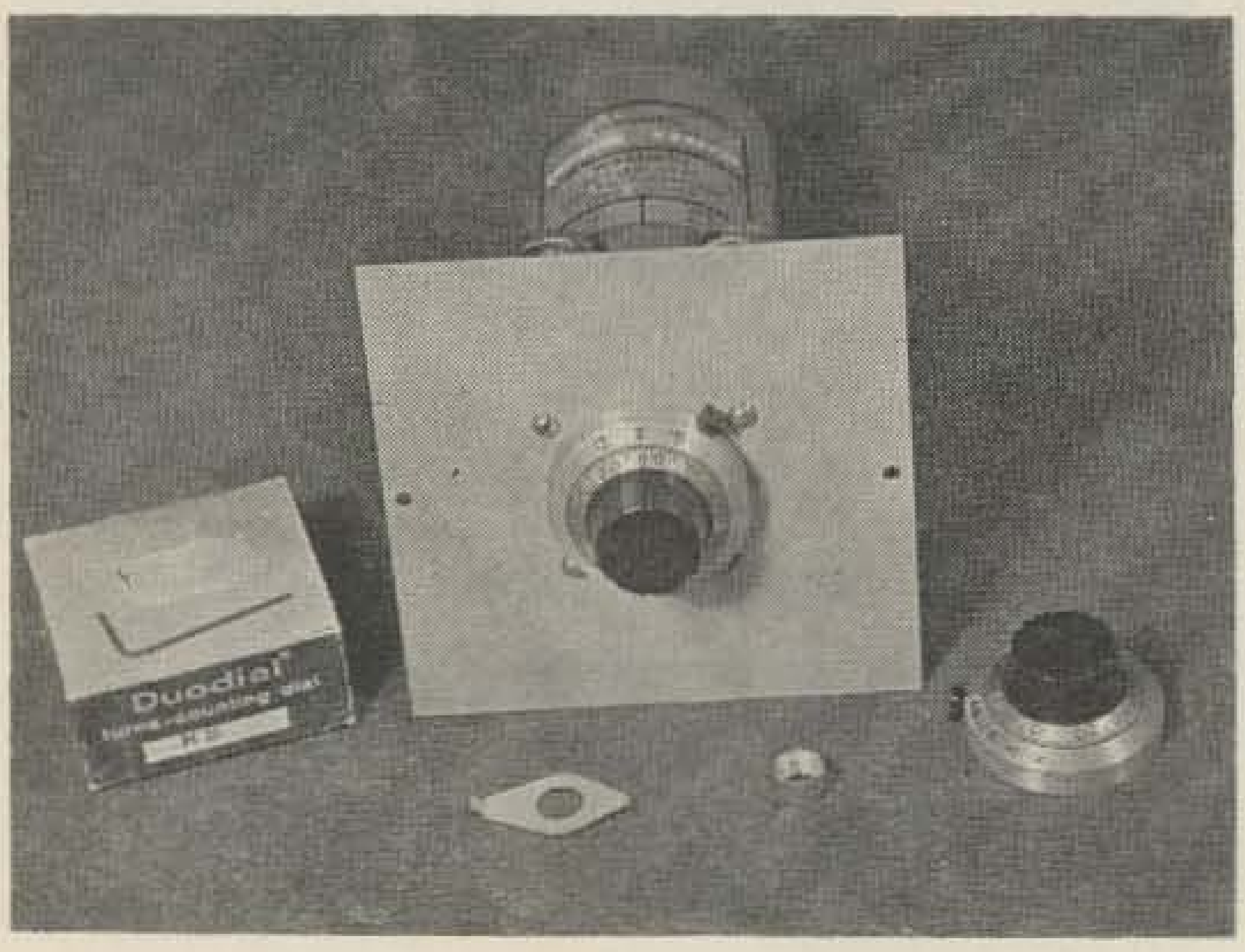
Many amateur applications require a reasonably compact, multi-turn dial with a high order of accuracy. Typical control problems include rotary inductors, variable vacuum capacitors and permeability tuned oscillators.

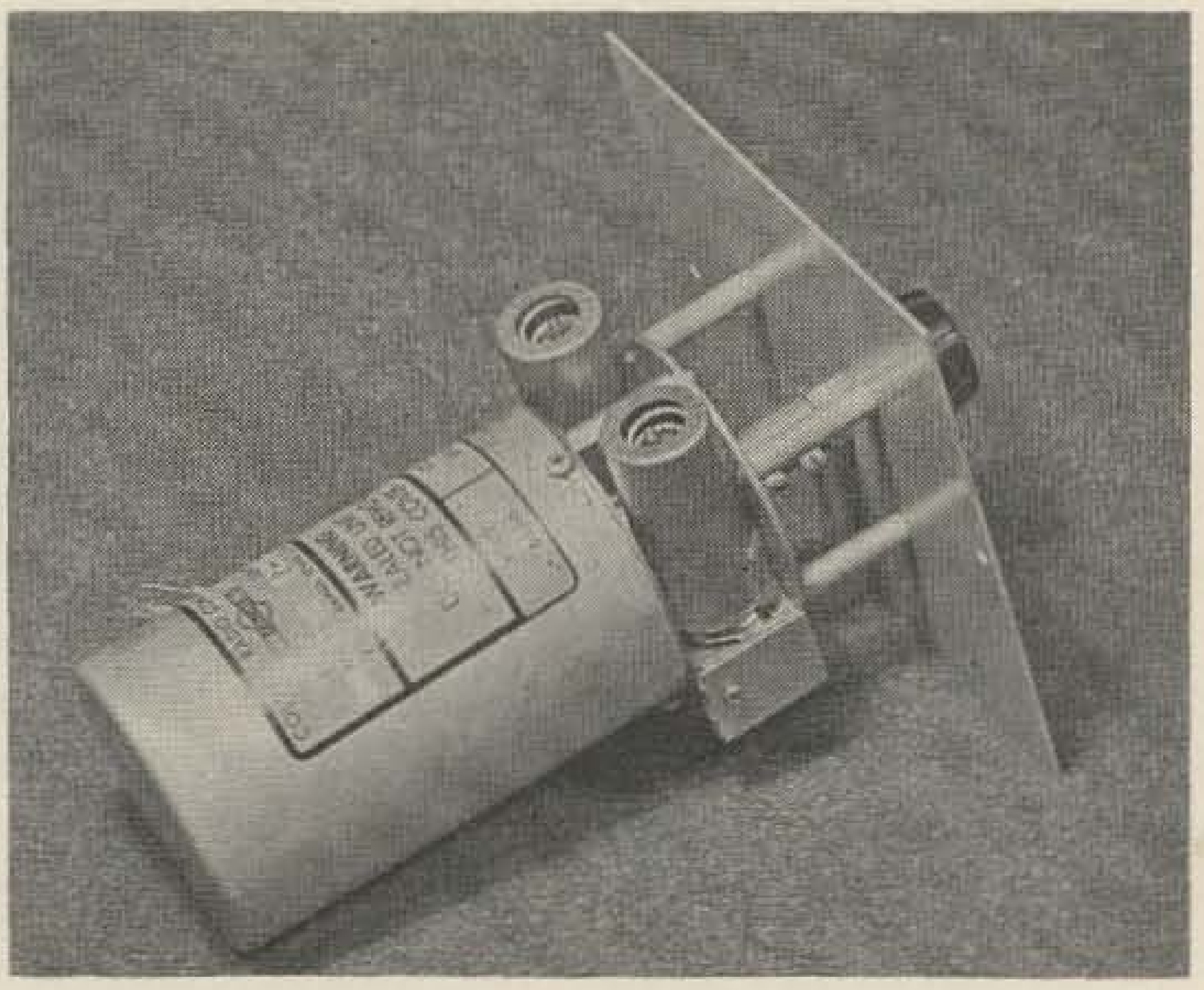
One answer exists in the wide variety of precision multi-turn potentiometer dials that are available. These dials are attractive, compact and provide excellent accuracy. Their use is particularly desirable in miniature portable and mobile equipment.

A typical installation is shown in the photographs. The Collins 70E-15 PTO unit is mounted on the panel using standoff posts. A ¼" extension shaft is installed in a panel bushing and a solid coupling used to secure the PTO shaft to the extension. A Beckman Helipot type RB turns counting dial is then installed. The dial consists of two parts as shown in the photograph. The dial retaining clip is secured to the panel with the special ⅜" bushing nut. The knob proper is positioned over the clip and held in place by the knob set screw.

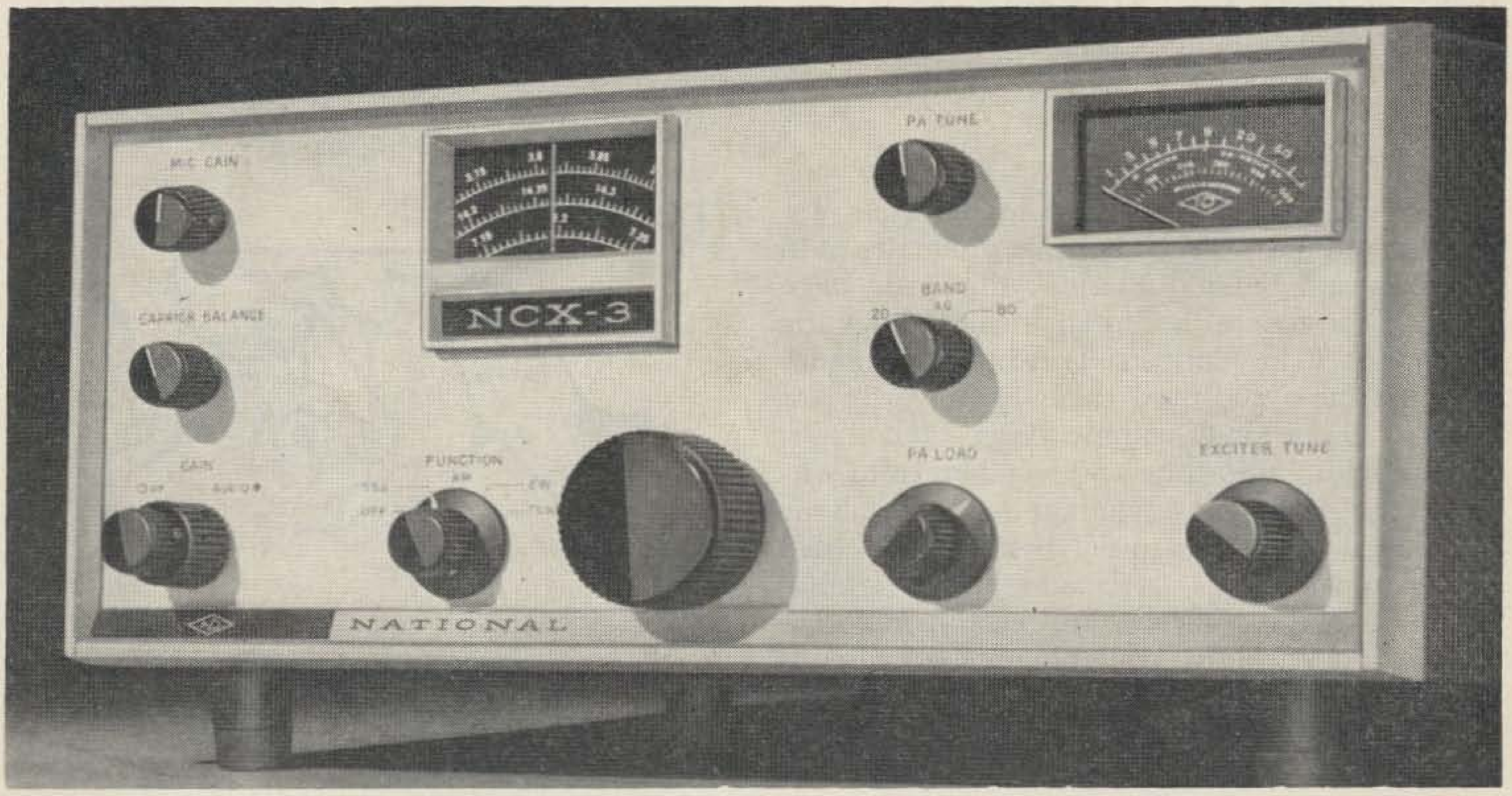
This dial, being direct driven, is free of backlash and provides direct reading calibration of the PTO over its 1 mc range. In the application shown, the PTO will be employed in a universal exciter with a basic range of 3 to 4 mc. A wide selection of these dials is available and almost any multi-turn control problem may be solved by their use.

. . . W4WKM





HANK HAS 'EM



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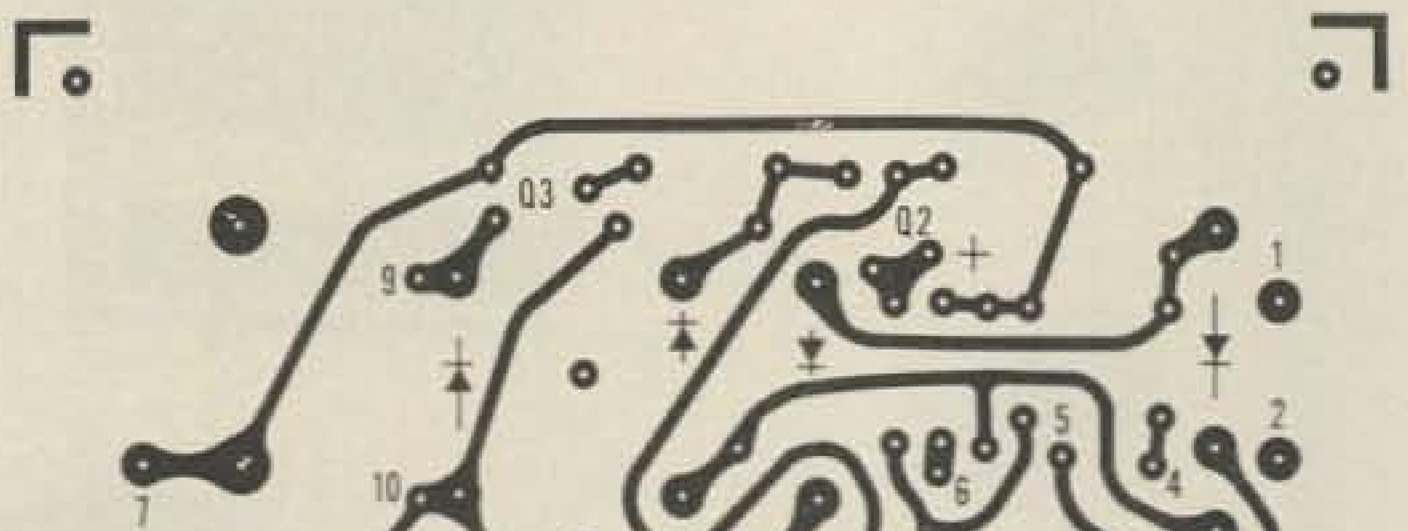
General Radio Co.
West Concord, Mass.

Etched-circuit boards first made their appearance about 1952. Many improvements in materials and techniques since that time have led to their general acceptance throughout the electronics field. Industrial electronics manufacturers have accepted them for a variety of reasons. On a small-volume basis, etched circuits provide uniformity and freedom from wiring errors. An added advantage in large volume is reduced cost. The initial cost of the board is low and it lends itself admirably to automated assembly. As the necessary materials became increasingly available, etched circuits began to appear in construction articles. Although ready-made boards are occasionally available for such projects, it is usually left to the reader to duplicate the board.

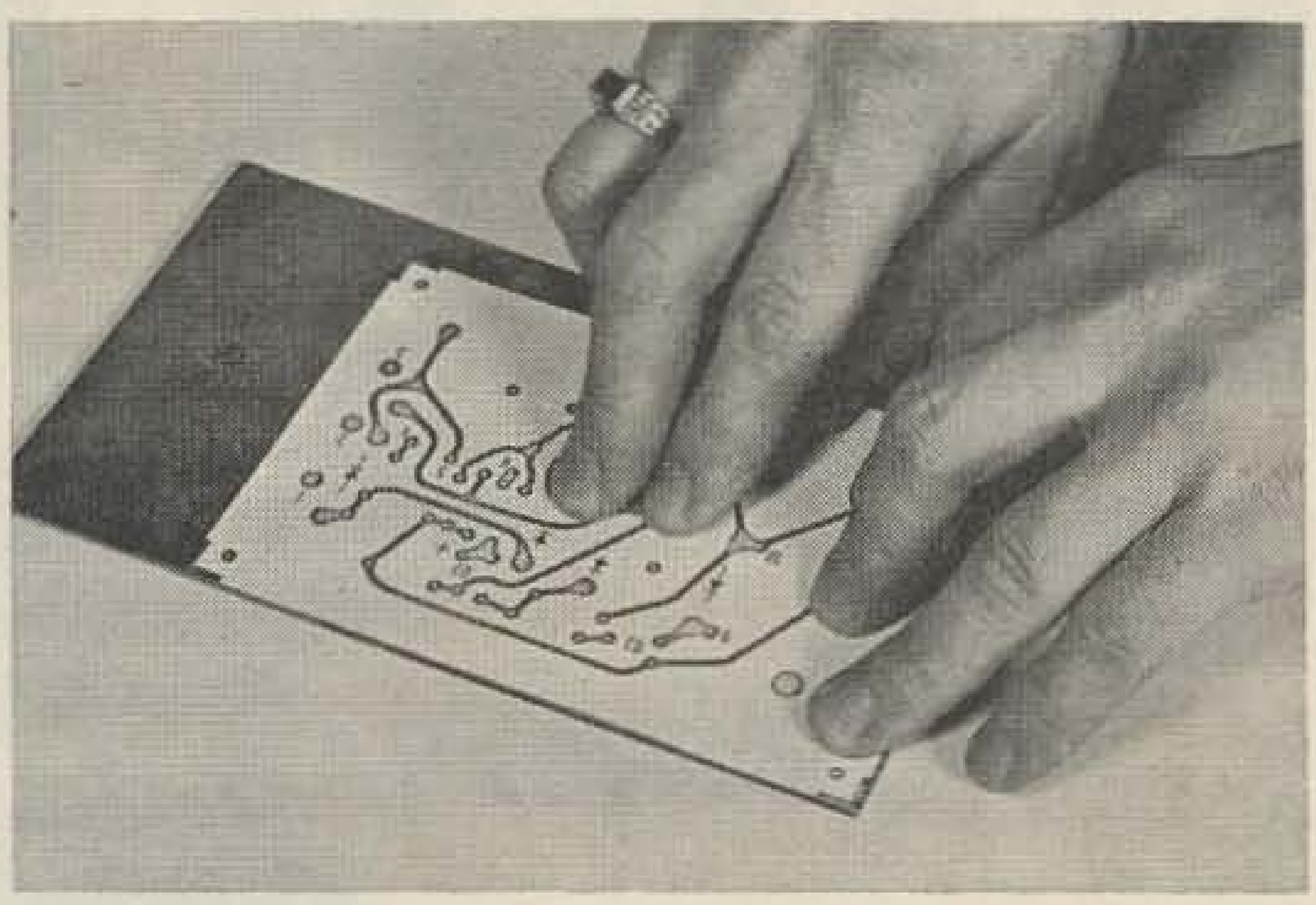
Before one starts to make an etched board, he should first determine if an etched board is really necessary. Two factors are involved. The first is circuit complexity; the second is the extent of the available facilities. A simple circuit may be assembled more rapidly by means of conventional construction techniques. Complicated boards or boards with high parts density should be avoided unless the equipment is available to reproduce them photographically. On moderately complex boards, a technique described in this article may be used. This method is simple, fast, requires only a few, long-lasting, special materials, and offers very good results.

The board should be made from a full-scale layout of a proven circuit. This may be taken from a construction article or it may be something of your own design. It is important, however, that the hole spacings be precisely those required on the finished board. The materials shown in Photo 2 are basic to laying out the board. The copper-clad laminate, the resist and the etchant are the only special materials required. Precut laminate is available in various combinations of size, thickness, and material. The etchant shown is a powder and comes with full instructions for mixing. The resist may be purchased in a collapsible metal



1—Typical etched-circuit board.

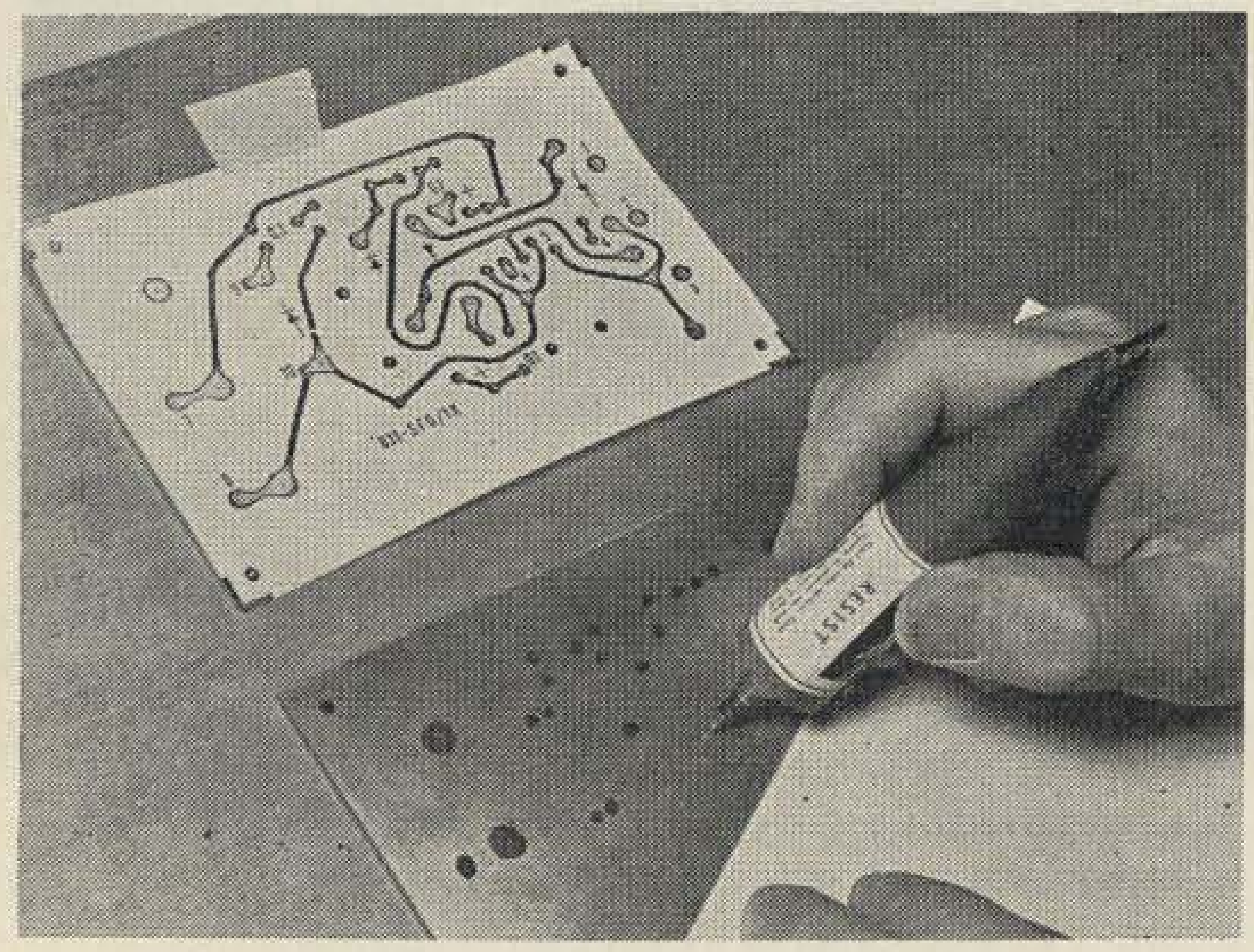
2—Basic materials required. The tubes contain rubber cement and liquid resist, the packet contains etchant.



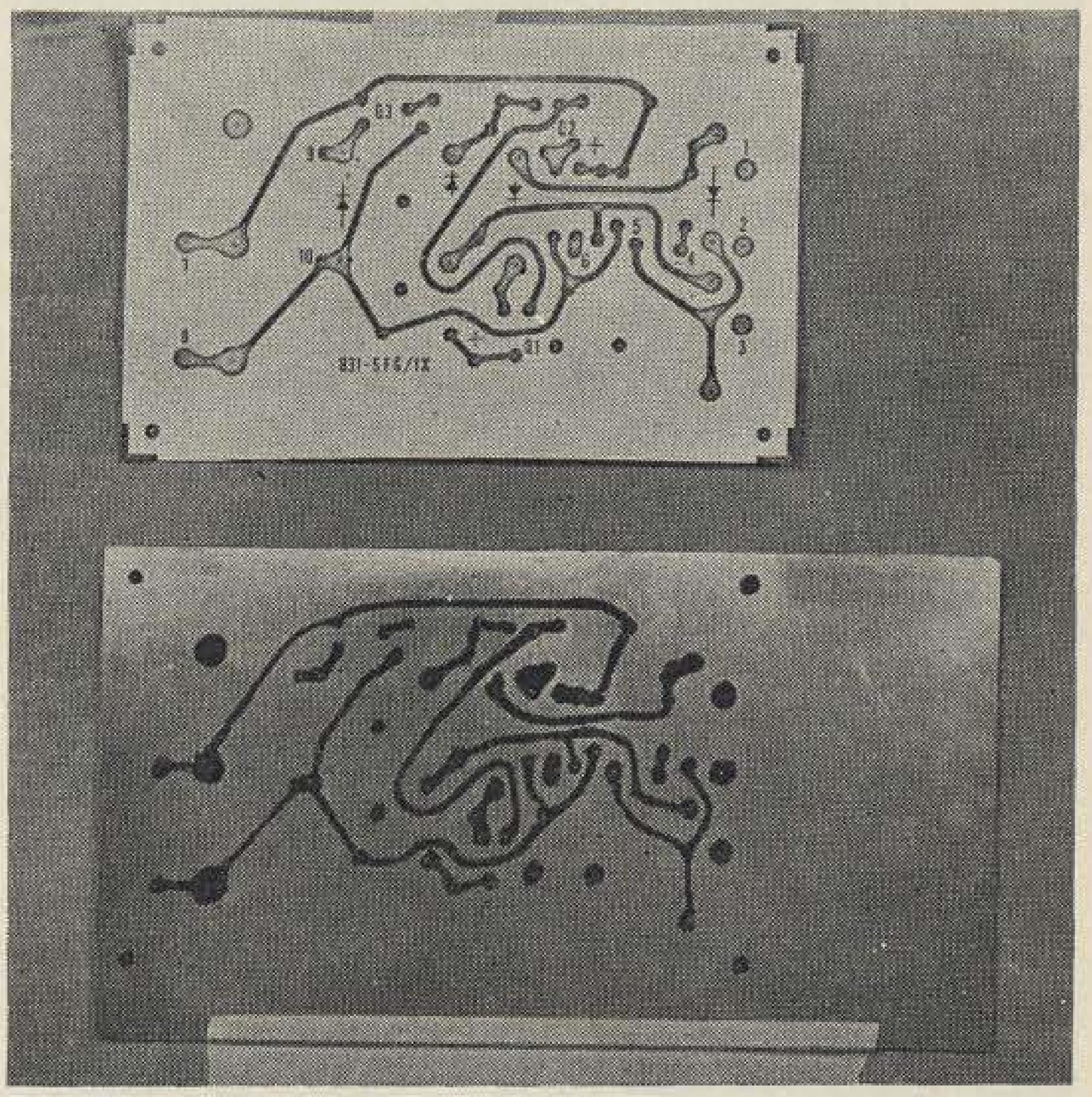
3—Trim the pattern to size. Apply rubber cement liberally to back of pattern and bond it to the copper side of the laminate.

4—Allow to dry, then lightly punch the centers for holes to be drilled later.

5—Carefully peel the master from the copper and save it. Remove all rubber cement from copper, then scour thoroughly. Avoid touching copper surface from now on.

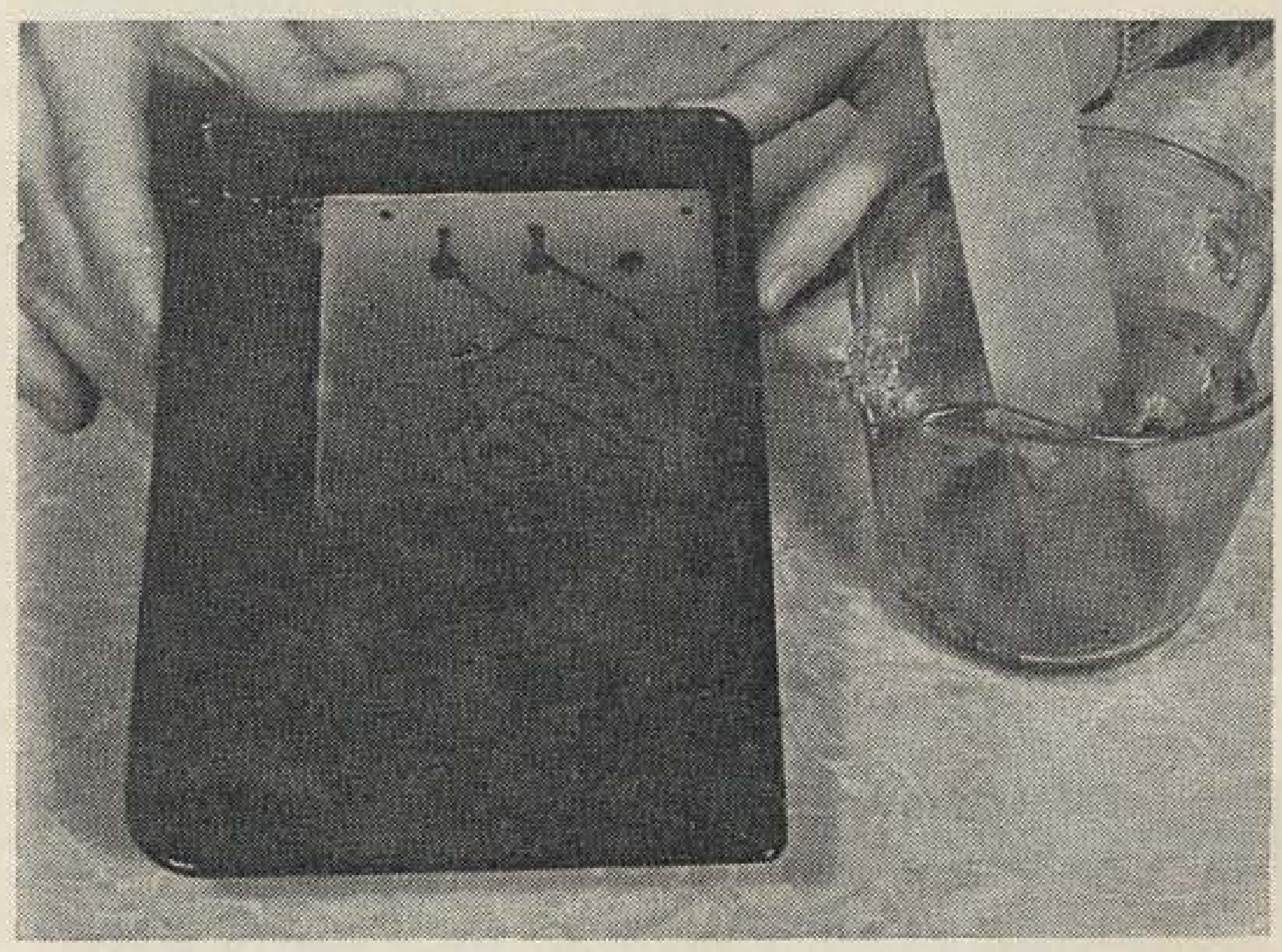


6—Punched centers provide convenient starting points for resist. 'Pads'' should be drawn first to prevent crowding. Original layout is used as a guide.



7—The conductors are laid down and the resist allowed to dry thoroughly.

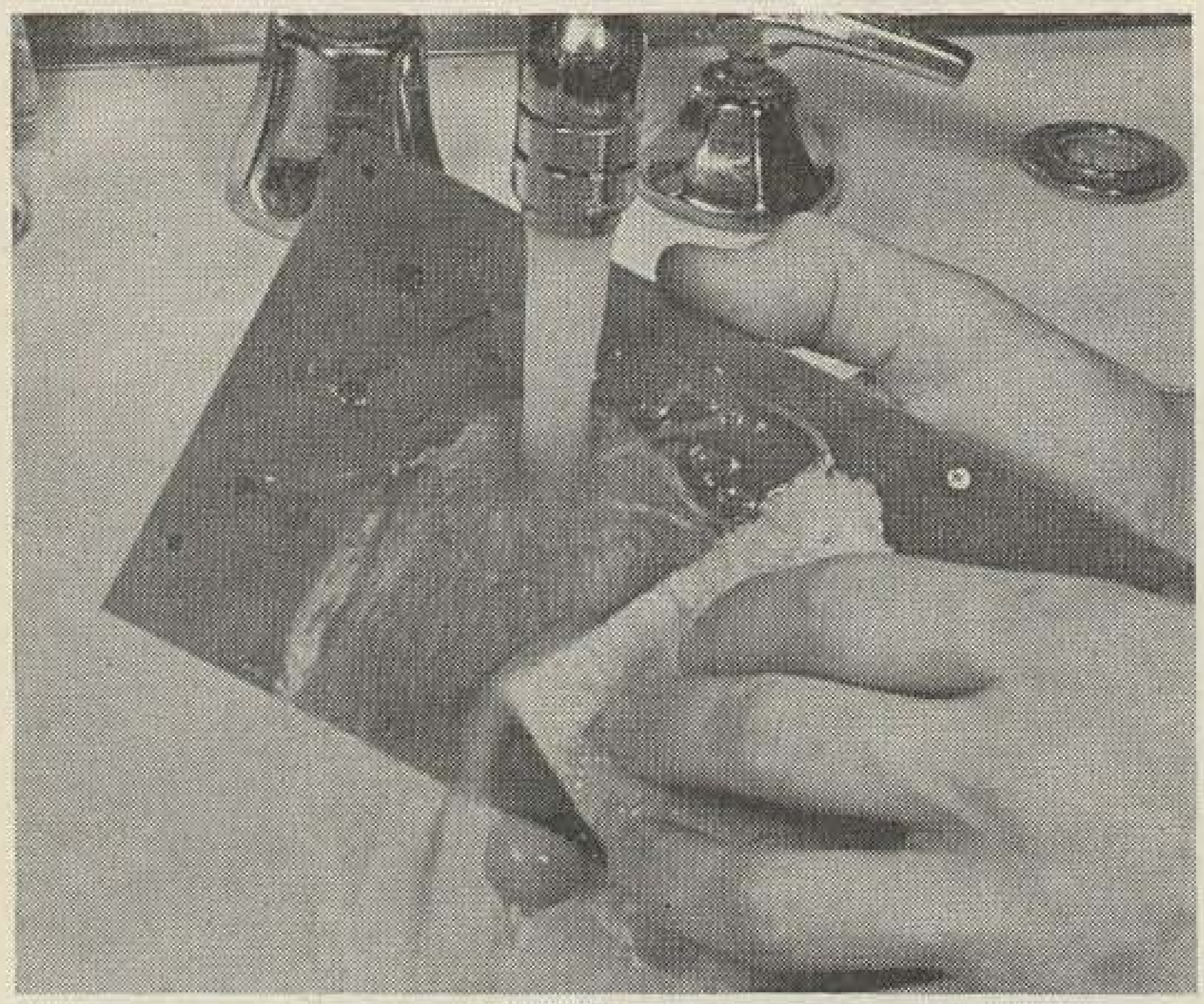
8—Etchant is mixed according to directions. A Pyrex container must be used for safety.



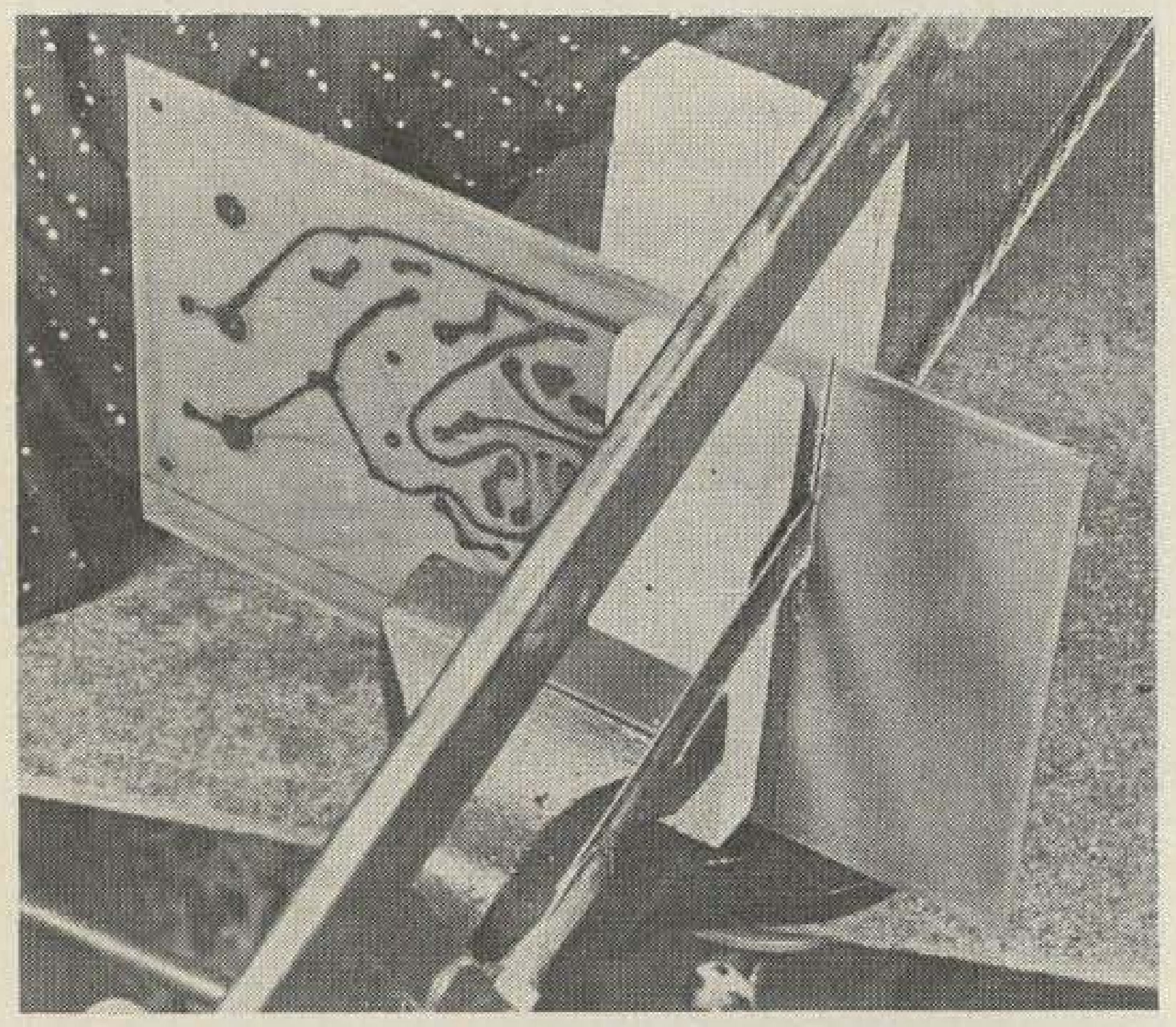
9—A shallow glass or plastic tray should be used to avoid contamination of the etchant.

tube tipped with a ball-point assembly. These materials are available from most of the larger electronic supply houses.

It is extremely important that the copper surface be thoroughly scoured with cleanser to remove any contamination. Fingerprints are particularly difficult to remove and if the cleanser fails, it may be necessary to use a very fine grade of steel wool. A uniform, high lustre must be obtained to ensure both proper adhesion of the resist and proper etching. Photos 6 and 7 illustrate the application of the resist Due to the spacings involved in the example, the pads are first laid down over the centers. The conductors connecting various pads are then drawn in with little difficulty, starting from the center of the board and working toward the outer edges. To correct mistakes, dried resist may be scraped off with a model knife or carbon tetrachloride on a cotton swab may be carefully applied. When mixing the etchant, be sure to follow the instructions. If a Pyrex tray of small size is available, both the mixing and the etching may be done in the tray. During the etching, the tray is rocked gently back and forth and from side to side so that the displacement of the copper proceeds uniformly at all parts of the board. Even so, etching may proceed more slowly in some areas than on the rest of the board. Rubbing these areas with a cotton swab will increase the rate. Once etching is complete, the board must be thoroughly washed to remove every last trace of the etchant. These traces could react with the humidity in the air to cause etching of the conductors themselves. The resist material should not be removed until the board has been cut to size and is actually



10—Board is removed immediately when all excess copper has been removed, and is thoroughly rinsed to eliminate all traces of etchant.



11—The board is marked, then cut to size. Soft wood blocks prevent damage to conductors.

12—Resist may be removed with carbon-tetrachloride. Cleaning should continue until rag shows no trace of resist; otherwise difficulty may be encountered in soldering.

13—All centers are drilled with smallest-size hole required. This provides pilot holes for larger drill sizes.

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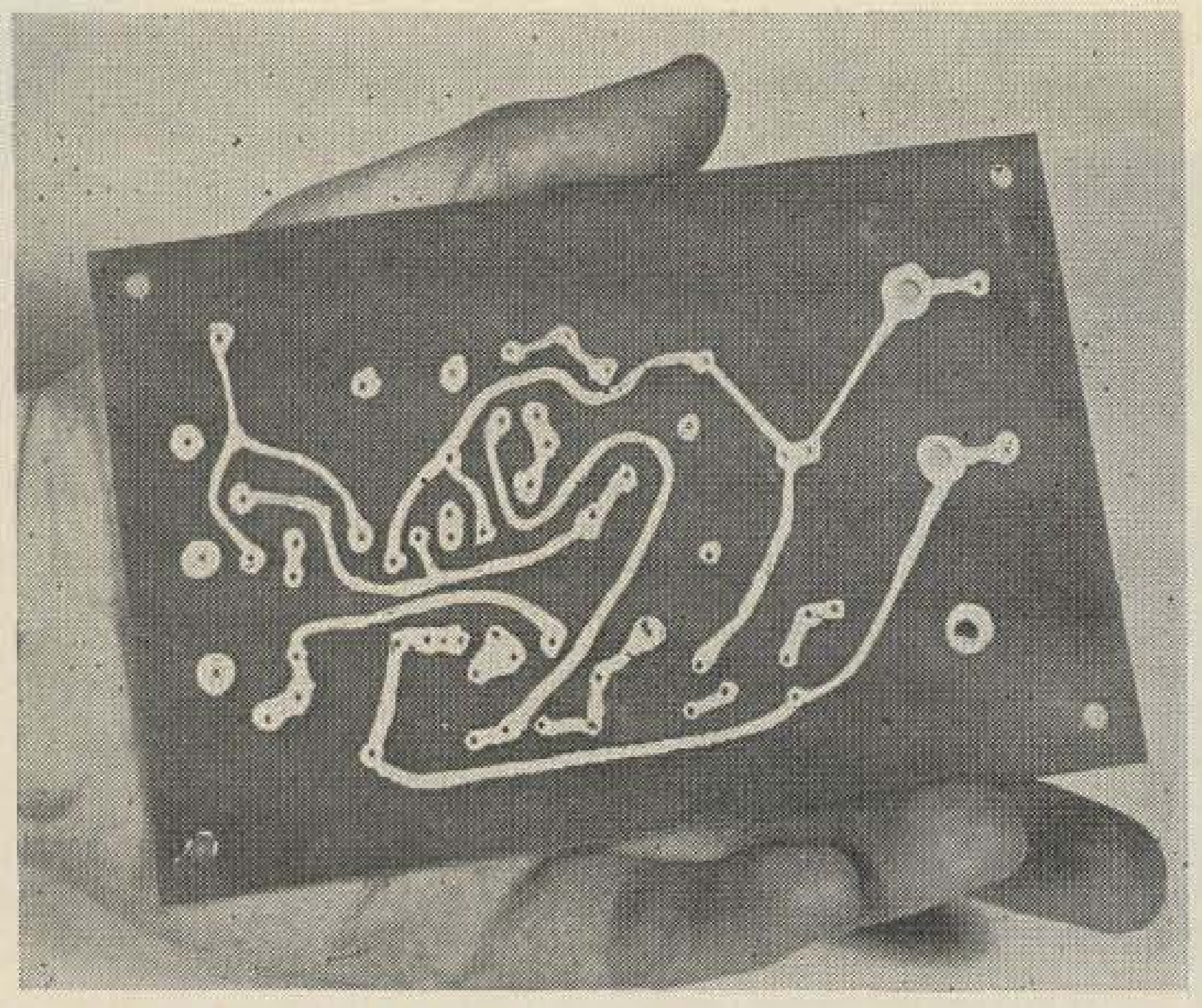
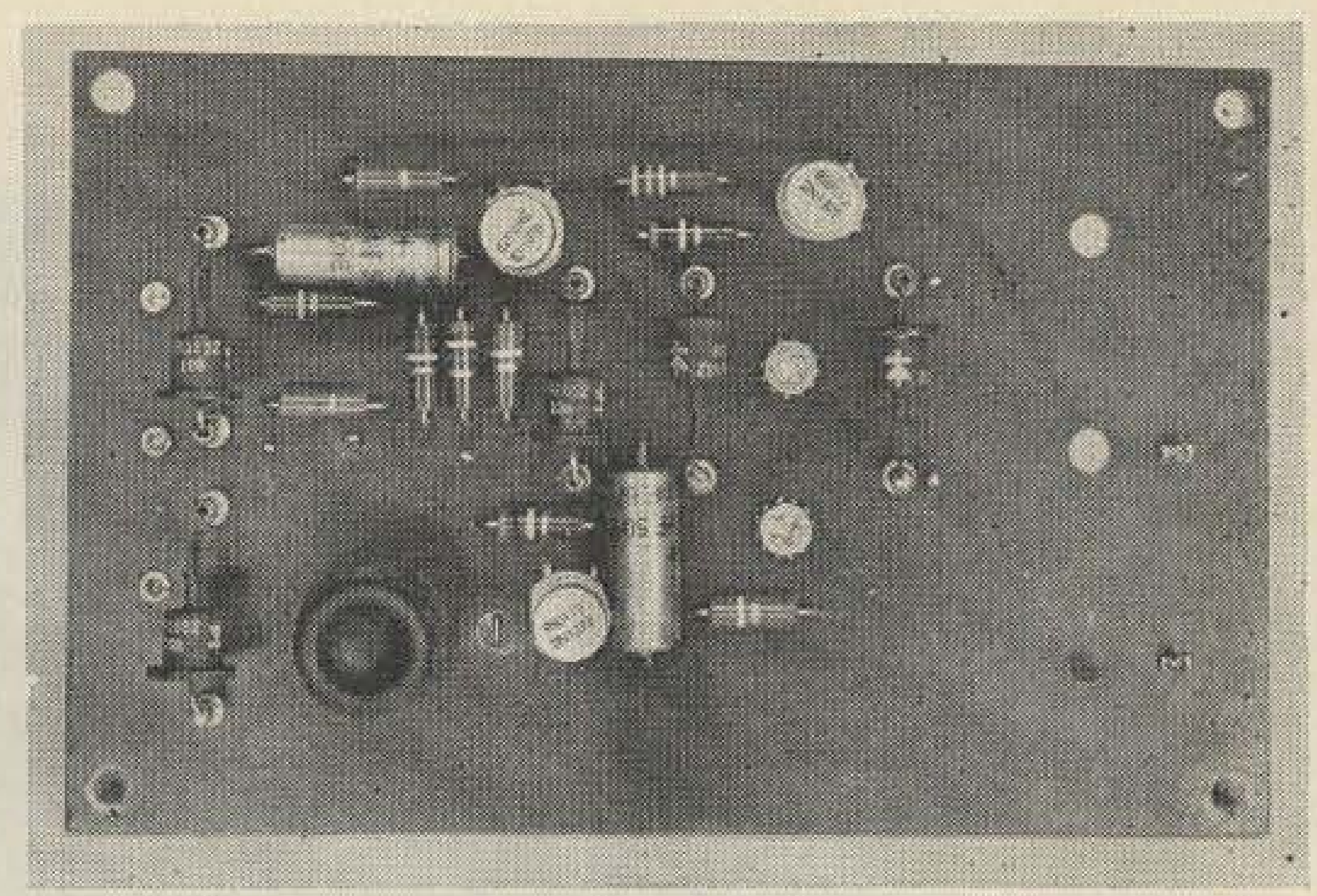


14—Finished board ready to accept components. After assembly, conductors should either be tinned or coated with clear acrylic spray.



15—Top side of assembled board.

ready for use. It serves as an excellent protection for the copper surfaces beneath it. Removing the resist exposes not only the conductors but also the centers punched in Photo 4. The author prefers to use the drill required for the smallest hole in the board as a pilot drill. This simplifies the task of keeping the holes where the punch marks are. The pilot holes are then drilled out to larger sizes where required.

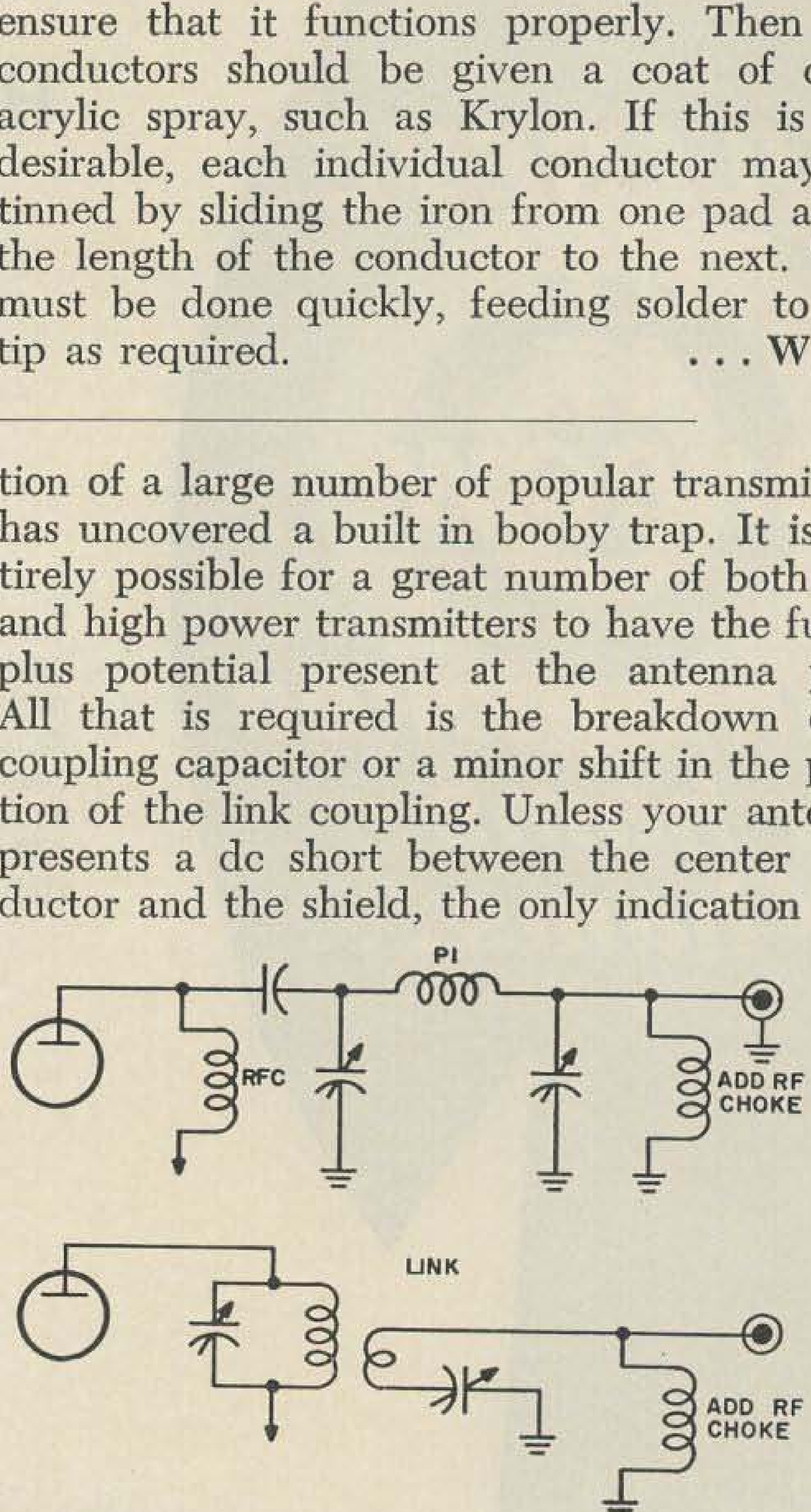
Once the board is finished the components should be mounted. The components are normally mounted on the side opposite the conductors. Their leads are inserted in the appropriate holes, bent slightly to keep the components in place, then clipped. The board should be checked to be sure that the right leads are in the right holes, proper polarities are observed, etc. Extreme care must be taken not to overheat the conductors during soldering, as this will cause them to release from the board. A 25-watt pencil-tipped iron will supply enough heat to make good solder joints quickly. The circuit should be tested electrically to ensure that it functions properly. Then the conductors should be given a coat of clear acrylic spray, such as Krylon. If this is undesirable, each individual conductor may be tinned by sliding the iron from one pad along the length of the conductor to the next. This must be done quickly, feeding solder to the tip as required. . . . W1ISI

Oversight

Harvey Hurwitz WA2HYS

It was a quiet evening in the shack, a gentle murmur of the QRM came from the Old Hearing Aid and the time had come to fire up the rig. After dutifully waiting for the filaments to heat, the key was depressed. Lo and behold, though the plate meter kicked up to maximum, yet there was no output. The best thing to do was to get out the dummy load and see what was wrong. After carefully removing the co-ax connector to the Gamma matched beam, you start to connect the dummy load. As the center pin on the load cable touches the center pin of the antenna socket there is a flash. A thirty-six cent oversight has claimed another victim.

If you think that this can not happen to you, you had better get out that old schematic and take a long careful look at same. Examination of a large number of popular transmitters has uncovered a built in booby trap. It is entirely possible for a great number of both low and high power transmitters to have the full B plus potential present at the antenna jack. All that is required is the breakdown of a coupling capacitor or a minor shift in the position of the link coupling. Unless your antenna presents a dc short between the center conductor and the shield, the only indication that



TYPICAL OUTPUT CIRCUITS

something is amiss will be the loss of output power. If, as you properly should, you have turned off the power before changing cables only the dummy load will suffer. On the other hand if you simply reach behind the set and pull the cable out, burned hands are the very least that you can expect.

The concept of "Fail Safe" construction is one of the basic criteria of effective design. I regret to say that many of the transmitters being produced today, both in factories and "home brew," have neglected this item. This problem has been found to exist in transmitters ranging from a few watts to a kilowatt or more.

Now that we have outlined the results of this oversight, let's get busy and eliminate the problem. Examine the final output stage on your schematic. If it is a Pi network, you will note a coupling capacitor, a tuning capacitor, a coil with associated band switch and a loading capacitor. One end of the coil will be connected to the antenna jack. It is probable that you WILL NOT find an rf choke running from the antenna jack center pin to ground. This thirty-six cent item could mean the difference between life and death. It has no effect on rf output, yet provides a path for dc to ground. It is commonly called a Safety Choke. In the event of a breakdown in the coupling capacitor, this choke will promptly blow the fuses by shorting the dc plate potential to ground.

If on examining your schematic you find that your transmitter utilizes link coupling, DO NOT assume that the unit is safe. It is not at all unusual for the insulation (if any) on the link coil to break down, or for the link assembly itself to come in contact with the tank coil or plate lines. Virtually all transmitters using link coupling have a load capacitor at the ground end of the link. This capacitor has the effect of preventing dc from shorting to ground. In this respect you can see that both Pi network and the Link coupled stage are alike. The cure is the same. Install the missing Safety Choke. The nominal value of this choke is 2.5 mh with a current rating of 200-300 ma.

It may be of interest to note that among the worst offenders are VHF transmitters using variable link coupling in association with plate lines.

To say that the power supply should be turned off before attempting any adjustment is naturally correct, yet it appears quite foolhardy to trust your life to a simple switch or relay. It is far better to blow the fuses or even have a bit of smoke than to chance sudden and efficient oblivion. . . . WA2HYS

de W2NSD

Never say die

IoAR

This is the last month that anyone can join the Institute with the plan of going on the ham flight to Europe in October for membership for six months previous to the flight is required by airline regulation.

As of this writing the reservations are starting to come in. Everyone on the 73 staff, possibly more infected by proximity with my enthusiasm than most readers, wants to go. We are arranging for fare-protector insurance which will protect anyone who finds that he is unable to go on the trip by reason of some unforseen dilemma.

We are going to have a ball, so come on along. The price for the round trip by jet plus air transportation throughout Europe plus hotel accommodations and breakfasts will be about $550 per person. This is what I paid just for my plane fare to Paris and back, so you can see that by traveling in a group we are able to realize some economies. Send $250 per person for a reservation. The trip leaves Idlewild October 6th and returns October 27th. We'll be visiting London, Paris, Geneva, Rome and Berlin. Don't miss it.

Grrr

Try this one on for size. You've just spent three years working the clock around for no salary in an attempt to build up something that you believe in, something that you want desperately to succeed. Then, all of a sudden, something completely beyond your control goes wrong and all of the good will that you've tried so hard to build up is hopelessly and perhaps forever damaged.

Now, as I try to piece together the hundreds and hundreds of delayed and even lost subscriptions, I wonder at the laws of our country that prevent me from what I could easily convince myself would be a case of completely justifiable homicide. I guess I am too easy-going. I kept believing the fellow who had contracted to operate our subscription stencil department. I believed him when he told me that he was only a little behind. I believed him when he said he was answering all complaints upon receipt. Then, after I no longer believed him, it still took over a month before I could locate the machinery necessary to do everything up here and to hire the girls to handle it.

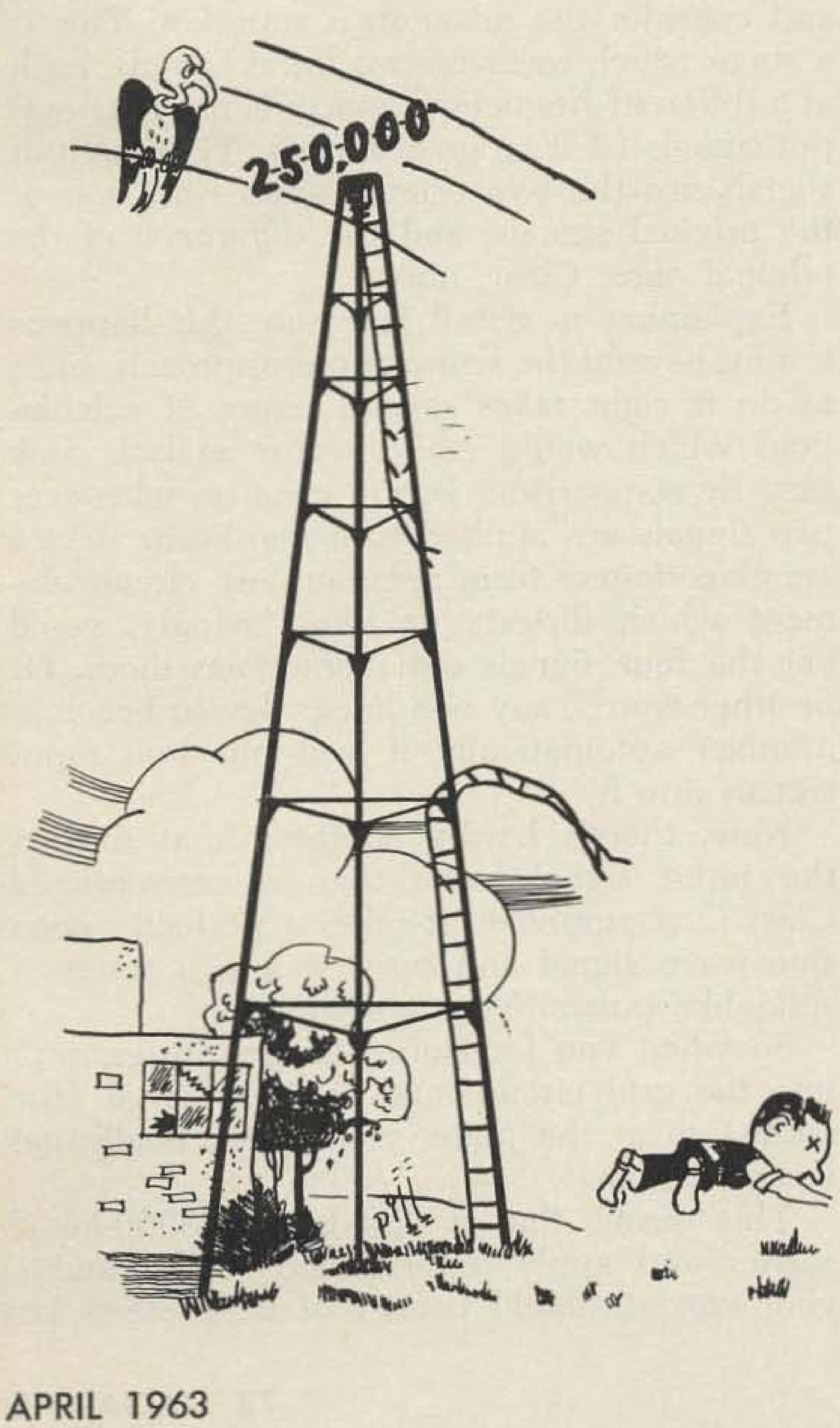
The apoplexy really set in when I got everything up here and found that all of the complaints were still in unopened envelopes. That just about did me in. Fortunately most of our subscribers are very forgiving. I am straightening things out as fast as I can. I've been up night after night working on all of the complaints.

In spite of the rather shoddy deal that many subscribers have had, only a few fellows have been nasty. I wish I wouldn't react so violently when they do write in and accuse me of being a crook. Somehow these incredible idiots have convinced themselves that the magazine is just a front I have used so that I could personally gyp them. When I finally cool down (after writing about six letters which I sure wish I could mail), I realize that many fellows go through life just looking for things to be mad about. I am just getting a little taste of what their family and co-workers have to put up with every day. It isn't necessary to be nasty . . . and it serves no useful purpose. My word, I've just waited eight weeks for my subscriptions to start to *National Review*, *Analog*, and the *Scientific American*. I've waited over

(Turn to page 116)

Institute Membership Drive

Frankly we were just a bit disappointed with the February showing. Let's put that old shoulder back to the grindstone and see if we can't get the membership drive back on the tracks and aim it at going over the top. There are a great many important reasons why you should bend your every effort at making this great membership drive a tremendous success. You know what most of them are so we don't have to go into all that over and over again. While on the subject, we want to ask those amateurs who have been critical of the Institute to please mind their own business . . . if they want to grumble they should join first, like all the other members. We would also like to lay to rest the vicious rumors that the reason we are aiming at a membership of 250,000 is that our printer mistook our order for 2500 membership cards and printed 250,000 instead. This did happen, of course, but there is no connection whatever between that little accident which could have happened to anyone and our drive for the same number of members.



(almost) All About Sideband

Staff

Unlike the weather and Mark Twain's comments thereon, almost everybody does something about sideband but hardly anybody ever talks about it.

The die-hard AM-er turns it off. The fervent mono-sidebander won't talk to the double-sideband boys, CW addicts either ignore it or dive enthusiastically into the middle of the mess. FM enthusiasts chuckle knowingly up their sleeves.

Yep, almost everybody does something about it. But the absence of talk *about* sideband leaves the newcomer in a somewhat confused position. His best friends don't tell him—frequently, because they haven't been able to dig through the mathematics of it either.

Oh, quite a few feet of paper have been expended in articles telling "all about sideband" before. And a few inches of this mass have told, in easily understood language, just what it is and how it works. But the conventional approach to talking about sideband so far seems to have been to begin with a discussion of vectors.

Vectors, in case you never met one, are imaginary little arrows with pointed heads which revolve in a multitude of directions while you're talking on a sideband rig. Since any discussion or "explanation" via vectors tends to leave most everybody else going around in circles too, we'll not be meeting them in this discussion.

What we *will* be doing is to examine in detail the various things that go to make up sideband.

When you look into the schematic of a typical modern sideband rig, the usual reaction is "ohmygaws! !" But it's not really all that complicated. The basic circuits themselves are simple enough, and most of them appear both in transmitters and receivers (a most significant difference from AM, CW, or FM). The thing that makes it look so horrible is simply that most of the circuitry is somewhat unfamiliar to most of us.

So, as we said earlier, we're going to take some detailed looks. In subsequent articles, we'll explore modulators, ways of disposing of the unwanted sideband (and why it's unwanted, poor orphan), linear amplifiers, instrumentation, measurement and alignment, power supplies for sideband, and finally the systems approach. The general format will follow that of our earlier series of technical articles, in which all common and many uncommon circuits filling a specific function were examined in detail, complete with circuit analysis and listing of pros and cons for each.

Before getting into all this circuitry, we have to start someplace. And the logical starting point is with the signal itself. Just what *is* sideband?

(Old-timers and sideband addicts, we're sure, will excuse a repetition of the basics they learned long ago. But they might find the approach we're using of interest, since it's not quite the same as that used in most handbooks.)

The first essential to getting a true understanding of just what sideband consists of is to find out what AM really is.

Let's back off to receiver theory a minute and consider the mixer in a superhet. This is a stage which receives two input signals, each at a different frequency, and puts out four output signals (if it's a good mixer). These output signals are the two original ones, the *sum* of the original signals, and the *difference* of the original ones. Clear, no?

Explaining in detail just how this happens is a bit beyond the scope of our approach, since to do it right takes several pages of calculations which would make vector analysis look easy by comparison. But in essence, whenever two signals are applied to a non-linear device (engineeringese term meaning any circuit element which distorts its input signal), you'll get the four signals out. Sometimes more. Or in other words, any non-linear device becomes a mixer automatically if you put two input signals into it.

Now, there's hardly anything that distorts the input signal more than a conventional Class C rf amplifier. It takes a perfectly good sine wave signal and turns it into a series of spike-like pulses. Very non-linear.

So when you feed one signal (the carrier) into the grid circuit, and another signal (the audio) in at the plate, you automatically get mixing action.

This means that if you take a 3900-kc rf carrier and apply a 2-kc tone to the audio, your output should consist of 2 kc, 3898 kc, 3900 kc, and 3902 kc.

And if you try that experiment, you'll find out that this is precisely what happens (if you use a sharp enough receiver to examine the output).

The 2-kc signal gets lost in the tank circuit, naturally, but the other three all go out to the antenna. They journey around a bit, eventually hit somebody else's antenna, clamber down the feedline, and enter his receiver. Once there, they go through another mixing process, through the *if* strip, and come face to face with a diode "detector."

If there's any other circuit element which distorts things as badly as a Class C amplifier, it's an unbiased diode. So let's look at just what happens in the "detector."

Remember, we're talking about *three* signals which left your transmitter, not just one. They all three hit the diode at the same time—and you might expect to get six output signals: 2 kc, 4 kc, 2kc, 3898 kc, 3900 kc, and 3902 kc.

Actually, because of some rather involved phase consideration, the 4-kc signal (beat between 3898 and 3902) never shows up. The three high-frequency signals get lost in the output circuits just like the audio disappeared from the transmitter output.

And what's left? The 2-kc tone we started with!

The object of all this is to point out that modulation and detection are really the same thing, and both are a mixing type process. For simplicity, let's just call it all "modulating" from here on in.

Now, what we've been talking about so far has been standard AM. But we had to find out the *real* way it works before we could go into the sideband situation.

You'll remember (from a few paragraphs back) that when we started with a 2-kc audio tone, we got two "side" frequencies by modulating action.

But speech doesn't consist of just one tone. In fact, recent research has cast considerable doubt on the idea that speech consists of sine-wave tones *at all!* For our purposes, though, we'll keep on pretending it does consist of a number of tones ranging from 300 to 3000 cycles per second. Such a group of tones is called a band, and the two "side frequencies" become two "sidebands" on the AM signal.

A little thought will show you that each sideband is a mirror image of the other, no matter what the modulating signal. If the audio tone at any one instant is 300 cycles, one side frequency will be 300 cycles *more* than the carrier frequency while the other will be 300 cycles *less*.

Thus, when we talk into a regular AM rig we shoot out into the ether a signal composed of three distinct parts: a carrier, which serves only to be modulated and produce sidebands, and to make the second modulating process at the receiver detector simple; an upper sideband containing all the audio tones but transposed into the *rf* spectrum *above* the carrier; and a lower sideband, identical to the upper one but lying *below* the carrier frequency.

Extensive engineering calculations, measurements, and tests have shown that to properly transmit 25 watts of audio, in both sidebands, the carrier power must be at least 50 watts. This produces a 75-watt output signal, containing 25 watts of transposed audio and 50 watts of carrier. For 250 watts of audio, 500 watts of carrier are required. And 1000 watts of carrier can handle only 500 watts of audio.

So with a full gallon, you send only 500 watts of audio—and this is composed of two identical halves, so in reality you're able to send only 250 watts of intelligence; the rest just goes along for the ride.

If you could get along without the carrier, you would come up to 1,000 watts all for audio—or 500 watts of intelligence, an instant doubling of true communication power.

But the two sidebands are mirror images of each other. Could one of them be left off without hurting anything? The answer, of course, is a resounding "Yes!" The result is single-sideband suppressed carrier, allowing 1,000 watts of talk power, which is four times as much as the legal maximum with AM.

Of course, we never get something for nothing. The price we pay for the four-time boost in power is increased complexity in the receiver (but, strangely, the transmitter is often *simpler* than an AM rig of comparable power) and vastly increased criticalness of tuning adjustments.

But we pick up some other advantages along the way too. Getting rid of the carrier does away with the annoying whistle that's a trademark of low-frequency phone bands. And the SSB signal is narrower, allowing twice as many stations to occupy the same space without any more crowding.

Now let's go back to our original example and see what happens to it in sideband.

We started with 3900-kc rf signal and a 2 kc audio tone. Let's apply them to a special kind of modulator, called a "balanced" modulator, which has the ability to null out one of its input signals from the output.

Now, instead of *four* frequencies in the output, we have only three. By adjustment of the modulator and circuit, we set things up so the three we still have are 2 kc, 3898 kc, and 3902 kc. The one we got rid of was the carrier.

The audio will still disappear in the tank circuit, leaving only the two side frequencies to go out to the antenna. At this point, we have "double sideband."

At the receiver, when the two side frequencies get to the detector, they will beat against each other to produce a 4 kc tone.

But this isn't what we started with; how do we fix it?

In AM, the original intelligence was recovered by mixing the sidebands with the incoming carrier. The carrier has been removed now. So, let's put in a new one.

This can be done either by injecting a 3900 kc signal at the receiver front end, or by using the BFO and adjusting it to the same frequency at which the 3900 kc signal would reach the detector.

Now we get the 2, 4 and 2 kc beats as before. *If* the phase of the locally-inserted carrier is exactly the same as was the carrier at the transmitter, the complicated phasing relationship mentioned earlier will cancel out the 4 kc note, leaving only the 2 kc we started with. But if the phase is wrong (and it will be if the frequency is off even a tenth of a cycle per second!), this cancellation either won't occur at all or will be only partial.

By using a very strong local carrier, such effects can be minimized but the audio recovered will be rather weak.

It's simpler to get rid of one of the two sidebands somewhere along the way, either in the transmitter or in the receiver, so that only *one* sideband reaches the receiver's detector. There, the single sideband can modulate a local carrier to produce clean, acceptable audio with a minimum of fuss and complication.

How, you may ask, do you get rid of that other sideband?

This is putting the cart before the horse; you have to get it before you can get rid of it. Therefore, the next subject in this series will be a rather deep look into modulators. There are many types of modulators—so many in fact, that the subject will require two articles to cover them comprehensively. In the meantime, if you're impatient, contact Radio Bookshop to order some of the tomes listed in the references below and do some homework.

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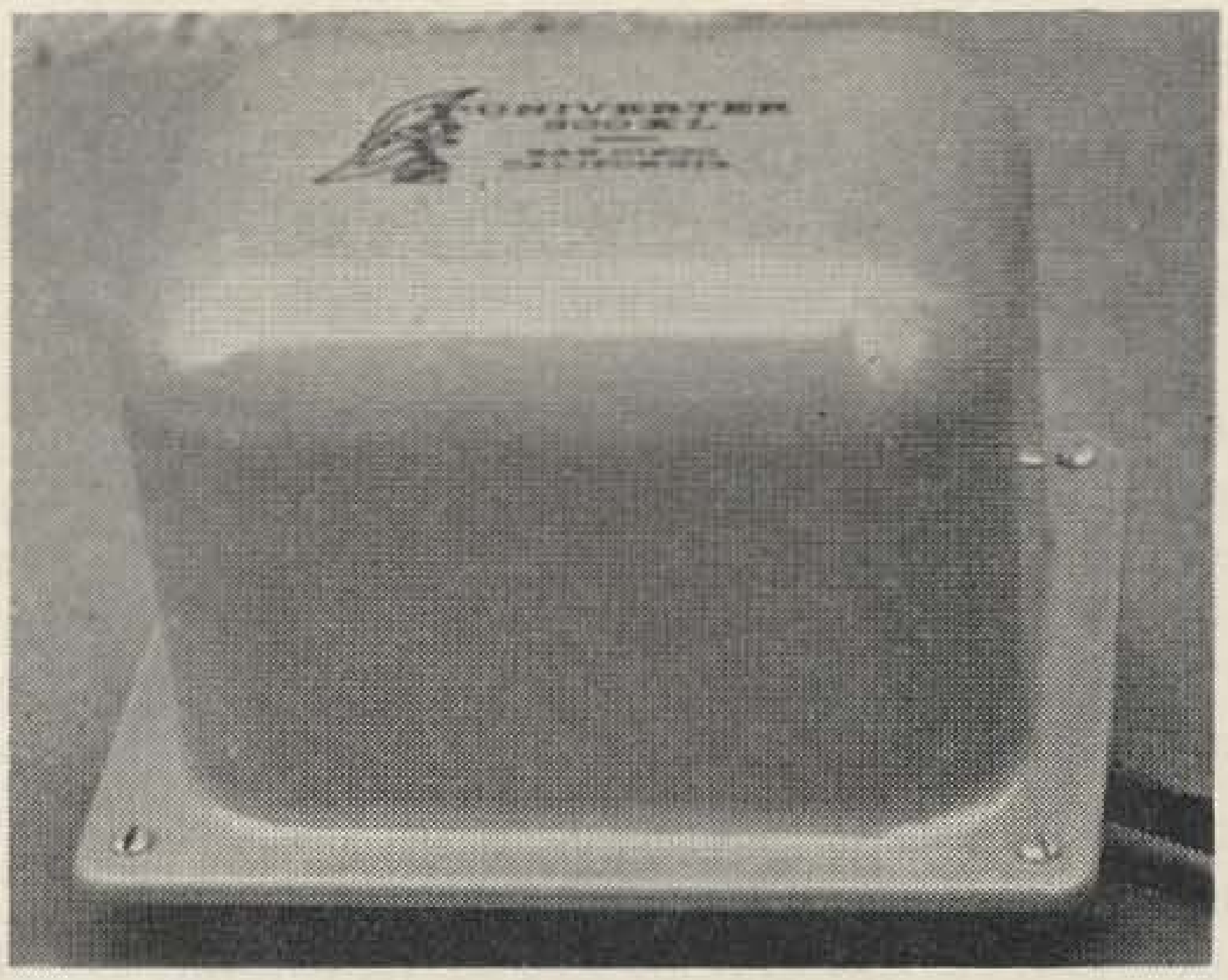

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The sun-spot cycle being what it is, there's an increasing interest in 10 meters and VHF bands for short-haul communications and "local nets."

You *can* put the "big rig" on the local net, if it happens to cover the band, but if you do it this way, you miss at least half the fun and almost all the value of local net operation.

The biggest advantages of local net operation derives from the use of completely separate stations—one for the local net, the other for general hamming—and the use of a squelched receiver on the local net frequency, which runs 24 hours a day. With this set-up you can receive calls even when you aren't expecting them.

One solution to the separate station problem is to go out and buy a little transceiver, a "Communicator" or a complete separate KW rig and 75S1 receiver. The other solution is to resort to the junk box. That was the one I adopted, along with a little horse trading.

The resulting station cost not a penny of cash outlay—although I'll confess to a fairly well stocked junk box. It sports a crystal converter working into a command set for receiving, and 45 watts of screen modulated rf in the transmitter. The ground plane antenna is a "fish pole special."

No special attempt was made at compactness, since the rig is essentially a fixed-frequency job and can be tucked away out of sight, controlled entirely by the PTT button on the mike, and the af gain and squelch control at the operating position.

Since the Tallahassee Key City Net operates on 29,560 and this is also the state-wide mobile calling and emergency frequency, my rig is designed for 10-meter operation.

The Transmitter

I used an 815 tube in the final because somebody once gave me a couple of them, and I hadn't up to that time, been able to figure out anything else to use them for. Almost any suitable beam power tube can be substituted with suitable adjustments in electrode potentials and drive.

Because nearly every junk box will contain different tubes, I make no attempt to describe my transmitter in detail. Layout is simple and construction un-critical, within the limits of good practice.

Instead, I will try to give you in general terms some ideas you can apply to improvising your own rig from what you already have on hand.

The initial model used a 6AG7 crystal oscillator quadrupling in the plate from a 7 mc crystal. However this didn't supply enough drive, so I built a 5763 oscillator on a subassembly mounted under the chassis. The 6AG7 was converted to a doubler. For some reason a 6CL6 would *not* work properly as a crystal oscillator with this circuit. I checked several 6CL6s and none of them would oscillate.

A GDO is helpful in hitting 20 meters with the oscillator plate coil and 10 meters with the driver plate and final tank coils. Three-quarter-inch diameter B&W Miniductor was used for all the coils. The buffer and oscillator are tuned with small 50 mmfd APC capacitors. A receiving type 75 mmfd variable tunes the final, and a small two-section BC variable serves as Pi loading capacitor.

The screen dropping resistor should be adjusted in value to give a screen voltage on the final which is approximately *half* the recommended screen voltage for regular class C operation.

Voice peaks will then swing screen voltage up to full recommended value.

A number of audio tubes were plugged into the circuits. With this carbon microphone, a 6SL7 (high mu triodes) gave more and better audio than a 6SN7 (medium mu triodes). A 6L6 gave better modulation than a 6V6, 6F6 or similar tubes. The rig would probably benefit from more audio gain.

This could be achieved either by using an additional voltage amplifier stage, or an audio step-up transformer for the mike (or both). If a crystal, dynamic or ceramic mike is used, an extra audio stage will be necessary anyhow.

Several features of screen-modulated amplifiers become pertinent in this rig. Since so much of the design is left up to the improvisations of the builder, it might be well to review a few of the important ones, and look over the angles and pitfalls.

Beam power tubes have several important characteristics which are unique.[3]

(1) The plate current (hence the output) depends more on the *screen* voltage than on the plate voltage.

(2) Screen current rises sharply as grid drive is increased.

(3) Screen current falls off as amplifier loading is increased.

(4) Screen current is *maximum* when the plate tank circuit is tuned to resonance.

Obviously, screen modulation itself is dependent on the first characteristic. In this amplifier, we leave the plate voltage practically steady while we change the screen voltage (and hence, the plate current.)

These audio-rate changes in output produce the "automatic QSB" characteristic of screen-

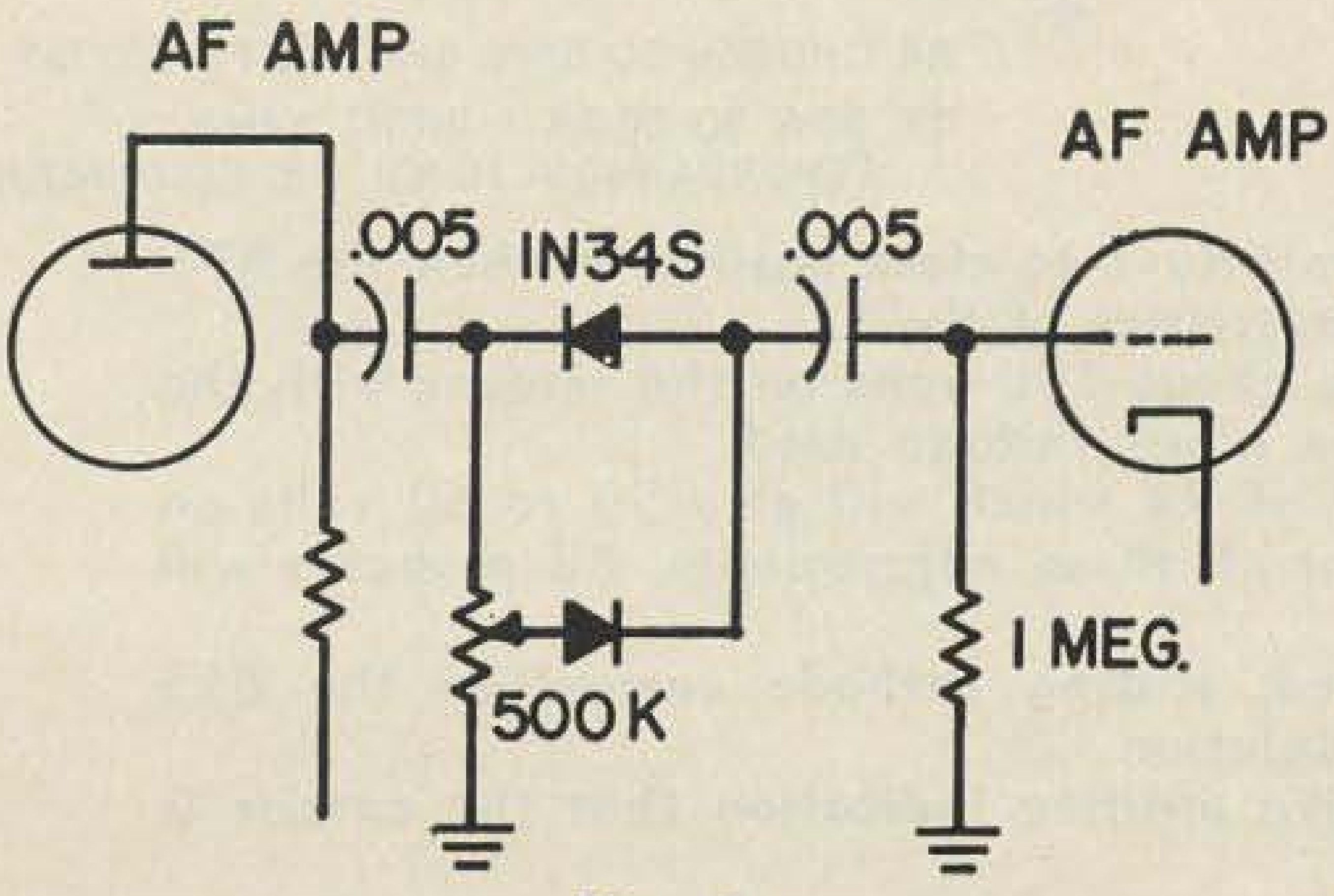
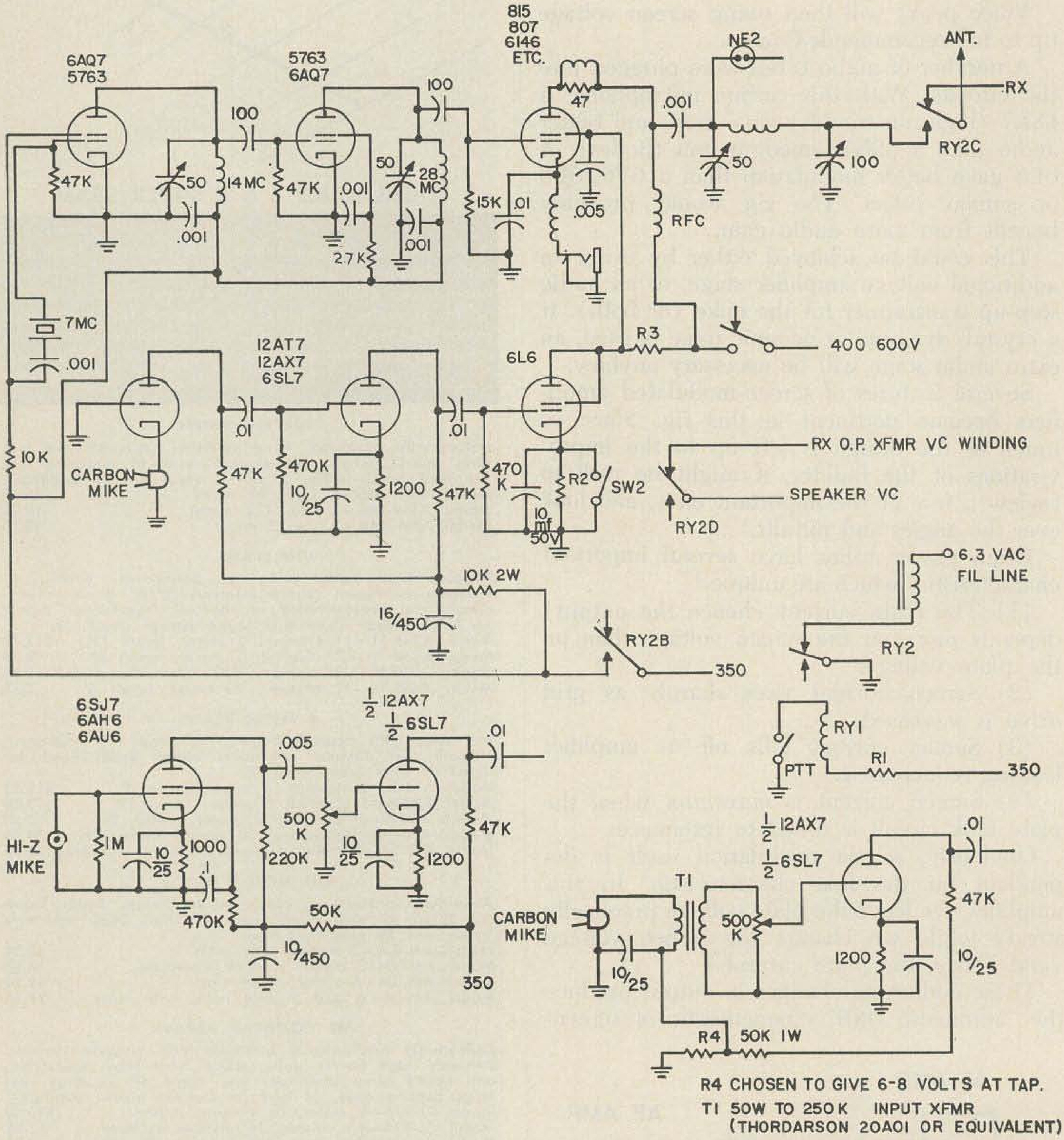


Fig. 2

modulated rigs.

Since *some* plate current flows, even when the screen voltage is zero, it is never possible to screen modulate an amplifier 100 per cent. If some means is provided for driving the screen *negative* on downward modulation peaks, complete plate current cut-off is achieved—but the resulting distortion is horrendous, since this portion of the screen-voltage-plate current curve is *very* non-linear.

TRANSMITTER



R-1—value chosen as maximum which will permit Ry-1 to close positively when the PTT switch is activated. Value will depend on characteristics of Ry-1.
R-3—With an 815 final, R-3 is selected to give about 150 volts on the screens with the 6L6 pulled out of the socket. Value depends on plate voltage used.
R-2—Plug the 6L6 in again and select a value of R2 which will give 50 to 60 volts on the screen with no modulation. SW-1 is open for all these adjustments. R2 probably will be about 1000 ohms, 1 watt.
SW-1—is normally closed for operation. Closed, resting cathode current in the 815 should be about 30 ma, with peaks to 60 on modulation.
The NE-2 may be mounted on the panel to give positive indication that the carrier is on. It will flicker brightly with modulation.
Inset shows alternative microphone input circuits.

It might very well be possible to increase the percentage of *upward* modulation well above 100 per cent by using some such non-linear audio device as the one shown in Fig. 2. I have not tried this circuit myself, but it should be quite effective in increasing the apparent "loudness" of your signal's audio.[1]

The diodes and pot result in supplying audio to your modulator with much higher positive-going peaks, and much lower negative-going peaks than are present in your normal speech. (Polarity of the diodes will depend on how many phase reversals follow the point where it is inserted in the circuit. Wrong polarity will, of course, result in stronger *downward* peaks, which is just what you don't want.)

With the quadrupling crystal oscillator, grid drive to the 815 could not be made to exceed about 1 ma, which is less than half what it should be. This resulted in low screen current (see 2, above) which produced high screen voltage and therefor poor modulation linearity and low percentages of modulation along with poor final amplifier efficiency.

Adding a driver stage brought grid drive up to 2.4 ma which is where it should be on an 815. This brought the screen voltage and current into line, with much improved audio performance.

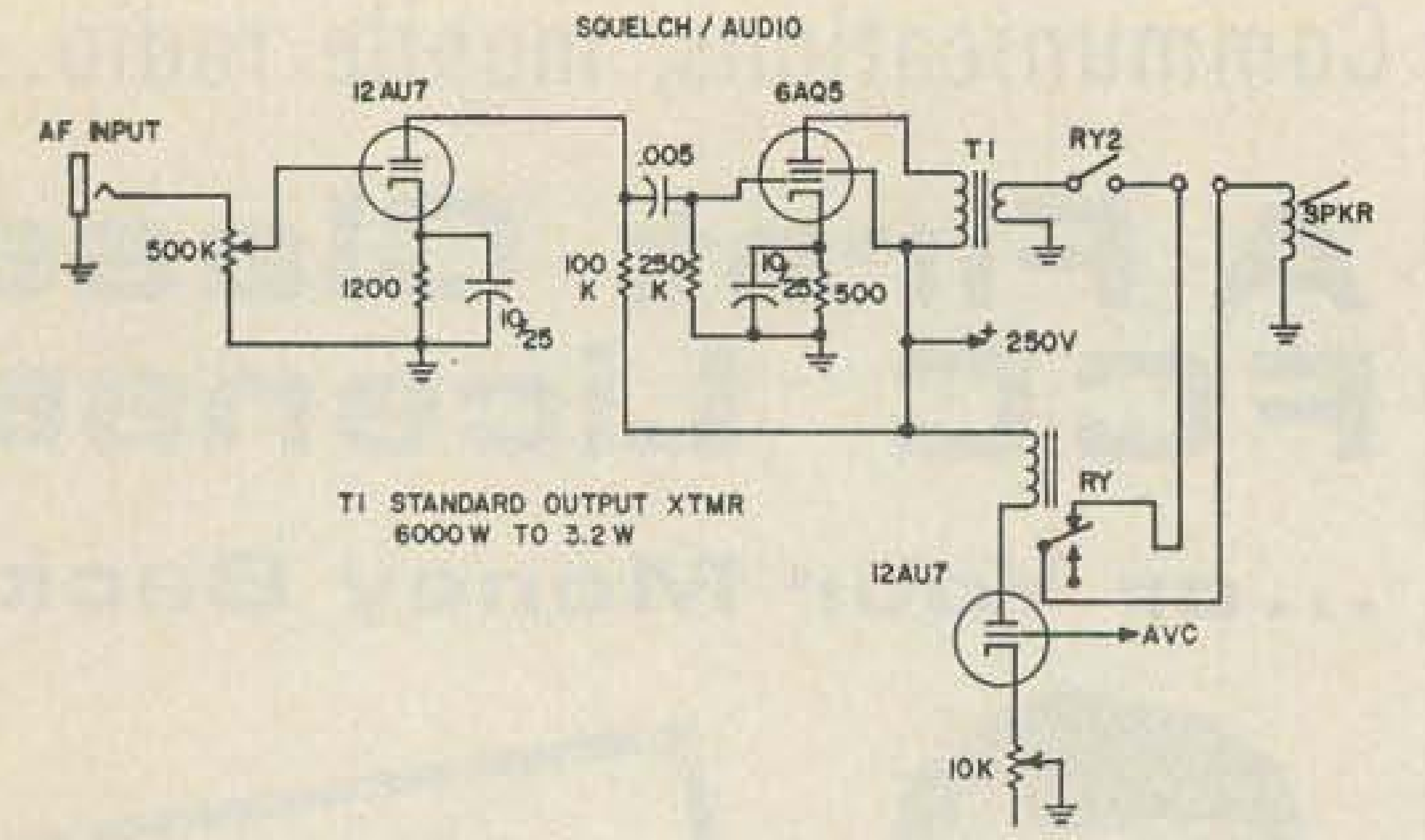
Choice of a clamp tube is important. Unless the tube can draw heavy plate current (this is another way of saying it must have low plate impedance) it does not exercise the desired effect on the screen voltage of the final amplifier.

With no audio signal at the clamp tube grid, the plate-cathode resistance is very low, and in effect forms the low end of a voltage divider formed by the screen dropping resistor in series with the modulator tube plate resistance. The final amplifier screen/cathode impedance parallels the modulator tube but is a much higher value.

As the modulator tube grid is driven negative by voice peaks, its plate resistance increases, thus in effect, "raising" the "tap" to which the screen is connected and supplying more screen voltage.

The lower this no-signal resistance can be made, and the higher the mu of the modulator tube, the more effective it will be. Thus a 6L6 works better because it has a lower plate resistance when triode connected and the mu is probably about the same as that of the 6V6, 6F6 and 6AQ5.

Adding modulator tubes in parallel will decrease the plate resistance (both in the no-signal and maximum signal condition) but will not change the mu. (Mu is the ratio of plate



current change produced by a given change in the grid voltage.)

Adjustment of the transmitter is routine.

It consists of making sure (with a GDO) that all resonant circuits are on the right bands, debugging any parasitics which may turn up, adjusting electrode potentials of all the tubes to their correct values and adjusting grid current in the final to its correct value.

The final step is proper loading of the final. An improperly loaded rf amplifier modulates very poorly.

Over-loading severely reduces screen current. Under-loading results in low output and loss of power.

PTT

The press-to-talk set-up may look a little odd at first. But it is actually quite straightforward. A surplus dc relay with a coil resistance of about 300 ohms was available. It wouldn't operate on the cathode current of any of the tubes, so the dropping resistor was a natural.

The antenna change-over relay is a 4-pdt job not designed for rf work, but it performs ok. Besides changing the antenna, it also turns on plate voltage on the final and exciter stages, and opens the voice coil to the receiver. This relay is mounted in the final amplifier compartment.

Receiver

Since this was to be essentially a fixed-frequency station, there was little need for fancy tuning devices, calibration or the other tricky gimmicks which make many hams unwilling to tackle a receiver.

It uses a crystal converter working into a surplus command set.

Even the converter oscillator crystal came from the junk box. It is a discarded citizen's band unit which gives a difference frequency of 2565 kc, with our local net frequency, and I used the command set which tunes from 1500 to 3000 kc.

The converter is conventional throughout. The 6AS6 is a low-voltage pentode I salvaged from a radar unit (does anybody know what else it's good for?) but a 6C4 or triode connected 6AU6, a 9002 or nearly any other oscillator will work. In fact, any circuit which will oscillate on the proper frequency will work.

With this tube and this crystal, I couldn't get oscillation with the crystal connected between grid and ground—perhaps because the plate voltage used (90 to 100v) was too low. If you use a new crystal it might be advisable to use the circuit recommended by the manufacturer.

The oscillator frequency doesn't matter, so long as you have a receiver to tune the difference frequency.

An interesting feature of this circuit is that the only tuned circuits are the antenna and mixer grid tanks tuned to the operating frequency. The output of the mixer is tuned by the antenna coil of the if receiver. To change output frequencies, it is only necessary to change the crystal.

The antenna and mixer grid coils are rough tuned with a GDO after the unit is assembled, then carefully peaked after the whole receiver is put into operation.

I made a standard conversion of the ARC-5 receiver except that I removed the 12A6 audio power amplifier to save power drain, and converted the BFO to an audio voltage amplifier.

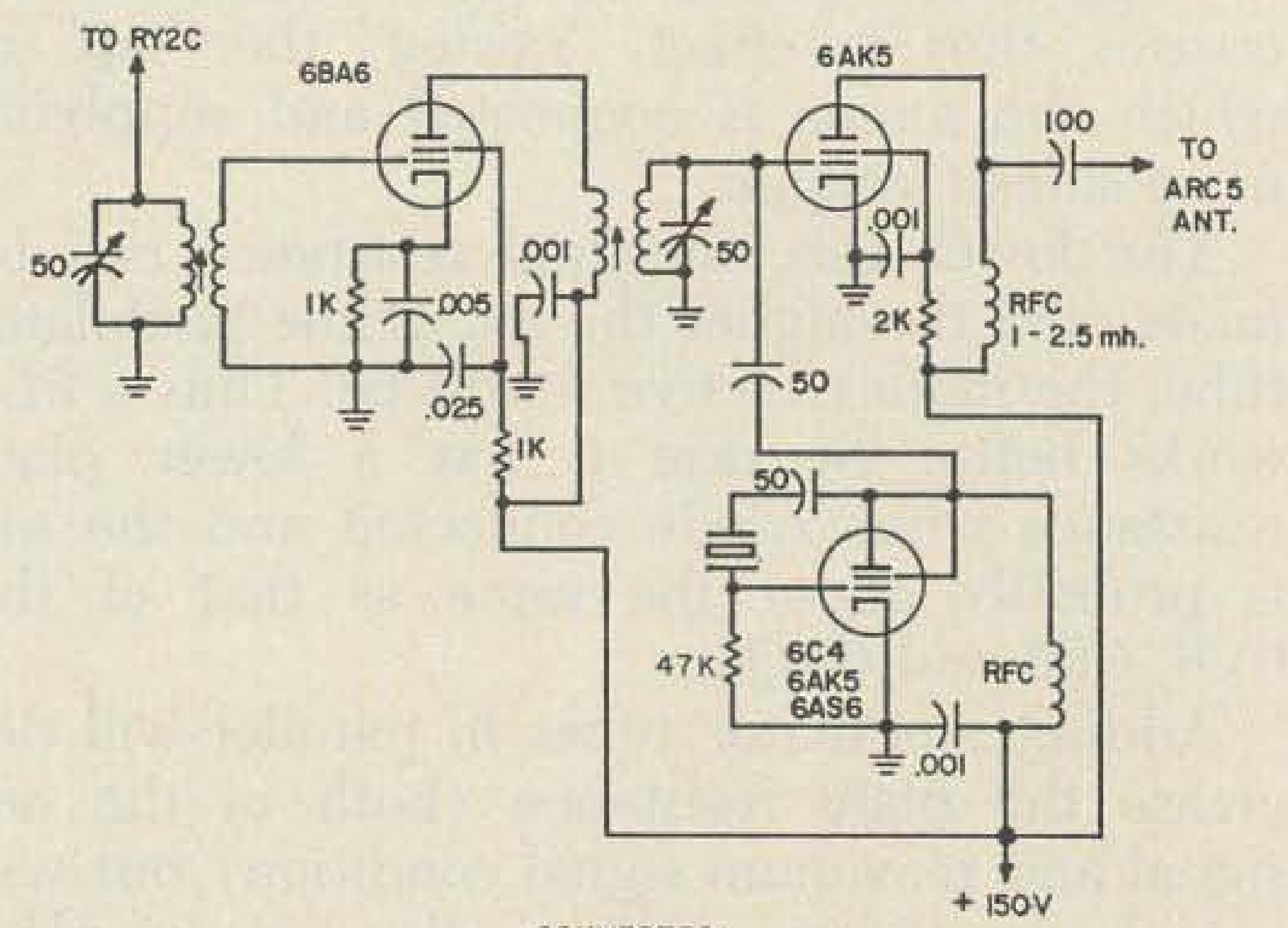
Negative bias to operate the squelch is picked off the diode detector load resistor.

Audio and Squelch

I made a separate unit of the audio amplifier and squelch circuit, so as to permit it to be placed at the operating desk, with the rest of the unit tucked away out of sight.

The audio circuit is a conventional 6AQ5 power amplifier driven by half of a 12AU7 which receives its audio input from the ARC-5.

The other half of the 12AU7 is a relay con-



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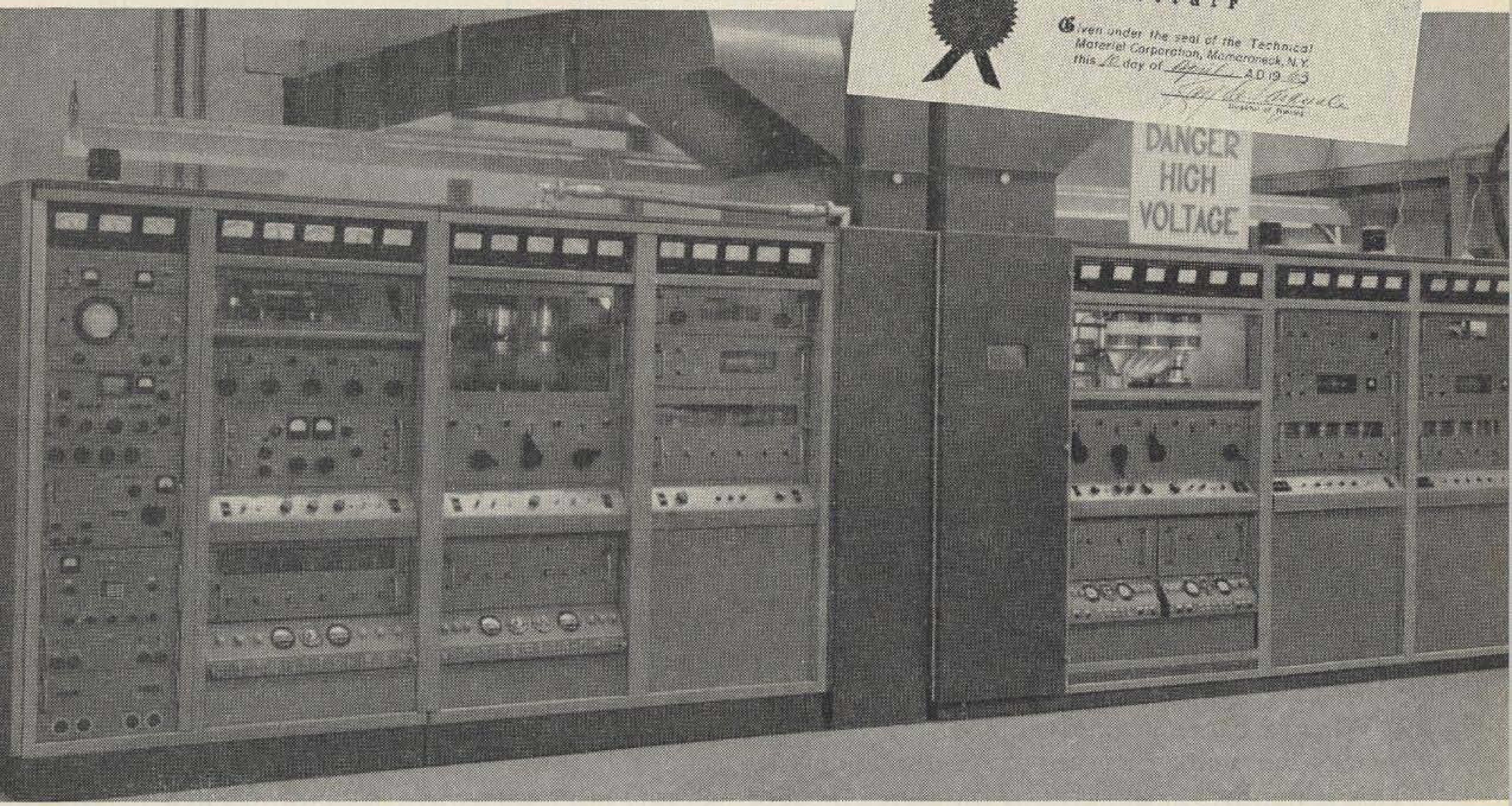

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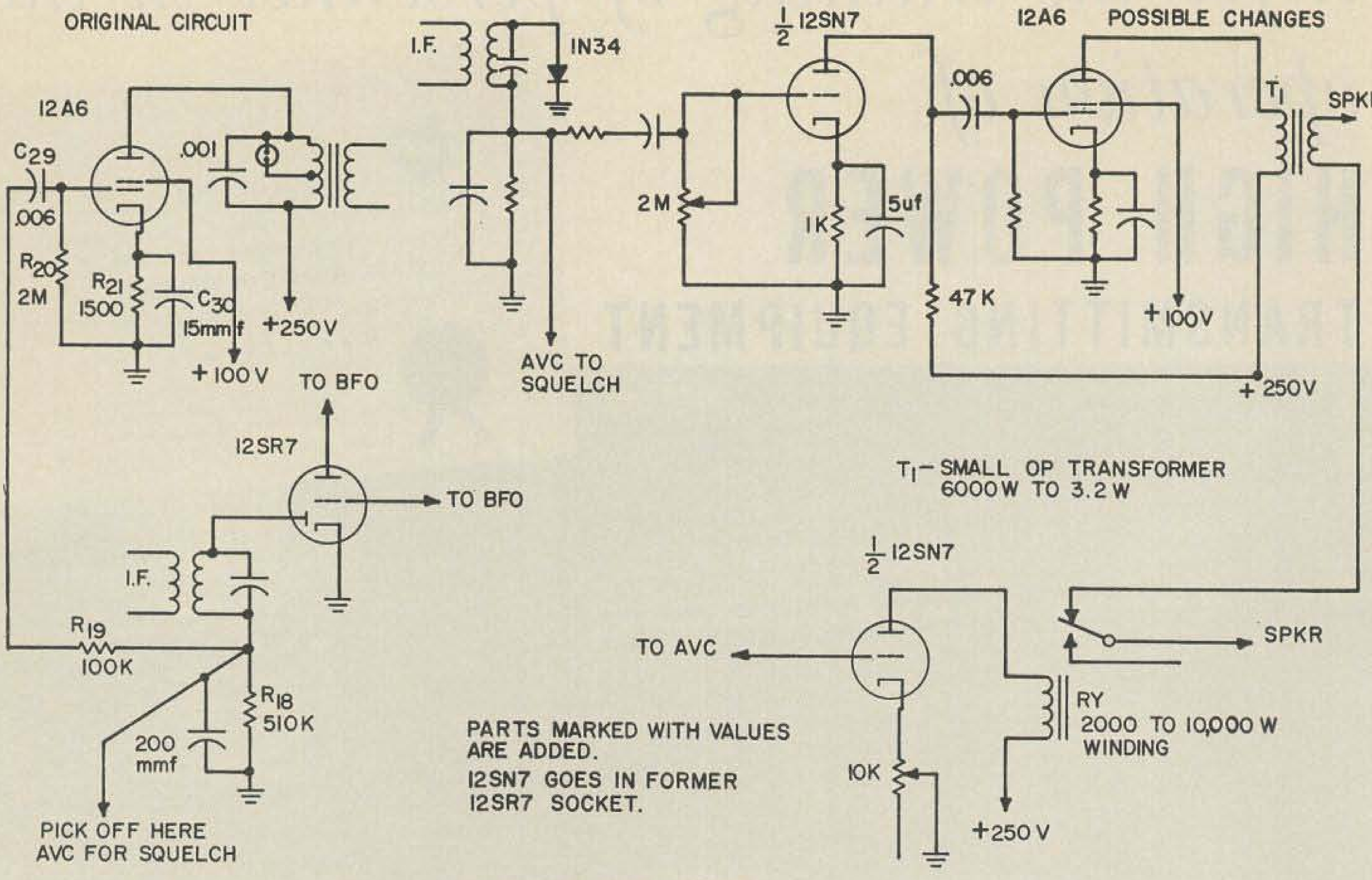


COMMAND SET CHANGES

trol tube. When the cathode pot is properly adjusted the relay is just pulled in, opening the voice coil lead to the speaker (or shorting the audio input, depending on how you want to work it).

When a carrier comes through the receiver, a negative voltage develops at the detector. This is applied to the grid of the squelch tube, causing the plate current to drop, permitting the relay to drop out, completing the audio circuit and Presto! we have audio output.

Many other suitable squelch circuits exist.[2] I happened to have components for this one.

There is no reason why this unit could not be built on the chassis of the ARC-5 if desired. There's room on the dynamotor deck. The 12A6 could be retained as audio power tube.

A crystal diode can be substituted for the detector diode in the 12Q7 (or whatever tube is used) and the 12Q7 socket re-wired for a 6SN7. Half the 6SN7 would drive the 12A6. The other half would operate the relay, which can be mounted on the dynamotor deck.

Naturally, any inexpensive receiver can be used as the *if*, including a broadcast receiver.

I debated using a super-regen receiver instead of the more elaborate system I used. I decided on the latter because it is capable of better weak-signal reception, it is not as susceptible to QRM from signals 15 to 20 kc from the net frequency (as super-regens are) and does not radiate spurious signals from the detector. Another factor is the limited choice of squelch for super-regen detectors.

A disadvantage to the system selected is that the *if* is quite sharp, and a net signal must be very close to frequency to be heard.

It would be quite possible to improve on this receiver. For example, a low-noise front end and converter would help with the weak extended-ground-wave signals. Choice of the 7 mc command set would provide a much broader *if*, less critical of small frequency discrepancies of net stations.

Conclusions

I have *not* worked 400 countries with this rig. I do *not* consistently get 5x9+ reports from Bhutan when the band is closed, or while using a wet noodle for an antenna.

However, using a simple fish-pole ground plane antenna about 45 feet in the air, I have one of the stronger signals on a local net dominated by Tenners (4.5 watts) Cheyennes (90 w to poor antennas) and 50-watt mobile rigs.

This rig has worked KZ5, KP4, W6, W7, W3, W2, W1 (on "short skip"—not extended groundwave). It has worked extended groundwave for 50 to 90 miles with a good antenna and comparable power at the other end.

Quality reports on the audio have all been good. Modulation percentage seems to be about as good as you can get with screen modulation. For purists, of course, it would be quite feasible to plate modulate the rig by making a couple of simple changes in the final screen circuit (like pulling out the clamp tube).

However, for its intended purpose—reliable local communication with no QRM, QSB or QRN—it can not easily be improved on.

Improved receiver performance and a better antenna would extend the limit of reliable groundwave coverage—but even so, if the "better antenna" turned out to be a beam, it would severely limit omni-directional local operation.

For 10-meter buffs who want variable frequency operation, it should be very simple to drive the crystal oscillator stage with a 7 mc VFO. A proper choice of converter crystal and tuning range for the output of the converter will provide excellent 10-meter reception in all parts of the band. For this kind of service, where re-tuning the transmitter is necessary after long QSYs, it would be desirable to put a meter permanently in the cathode of the final amplifier and perhaps a second meter in the grid return, to monitor the drive. Of course, the same meter could be switched back and forth between them, leaving suitable shunts installed in the leads to be monitored.

However, the rig described admirably meets the demands it was designed to satisfy. So I expect it to see a good deal more service before making any further modifications.

. . . W4MLE

(1) CQ, June 1959, page 39, "A Positive Peak Expander," Compton W3BSA.
(2) 73, Dec. 1960, "The Perfect Squelch" staff.
(3) "Understanding Tetrode Screen Current," QST, July 1961, page 26, Meacham—W6EMD.

Letter

Instant Conversion of BC-603 FM to AM

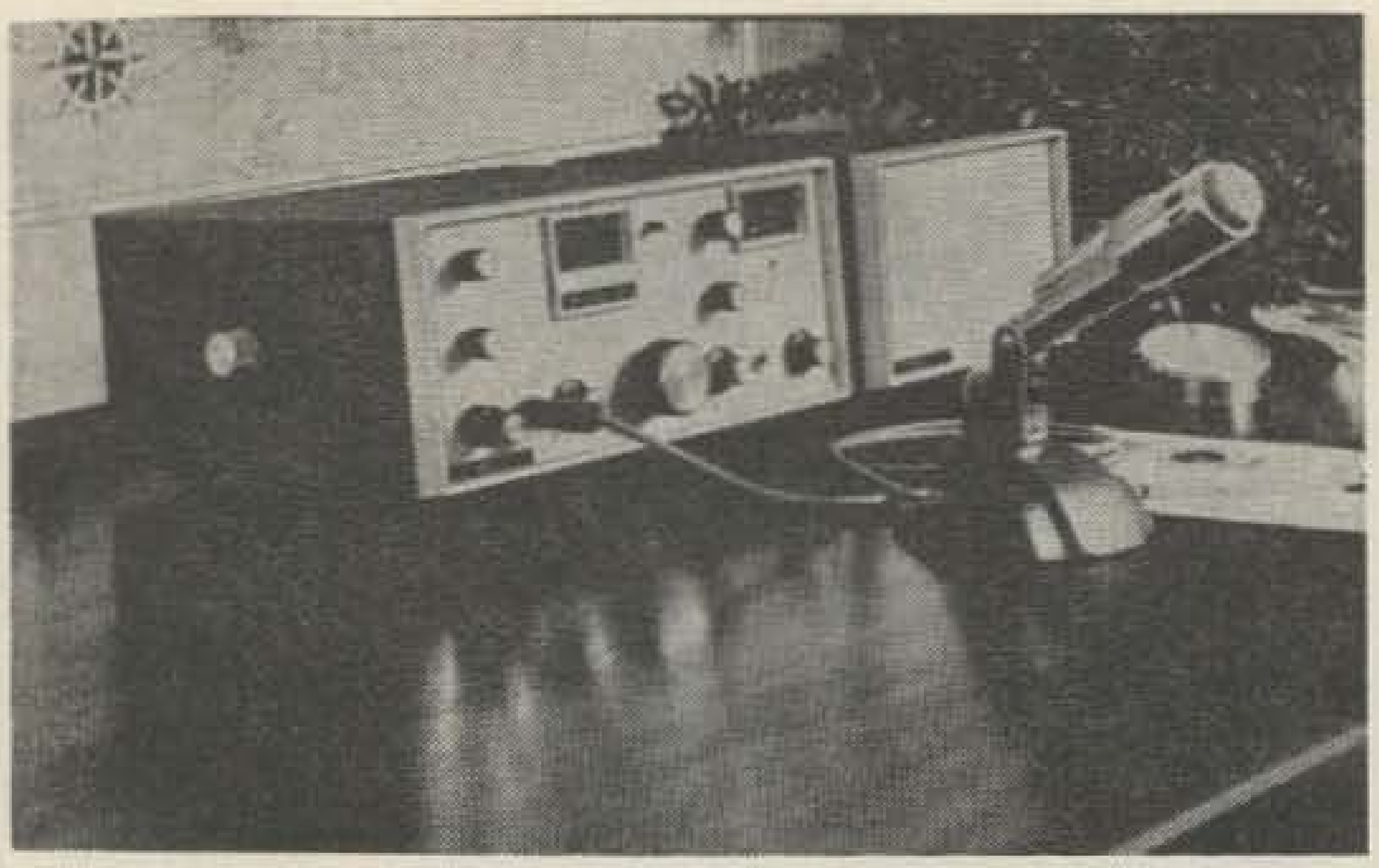
Wayne,

It takes longer to write about this conversion than it does to do it. I acquired a new BC-603 off a disgruntled ham for next to nothing, and spent nothing to convert it, RESULT, one very good Receiver for 20 to 28 mc. On the back is a socket where power and test plug is applied. JUMPER A WIRE FROM PIN 3 TO PIN 18.
LIFT EITHER END OF RESISTOR R-10.
APPLY POWER. Call lite, BFO, and Squelch all operate as usual.

. . . K9HTM

EXPIRING?

73 subscribers can easily check their date of expiration. The last two numbers indicate this: 53 means May 1963 is the last issue we will send on their subscription. N5 tells you that November 1965 is the last issue.



The NCX-3

Wayne Green W2NSD/1

The bands have been well occupied during recent months with speculation on the many new sidebands transceivers, and the new National NCX-3 tri-band job weighing in at $369 seems to have created a particular stir. The Collins transceivers put enough fellows on the air with mobile SSB rigs to show us all that this was the way to live. The appearance of the Swan single band transceiver proved that a demand had been built up for lower priced transceivers, if you can call completely sold out production any kind of proof. National obviously forecast the trend some time ago and made every effort to come up with a package that would fill the bill.

Many of us have been wondering when National would return to making transmitters, an art form that they have left alone for over twenty years now. How many old timers remember the NTX-30 push-button exciter or the National 600 transmitter? I've got the power supplies and modulator from the old 600 and they are still in daily use driving my two and six meter kilowatts. I expect they will still be going as long as I can get on the air.

Being close to Boston there was little problem in cadging an early production model NCX-3 so we could find out how much of the design of this gadget came from the engineering department and how much from the advertising agency, where it would appear in the ads but not in the finished product, a design technique not unknown in the ham field. Exhaustive tests did not uncover any overstatement of the specifications in the National ads. Indeed, they were invariably on the modest side.

First impressions are important and I must admit to being quite favorably impressed by the trim good looks of the rig, its light weight, and its solidness. The solid extruded aluminum front panel with white anodized (very difficult to scratch) finish give not only the beauty of simplicity, but help considerably to make the unit extremely sturdy for stability.

The installation took about one minute, and consisted of plugging in the power cord, the speaker/power cable to the rig from the separate supply (model NCXA), the antenna and the mike. The back lit tuning dial and S-meter not only look great in the shack, but are particularly good for mobile operation where you want to have a minimum of glare and a maximum of see.

Peaking the Exciter-Tune and PA-Tune controls on the received signal and then loading the final to 300 ma was all that was necessary to tune up the NCX-3. Switching to SSB, I called in on a QSO and was pleased to get good signal reports from all hands. The VOX circuit and anti-trip circuit worked extremely smoothly, doing a lot better job that the earlier engineering model that I had checked a couple months ago. The redesigned VOX circuit and extra stage of anti-trip amplification allowed me to turn up the gain full blast and still have the VOX work when I spoke normally in the mike.

The bandspreaded Exciter-Tune and PA-Tune controls make the tuning quite uncritical and greatly simplify mobile operation where you don't want to fuss too much while zipping along. The main tuning control is a large knob driving the tuning condenser through a 45:1 miniature Velvet Vernier with

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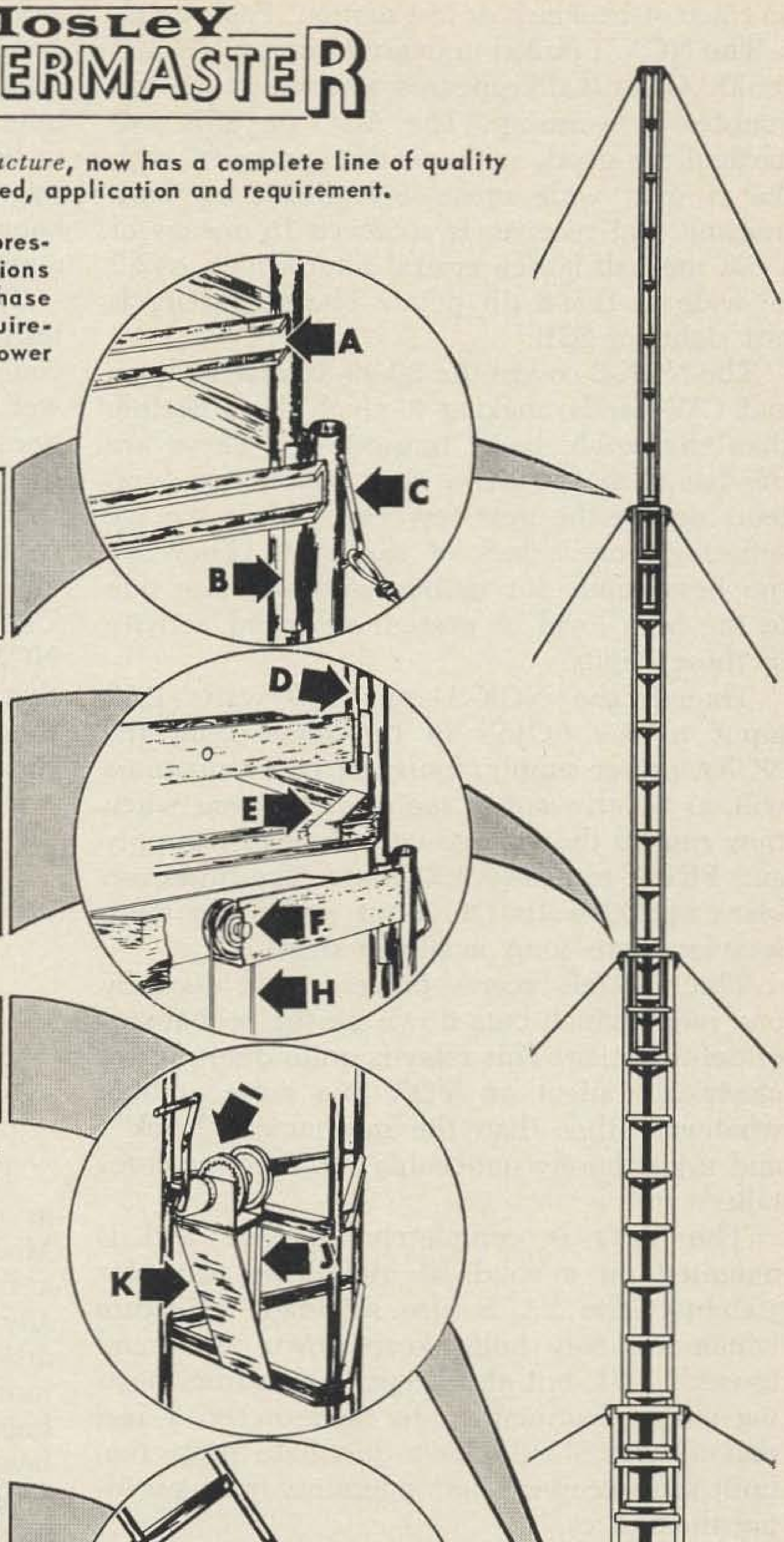

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CTL-30471	71	290	229.95
CTL-50354	54	320	245.95
CTL-40471	71	395	274.95
CTL-30588	88	390	319.95
CTL-50471	71	460	346.95
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The NCX-3 pulled in everything my NC-303 could. All drift disappeared after less than ten minutes of warm-up. The AGC on SSB was particularly good, with no thumps, even with the rf gain wide open. Selectivity, on both transmit and receive, is achieved by means of a 5.2 mc half-lattice crystal filter which is 2.5 kc wide at the 6 db point. The selectivity is just right for SSB.

The NCX-3 covers the 20-40-80 meter phone and CW bands, making it much more flexible than the single band transceivers. These are the bands that will be most usable for amateurs during the next few years while we are suffering from a lack of sun spots. They are the best bands for mobile sideband use due to the high level of present sideband activity in these bands.

Though the NCX-3 runs 200 watts PEP input to the 6GJ5's in the final using the NCXA power supply, I suspect many amateurs will, as usual, want to see what happens when they run up the voltage with their own supply and PEP it to nearly 400 watts. The tubes run black at 200 watts DC input, so I'll bet there is a lot more soup available there.

The transmit-receive process is all done by one relay, which cuts down on the probability of defunctation. This relay is quite quiet, being electrically silent on VOX (no noise audible whatever other than the mechanical "click") and a just barely noticeable "pop" on push-to-talk.

The VFO is completely shielded and is mounted on a solid ⅛" aluminum plate for stability. The PA is also shielded, a feature which not only helps keep down any trend towards TVI, but also keeps fingers from passing along electrocution to their owner. I feel that all rigs should have adequate protection built in to keep careless operators from suiciding themselves.

The ac supply (NCXA) is hernia heavy with its huge power transformer and two filter chokes. This one stays cool and has excellent regulation. I didn't try the dc supply as the rig was just on loan and I didn't want to make holes in the Porsche. It switches at 200 cycles (half the usual frequency) and gets away from the transistorized whine problem.

Though the NCX-3 is designed primarily for SSB operation, it does put out well when switched to AM. This changes the receiver over to an AM detector and you insert carrier in case you run across anyone that still can't figure out how to tune in SSB. Unlikely. On CW the VOX circuit gives very fast break-in and less than half of the first dit is clipped even with the bug bugging away at 25 wpm. The VOX Delay control lets you adjust the time for receiver recovery from between words to between letters. No sidetone is provided so you have to use a separate CW monitor or know what you are doing without one. Simple matter.

The NCX-3 did a fine job here during our tests, was easy to operate and brought in very complimentary comments. It looks nice, works well, and is certainly reasonably priced. National has done a beautiful job on their return to the transmitter field after all these years.

I guess that the biggest problem that we had with the NCX-3 during our test was that just about every ham that dropped by to see the 73 headquarters ended up mostly seeing the NCX-3, giving it a few flings on the air and then getting mad when we tried to explain that this one had to be returned to National after the test and couldn't be sold to them.

. . . W2NSD/1

Solving the Bird Problem

Robert Swearengin W5HJV
73 Staff

The radio amateur has made great strides in communications . . . RTTY, SSB, VHF, Moonbounce and project OSCAR are indeed a tribute to the fraternity. A glance through any amateur publication will reveal technical articles which command the respect of the most hardened professional. Even the average ham, who might be an English teacher or a lawyer by profession, has a working knowledge of electronics and is able to maintain his own equipment.

In spite of this, however, one phase of the art seems to be standing still. Little improvement has occurred in the CW segment of the hambands, and poor keying is as common as it was ten years ago, if not more so.

The arguments for and against CW will not be discussed here, as this is not the purpose of the article. I happen to enjoy CW personally, but amateurs compose a versatile, loose knit group and we all have our "druthers." Let it suffice to say that CW is efficient and CHEAP, and is therefore probably here to stay.

Considering recent advances in transmitter construction and design, it is difficult to understand the trend toward sloppy keying. The time was when Joe Ham would immediately zero in on one of those chirpy, buzzy signals, because Joe knew it was probably XY3PU, who didn't have a radio store around the corner, and was of necessity running a pair of surplus 5Y3's in the final. Nowadays, though, Joe tunes in only to discover (after sweating out fifteen minutes of CQ's) that the signal is being produced by good old Lewis Lid over in the adjoining county.

Now, granted it is tougher to tame a signal on the higher frequencies, but what about 80, 40, and 20? The ratio of bad signals to good, even on the lower frequencies, is certainly worthy of consideration. In fact, some evenings the low end of 20 sounds like the aviary at the Dallas Zoo.

This is no doubt partially due to the RSB* system prescribed to by many CW operators. A five kc chirp with raw ac on the final plates might bring a T8 report if the fellow on the other end doesn't happen to like your fist. This type of reporting is misleading to say the least, and is especially tough on the DX station, who often has no other means of checking out his equipment. In actuality, most hams are grateful for an honest report, and are concerned if their signals are not up to par. Perhaps some of the offenders on the CW bands don't realize that their signals are not as clean as they should be.

Oddly enough, the chirps, clicks, and backwaves do not always emanate from homebrew equipment. In fact, as often as not, a commercial job is responsible for the offensive signal. However, this can easily be rectified by a little ingenuity, a letter to the company manufacturing the equipment, or both.

Most keying problems can be solved with a minimum of effort. Certainly grid block and differential keying are to be preferred, but even oscillator keying can be perfectly acceptable with good voltage regulation. If break in operation is not desired, keying the final cathode is simple, and works quite well on smaller rigs.

So how about it, fellows? You too can have a good, clean signal which is a pleasure to copy. The ham has always had a reputation for doing a FB job with the materials on hand, and for solving his own problems. Here is an area of our hobby which needs a bit of improvement. Take an extra five minutes to check your keying with someone across town, and if necessary sacrifice that one evening's operating time to make a few improvements. Then make your next RST report an honest one . . . the ham on the other end will appreciate it.

. . . W5HJV

*Readability, Strength, and Bull

How Low can you Go?

Richard Genaille K4ZGM
719 Quarterstaff Road
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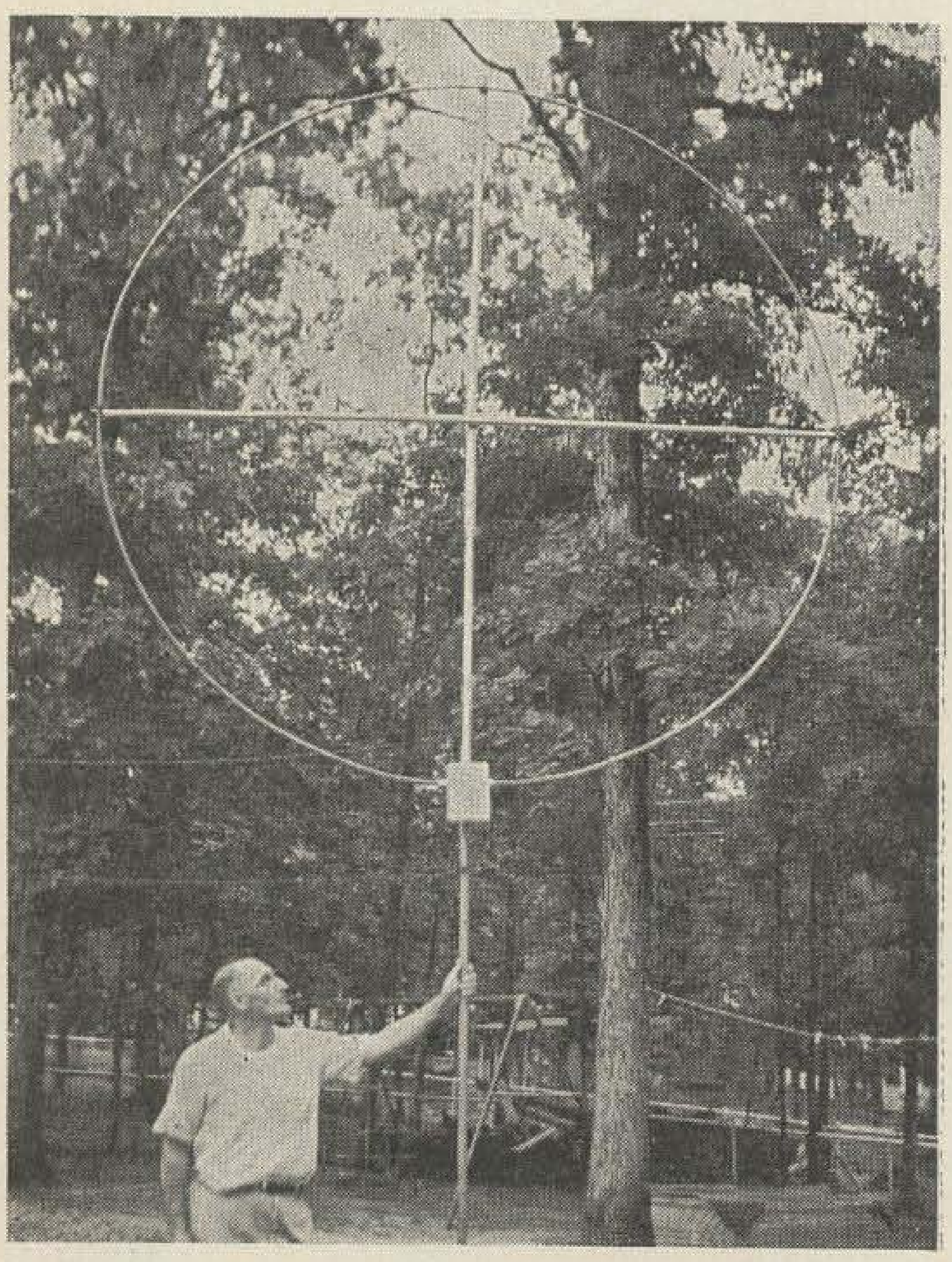
In these days of transistors and nuvistors, lasers and masers, gigacycles and nanoseconds, anyone who starts talking about radio stations operating around 15 kilocycles or below is usually looked upon as some kind of a nut. The author is no exception and, in the process of informing his engineering confreres as to what fascinating things are happening on the very-low and extra-low frequencies, is often subjected to considerable eyebrow raising. This is not surprising at all when one considers that the higher frequencies have been in the limelight for some time. Articles dealing with the radio spectrum below the broadcast band have been few and far between and, unless one subscribes to a wide variety of technical publications, it is almost impossible to realize that significant developments are presently taking place on these frequencies.



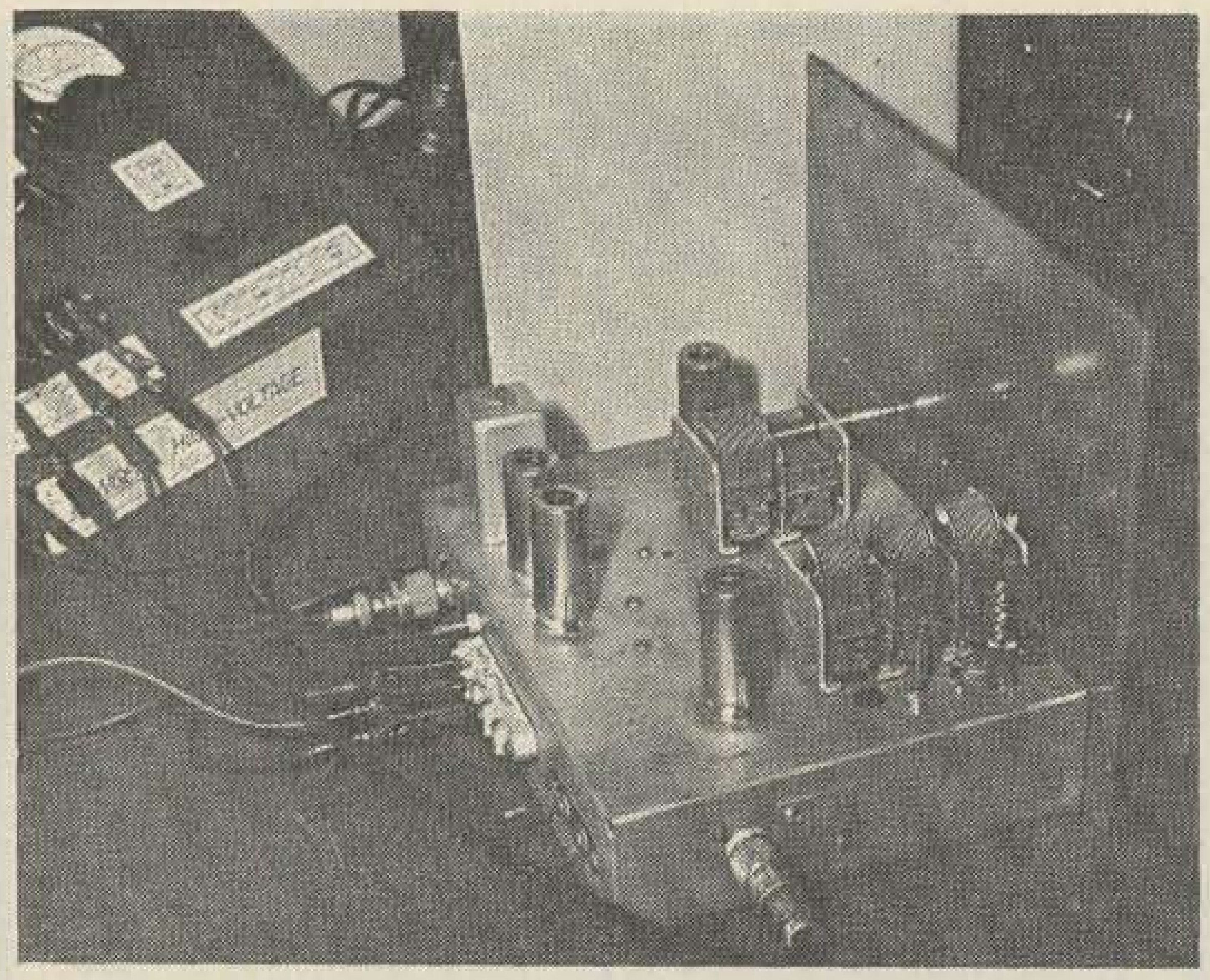
The author with VLF loop antenna (18 kc).

It is beyond the scope of this article to cover in detail all of the interesting and fascinating developments which have been and are taking place on those frequencies below the broadcast band. The author's purpose in presenting this article is to outline briefly some of the "goings on" and to provide a bibliography of recent articles that the reader can consult for further information on various phases of very-low and extra-low frequency work. It might even be possible to stir the imagination of a sufficient number of experimenters so as to produce a run of interesting construction articles on extra-low frequency experiments or on low cost, precise frequency standards for ham or shop use taking advantage of the highly stabilized transmissions of the network of high-powered VLF stations.

To get an idea as to the range of the radio spectrum with which we will deal you may wish to consult Table 1 for the frequency band nomenclature. This table is, of course, a partial listing. For those who are not in the ranks of the very-old timers the long wavelengths from about 3,000 to 23,000 meters were used exclusively in the early days of radio for transoceanic communication and are still used for specific services. Some of the early experiments of Marconi indicated that as the height and capacity of an antenna were increased, the distance over which communication could be held also increased. For this reason the wavelengths used for long-distance communication gradually increased until World War I when wavelengths of 10,000 meters (30 kc) or more were used with various types of large top-loaded antennas. During and after the war, the wavelengths used continued to increase to upwards of 23,000 meters (13 kc). Experiments made on the higher frequencies after World War I gradually proved the usefulness of the higher frequency bands for worldwide radio communication. Much of the work and many of the experiments that caused the shift to the higher frequencies came from the radio amateur. It may come as a great surprise to a number of hams to know that as far back as 1923, a single-sideband transatlantic radiotelephone circuit was in operation on 55 kc. This transmitter was operated by the American Telephone and Telegraph Company.

To determine how low one can really go let's start out with the low end of the broadcast band and see how far we can go. The frequency allocations for various services are shown in Table 2. From the low end of the broadcast band to about 415 kc we have stations operating in the maritime mobile and mobile service. The well known distress and calling frequency of 500 kc is located in this range. From 415 kc down to 200 kc we have the myriad marine radio beacons, aeronautical radio beacons and aeronautical range stations. In this range you might hear your local airport's station providing weather information or landing instructions to nearby aircraft. As is usually the case one can tune from 415 kc on down to 200 kc and find that the entire spectrum is loaded with stations. Just below 200 kc one can hear stations TUK and MSF transmitting a signal consisting of dots and dashes which, when used in conjunction with U. S. Navy Hydrographic Office Charts, can assist in determining one's bearing with respect to the stations. These stations are known as CONSOLAN or navigational aid stations. From about 194 kc down to 14.7 kc there is a multitude of stations all chattering away with CW. The listing in Table 3 is a small one of the stations usually heard by the author but it is by no means a complete listing. The author was fortunate in being able to obtain a reproduction of part of one of the international frequency lists prepared by the International Telecommunications Union and was amazed to see that there are some 500 or so stations listed for the frequency range from 100 kilocycles down to 14.29 kilocycles.

Receivers capable of tuning the low and



Simple 10 to 520 kc converter constructed by the author.

very-low frequency ranges are available on the surplus market if you do not wish to construct a converter to use with your regular receiver. Some of the popular surplus "buys" which are still available are the BC-453 tuning from 190 to 550 kc, the RAK Navy Low Frequency TRF Communications Receiver covering from 15 to 600 kc, and the BC-348 receiver which can tune the 200 to 500 kc range. The author uses a home constructed converter in conjunction with a Hallicrafters SX-96. This converter, which tunes from about 10 to 520 kc, was described in the September 1961 issue of Electronics World. More sophisticated receivers are available but are quite expensive and are used for making extremely accurate frequency and time measurements using signals from the high-powered VLF stations to be described later in the article.

Much of the more interesting work taking place in the radio spectrum is being accomplished in the very-low frequency range from 3 to 30 kilocycles and in the extra-low frequency range below 3 kc. There are several reasons for this. First, it is known that only frequencies around 20 kilocycles have the usable capability of penetrating salt water. With our Navy's fleet of Polaris submarines roaming the seas of the world there must be some dependable means of communcations provided. The Navy VLF stations are used to transmit messages to these submarines even while the subs are submerged to a depth of 90 or 100 feet. In addition to this feature, the very-low frequencies are not subject to complete deterioration as are the higher frequencies during auroral or other disturbances. In many cases of severe geomagnetic storms and other of nature's tantrums the very-low frequencies are our only means of communication with Europe and other areas of the world. The very-low frequencies have recently come into their own for the purpose of making precise time and frequency measurements. Since VLF signals are usually of the ground wave type the height of the ionosphere does not become a factor as it does for the higher frequencies. The feasibility of transmitting VLF signals on very low radiated power was established several years ago by the National Bureau of Standards station WWVL operating on 20 kilocycles from Sunset, Colorado. Radiating 15 watts, this station was heard as far away as 9,000 miles. NBS has another station operating from Boulder, Colorado on 60 kc. This station, WWVB, presently runs only 1.5 watts and can only be received using special receivers. Present plans call for an increase in transmitter power for both of these stations in the near future.

The U. S. Navy operates a number of high-powered VLF stations which are all precisely controlled in frequency. One of these stations is NBA located in the Canal Zone and operating on 18 kilocycles. NBA operates 24 hours a day and is the station most used for frequency and time measurements. To make use of the transmissions from NBA and WWVL a number of manufacturers have entered the field of VLF tracking receivers. Among these are the Textran Corporation of Austin, Texas which makes a fully transistorized VLF tracking receiver featuring phase-locked reception of VLF signals for long-term and short-term accuracy for frequency measurement. An accuracy of one part in 10^9 can be obtained in intervals as short as 30 minutes. If you want one part in 10^{10} accuracy you can get it over a 24 hour interval. To obtain this type of accuracy using the higher frequencies entails a measurement interval of many days due to the method by which higher frequency waves are propagated. Motorola Incorporated of Chicago, Illinois manufactures a frequency standard with output signals which are stable to plus or minus 2 parts in 1 billion per day. This unit provides 1 mc, 100 kc, and 10 kc output signals. The VLF secondary standard is phase-locked to either WWVL or NBA. Considerable work continues to be done to improve means for obtaining precise time and frequency measurements. The need for this extremely high accuracy is dictated by the future use of satellites for making more precise geodetic measurements. The accuracy with which these and other satellites may be tracked is of prime importance. Work is now being done to utilize the 100 kilocycle LORAN-C stations transmissions as a means of providing precise time for large areas of the world. For those who may feel the urge to come up with a low cost professional type frequency standard making use of the transmissions of the VLF stations the author would recommend some of the articles listed in the bibliography. Some additional information on making VLF frequency comparisons may be had for the asking from the Hewlett-Packard Company in Palo Alto, California. Application Note 50 describes methods of making measurements using H-P Laboratory equipment. The General Radio Experimenter for June 1962, published by the General Radio Company of West Concord, Massachusetts, discusses in detail VLF standard frequency calibration. For those who wish to know more about Universal Time (UT), Ephemeris Time (ET), and Atomic Time (AT) plus an abundance of other information on Frequency and Time Standards, Hewlett-Packards Application Note 52 is a handy publication to have around.

Not too many years ago it was believed that lower frequency radio waves would be impeded by the ionosphere from passage into outer space. The ionospheric barrier or shield becomes essentially negligible above about 100 megacycles accounting for the wide use of the VHF for telemetering functions in connection with satellite work. On February 21, 1961 a two-satellite combination was launched from Cape Canaveral. One satellite was the Navy's Transit IIIB and the other LOFTI I. The LOFTI I satellite was to have separated from the two-satellite package for the purpose of making certain low frequency tests. Unfortunately, proper separation did not take place which prevented the programmed sequence of events from taking place. Only certain tests were possible under the circumstances. LOFTI I is one of a series of Navy satellite experiments to determine the extent of very-low frequency penetration of the ionosphere hence the name LOFTI for LOw Frequency Trans Ionospheric. The orbiting of LOFTI I proved that VLF radio energy transmitted from the earth was present in the ionosphere in useful amounts. LOFTI I received the 18 kilocycle transmissions from several stations during its orbits. Signals were received as far away as 10,000 miles from their source. The findings of this test have given additional impetus to the investigation of possible use of VLF for communications between the earth and outer space.

A round-up of VLF information would not be complete without a few details concerning one of the Navy's newest VLF stations NAA in Cutler, Maine. The former NAA was originally located in Arlington, Virginia and was quite well known to the old timers many of which copied their first CW from this station. Some years ago the station in Arlington went off the air. It is quite appropriate that this famous call be used at another station which is somewhat on the spectacular side. NAA is now back on the air with a rather loud voice, 2 million watts, and on 14.7 kilocycles. This station has a tremendous range and is capable of transmitting to submerged submarines in almost all parts of the globe. The size of this monster is hard to believe. The antenna is made up of 64 miles of one inch bronze antenna wire. This wire is supported by some 26 towers ranging in height from 800 to 980 feet, nearly as high as the Empire State Building in New York City. The antenna insulators are over 70 feet long. To maintain and correct antenna tension and strain from wind and ice loading the counterweight towers carry counter balances of 202 tons each. The ground radial system, which is partially under sea water, consists of over 11 million feet of copper wire. As if the facts concerning the antenna system itself were the ultimate, some facts regarding the transmitter are no less startling. Four separate final amplifiers running 500 kilowatts each provide total final amplifier power of 2 million watts. The helix house which houses antenna coupling and de-icing equipment is 8 stories tall and contains a helix coil 20 feet in diameter and 40 feet tall wound with 3½ inch diameter Litz wire. The coaxial matching section is so large in diameter that a full grown man can stand comfortably inside the section. Curious enough, keying of these high-powered brutes on the very-low frequencies is limited to as low as 25 words-per-minute due to the normal Q of a VLF antenna system. The author has heard that all "Harry" breaks loose if these transmitters are used to transmit information requiring greater bandwidth than that which is provided by the antenna system.

Several additional VLF stations have been proposed for installation in the very near future. The Navy plans to install another high-powered station to be located in Australia. NATO is planning to build a high-powered VLF station on the coast of Northumberland in England. This station, which will operate on 19 kc, is to be used for high reliability radiotelegraph transmissions to ensure that transmissions will be immune as possible to the effects of ionospheric disturbances. The power to be delivered to the antenna will be in the neighborhood of 500 kilowatts.

The 3 to 30 kilocycle region was formerly known as the frontier of the electromagnetic spectrum until just recently when lower frequencies were successfully transmitted over a considerable distance in connection with a long-range Extra-Low Frequency study being made for the U. S. Air Force. A 400 cycle-per-second signal was transmitted from Boron, California to El Paso, Texas, a distance of approximately 750 miles. This was accomplished by the use of a 300 kilowatt output 400 cycle alternator for a transmitter and an antenna 2 miles long. These tests were conducted to prove out a theory that long-range ionospheric propagation could be achieved at extremely low frequencies. As far as the author can determine, this is the lowest frequency transmitted over such a range by man-made equipment. Someone at this point is sure to wonder why, with 300 kilowatts of 400 cycle signal originating in Southern California there are not a flock of people running around with ruptured eardrums. It's awful easy to get sucked in on this business of why can't you hear these signals when they are in the audio range. The answer is pretty obvious. It depends on the medium of propagation. If the 300 kilowatts of 400 cycles were coupled to a loudspeaker capable of handling that amount of power there would be a lot of people with severe ear trouble near Boron, California. Fortunately this power was coupled to the atmosphere through the use of an antenna. Enough said.

Below 400 cycles one can only surmise what may eventually take place. It has been suggested that a high-power station operating on a frequency of about 10 cycles may overcome the lightning noise over the entire earth to provide worldwide communication which will be independent of diurnal cycles, sunspots, auroral conditions and other disturbances which can completely wipe out higher frequency communications at times. Some interesting natural phenomenons occur in the frequency range of from 300 to 15,000 cycles which are being investigated by scientists. These are the "whistlers" and sferics caused by lightning and other disturbances which generate considerable electromagnetic energy. The bibliography contains several articles covering these interesting signals generated by Mother Nature.

How low can you go? We had better quit while we are ahead. Experiments are now underway in several countries where they are trying to do something with the resonant cavity formed by the earth's surface and the ionosphere. Observations have been made of this cavity resonance and it has been determined that the fundamental frequency is about 7.8 cycles-per-second with a Q of about 4. The author sincerely hopes that no one succeeds in setting up a 7.8 cycles-per-second oscillation in this cavity of ours or we will all wind up with scrambled brains.—How low can you go?

. . . K4ZGM

Table 1. Frequency Band Nomenclature

Frequency Range	Frequency Subdivision	Wavelength (Meters)
Below 3 Kilocycles	Extra-Low Frequencies	Above 100,000
3-30 Kilocycles	Very-Low Frequencies	100,000-10,000
30-300 Kilocycles	Low Frequencies	10,000-1,000
300-3000 Kilocycles	Medium Frequencies	1,000-100

Table 2. Frequency Allocations For Various Service

Kilocycles	Service
10-14	Radio Navigation
14-90	Fixed, Maritime Mobile
90-110	Fixed, Maritime Mobile, Radio Navigation
110-160	Fixed, Maritime Mobile
160-200	Fixed
200-285	Aeronautical Mobile, Aeronautical Navigation
285-325	Maritime Navigation (radio beacons)
325-405	Aeronautical Mobile, Aeronautical Navigation
405-415	Aeronautical Mobile, Aeronautical Navigation (radio direction finding)
415-490	Maritime Mobile
490-510	Mobile (distress and calling)

Table 3. Typical Very-Low and Low Frequency Stations Heard By The Author

Station Call Sign	Location	Frequency	Power
NAA	Cutler, Me., U.S.A.	14.7 kc	2 megawatts
GBR	Rugby, England	16.0 kc	300 KW
FUB	Paris, France	17.0 kc	———
NBA	Summitt, C.Z. Panama	18.0 kc	300 KW
NPG/ NLK	Jim Creek, Wash.	18.6 kc	1 megawatt
NPM	Lualualei, Hawaii	19.8 kc	500 KW
WWVL	Sunset, Colorado	20.0 kc	15 watts
NSS	Annapolis, Maryland	22.3 kc	500 KW
WWVB	Boulder, Colorado	60.0 kc	2 watts
MSF	Rugby, England	60.0 kc	10 KW
GYC	Whitehall, England	78.2 kc	———
NHY	Pt. Lyautey, Morocco	112.0 kc	———
WSL	Amagansett, New York	113.0 kc	———
CFH-L	Halifax, Nova Scotia	115.3 kc	———
NSS-WM	Annapolis, Maryland	121.5 kc	———
CFH-LA	Halifax, Nova Scotia	132.5 kc	———
CKN	———	133.0 kc	———
WCC	Chatham, Massachusetts	147.5 kc	———
MSF	Cape Hatteras?	———	———
TUK	Nantuckett, Massachusetts	194.0 kc	———

(Continued on next page)

HOW LOW CAN YOU GO BIBLIOGRAPHY

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High Efficiency Switching

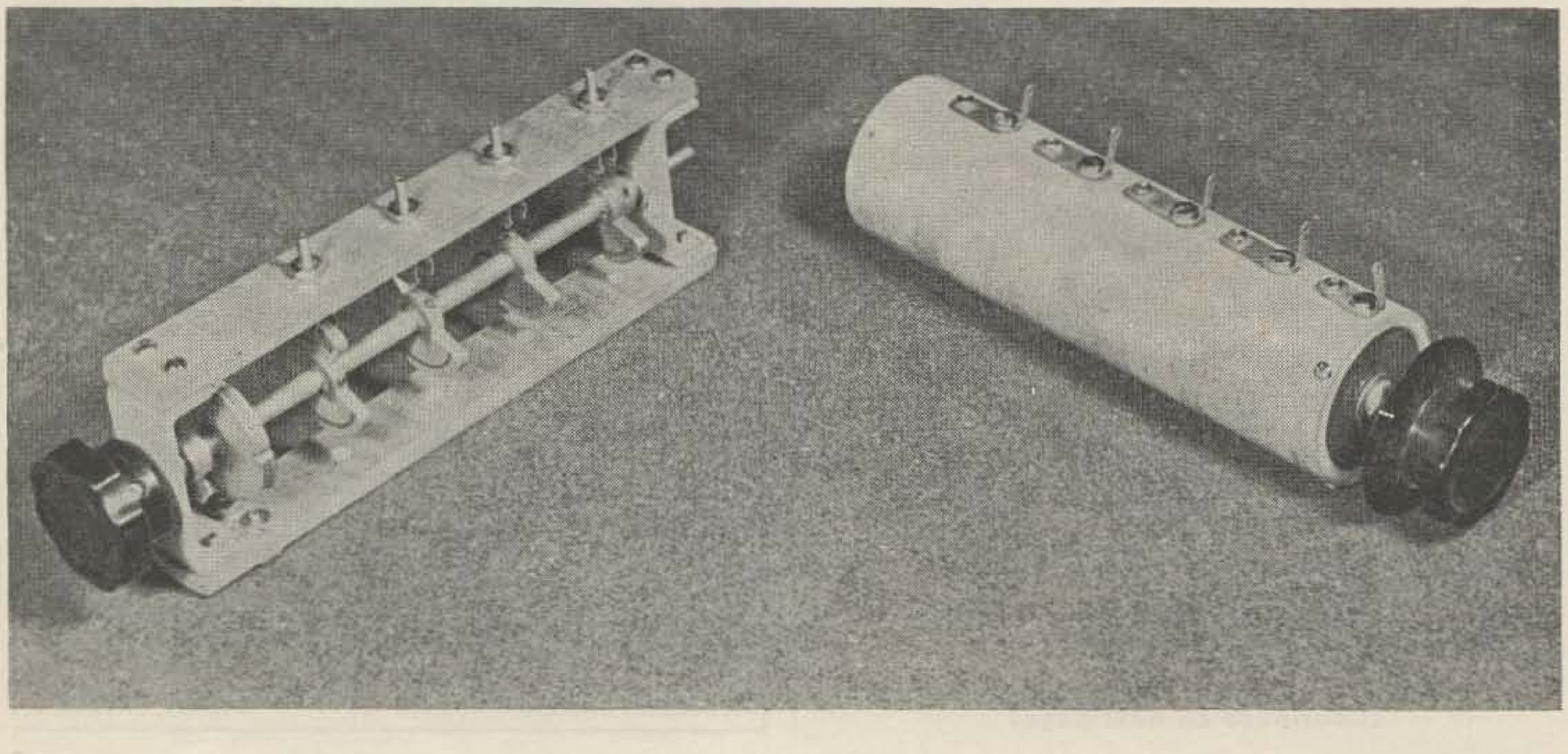
Roy Pafenberg W4WKM

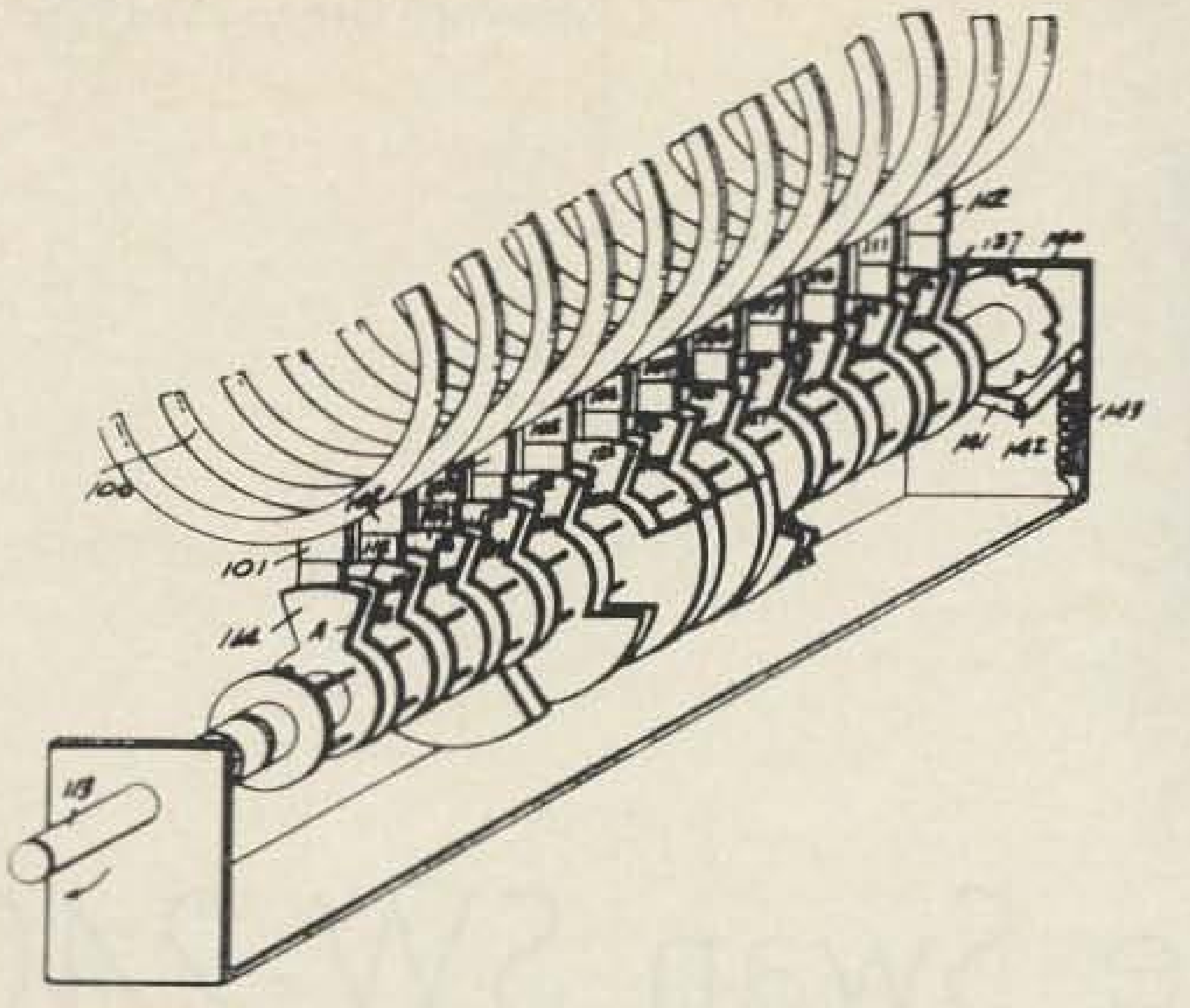
Many methods have been devised for the switching of higher power rf tank circuits but they all have certain disadvantages. The system shown in the photograph is a simple, straightforward answer to many of the problems. The basic device consists of a number of segmented disks secured to a common conductive shaft. The segments are arranged so that, with a coil tap connected to the contact for each disk, the coil is progressively shorted out as the shaft is rotated. The shaft contact is connected to the low impedance or rf ground point of the coil, depending on the circuit used.

The photograph shows two versions of the switch. The open frame model is designed to be mounted parallel and immediately adjacent to the rf coil, with the coil taps directly connected to the disk contacts using short heavy leads. The other model is assembled inside of an insulating tube and is designed to be inserted through the center of a coil.

Advantages of this switching method are obvious. An efficient and direct rf path is established through the low resistance contacts, segmented disks and the conductive shaft. This is in contrast to the circuitous rf path which exists when conventional tap switches are adapted to progressive coil shorting applications. Further, the physical arrangement may be made so that the relatively short coil tap leads do not materially change the resonant frequency of the tuned circuit.

This switching system was devised by Jack Bowden, W4SYJ, to replace the manually installed shorting bars on the inductors used in





the PA and IPA stages of a Press Wireless 15 KW high frequency transmitter. The drawing shows the switch configuration which was used in the push-pull final stage.

The basic system is protected by US Patent 2,493,746 and the "inside the coil" version is the subject of current patent action. Amateurs with access to machine shop facilities are welcome to apply the design as they wish. Manufacturers interested in securing manufacturing rights should contact W4SYJ directly.

. . . W4WKM

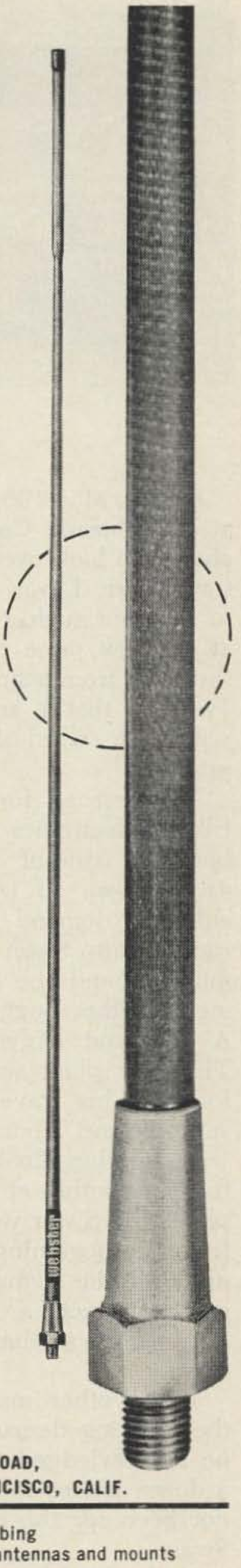
Photo Credit: Morgan S. Gassman, Jr.

Parts Sorting and Storage Trays

Segregation and storage of small parts used in construction projects can be a real problem, particularly with the miniature components now in common use. One "no cost" answer to this problem is shown in the photograph.

The top of an ordinary egg carton may be removed and the tray used for sorting components or hardware. If extended storage is contemplated, the lid may be left on to keep out dust and to permit stacking of the cartons.

Photograph by: Morgan S. Gassman, Jr.



Wayne Green W2NSD/1

The Swan SW-240

Back in May 1961, when I met Herb Johnson at the Phoenix Convention and had my first chance to look over his then brand new Swan transceiver, I was surprised that he was able to turn out such a piece of equipment to sell at the low price of $275. Herb was turning them out from a small plant in Benson, Arizona (where's that?) and hardly able to keep up with the word-of-mouth demand for the product.

The first ad for the Swan was placed by Elliott Electronics in Phoenix in the September 1961 issue of 73. This really put the skids under them to try and keep up with the enlarged demand. Sideband operators began running into Swan users on the air in growing numbers and the enthusiasm of these "salesmen" further bogged things down at Benson. A new and larger plant was badly needed. The new plant was put at Oceanside, California. This gave much better sources of supplies and labor.

When they finally got things running relatively smoothly at the new plant the first ads placed by Swan were run in July 1962. Right from the beginning they were unable to keep up with the demand. The combination of a good product, a low price and a pent up demand for sideband transceivers made things click.

While other manufacturers were aware of the growing demand for transceivers, it must be acknowledged that we wouldn't have over a dozen makes to choose from today if it had not been for the extraordinary success of the Swan.

Herb clearly saw the coming of the multiband transceiver, so new Swan 240 tribander has now replaced the three single band models. It is hard to believe that the price of this tribander is only $45 more than the monobanders. The price of the 240 was kept low by the rather ingenious method of building a sideband transceiver that is designed specifically for that: sideband transceiving. The unit covers all three currently usable SSB bands, has adequate power to be used barefoot, and does not push up the price tab by trying to be all things to all people.

If you do want to use the 240 for AM operation the instruction book explicitly tells you how to make the additions and small changes necessary for this. Isn't this better than putting it in for everyone and adding another $25 or so to the tag? CW ops can easily install grid-block keying according to the instruction book modifications and even extend the range of the 20 and 80 meter bands to cover the CW segments. The 240 normally tunes and transmits lower sideband on 40 and 75, and upper sideband on 20 meters. Since almost all of the SSB operation on these bands observes this custom, the need for switching sidebands is rare. The chap who does want to be able to switch can order a simple kit to add to his 240 which will enable him to get on the wrong sideband and wonder why no one comes back to him.

One of the major problems that has bedeviled ham manufacturers is drift. Commercially built ham sideband gear was virtually impossible just a few years ago due to the warm-up and operating drift inherent in receivers and VFO's. Though these problems have been drastically reduced by modern components, circuits and mechanical designs, we still have not been able to produce a driftless rig. Swan's 240 has an interesting approach to this problem. They do everything possible to keep drift to an absolute minimum and then provide you with a trimmer so you can introduce positive or negative temperature compensation to correct for any variation in components or in aging changes. Perfectionists should have a lot of fun with this little feature.

The 240 watt PEP of the Swan apparently caused some dismay in the sideband transceiver manufacturing field where everyone watches the other fellows power claims about as carefully as the car manufacturers watch the horsepower claims of competitors. As I understand it, Swan had to get a signed note from RCA saying that 240 watts PEP didn't exceed their ratings for the 6DQ5 before certain magazines would accept their advertising. Heh, heh! I wonder what you can really run to the 240 if you start using ham-type inputs to the rig instead of commercially approved inputs? So the tube blushes a little when you yell, remember what we used to do to 6L6's? On the other hand, 240 watts PEP is about the same effective juice as you put out with an AM kilowatt . . . and for many years this was considered pretty fancy.

There is another factor to be considered here too . . . that little old car battery. Even a heavy duty battery may get kinky if you try to run too much power while mobiling. Alternator systems will soon be popular and perhaps we can at that time give more consideration to the idea of running higher mobile power, with the higher cost of the power supply, etc. For the present the Swan would seem to be a good compromise, running as much power as possible without putting a killing strain on the car system.

Installation

The 240's mounting bracket (included with the transceiver) can be quickly bolted under the dash of almost all cars. The 5½" heighth doesn't force you to wear knee-pads. The loudspeaker of your car radio can be hooked in so a second separate speaker is not needed. The power unit can be bolted to the firewall behind the engine or on one side under the hood, with the power cable feeding through to the rig. The whole installation really shouldn't take more than two or three hours once you get the tools out and get at it. You'll probably spend more time putting in the antenna than the rig.

Well?

We tested the Swan 240 here at the 73 HQ hamshack for several days and were very pleased with it. The reports were more than satisfactory from the chaps we contacted and we could find no advertised specifications that were exaggerated. We all agreed that we really enjoyed using the Swan.

. . . W2NSD/1

Stimulus in the Space Age

Howie Ryder W1WQH

"I wish ideas were born from boredom," I said to Paul W1YPZ as we sat in the Maintenance Shop at Hanscom Air Force Base, Bedford, Massachusetts. I had just returned from England after being stationed there for four years and Paul was back from Labrador. We were off duty today, but we had gone to the Maintenance Shop to read the Bulletin Board. "Let's do something really unique . . . what hasn't been done yet, Paul?" I asked anxiously. "How's about launching a rocket full of Ham gear to the moon?" replied Paul jokingly. "That's it, buddy," I exclaimed, suddenly remembering an incident that I had seen in England. "Let's brew up a 2 meter transmitter and launch it with a balloon. Back in England a couple of "G's" made a little 2 meter transmitter and launched it to 52,000 feet and it was heard 59-plus all over the British Isles. Just think, Paul, we could launch a Slow-Scan Television Camera, or a movie camera, or use Amateur Telemetry just like they do at Canaveral to measure humidity, temperature, barometric pressure, light intensity, or launch a telescope with a camera to see the moon without the distortion of 99% of the atmosphere, or we can take a picture of the sun with the stars out, and . . . and . . . " "Hold on, Howie, we will devote our lives before we even do one of those projects you mentioned," Paul said with apparent enthusiasm in his voice. "Well, Paul, you have been talking of making a computer if you had a use for it; here's your justification." I said coyly.

In no time at all we arrived at the Weather Station of a near-by radio site. After introducing myself and explaining our tentative projects, the Maintenance Chief gave us an old Radiosonde Modulator with the barometric switch and calibration sheet and a 9 foot balloon. He also invited us to launch the balloon from his site as they have a Neems-Clark VHF receiver and can prepare the NOTAM for us. A NOTAM is a notice to all Flight Facilities that an unusual occurence will take place in an airway. This must be filed in advance of any tentative airborne project to the CAA including a complete description of the craft. THIS IS A MUST. Another point worth mentioning is that the object must have an infallible parachute if it is intended to be flown over land.

We arrived back at the shop and I was already planning on launching of a movie camera. I was ready to ask the members of the MARS station to donate for the purchase of an 8mm movie camera at the local pawn shop. Luckily, Paul had been in charge of Photographic Hobby Shop in Labrador and mentioned the possibility of the camera swaying like a pendulum or twisting uncontrollably, and as we had no idea of the light intensity up there we couldn't get the proper settings on the camera, and retrieving it was almost impossible without elaborate tracking equipment. Telemetry could tell us everything except if we could retrieve the payload. The most important consideration on the retrieval is the winds aloft and how they will affect our balloon. The balloon is entirely at the mercy of the winds, and it will travel as fast as the wind. The only man that we knew that could give us this information is the weather forecaster at the airport. When we arrived at the weather station desk the forecaster wasn't there so we looked at the charts on the wall as we waited. The chart that caught our eye gave the winds aloft, their speed and direction, as well as the temperatures. At 30,000 feet the temperature was minus 45 centigrade and the wind was coming from the northwest at 200 mph. Discouraged at this, we started to leave when the forecaster arrived. We told him of our tentative project and he proceeded to plot a free rising object from the ground to 70,000 feet. The resultant of all winds would make the payload drop about 15 miles west of here. Wow, that shot the spark in us again!!

We listed the information that the balloon payload was to tell us:

1. Altitude above sea level
2. Light Intensity at 50,000 feet
3. Pitch and yaw of payload
4. Possibility of recovery

To do these things we found it was best to take one at a time. The altitude indicator was the easiest to tackle. We had the barometric switch that we had removed from the radiosonde modulator that we were given. This switch is nothing more than an aneroid barometer with the expanding diaphragm pushing a rod that acts as a contact of the switch. As the pressure decreases outside, the air inside the sealed cannister pushes the sides of the cannister. This movement of the sides is amplified by a long rod on a pivot near the cannister, so a minute change of expansion of the cannister results in a noticeable change at the end of the arm. This arm slides along a piece of bakelite that has minute wires, about #24, running across the bakelite. The arm slides across one wire, then it hits the bakelite, and on to another wire, making and breaking the circuit as it travels. We made this switch key an audio oscillator of 230 cps. The output of the oscillator would go to the grid of the crystal transmitter oscillator to frequency modulate it. On the ground we would take the audio from the speaker output jack in the receiver and hook it to a modified VOX circuit. This audio discriminator consisted of nothing more than an audio pre-amp (12AX7) and another amplifier (6C4) with a parallel tuned circuit in its grid to ground set for 230 cps and a 10,000 ohm relay shunted by a 20 mfd capacitor in its plate circuit. When 230 cps was received it would pass thru the amplifier and energize the relay putting on a light. Any other frequency would not energize the relay because the circuit had a very hi-"Q."

The measurement of the light intensity required a little thinking on our behalf. We finally decided to use a multivibrator circuit. The light picked up by the photocell would generate a minute voltage which we fed to a dc Amplifier. The output of this amplifier went to a multivibrator that was voltage sensitive. The varying voltage varied the frequency of the multivibrator from 10 cps with no light applied to 130 cps with intense light focused on the cell. On the ground we were to utilize the same receiver's audio output and feed it into a band-pass filter to an amplifier. The amplifier had a pre-emphasis circuit using a diode as a resistor. As the frequency was increased, the tubes plate current was increased. We calibrated the meter by laying a photographic light meter next to the cell and taking a reading on the light meter and calibrating our meter. The accuracy was outstanding.

Finally we came to the pitch and yaw problem. This was conquered by utilization of a mercury switch with one common and two poles. If we tilted the switch one way, it would parallel a capacitor with the common capacitor and lower an audio oscillator to about 1 kc. If it tilted the other way a different capacitor would be switched in parallel and it would lower the frequency to 850 cps, and if the payload was rising steady, we would get a tone of 2 kc. The receiving section was the same principle as our altitude detector with different resonant filters in the grids.

Identification was performed by a motor driven coder-keyer from war surplus. Every eight minutes the carrier would be interrupted and ID would come out in CW. DE W1-WQH/1. (ID may be eliminated if the FCC in Washington, D. C. authorizes it in writing; we didn't try.)

The big day came with all the glamour of Lt. Col. John Glenn's trip to space. We bought two tanks of helium for $13.50 and inflated the balloon. Then the pre-flight came. After checking the parachute release (this consisting of a thread hooked to an opened drag chute that would break by wind pressure and allow a big master chute to open up), we checked all the telemetry equipment and it was "GO." We had made a helical antenna as described in the VHF HANDBOOK.

The transmitter was a 6C4 operating crystal-controlled on 147 mc. and had a power input of 250 milliwatts. We fed all the signals from all the oscillators to the grid and FM'ed it. There was absolutely no signs of mixing at all.

Paul released the balloon and it leapt skyward. I watched the panorama of lights pretending that I was the key controller at the Canaveral launching. The light intensity meter went beserk as the cell was aimed toward the ground and then the sky. The Pitch and Yaw lights were beautiful, the ones to the right and left were red and the center was green, and it dashed from red to green to red so fast that I could hardly distinguish them going on and off. The Altitude light blinked on and off rapidly as each time it went on meant the balloon had traveled 750 ft. It was rising at 1300 fpm. We were tape recording the audio in full from the receiver so we could play it into the console again to double check. We also wanted to note any audio drift due to the extreme temperatures it was going to be hitting. The swaying slowed down a bit at 10,000 ft., and went really crazy at 30,000 ft. (I'd hate to be in a balloon at 30,000 ft.). At 40,000 ft. the swaying almost stopped, and as we hit 50,000 ft. the Pitch light was always in the green. A quick call to the weather forecaster told us that the winds at 50,000 ft. were only 3 mph. The light intensity meter read that if we set a camera of F 16 at 1/50 second shutter speed we would get a glorious picture in color. I bet the sight was beautiful. A SWL buddy in Maine heard the signal 59 plus and he was 450 miles away.

All of a sudden everything went haywire. All the lights were flashing like mad. I grabbed the headphones and the transmitter sounded like someone was wringing the oscillator's neck. The balloon had broken at 62,000 ft. and the air was so thin that there wasn't enough pull on the thread to pop the master chute; the drag chute doing the pulling. It was falling mighty fast. We found out later that it was coming down at about 235 mph. Then the lights slowed rapidly and began a descent of 250 fpm. The master chute had opened. We lost communications two minutes later as it got pretty low. I've been thrilled before, but that was definitely the biggest. Everything worked perfectly.

Two days later we received a phone call from a kid in Maynard, Mass. saying he had found the balloon in a field there. We had our telephone number on it. It was pretty well together when we got there, only 12 miles airline from where we launched it. The secret is to have enough lift to get it out of the jet stream as fast as possible, or it'll be leaving you at 200 miles per hour. Total flight time was 1 hr. 45 minutes. Whotta' ride!!

We're almost finished with our camera payload. We are using three balloons because we are aiming at 120,000 ft. We will also be able to release the balloon as soon as the film is gone. I'll be sure to send a photo to Wayne Green and I hope he'll show it to the readers for us. I am also hoping that we, the "hams" of the United States, can contribute as much to the new science of telemetry as we have to the field of communications itself. I urge any club that wants to get out of the rut, and to become scientists instead of technicians, to utilize instead of operate, to make an inexpensive attempt at this new field . . . AMATEUR TELEMETRY.

. . . W1WQH

160 Meter Band Changes

Area	Maximum DC plate input power in watts 1800 to 1825 kc and 1875 to 1900 kc Day	Night	1900 to 1925 kc and 1975 to 2000 kc Day	Night
Ala., La., Miss., Puerto Rico, Virgin Islands, and other U. S. possessions in the Caribbean sea area	No operation		100	25
Alas.	200	50	No operation	
Ark., Ill., Kan., Mo., Okla.	100	25	200	50
Ariz., Col., Ida., Mont., Nev., N. M., Utah, Wy.	200	50	500	200
Calif., Hawaii, Ore., Wash., and Baker, Canton, Enderbury, Guam, Howland, Jarvis, Johnston, Midway and Palmyra Islands	No operation		500	200
Conn., District of Columbia, Del., Mass., Me., Md., N. H., N. J., N. Y., Penn., R. I., Vt., Wake Island	500	200	No operation	
Ind., Ky., O., Tenn.	100	25	100	25
Ia., Minn., Wisc.	500	200	200	50
Neb., N. D., S. D., American Samoa	500	200	500	200
N. C., S. C., W. Va.	100	25	No operation	
Mich.: Northern peninsula ..	500	200	200	50
Mich.: Southern peninsula ..	500	200	100	25
Tex.: East of 105 degrees W	100	25	200	50
Tex.: West of 105 degrees W	200	50	500	200
Va.: Arlington and Fairfax counties and city of Alexandria	500	200	No operation	
Va.: All other than above ..	100	25	No operation	
Fla.: The counties Columbia, Union, Bradford, Putnam, Lake, Osceola, Okeechobee, Martin, Palm Beach, Broward, Dade and counties to the east of these	25	25	No operation	
Fla.: The counties Hamilton, Suwannee, Gilchrist, Alachu, Marion, Sumter, Polk, Highlands, Glades, Hendry, Collier, Monroe, and counties to the west of these	No operation		25	25
Ga.: The counties Union, Lumpkin, Hall, Jackson, Barrow, Walton, Morgan, Putnam, Baldwin, Wilkinson, Laurens, Wheeler, Telfair Coffee, Atkinson, Clinch, Echols and counties to the east of these ...	25	25	No operation	
Ga.: The counties Fannin, Gilmer, Dawson, Forsyth, Gwinnett, Rockdale, Newton, Jasper, Jones, Twiggs, Bleckley, Dodge, Wilcox, Ben Hill, Irwin, Berrien, Lanier, Lowndes and counties to the west of these	No operation		25	25

Letter

ELEPHANTS HAVE THE RIGHT OF WAY

Dear Wayne,

I have noted over various issues of 73 Magazine, your interest in Motor Rallies, so am enclosing details of the East African Safari which I hope 73 readers and yourself may find of interest.

Briefly, the Safari is organised by the Royal East African Automobile Association, and is run on a yearly basis usually over the Easter Holiday week-end. The next Safari will therefore be between 11th and 15th April, 1963.

The course is held over East African roads which can vary from a good tarmac surface to rough murram. Road conditions depend a great deal on the weather experienced —it is usual however, to expect rain at some time and place over the 3,000 mile course. The course also varies in altitude from sea level to around 9,000 feet above sea level. These are, however, details with which you personally are probably aware Wayne, and I am therefore writing primarily from a Radio Amateur's interest in the Safari.

Each year the Radio communications around the course are handled by members (and other volunteers) of the Radio Society of East Africa and the Uganda Radio Club.

Because of the nature of the terrain and sparsley inhabited parts of the course, telephone communications are not always available. Radio Mobile stations are therefore set up at strategic control points, where cars are scrutinised and times checked etc. by the Safari Officials. The details are then transmitted back to Nairobi, where the main Safari control point (the start and finish of the Safari) is situated. In this way, it is possible to keep a close check on the positions of the participating cars.

The main safari control point is then able to operate a progress board, which is available for the general public, news broadcasts, etc. In practice our Mobile Stations work on a frequency of around 7070 kc/s with a S/By frequency in the 80 metre band.

Three main stations are usually set up in the three main communication centres and towns of the three Territories of E. Africa—KAMPALA (for Uganda)—DAR-ES-SALAAM (for Tanganyika) and NAIROBI (for Kenya—also the Radio Control Station). These three main stations are usually sited in as far as possible good radio positions, and operate with as much power as possible to the legal limit of 150 watts. The main stations work the mobiles in their own particular countries, then work back to Nairobi control. It should be mentioned here that due to the lentgh of the safari, Kampala (Uganda) will have closed down by the time the cars enter Tanganyika, and Dar-es-Salaam is ready to feed back reports to Nairobi.

The mobiles consist of anything and everything the E. African Amateur can press into service. Equipment ranges from war surplus battery transreceivers to "Maradadi" commercial gear. Where mains supplies are available, they are naturally preferred as sites so that mains supply mobile stations are occasionally located in the local "pub" (which may be on the grid or have its own generator), some small distance from the official check points or controls. Other mobiles "set up shop" at the side of the road with an aerial strung from the nearest suitable tree.

Power inputs therefore, range from a couple of watts up to the legal limit. Ingenuity is paramount—one stalwart who found out there was a mains supply at his official control point, took along a BC.610 in the back of his car (suitably modified for 150 watts—of course!!!). We were faced with a rock-crushing signal from the bush which made the local main station look rather silly!—we still haven't found out how he managed to get a BC.610 in the back of a car.

Another operator faced with a site with no suitable buildings or trees, finished up with the aerial tied to a bamboo pole lashed to his car—still another had a 30′ whip waving in the breeze. Amazingly enough, these occasional necessary lash-ups do work, and are a credit to the Amateurs participating in an operation which, from a radio point of view, includes some very difficult sites.

In view of the number of control points and radio mobiles required (we operated 32 stations last year), it is usually necessary that some members operate more than one station. Although there are about 60 licensed amateurs in E. Africa, it is obviously not possible for all to be available for the whole Easter Holiday period of 3 days. Thus, some participants open up a mobile, then when all the traffic has been passed, pack up and hurtle across country on a "Safari" of their own to open up another station on another part of the route which will be used later.

This can be expensive if any breakdown of car or gear are experienced by the operators. One member of last year found himself in Mombasa with about 5 shillings (75 cents) to get himself, wife and car back to Nairobi, a distance of over 300 miles. He solved this problem by selling his rig in Mombasa and set out with enough cash for the journey, plus a few beers on the way as well!

To ensure trouble free reception at the network control station (Nairobi) a suitable site—usually a member's house—is chosen a few miles from Nairobi, where ignition or other forms of man made interference are at a minimum. This station operates 24 hours a day for the whole duration of the safari, and is the main source of information for the Safari Officials. Contact with the regional main stations is as stated on 40 metres with an 80 metre standby frequency for the uncertain propogation conditions experienced during the hours of darkness. From the network control station, reports and information are fed to the main safari headquarters control by a phone VHF link. (Incidentally, all the network is normally operated on phone—C.W. being used only under difficult conditions.)

The main safari headquarters control is situated in the middle of Nairobi, where noise on H/F prohibits the setting up of a radio station operating on 40 and 80 metres. (We know—we've tried it before!)

Apart from occasional freak blackouts, we are therefore able to operate a fairly reliable network. Naturally, where telephone facilities are available they are used, but, in the more remote regions the service even if available, operates on a dawn to dusk basis. This means a radio mobile station is required if the cars will be routing through that sector at night.

Other regions have no telephone service at all—there is the added hazard that where lines are overhead, elephants think nothing of using the poles to scratch themselves with usually disastrous results to the service.

With improving DX conditions on the lower H/F bands, it is probable that the next R.S.E.A. networks of April 11/15, 1962 will be heard over greater distances than usual. Reports of reception would therefore be welcomed after the safari.

The Safari Committee are supplying QSL cards to all transmitting members, these should be in circulation in the next few weeks. As a large proportion of them will undoubtedly find their way to the U. S. A. I am enclosing a specimen card, which some of your readers may expect to receive.

Few other Amateur Radio exercises operate under field conditions such as we experience in E. Africa. The local wild life can, and often does, interfere with the safari usually at the expense of the competitor. As local road signs state—"ELEPHANTS HAVE THE RIGHT OF WAY" and "BEWARE OF BIG GAME."

I am enclosing both a specimen QSL card Wayne, and also a copy of the Safari Regulations, which you personally will probably find of interest. If you care to print these details as a small article in 73 Mag, I would be grateful if you could send a copy for the Radio Society of East Africa. I personally do not have a subscription to 73 as with moving around out here, I rarely get a full year delivered. However, you may like to know the magazine is on sale in Nairobi.

Best wishes to you and 73 magazine.

Very sincerely,

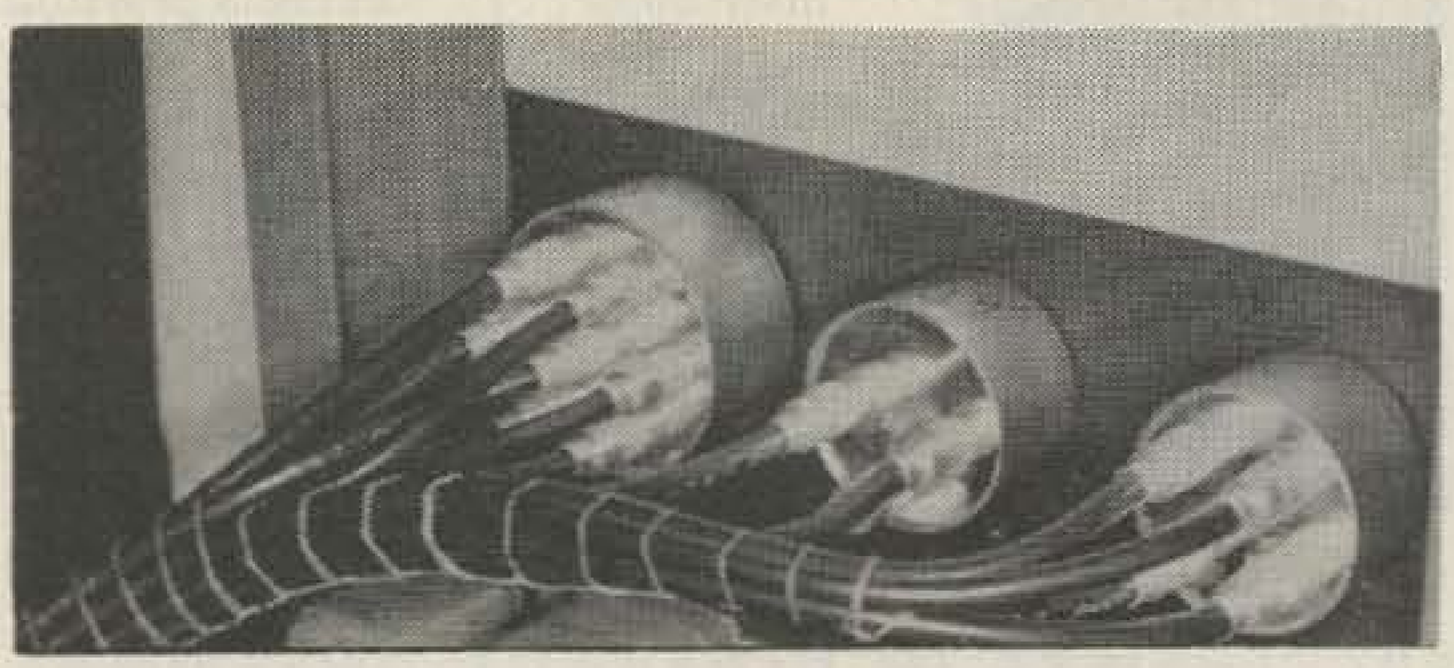
Frank W. Unstead—VQ4GF.
Communications Member,
East African Safari Committee 1962/63.

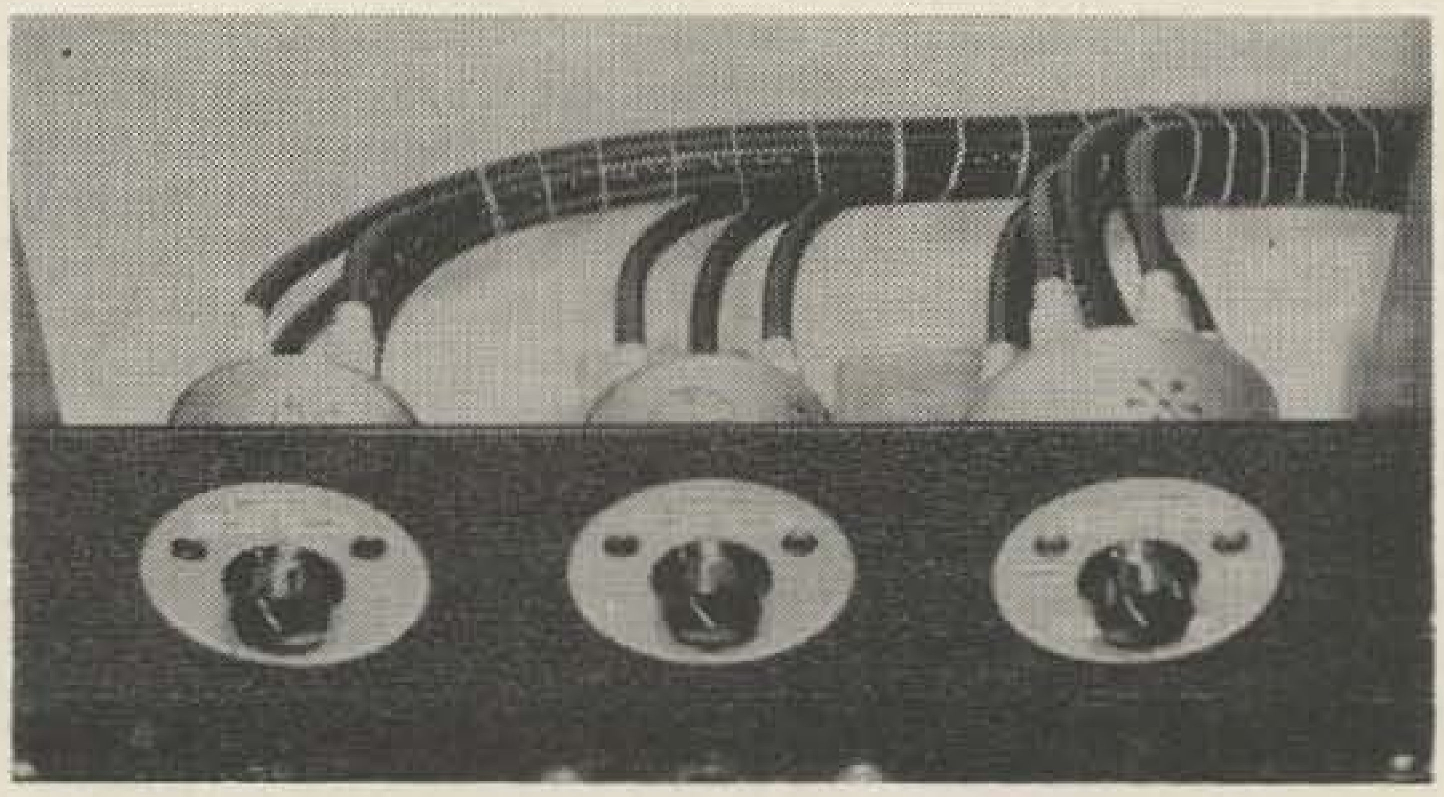
Waters Coaxial Switches

Tom McCann K2CM

The photographs tell most of this story. If you do much changing of coax you've been needing a set of good coax switches. It sure does get old to trace back each of those dangling lengths of coax to be sure it is the right antenna or that it goes to the right piece of gear. Then comes the skinned knuckles as you try to unscrew one cable and connect the new one. Just take a closer look at the way all this can be handled with the Waters coaxial switches.

Waters pulled a clever one on other coax switch manufacturers when he had the connectors come out the back of the switch instead of around the edge. This allows you to tie all those cables together in a neat harness without having to put separate right-angle connectors on every cable.





The photo shows all three types of Waters switches. You need a single contact multi-throw switch for changing antenna feedlines. The Waters Model 335 allows you to connect five different antennas and a dummy load. I do highly recommend that dummy load . . . or haven't you ever had someone plop on top of you and tune up? This does not help make our hobby enjoyable. The antenna switch is on the right.

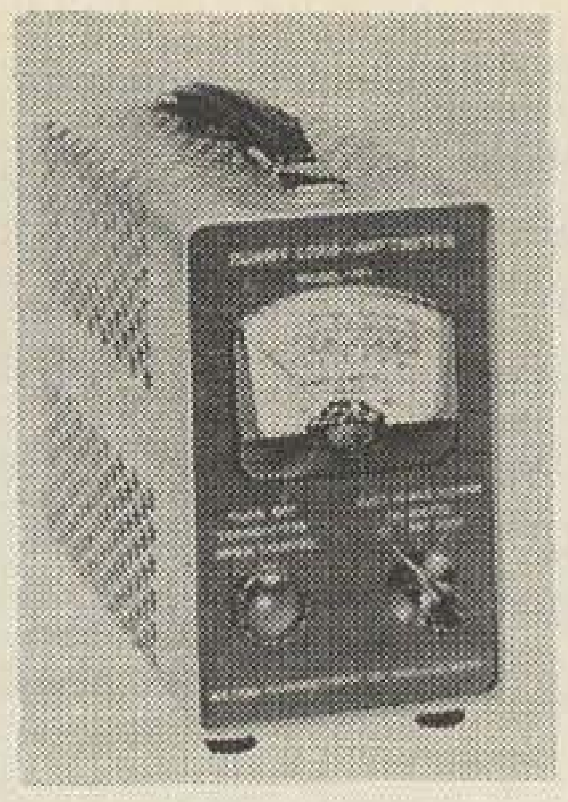
On the left is the Waters Model 336 transfer switch. This is the one you use when you don't need the linear. Flick and you are on the exciter alone. Why not start a whole new movement in our hobby and do as the law says: use the minimum power necessary for communication. It is a lot more fun to tell the fellows that you are running twenty watts than a kilowatt . . . definitely puts you one up.

The center switch is the Waters Model 341 simple transfer switch (single pole double throw) which I use to switch between the outputs of two different transmitters. This could be used to switch receivers. Before I put in this switch I had quite an investment in coaxial relays to switch over from HF to VHF transmitters.

The results of all this switchification is a much neater shack, a lot less money invested in relays, and much greater flexibility than ever possible before.

Waters has some interesting features on these switches. They are easy to operate, not requiring the usual wrench. The escutcheon plate is grey with white squares for labeling the switch contacts with ink, pencil or decals. The switches are completely encased for shielding and protection against dust and moisture. The schematic of the switch is printed right on the case so you don't have to save paper instructions which have to be found every time you want to make a change. The SO-239 connectors on the switches mate with the usual PL-259 coax plugs. Insertion loss and crosstalk are negligible, right on up past two meters. They'll handle a full kw easily . . . but don't switch while the power is on . . . OK?

Try some of these newfangled coax switches and you'll like 'em. . . . K2CM



New Product

Loaded

Waters Manufacturing is developing quite a ham line. They have just added to their line of coax switches, Q-multipliers for the Collins gear, and Hybrid Coupler (phone patch) by announcing a dummy-load/wattmeter. Boy, would it be nice if more fellows used a dummy load instead of our round-table frequency for tuning up. This unit has three scales reading 10, 100, and 1000 watts. There is a light on the front panel which tells you when the dummy load is ready for a rest. It will work just fine all the way up to 250 mc. $79.75. Available through most of your ham equipment distributors. Send to Waters, Wayland, Mass., for details . . . or just go out and buy one and be done with it.

Strays

It is with deep regret that we report the passing of L. A. Rapp, W1OU, well known for his infrequent and not overly dependable articles. We understand that Mr. Rapp expired in a fit of apoplexy brought on by reading proofs of his latest article for QST. RIP Rapp.

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Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

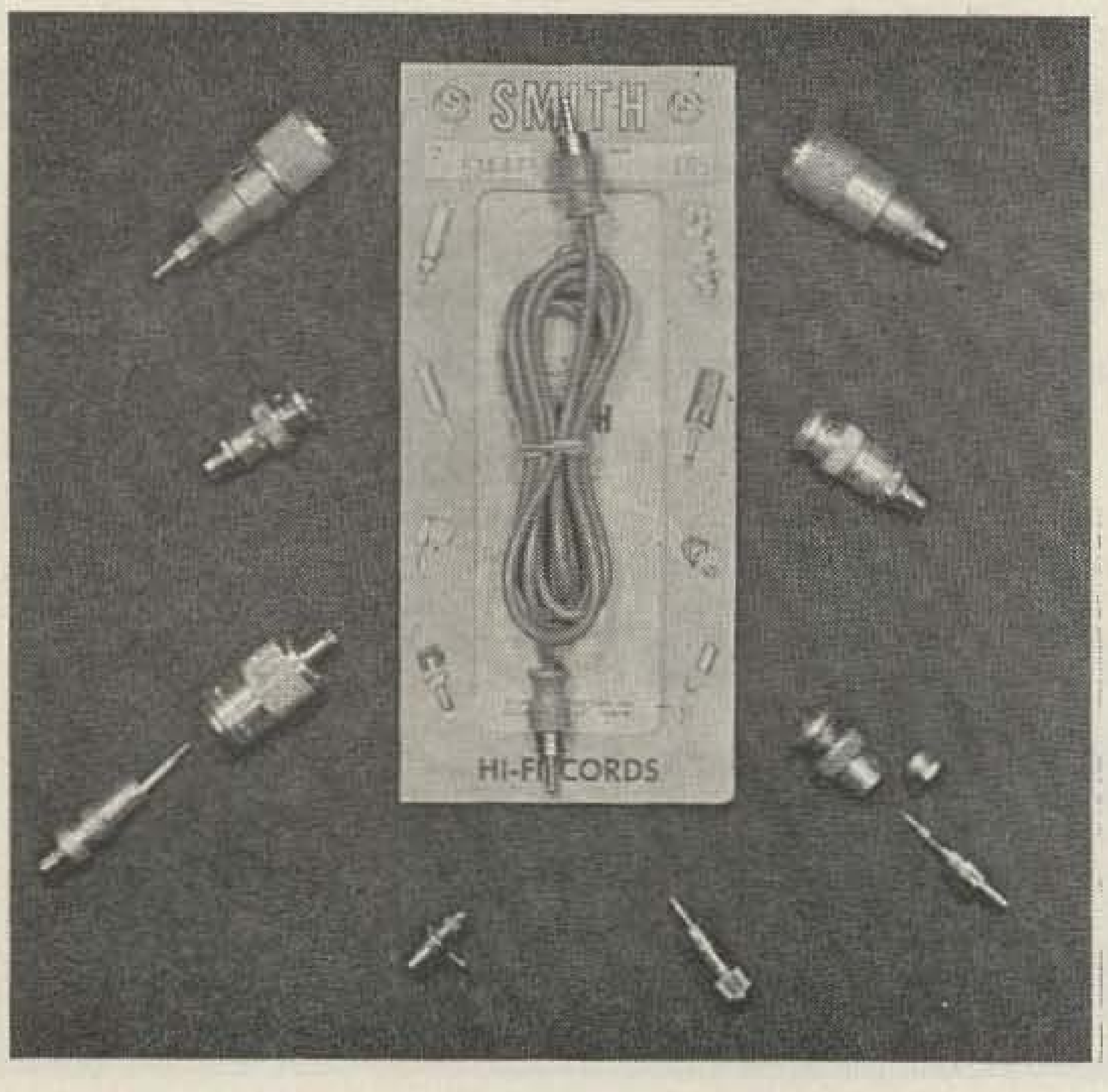
Photo Credit: Morgan S. Gassman, Jr.

Inexpensive Coax Connector – Adaptor System

The Hi-Fi boom has resulted in at least one side advantage to the constructing amateur. The mass market for suitable audio connectors has made available improved phono type plugs and jacks along with molded plug type cords of various lengths. These shielded cords may be purchased with a wide variety of terminating connectors. The H. H. Smith, 4' molded cord shown in the photograph is typical of the various cable assemblies available and which, in themselves, will meet many amateur requirements.

The modern phono connectors shown at the bottom of the photo are the heart of the connector-adaptor system to be described. Both the plug and jack are made of brass, heavily nickel plated. The jack stud is threaded and mounts in a single ¼" hole, using the nut supplied. The plug is equipped with a lug type cord clamp and fitted with a threaded-on brass sleeve. Both of these items are available from numerous sources. High quality Japanese imported versions are particularly economical.

These plugs and jacks and the various coaxial connectors in general use may be assembled into a versatile series of adaptors that will greatly simplify the interconnection of equipment. While designed for the shop, there are many permanent installation requirements that can be met by their use. A few words of caution are in order. These are, in no sense of the word, high power connectors. Further, neither the connectors or the cords are of matched impedance construction. However, this is no particular problem in many applications. After all, the old reliable PL-259 and SO-239 connectors have been with us for many years and no pretense of matching was made in this series of fittings. As a further precedent, Collins uses the photo type connectors extensively in low power, relatively non-critical applications.



Now, to work. The photo shows several typical examples. In the top-left adaptor, the brass sleeve is removed from the phono plug and the sleeve discarded. The shank of the phono connector is wedged into the ferrule of the PL-259 (Not PL-259A) and spot soldered in place. A bare lead threaded through the assembly and soldered to the tips completes the assembly.

In the top-right adaptor, the ¼" mounting nut for the phono jack is spot soldered in the ferrule of the PL-259A coax plug. A lead is soldered to the phono jack lug, a short length of sleeving slipped over the lead and the jack threaded into the nut. Soldering the tip connection of the PL-259A completes the job. In the bottom-left unit, the same thing is achieved by spot soldering the jack, less nut, into the sleeve of a UG-176/U adaptor.

The center-left adaptor consists of a UG-260/U BNC plug with the phono jack inserted in the reamed-out clamping sleeve. A spot of solder holds it in place. The UG-260/U center pin is soldered to the phono jack lug and the sleeve is then threaded into the body of the coax plug. The adaptor shown at the center-left is similar except the jack mounting nut is soldered to the back of the coax plug clamping sleeve.

The connector-adaptor shown in the right-lower portion of the photo is particularly appealing. The UG-88/U or UG-260/U clamping sleeve and the shell of the phono plug are both removed and discarded. The coax connector center pin is soldered to the phono plug tip using a short piece of solid wire. The phono plug shank is then threaded into the body of the coax connector. Since the threads match, that's all there is to it.

This series of connector adaptors may be expanded to meet your own individual requirements. These rugged and reliable fittings are easily assembled from readily available, inexpensive materials and the finished product fills a universal requirement.

. . . W4WKM

FOREIGN SUBSCRIPTIONS

The foreign subscription rate to 73 is $4.00 U. S. per year, however we will accept cash or checks in foreign funds at the following rates:

Canada	$3.75	Germany	16 DM
Mexico	$44	Hong Kong	$23
Austria	115 sh	Italy	2500 Lx
Australia	36/	Netherlands	14.50 Fl
Belgium	200 BF	Norway	29 NKr
Denmark	27.60 DKr	Portugal	1150 Es
England	28/6	Spain	200 Ptas
Finland	1.42 FM	Sweden	20.80 SKr
France	20 NF	Switzerland	17.50 SFr

Plot Your Skip Zones

Don Grayson W9QKC
8125 Harrison Drive
Lawrence 26, Ind.

With the decreasing sunspot cycle many of us are going to have to place more dependence on the lower frequencies. With this comes the old low-frequency bugaboo, skip zones, or "Why I can't talk to —." We are all familiar with the fact that the frequencies from around three to thirty megacycles normally propagate by bouncing off of the ionosphere, which acts as a gigantic mirror. Obviously there are going to be areas that the radio waves bounce over or "skip" as shown in Fig. 1.

Now if we carefully plot all of the contacts in a particular band on a map, noting the time of contact, we should get a plot of the areas indicating the skip zones.

There are several interesting observations that can be made from such a map. You will notice that the contact range increases at night and decreases in the daytime. For the first bounce on 40 meters this amounts to about plus or minus 15 miles, for the second bounce plus or minus 50 miles and for the third bounce roughly plus or minus 150 miles.

The contact zones also tend to move out and widen as the sunspot cycle activity decreases. Since the start of my 40 meter chart in 1953 the inner edge of skip zone number three has moved out at least 35 miles.

It is interesting to note that even though my first skip zone just misses St. Louis by about 20 miles I have no record of any contact there.

Predictions can be made as to the expected signal behavior from the station's relationship to the skip zone and time of day. A QSO with a station that is on the outer edge of a contact zone can be expected to increase in signal strength as night approaches. Conversely the strength could be expected to drop if dawn was approaching. It is assumed that isolated QSO's inside the "dead" areas of the skip zones are due to other less dominant methods of propagation. These contacts are usually characterized by great signal strength in that local area, rapid deep fading, and no repeatability.

A sporadic "E" layer cloud is a typical example of this behavior. It can be thought of as a small detached area of ions drifting about under the "roof" of the "F" layer like a cloud. Obviously this cloud will reflect signals into only one rather small area from your station and since this is a rather unstable drifting cloud of ions it is most unlikely that the cloud will retain any permanency.

. . W9QKC

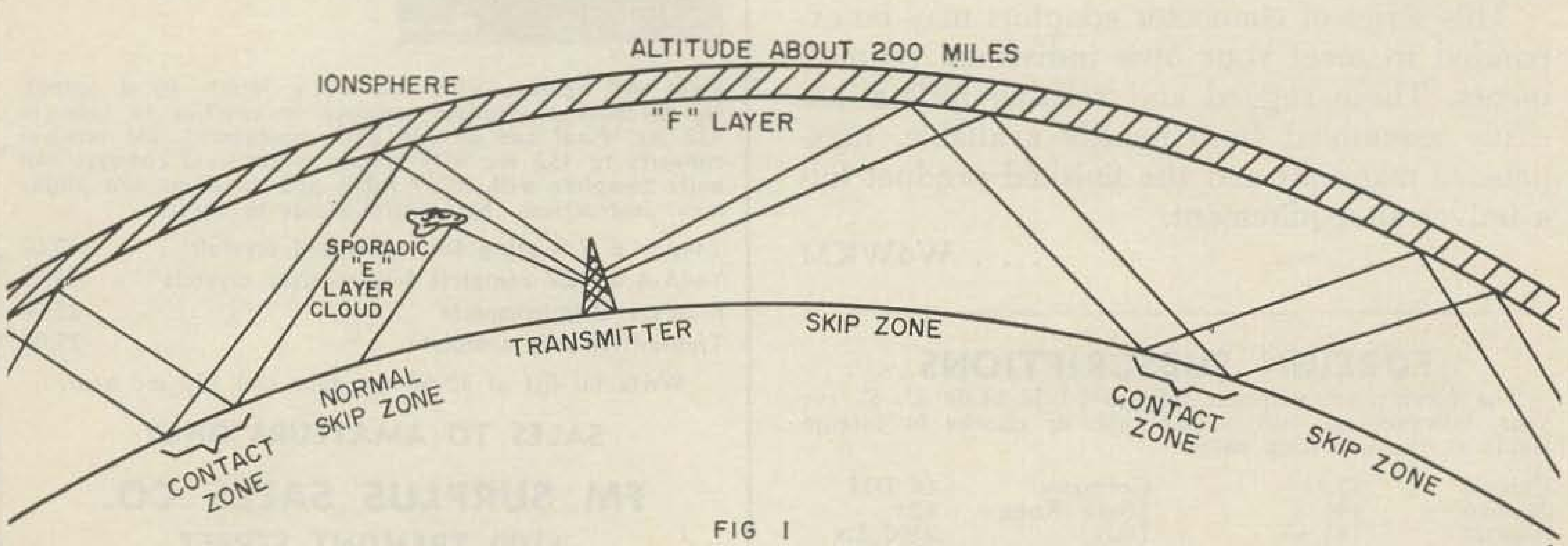


FIG 1

The F layer of the ionosphere increases in altitude during the hours of darkness thus moving the "contact zone" further from the transmitter. Note the possibility of a contact in the normal skip zone due to reflection from the sporadic E layer.

Strays

Please be on the lookout for the following which disappeared from the 73 Headquarters Building sometime, we're not sure when, in January or December: 1-VW Station Wagon, 4-RTTY Machines, 1-NC-300, 1 National-600 transmitter, 1-100′ tower, 1-Tribander, and 1-K2PMM, all of which seems to have turned up missing at about the same time. Small reward.

Letters

Cheri—

A visitor from the ACLU added two links to my chain and now I can reach the typewriter.

One harebrained idea a month has been enough, and you've been getting in there first, but you can't keep it up forever. For when you run out of whatever it is you're on, here is a spare—I suppose you are familiar with the "silent period" observed internationally afloat and adrift (15-18 and 45-48 past the hour) and probably think of it as the best time to work DX on 500 kcs. Well, then? Even two minutes at the beginning of each hour (below UHF) (but on all the other bands) would give us lids a chance to hear what the hell is going on beyond the California curtain. From the other side of the Gitchee-Goomee this miniscule Open Door policy might bring cries of delight; it might act like a funnel; it might recall Ellis Island in the eighties; it might be ignored. Forget it.

You will be interested to know that the trouble with 73 is that each issue is not always better than all the preceding issues. Could you use more articles like "Complicating the Simplescope" please. I read it right away because it had "simple" in the title, and I knew it was for us little people. Frivolity aside I think it was the best in the November issue. Of course your editorials are fun to search for potential libel and psychiatric significance, but I really read them for their prescience, wit and logic. You bet. By and large you are doing a fine job with 73 and here on the minimum-security farm it has outrun the other magazines of the "Big Three." We've dropped Vogue and Horizon.

Here's an opening for a professional, deprecatory chuckle and a condenscending pat on my greasy little head. "How's My What?" (Sept.?) brought me mail that surprised me. Another letter came today and gave me the courage to expose my impressionable naivete. As the responsible editor you might want to know that roughly a score of letters and QSL cards have been received, all commendatory and expressing with more or less eloquence a thoughtful, sincere response to the article. Maybe this is an unremarkable reaction—I don't know. As a true blue chap, however, I pass on the facts and let the editor assess them for policy signicance, if any. Noblesse oblige—no snickers.

. . . W7IDF, Ken Cole

Dear Wayne,

As an advertiser in your magazine I want to tell you that I am just not getting results. Last month I only received one reply to my ad. If it weren't that this reply was in the form of a $12,000 order I would cancel my ads.

Name Withheld

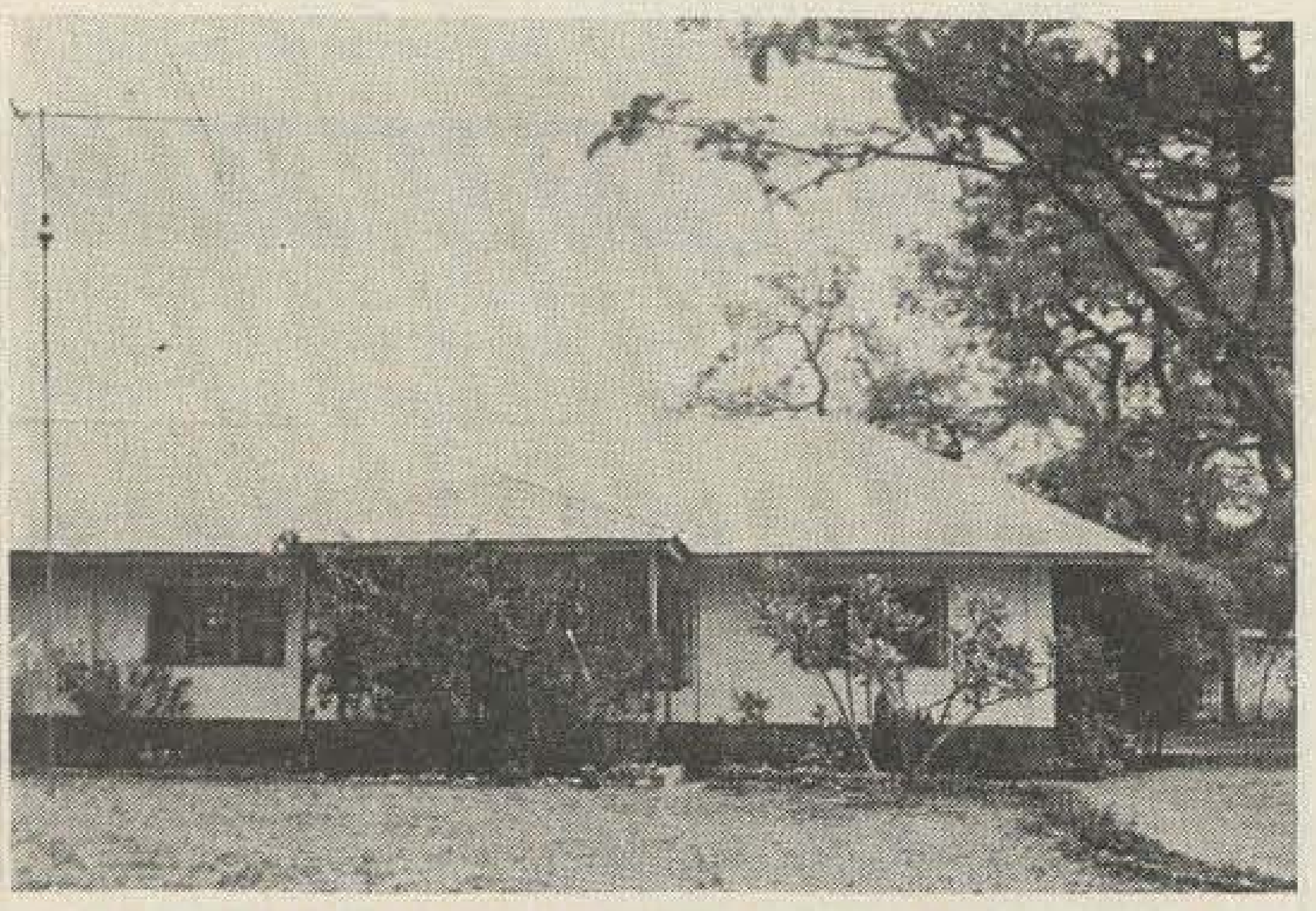
One Ham in a Million!

Carole Hoover K9AMD
401 East Wood Street
Hillsboro, Illinois

Hundreds of U. S. DX-chasers and certificate hunters are indebted to 5N2JKO, Dr. Michael Dransfield, of Samaru, Nigeria, and if you need proof, just check the foreign section of your call book. Obviously, every station in a country with scarcely more than a dozen active hams is vital; but, needless to say, one station who handles not only the QSL Bureau but issues the 5N2 Award is particularly priceless! Such a ham is 5N2JKO.

Mike became a ham thanks to a case of BCI!

"One night in 1947 while I was listening to the BBC at home in England, I heard G2KU working a PY," Mike said. "I didn't know anything about amateur radio, but I copied the PY's address and wrote him a letter. Later, he worked another local, G2AXG, who invited me to his shack."



The QTH of 5N2JKO. His shack is located just to the right of the antenna mast at the left of the photo.

That introduction was enough and Mike became G3JKO shortly after graduating from Nottingham University with a bachelor's degree in Botany, Zoology, and Chemistry.

"After getting my Ph.D. and spending two years in the British Army as a radio instructor, I was off to Sudan where I operated as ST2KO with a 10 watt CW transmitter," Mike recalls. "Next came the transfer to Nigeria in 1959 and a change to ZD2JKO."

In January 1961, all Nigerian call signs were changed to the new 5N2 prefix following the country's independence from British Colonial rule, and Mike became 5N2JKO.

As a cotton pathologist in charge of controlling cotton diseases for Nigeria, Mike is on the air more between November and April when there are no crops in the ground. He prefers AM and uses a single 6146 at about 40 watts, an Eddystone 888A receiver, and a Mosley TA-33, Jr. beam, keeping W4MCM busy handling his QSL's.

"We started the 5N2 Award in September 1961 to stir up a bit more interest among amateurs here and overseas, too," he stated. "And it was at the request of certificate hunters around the world also. So far 108 awards have gone to about 35 countries."

The award is given to any amateur contacting five Nigerians since January 1, 1961, using phone, CW, or both on at least two bands. QSL's aren't needed, but a check list showing call sign, date, time, band, and reports will do the job if accompanied by five IRC's. Shortwave listeners can get an award by sending five QSL cards and the IRC's to 5N2JKO, Dr. M. Dransfield, Regional Research Station, Samaru, Zaria, Nigeria.

Handling the country's QSL bureau keeps Mike in touch with other active amateurs including 5N2AMS, Angus, and his XYL, 5N2-DMS, who are famous for their DX-peditions.

Dr. Mike Dransfield, 5N2JKO, shown in his laboratory examining some bacteria. He operates more when crops aren't in the ground.

Mike is shown with a few of his many QSL cards. From Nigeria, his personal score is 204 countries worked and 173 confirmed on both fone and CW with 133 confirmed on fone only.

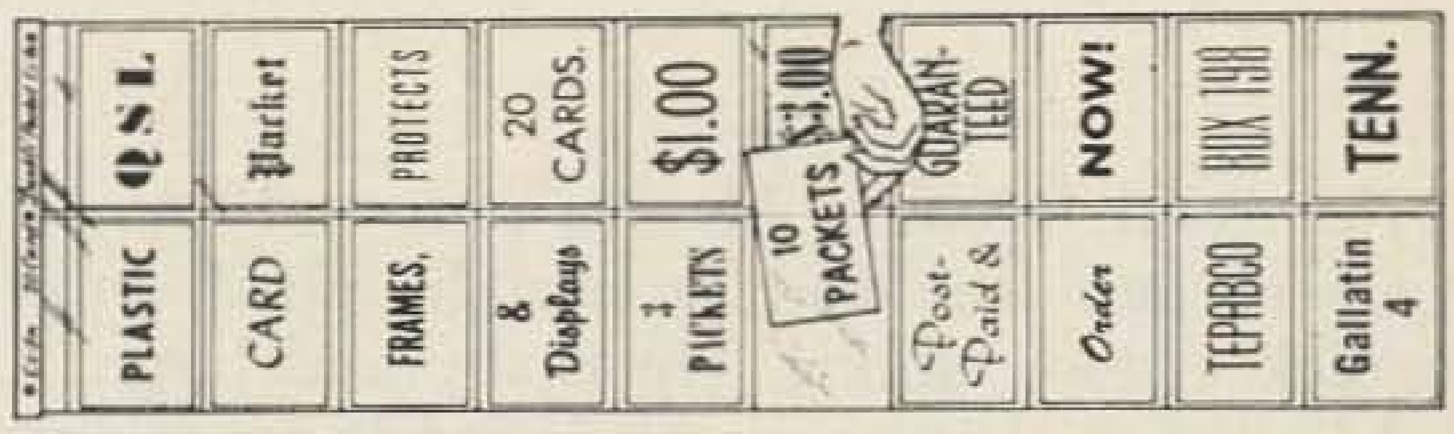
AM operators are 5N2SMW, 5N2BRG, 5N-2RJO, and 5N2JSC. Apt to be found on either AM or CW is 5N2RSB, 5N2RDG, 5N2ATU, and 5N2FEL. CW specialists are 5N2IJS, 5N-2LKZ, and 5N21ND. Answering on SSB are 5N2EBL, 5N2BCF, and 5N2JAH. VP5JG is operating currently as 5N2JRG.

"Mail takes up to 10 days to reach the more distant parts of the Northern Region, and telephone service is very primitive," Mike said, "so all of the 5N hams work together as a club regardless of vast distances between us. We meet twice a week on 40 meters to keep in touch."

Joseph Beke, one of Mike's assistants, is shown at work. Dr. Dransfield is a cotton pathologist for the government.

Planning an extensive trip across Africa in December of this year, Mike is looking forward to his first Stateside visit in December 1964. By the time he arrives, it's safe to say this enthusiastic ham is apt to find a red carpet of ham friendship stretching from New York to San Francisco.

. . . K9AMD



Operating News

There is no operating news this month.

What is a Ham?

Elmer Olson K7GPZ
5733 North 41 Place
Phoenix 18, Arizona

First and foremost he is a person 10 to 75 years of age who had or has the good sense to pick a good hobby. He is, by and large, a good citizen, above average in intelligence and has a well-rounded knowledge of his hobby. At least this is true of the Hams I know or to whom I have talked. He has respect for the law, having studied government F.C.C. regulations, and values his ticket enough to walk the "straight and narrow." He does not hesitate in letting his fellow Hams know, if in his opinion, they are "skating on thin ice." His purpose in pursuing his hobby is the advancement of Amateur Radio and the comradery enjoyed while talking to fellow Hams.

There is no other hobby I know of which offers such a wide variety of interests and affords the opportunity to practice any or all of them. The potential for good-will all over the world is limitless. Here are a few–

Builders – The builder leans toward the introvert type, but he is the backbone of Ham Radio. He is constantly trying new circuits, improving his transmissions and in the process discovers new, more efficient, more compact and in a great many cases, cheaper ways to build receivers, transmitters, antennas and a large variety of test equipment. In the younger Hams, in this category, you will find the future Electronics Engineers, Technicians, and a good supply of trained men for the Armed Forces. He is the man his fellow Hams call on to help in solving a knotty technical problem. He always seems to have the time, no matter how busy he is with his own affairs, to lend a hand.

Rag Chewers – These are the extroverts who will talk for hours on any and all subjects. They come from all walks of life, trades, and professions. If you listen, particularly on sideband, you can hear most any subject discussed pro and con and by experts. Do not sell the Rag Chewers short. They have disseminated a lot of knowledge down through the years.

Clubbers – These are the organizers, the men who delight in getting people together for Club meetings, Ham Fests, Field Days, etc. They are invaluable in knitting together a group of area or community Hams into a solid organization. Their purpose is to get all the Hams together socially and technically and to encourage all members in the organization to participate in community affairs, civil defense and emergency operation. They are also the public relations men for Amateur Radio.

DXers – This group is always looking for that "rare one" on the other side of the globe. They have the patience to wait it out and in the process learn more about people and geography than most of us "willy-nilly" DX Hams.

Contesters – Nothing delights this group more than running up a big score. To be up near the top they must be constantly improving their stations and perfecting their operating techniques. There is a lot of competition and anyone near the top had to earn it.

Awarders – These boys are out for certificates, WAS, WAC, WAZ—etc. They are also in the extrovert class and want to show their accomplishments. They are proud of their awards and work hard to get them. We all have some cracks in the walls of our shacks which could be covered by one or more of these framed certificates if we made the effort to qualify.

Teachers – Teachers, I guess, are the same the country over, dedicated to impart knowledge even when the pay is not so good. Teachers in Ham Radio are no exception, they spend hours of their free time teaching Radio Theory and Code. Their satisfaction is in taking a group of beginners through the Novice Class and winding up with a group of competent General Class operators. We can all think back to someone who encouraged us and carried us over the rough spots.

The Handicapped – Last, but by no means least, are the physically handicapped. Some are blind or near blind, some are semi-paralyzed and confined to wheel chairs. Some have heart conditions, which preclude anything but the minimum amount of exertion. These Hams keep in touch with the world, gladden the hearts of our Service men and missionaries abroad by running phone patches to relatives in the States. They handle emergency traffic and by and large are always on the job. I might add, at this point, that there is never a shortage of able bodied Hams to help them keep their equipment in shape, from checking tubes to erecting and repairing antennas.

There are also duties and obligations connected with this business of Ham Radio. Loyalty to your local Clubs and National Organizations, who are trying to protect our interests by alerting us to adverse legislation, is one. We are strong enough in numbers to make our presence felt if we will take the time to write our Congressmen or otherwise make our thoughts known. We should pay proper homage and respect to the pioneers who made this absorbing hobby possible. Our operating technique should be such that courtesy and "give and take" should take precedence over being "technically right." There is room for all of us in all modes, classes and frequencies if we will pick our spots and times. The Golden Rule will also work in Ham Radio.

I know I have only touched on a relatively few points on "What is a Ham," but I think it gives the general idea.

Finally, I would like to repeat again, what other Hobby makes possible such a variety of interests, opportunities for private or public service and personal satisfaction? ... **K7GPZ**

Letters

Dear Wayne:

WA6DEA has pointed out a glaring error in The Instantaneous Dissipateor Tube article of August (page 49). Seems as though I forget about the other half of the cycle in a half wave rectifier system (A voltage doubler is really two half wave systems in series). Assuming the supply is unloaded, the capacitor will charge up to peak voltage of 1000 volts on the positive half cycle. On the negative half cycle the secondary voltage will be in series aiding polarity thus giving a total of 2000 volts inverse peak on the rectifier. So if there is any thought of unloading the supply it would be wise to use 5 silicon rectifiers on each side of the voltage doubler circuit. At W7CSD I have never allowed the supply to be unloaded to the point that 1400 volts is exceeded. This is too high for 1200 vip system used. Guess I have just been lucky. WA6DEA also suggests the installing of a 500K resistor across each of the rectifiers to insure equal voltage division across the series string. Again I have been lucky with my 3 for $1 silicons and have not lost any via this route.

. . . Bob Baird W7CSD

NSD:

I got sick, sick, sick of the meaningless grid printed on the limp plastic of the CRT of my kit 'scope. So I had W0KLG whomp me up a plexiglas disc with two intersecting lines scored on it. Half way out on each arm is a small mark. This disc replaces that irksome grid and since the human eye is excellent at interpolation a high degree of accuracy is still possible. The 'scope looks 100% neater.

Bob. K0GKI

Dear Wayne,

You might mention the far more popular VHF-FM frequencies of 146.94, 147.3 and 147.5 mc along with the Video Rangers on 52.525 mc. This being a channel two area six meters ops frequently get lynched.

. . . Fritz Hervey W9IIU

Dear Staff:

Three days ago a friend let me glance through your October issue. There I saw your article, "A Like-New Mixed Circuit." Since my old Super Pro was starting to feel its age I figured that this might be just the tonic.

So, after stuffing the mag. into my coat pocket when my friend was occupied with that ZL station he needed, I excused myself and hurried home to see if at last this might be my solution to that high noise level, low signal level, etc.

Using a war surplus LP-5 signal generator to set an "S" signal of 2, I found that I just could pick out the signal through the noise. So out came the soldering iron, and the rest of the elements.

The conversion itself took a bit over one hour. Most of the time was spent looking for the 4.7K resistor.

After alignment, the set was tuned on and it was found that a full 3 "S" units was gained. The conversion made was for the 12AT7. However, a 12AU7 produced just under 2 units and a 12AX7 produced just under 3 units.

All in all, the time spent was more than justified in that the noise level that had bugged me so before was now in the background.

Going a bit further, I pulled the first RF and replaced the circuit with a cascode circuit. After alignment, a reading was taken and it was noted that with a 12AT7 in the circuit I would pick up only 2 more "S" units. So, I pulled the second RF tube and replaced it with another cascode circuit. After I was able to kill the oscillations that kept creeping in and re-re-aligning the front end, I had gained another 2 units. Not only that, but the noise had retreated to the point of "just barely!!!"

Well, I have returned the magazine that I made off with, and have had several comments from visitors as to the FB way my "OLD WARHORSE" sounds. And now I'd like to thank you for printing the article. It sure works good. And best of all, it makes an old RCVR "LIKE-NEW."

. . . Jim Whitfield K6BHN

Strays

WoDSU and KoKEK are the first members of the newly formed Real Rag Chewers Club with a six hour QSO. WA2RIN and WA2UOA became members with a contact a few hours after the WoDSU QSO. WoDSU was also the first winner of the Worked Almost All States Certificate. W1PYM submitted the first cards for the elusive DXDC award. WAoAVG was first to join the exclusive Certificate Haters Club.

New Product

Epsilon

has come up with a corker of an idea in their new code practice record . . . it tells the story of Nicola Tesla. I doubt if you could find a more interesting or incredible story to tell on a record either. Tesla was a fantastic genius, though few people know much more about him today than that he probably had something to do with the Tesla coil, whatever that is.

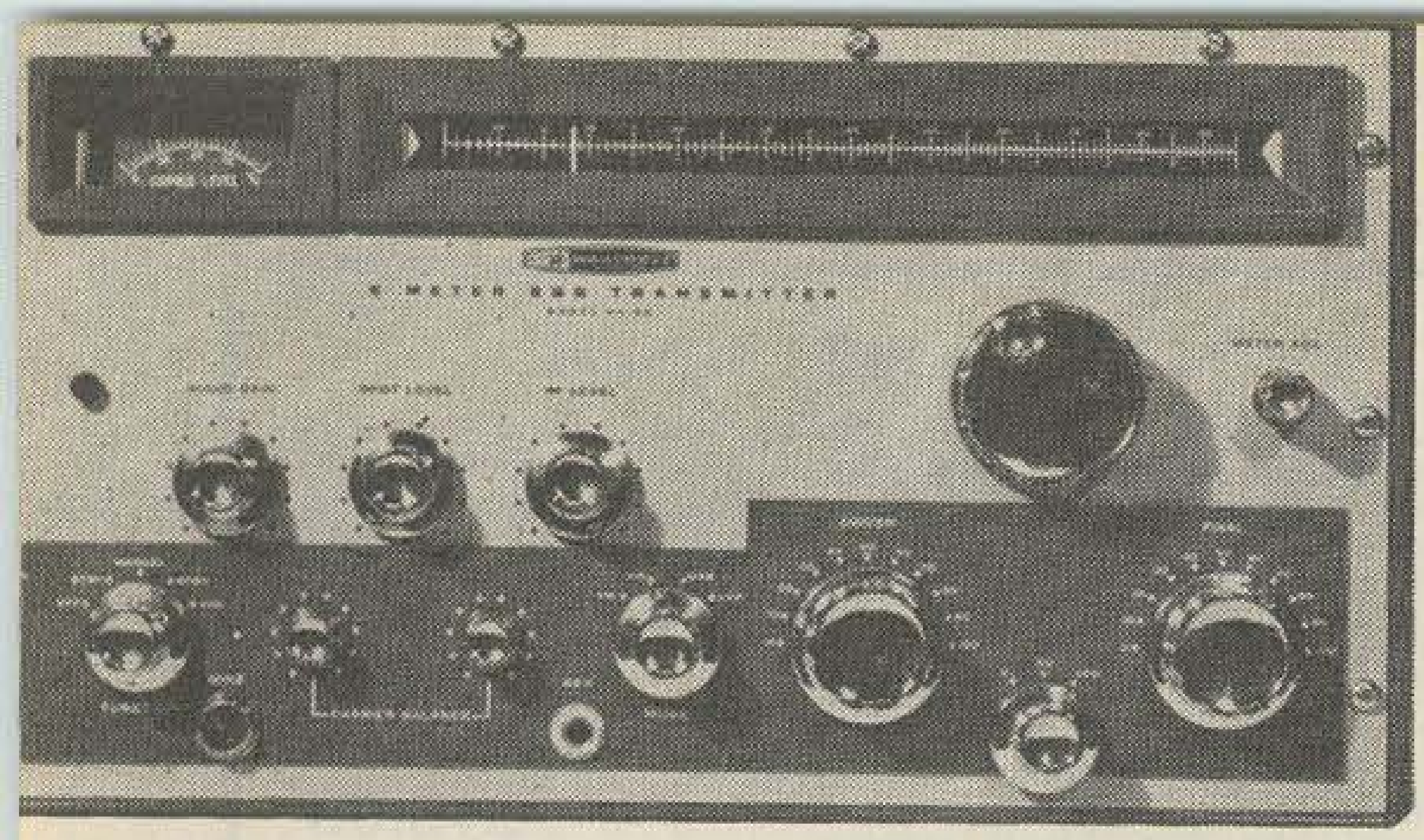
Tesla, this man of which few of you have heard, probably did more to make the world the modern place to live that it is today than any other single man in the history of the world. He has had more impact on our lives than any world leader. Tesla was not just an inventor, he was a discoverer of basic principles. This is April and I'm making it all up, eh? Well, this is fact . . . Tesla lived and he changed the entire world as a result.

What, you ask skeptically, did Tesla invent? He discovered so many basic principles that it beggars the imagination. As a starter he discovered alternating current. He invented the ac generator, the ac motor, the transformer, the high tension transmission line, the electric clock, etc., and had virtually all of the basic patents in the field. He gave us every essential of modern radio, including the tuned circuit, the loudspeaker, remote control and even radar. He discovered neon and other gaseous tube lighting, fluorescent lighting and even some lighting methods beyond those we now have today. He planned and started construction on the first true broadcasting station, several years before engineers even admitted that it would be possible for voice to be broadcast.

It was Tesla who conceived the three phase system as well as single phase system. It was he who established sixty cycles as our power standard. Who thought of putting transformers in oil? Tesla. In 1890 Tesla demonstrated the first diathermy machine. He discovered "X" rays and described them quite accurately 13 years before their official "discovery." He developed the first radio tube in 1890 and described his proposed broadcasting system in 1893. When you consider that Marconi started studying electricity in 1895 this is perhaps in better perspective.

Tesla came up with many more incredible discoveries . . . some day I'll have to write an article all about him. You'll find this Epsilon record not only a great help in learning the code, but of great interest for its content.

. . . W2NSD/1



Heath 6M SSB Transmitter

Kent Mitchell W3WTO

Almost every metropolitan area of the United States has experienced a boom in 6 meter activity during recent years . . . due in no small respect to Heath's introduction of their now famous 5 watt power house, the "Sixer." Then too, and especially during band openings, quite a few of the boys may be heard modulating a Heath 120 watt "Seneca." Indeed, our most popular VHF band might sound altogether different without Heathkits. Now however, 6 meters is going to sound different *with* Heathkits . . . namely the HX-30. This new SSB transmitter is going to become as popular as sliced bread!

A complete, self-contained unit (not a "transverter"), the HX-30 offers a frequency coverage of 50.0 to 54.0 megacycles in four, 1 megacycle steps, an ultrastable fine tuning VFO, and excellent on-the-air audio characteristics with unwanted sideband suppression on the order of 40 db. Carrier suppression is 50 db below maximum rf output.

Providing 10 watts peak envelope power output SSB, 10 watts of CW, and 2.5 watts with AM, the rig may be used as an exciter for a linear amplifier (such as Heath's HA-20, to be featured in a later article), or run "barefoot" with excellent results.

The single sideband signal is generated in this transmitter by the phasing method. Beginning right at the mike input, let's follow the audio through the rig until it emerges from the antenna coax jack as a single sideband rf signal. The heart of the rig is the balanced modulator shown in Fig. 2. A speech amplifier not only boosts the mike input, but attenuates the audio frequencies below 300 cps and above 3000 cps, which experience has shown to be the only really necessary range for good voice intelligibility. The audio is now split into two equal, but 90 degree out of phase signals by an audio phase shift network. Amplified by V3A and V3B, these voltages are applied to the grids of balanced modulators V4 and V5. An rf carrier is generated at 11.5 mc by a crystal controlled oscillator V2B and also applied to the grids of the balanced modulators after it too has been split into two 90 degree out of phase signals. So now, at the grids of V4 and V5 we have two separate carriers being combined with modulation. Here is where we eliminate the carrier and produce the desired single sideband signal. Both balanced modulators, consisting of two triodes each, V4A, V4B and V5A, V5B, each have their grids connected in parallel for rf, and in push-pull for audio through. The plates of each balanced modulator are connected in push-pull through a common tank circuit and are 180 degrees out of phase with each other. The

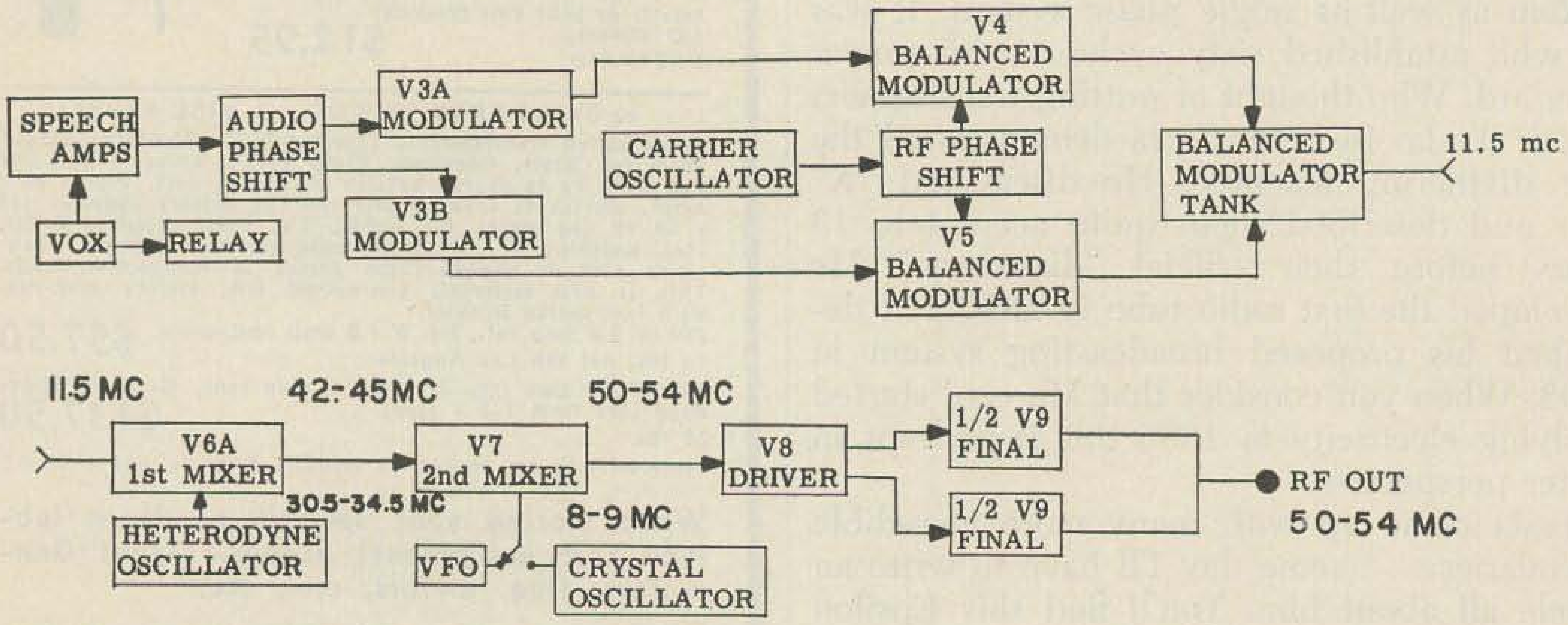


FIGURE I
HX-30 BLOCK DIAGRAM

product of all these phase relationships results in the carrier being balanced out and four sidebands containing the audio, with two inphase sidebands combining and two out of phase sidebands canceling . . . leaving only a single sideband signal. A more detailed explanation of how this phasing occurs may be found in several good texts available, such as the *Single Sideband Communications Handbook*. Howard W. Sams and Co., Inc. ($6.95 from Radio Bookshop). Two CARRIER BALANCE controls on the front panel of the HX-30 are pots in the cathode circuits of the balanced modulators and enable their output voltages to be adjusted for equal amplitude.

Transition from upper sideband to lower sideband, and vice versa, is performed simply by reversing the phase of the audio signals on the grids of the balanced modulators. Placing the MODE switch to the AM position removes the audio from the grids of V5, unbalances V4A and V4B, thereby reinserting the carrier in the output at T4 and combining it with two out of phase sidebands . . . or in other words, giving us a conventional AM signal. The CW mode is produced in a likewise manner, with the exception of removal of audio from both the balanced modulators.

So, we now have a SSB rf signal at 11.5 mc, a long way from 6 meters, but from here

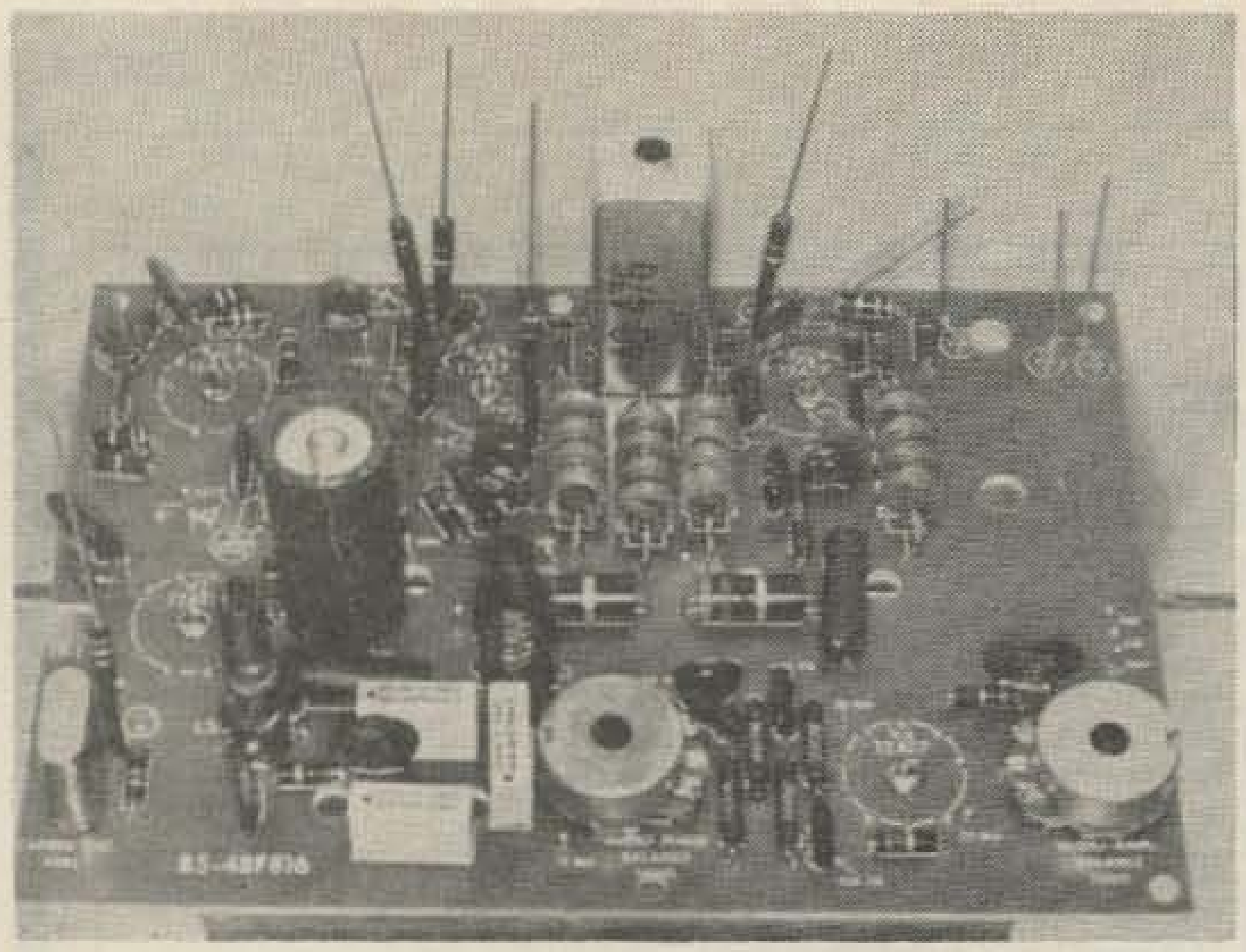


Fig. 2

on out the rest is easy. The 11.5 mc signal is coupled to the pentode section of a 6U8 tube operating as a mixer, where it is heterodyned with the output of a crystal controlled oscillator, the triode section of the 6U8. When the oscillator crystal frequency is 30.5 mc, the output of the mixer is 42 mc. When this 42 mc signal is heterodyned in the second mixer, a 6CB6 (V7), with the output from the VFO or an 8 to 9 mc crystal, we will have a 6 meter

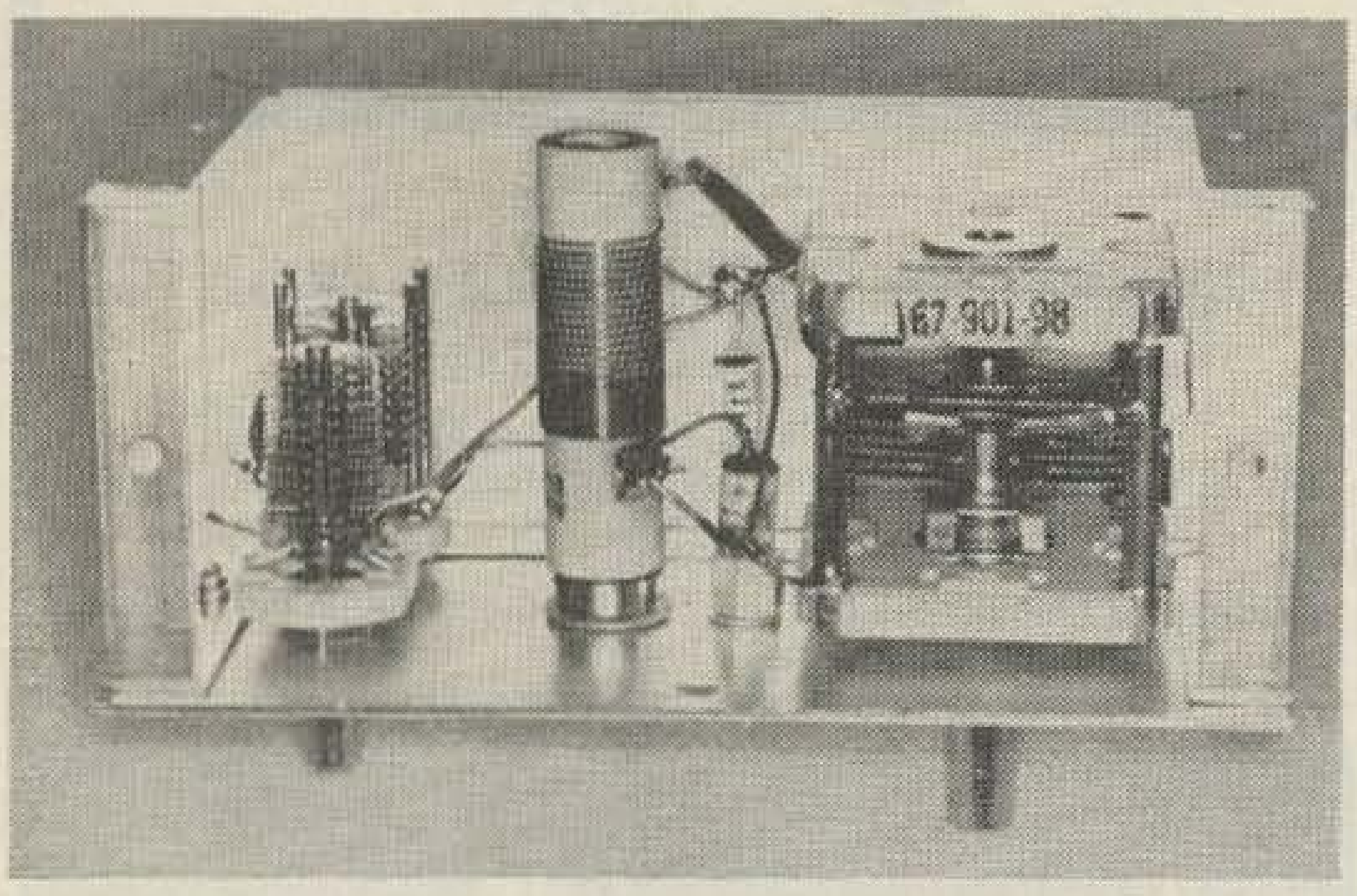


Fig. 3

signal, between 50 and 51 mc. Other 1 mc segments of the band may be covered by changing the first oscillator crystal to the appropriate frequency. A 31.5 crystal will cover 51 to 52 mc, a 32.5 mc crystal will cover 52 to 53 mc, and a 33.5 crystal will provide an output between 53 and 54 mc. Output of the second mixer is coupled to a 6AK6 driver amplifier (V8) and then to the 6360 final amplifier, operating as a push-pull Class AB1 amplifier. Link coupling is employed from the final to the rf output jack.

Assembly of the HX-30 is a pleasant and satisfying task, easily accomplished within the 30 hours mentioned in the Heath ads. Actually, I required 29 hours, in spite of the fact that I was taking notes and photographs as construction progressed, having this article in mind. Rapid assembly is made possible by the use of four heavy duty etched circuit boards and three precut and laced wiring harnesses. Obviously, a great deal of forethought and planning went into this transmitter, both

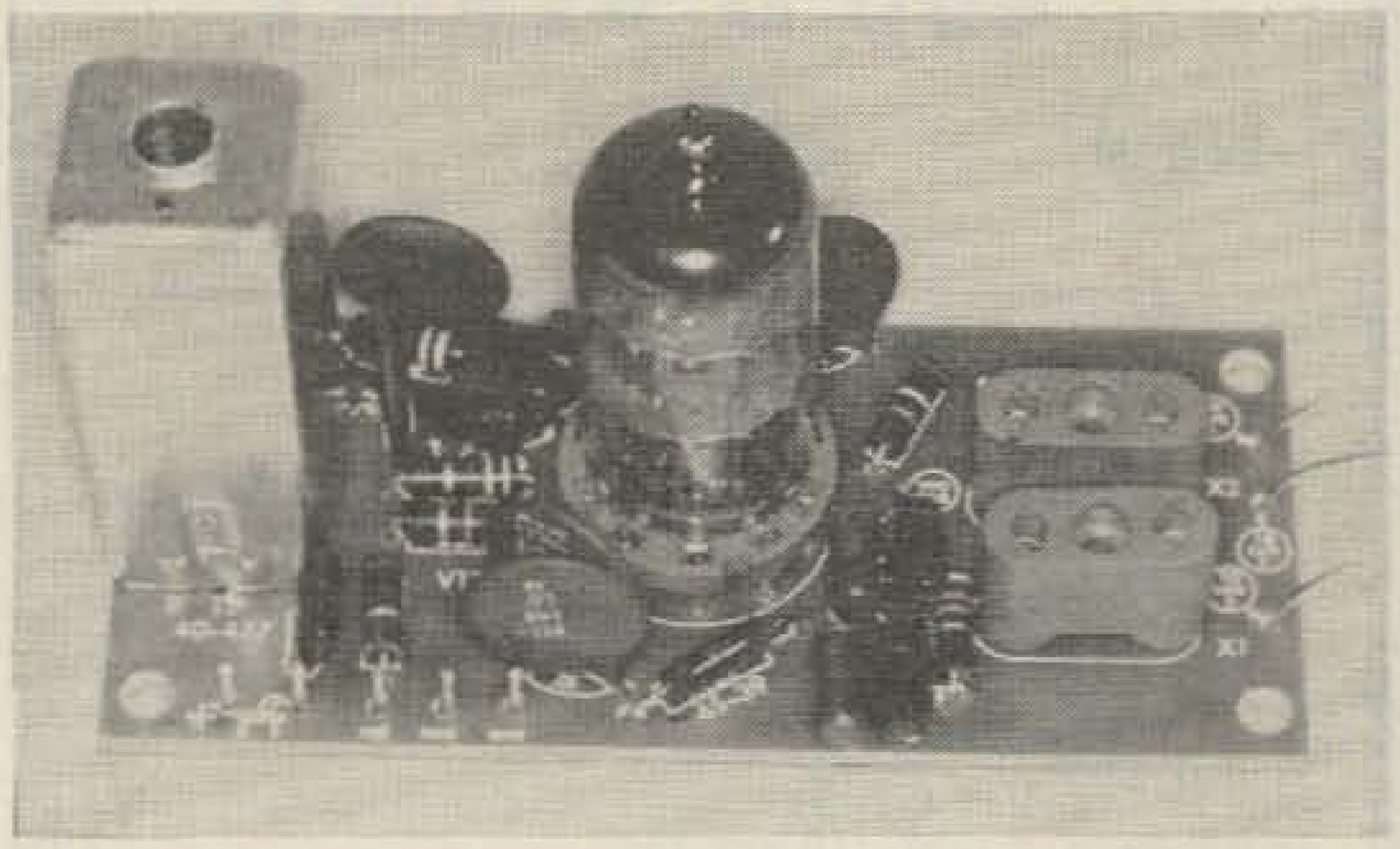


Fig. 4

mechanically and electrically. To cite one example, the tubes and circuit components are located on opposite sides of the etched circuit boards. When the boards are mounted, the tubes protrude upward through the chassis, thereby isolating the components from tube heat. Another example along the same lines is the complete isolation of the VFO tank circuit from other circuits. Fig. 3 shows the interior of the VFO tank compartment, prior to its complete shielding. On the right is the VFO frequency capacitor, to the left are a bandspread trimmer and a temperature compensating capacitor. Fig. 4 is a close-up of the VFO circuit board. Note the two crystal sockets which are for optional crystal control, utilizing the triode section of the 6CH8 VFO as a Colpitts oscillator. Figure 5 shows the completed VFO assembly. The large fine toothed gear visible in the background is a portion of the VFO gear drive assembly. Providing exceptionally smooth VFO tuning, the helical gears give a ratio of approximately 45 kc per turn of the spinner knob. Nine inches on the slide rule type dial equals only one megacycle of the 6 meter band! Compare that to your present 6 meter VFO or receiver dial.

Alignment of the completed kit is simple and requires a minimum of time and effort. An unusual feature is the use of test point jacks and a test probe connected to the front panel meter for alignment. The meter is then normally used as a rf power output indicator and to null out the carrier. The initial adjustment of the audio phase and amplitude controls require an oscilloscope for optimum suppression of the unwanted sideband, but once set need no further attention.

Other features of the HX-30 well worth mentioning include complete shielding of the final tank assembly, copper plated cabinet interior, built in VOX and anti-trip circuitry, and grid block keying along with a key click filter for clean CW signals. Although the rig was basically designed for SSB operation, it will produce good signals with other modes of transmission . . . no skimping was done here. Also, all Heathkits now include a sufficient supply of multi-core solder at no extra cost. Another pleasant surprise was the inclusion of five free log books and a fine simulated leather vinyl cover.

On the air tests resulted in reports of excellent audio quality, no trace of carrier and very good suppression of the unwanted sideband. Several QSO's were made with stations 75 miles over the Blue Ridge mountains, quite a haul for only 10 watts on 6 meter ground wave, and a feat that is hard to duplicate with a lot more watts of AM from this QTH. Needless to say, sideband really gets through.

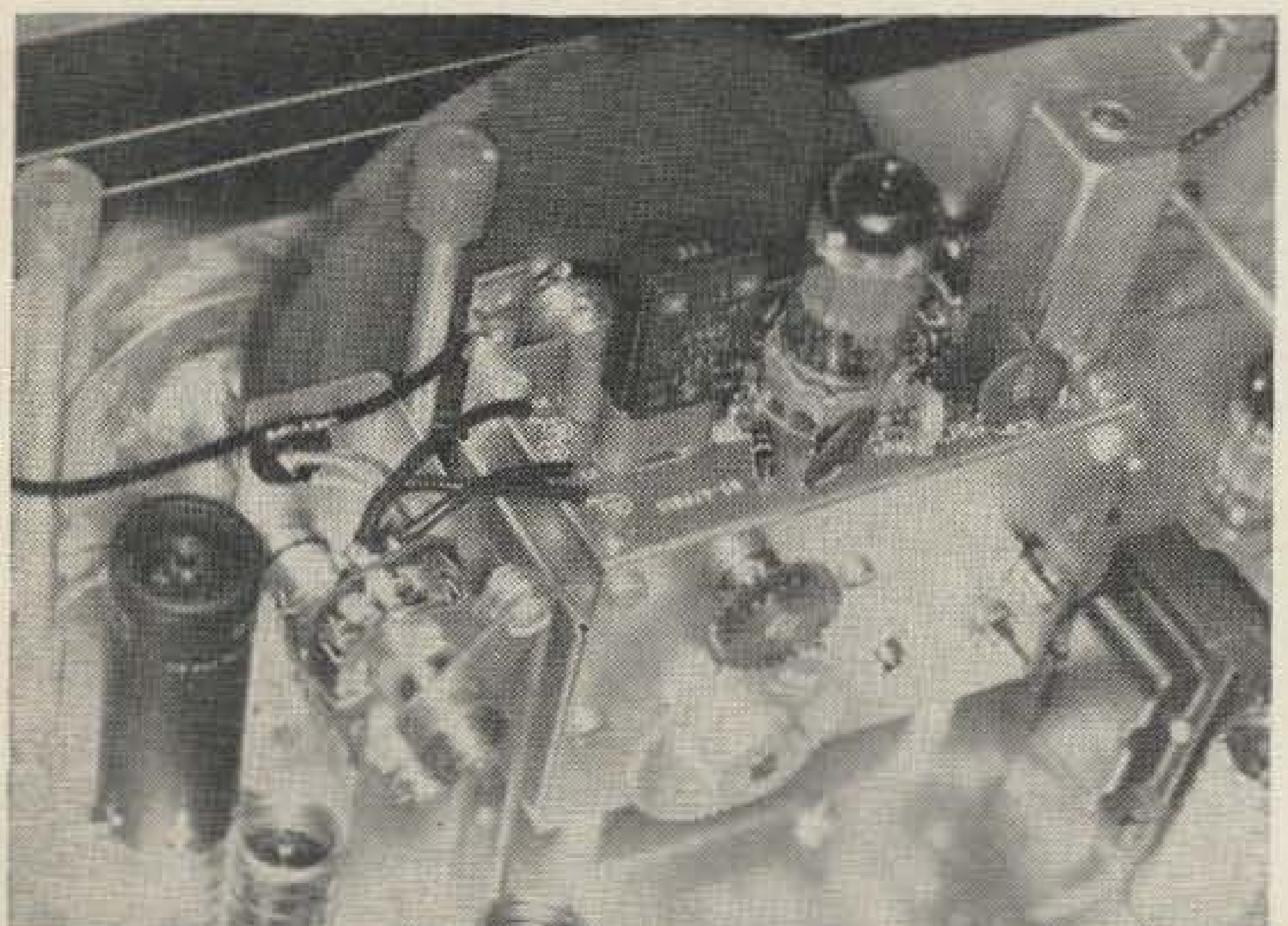


Fig. 5

Even as I was testing my own HX-30, I heard several other local stations using them on the band. Haven't you ordered your HX-30 yet? See you on 6 meter sideband!

. . . W3WTO

SPECIFICATIONS

Frequency Coverage—50.0 to 54.0 megacycles in four, 1 megacycle segments. VFO or crystal control.
Emission—SSB, selectable upper or lower sideband. AM (inserted carrier with low level, amplitude modulation).
RF Power Output—SSB (P.E.P.) 10 watts
AM 2.5 watts
CW 10 watts
Carrier Suppression—50db or more below maximum output.
Unwanted Sideband Suppression—40db or more below maximum output at 1000 cps input.
Distortion Products—30db or more below maximum output at 1000 cps input.
Hum and Noise—40db or more below maximum output.
Output Impedance—50 to 75 ohms, unbalanced.
Crystals—11.5 Carrier oscillator (furnished) 30.5 First heterodyne oscillator (furnished), providing operation between 50.0 to 51.0 mc. Crystals for higher band operation are not supplied.
Audio Frequency Response—300 to 3000 cps.
Keying—Grid block keying with key click filter.
VFO Tuning Knob Ratio—Approximately 45 kc per turn.
Power Requirements—117 VAC 60 cps @ 95 watts.
Dimensions—16⅝" wide, 10⅛" high, 10" deep.
Weight—40 pounds.
Price—$189.95

(W2NSD from page 64)

ten weeks for *Life, Changing Times* and *Aquarium*. And the difficulty I had with the *National Observer!* I subscribed to it twice (poor memory) when it started. First I tried to have the two subscriptions made consecutive, then, after I had read the paper for a few days and found it a crashing bore, I tried to cancel my subscriptions. Fat chance. I gave up after about ten letters, none of them nasty, and let them send the silly papers until they got tired. *Newsweek* is a lot better.

Our subscriptions are now being handled on a daily basis right from our headquarters and complaints, which are almost unknown now, are handled immediately. No matter how good we are from now on I know I'll have fellows come up to me at conventions years from now to tell me that they have never subscribed because they heard that we never send subscriptions. I'll kill 'em.

IoAR vs ARRL

Letters to the Institute of Amateur Radio have divided themselves into several discreet groups. There are those from fellows who are interested in our present projects of travel and aid to Ham-TV, wide-band FM, etc. Then we find a group of letters from fellows who are suspicious that the IoAR is out to get the ARRL, which seems to me to be rather silly, at best, in view of the clear statement that was made when I first announced the Institute. Then we have letters from fellows who suggest functions for the Institute over and above those so far outlined. No doubt, as the Institute gathers force, there will be services that it can render and activities that it can foster, but much as the large group of ARRL dissidents dislike the idea, I believe that we should make it a basic tenent not to overlap or duplicate services and functions of the ARRL.

Quite a few letters express the thought that amateur radio is not being adequately represented and that something should be done to improve this situation. They suggest that the Institute should attempt to represent the amateur. Frankly, I am astounded at the ignorance of fellows who make such a suggestion. Surely by now they must know that the Institute cannot represent the amateur. Surely they must have absorbed some faint notion of the present legal setup in our country for the changing of our rules and regulations. Is it possible that anyone can, after all these years, be unaware that it is the individual amateur that has full say on these legislative matters and whose responsibility it is to communicate his interests to the FCC directly? The FCC made it as plain as they possibly could that while they would consider the comments of all clubs and interested groups on any proposed legislation, that the decisions on all matters would be made on the basis of the arguments submitted by all interested parties. This means just what it implies: the FCC wants to hear directly from the amateurs, not from the Institute. The Institute cannot, unless it wants to set up its own laws, represent the amateur.

Since we are all on the air and can talk over ideas that we have with an unlimited number of fellows in this way, we are all in a good position to work out new legislative proposals to submit to the FCC. Our magazines are a fine sounding board for new proposals too, for they make it so everyone can consider the new ideas and discuss them on the air.

It is unfortunate that so few amateurs are apparently interested enough in their hobby to register their opinions with the FCC on proposed rules. With apathy at its present level it is quite possible for a handful of fellows to exert a strong influence on the hobby. Someone has to speak out for our hobby . . . why shouldn't it be you? We lost our "battle" for reciprocal licensing last year just because everyone was hoping that someone else would do something. The best we managed to stir up was a small flutter of letters. Some battle.

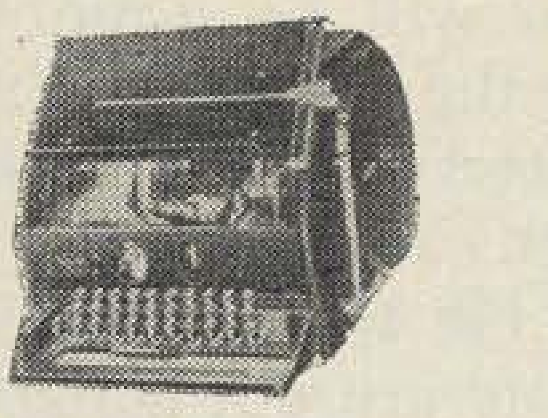
Let's suppose that you have thought things over quite a bit and feel that you have some good practical ideas for changing the present amateur regulations. After talking these ideas over on the air and finding that you are not out there all alone with your grand plan, your next step is to put your ideas down on paper and document them with all the facts you can. Send this paper and 14 copies to the FCC, Amateur Division, Washington 25, D. C. The Amateur Division is run by some mighty savvy hams and if you are out in left field somewhere in your petition they will either turn it down or let it die of starvation. If your ideas seem to have promise they will probably feed the petition into the hopper and it will

(Turn to page 118)

Strays

K6BX would like to make schedules with other hams who suffer from Logorrhea. W6RNC please note.

MESHNA'S STUPIFICATIONS



MODEL 14 TELETYPEWRITER, includes typing keyboard, printer, cover. Sold "as is," some pull-bars may be broken. Otherwise in fair condition. $32.00

We still have some 11/16 punching tape, 40 rolls per carton. Two cartons make 100 lbs. . . . save on shipping. per carton. $5.00

NAVY ARB RECEIVER 195kc—9.05 mc. Covers 40-75-80-160 meters. Xlnt with all tubes. $32.00

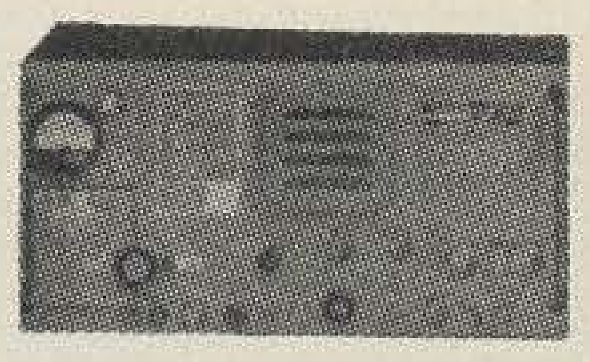
BC-453 (Q-5'r) 190-550 kc exlnt $12.75
80 METER ARC-5 (3-4 mc) transmitter, xlnt .... $ 9.50
BC-458 (5.3-7 mc) transmitter, xlnt .... $ 8.50
ARC-5 MODULATOR MD-7, brand new .... $ 8.50
17 FT. BALLOON, double plastic, wgt 26 lbs, aluminized .... $ 4.50
RA-62, AC Supply for SCR-522, xlnt $35.00
28 volt DC supply 4 amps from 115 volt 60 cycle, unused $12.50
MAGNETICALLY REGULATED SUPPLY, brand new. Output 150 DC 3.4 amps plus 300 volts 3.2 amps. Wgt. 100 lbs., 2 rack panels $50.00
PHILCO TRANSISTORS, HF OSC/CONV similar to SB-100 .... 80c ea., 3/$2.00
1,000 KC CRYSTALS, HC-6 holder .... $ 2.25
TRANSISTORS, 15 pieces PNP low voltage, OK ... 15/$1.25
NATIONAL TRANS. COND. TMK-150, 150-10, 5, unused .... $ 1.50
220 MC DIPOLE ANTENNA, Brand New w/coax socket $ 3.00
TECH. MANUALS, fresh as new: any one at $2.50 BC-603, BC-659, BC-683, BC-1,000, ARN-6, ARC-27. Take your choice.
CRYSTALS, HC-6 metal holder. Your choice $1.00 each 37.85, 38.85, 39.85, 40.85, 41.85, 42.85, 45.85, 46.85, 47.85, 48.85, 49.85, 50.85, 51.85, 52.85, 53.85, 23.635, 24.544, 25.635, 26.259 mc.
"LM" POWER TRANSFORMER, original issue, 115 volt 60 cycle in. .... $ 1.75
#S-49 TRANSFORMER, 4200 volts CT 300 ma, unused 115 V 60 Cycle in. .... $ 15.00
IBM WIRED MEMORY PLANE, 4096 bit. .... $ 12.50
IBM MEMORY DRUM .... $ 50.00

All material FOB Lynn, Mass. (you pay shipping).

New catalog #62F, Rush 10c handling charge.

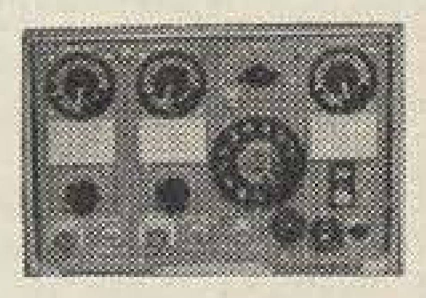
JOHN MESHNA JR.

19 ALLERTON ST., LYNN, MASS. phone 617-595-2275

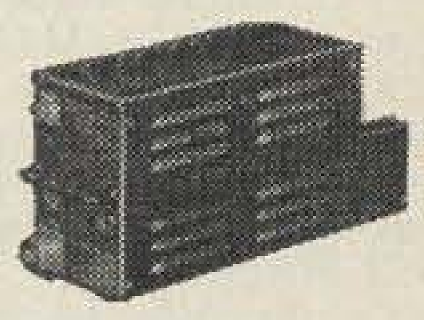


TRC-8 RECEIVER, 230-250 mc, easily modified for 220 or 2 meters. Written up in "CQ" May-June 1960. Built in squelch, speaker, 115 volt 60 cycle power supply. Ours like brand new in desk-type trunk. Schematic included. Wgt. 100 lbs. $35.00

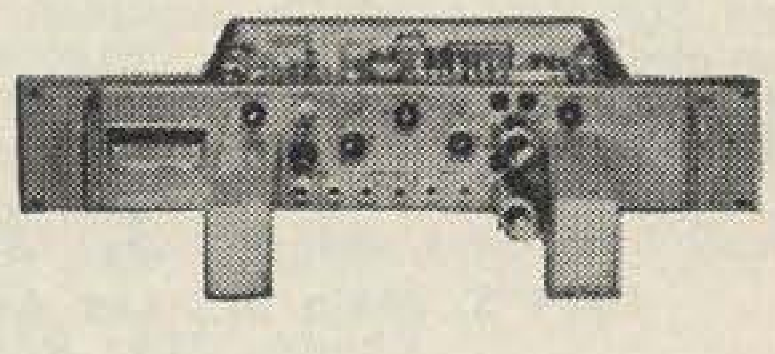
NICKEL CADMIUM BATTERY, the lifetime battery 1.2 volts 4 amp hr. charge & discharge indefinitely. No known life termination. Xlnt charged, ready for use. $2.00



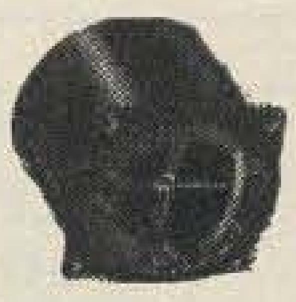
REMOTE CONTROL, brand new, consists of tel. dial, selsyn indicators, switches, pots, lights, housed in gray aluminum case. Gov't cost $150.00. Experimenters delight. Wgt. 29 lbs. $6.00



BC-733 RADIO RECEIVER, converts to regular FM receiver, converts to 6 meter and 2 meter receiver. With all tubes, xlnt. $7.00



PHILCO LINE TERMINATION & signalling unit, standard rack mount, contains hybrid coil, relays (4) transformers (115 v 60 c) trans "T" pad, rec "T" pad, 3.5 kc osc sect, tubes, etc. Imp. 600 ohms. Good for fone patch, signalling on line, etc. Gov't cost $421.00 and brand new in gov't package. Shipping wgt. 33 lbs. Late style eqpmt. $12.50



DUAL MICRO-AMMETER (150 microamps), used for conversion to teletype freq. shift and tuning indicator. We include conv. sheet. Xlnt used ... $2.00 brand new cond. .. $2.75

IT ADDS UP

Let's sit down and discuss this matter of subscribing calmly and unemotionally. The fact that we are almost insane on the subject of your subscribing should have no bearing on the matter. What matters to you, primarily, is that by subscribing you pay less for your magazine (only 25c a copy on a three year subscription, a saving of $5.40). You also don't have to fret over possibly missing one of our special issues which seem to disappear from counters and newsstands almost overnight. Heh, heh . . . wait'll you see our special June surplus issue. We are also preparing special sections on towers, quads, VHF, etc., for future issues. Your subscription copy comes to you wrapped in a sturdy wrapper so it won't be dog-eared and beat up.

Name .... Call ....

Address ....

City .... Zone .... State ....

☐ $3.50 One Year ☐ $6.50 Two Years ☐ $9.00 Three Years

☐ $40 Life (yours or ours)

50c each enclosed for the following back issues ....

(Jan. '61 and June '62 out of print) Class license ....

☐ $1.00 enclosed for one year membership in Institute of Amateur Radio.

73 Peterborough, N. H.

(W2NSD from page 116)

get a docket number designation. Once published, you can be sure that every amateur who doesn't like the idea will be grumbling about it and many will file the necessary fifteen copies of rebuttal. Supporters will also have to send the usual 15 copies. You can also be sure that the ARRL will file their comments. While the ARRL comments are not supposed to carry any more weight than individual comments, you can be sure that they will be well thought out and, if for no other reason, on this basis alone carry much weight in the final analysis.

If not too many good reasons have been brought out by interested amateurs and the League against your proposal, it is possible that the FCC may eventually change the regulations and your brainstorm be put into practice. This has happened to a lot of fellows down through the years. I remember quite vividly the violent and long drawn out battle that we had over getting RTTY FSK on the lower frequencies. Everyone seemed to be against us, but we finally made it.

It doesn't seem to me that there is any need for the Institute to enter into this business of representation of the amateur. The ARRL is doing what little representation that is possible these days, so why duplicate? There are more than enough undone things to help our wonderful hobby without attempting to duplicate existing functions of the ARRL.

TV on Two & Six

The Institute has been busy supporting one of the smallest of the splinter ham groups, the Ham-TV'ers, by submitting a petition to the FCC for the allocation of two one megacycle television bands in the upper reaches of the six and two meter bands. Should the FCC take favorable enough action on this petition to assign it a docket number we will publish the full text of the application.

Some of the systems for getting a television signal on the air are so simple now (see our book on Ham-TV by WOKYQ and the bimonthly ATV Bulletins) that the major limiting factor holding back the development of further experimentation is the restriction put upon us to remain on the 420 mc band or above. Since one megacycle wide TV has been proven practical and since the top two megacycles of the six and two meter bands are virtually unused at present and are not needed to provide adequate frequencies for AM, CW, SSB or RTTY communications, their use for amateur television would not only facilitate the growth of ham-TV by making it possible for the many amateurs who are now active on these bands to try this new mode of operation, but it would also provide an effective answer to those critics of the amateur service who point to our present lack of utilization of these important frequencies.

Please note that the Institute is supporting this petition in behalf of the ham-TV group and not as a representative of the radio amateurs in general, though we did run a questionnaire in 73 which was answered overwhelmingly in favor of this petition and thus tended to indicate that the readership of 73, at least, thought this was a good idea. Until such time as all hams are 73 readers and become eloquent in their own behalf, I don't think it will be possible for the Institute or 73 to even consider representing amateur radio.

I note, with some regret, but no surprise, in the March issue of *QST* that the ARRL intends to oppose the development of ham-TV, as they did RTTY some years back. They fought with every strategem they could muster to prevent FSK RTTY on the low frequencies. They feel that the ARRL slow-scan system should be promoted, but that amateurs should not be encouraged to try restricted bandwidth television since the "techniques to be used would be crude copies of commercial practices . . ." This decision by the ARRL was made by the Executive Committee. I believe that a simple polling of the amateurs who have shown an interest in ham-TV will show them, as it showed me, that the opening of the six and two meter bands to ham-TV is as crucial to the development of this phase of our hobby as was the opening of the low frequencies to ham-RTTY'ers.

QRM

The W3PHL article in February evoked several angry letters. The gist of the complaint was that PHL has been transmitting an unholy signal on 40 and 75 and refuses to stop. Unfortunately none of the angry complainers had anything more technical to contribute than that PHL's signal is too broad. Though I was not aware of all the emotion choked up in Fred's little tempest on the low end of 75, I do feel that I would be doing great harm to the basic principles of freedom which our country champions if I were to reject articles on the basis of the personal popularity or unpopularity of the authors.

Obviously the high power complications of the article will run afoul of either FCC inter-

(Turn page)

(W2NSD from page 119)
pretation of current regulations or future clarifications of the rules. However the low power applications might be important where we want the maximum go per watt.

The publication of the article should prompt our more erudite readers to submit articles clarifying any inaccuracies and we all will have learned something.

Ham Manufacturer

On some lower level of awareness I suppose I realize that it is ridiculous for me to keep thinking about starting a sideline of ham gear. You probably know how I feel for most of us get the urge every now and then to try our hand at making some gadget and selling it to our fellow hobbyists. I have quite an added advantage in this for few people are in as close touch with a market as I am with ham radio through the hundreds of letters (mostly unanswered, I'm afraid) that come in here daily.

There probably is a small shred of jealousy over the success of CQ's venture into manufacturing with their "Raytronics" Nuvista-Plug VHF preamplifiers needling me. I had always been held back from serious consideration of manufacturing by worries and doubts as to the reaction of other manufacturers (these are the advertisers, son) in the field. Apparently, like many other accepted beliefs, this one was a little leaky in the applied logic department. Well, I may learn slowly, but I do learn.

Another goader into this field of endeavor is the failure of many other ham manufacturers to make a go of it. I've watched quite a few sink into oblivion in the last few years, most of them quite unnecessarily.

The insurmountable stumbling block for me is picking the name for this enterprise. Several come to mind, but how can I make a firm decision when I want to use them all? There is Aabco, a fine name for a company because it will always be listed first in any advertising list. Zzyd company will inevitably be last on any list. Then there is the Rosy Prospects Company, a name I spotted over in Formosa a couple years back while on Operation World Wide. Or why not be matter of fact about it and have Stuff Manufacturing Company? How about Debacle Manufacturing Company, then every item we turn out could be stamped "Debacle." Or maybe Caveat Emptor Manufacturing? Or perhaps we should be devious and call it the New Hampshire Pickle Works, like that Horseshoe company that actually makes tools these days. Honey-Bucket Engineering might be to the point. Or perhaps Our Gear Works. Maybe something more modern, like Do, Dad! Manufacturing . . . then every product would have Do, Dad! on it. Or Capitalistic Swine Manufacturing Company. How about the Honest John Division of El Gyppo Company? Possibly Carbunkle Labs? Or even Festerbestertester Labs, which would be fine for answering the phone.

Many more equally apt names come to mind, but apparently I am frozen into immobility by indecision . . . or is it perhaps that I am so utterly behind on keeping 73, the Institute, the European Tour, the 73 Parts Kits, Radio Bookshop, and dozens of other little schemes from collapsing?

JOB

It might be a good idea for us to run a little help wanted list in 73. Every now and then someone calls and wants to know if I can recommend anyone for a particular job. Usually I can't. For instance, just the other day a chap called who has a rather interesting proposition for a ham between 28-45 who has some management and possibly financial experience. This looks like it has good possibilities. If you are interested drop me a letter giving your complete history, credit and personal references, photo, etc. If the chap is interested he will pay your way down to Texas for a personal interview and if you are accepted he will give you a contract with provisions for later participation and salary expansion. He is prepared to pay relocation expenses. Actually he has two businesses that are about to be started and he will be needing two good hams to run them for him. It will be a lot of work, but it should be worth it.

While we've had more than enough applications for summer work here at 73, we're still keeping an eye peeled for one or two hams to join the staff on a permanent basis. The closeness of our work makes personality factors even more important than experience, for an eager fellow can learn the work and we haven't the time to invest in psychotherapy to correct little personality faults such as inconsideration, laziness, dishonesty, sloppiness, and stupidity. The pay is lousy and the work is hard. The days are long and the weekends short. But we're going places . . . or have you noticed that this issue is 128 pages, the largest issue we've ever published? Many of our staff will be going on the European trip this year, new members will probably be able to go on future trips.

What is the work? There are so many things to do it is hard to even start. Manuscripts have to be kept track of and processed. Advertisers have to be coddled. Equipment has to be tested. Dishes have to be washed, horses have to be fed, cars have to be washed, towers have to be erected, envelopes have to be stuffed, our offset press has to be run and cleaned, books have to be kept, the house has to be cleaned, new buildings have to be built, typewriters have to be cleaned, stencils have to be sorted, wrappers have to be addressed, things have to be filed, walls have to be painted, letters have to be answered, books have to be mailed, kits have to be assembled and mailed, magazines have to be carried, filing cabinets have to be struggled around, booklets have to be assembled, the HQ station has to be kept active, new antennas have to be tested, our parts kits have to be built and tested out, and 1000 other things.

There are reasonable apartments and houses in the vicinity, and we have room in the HQ building for temporary living while house-hunting progresses. Warning: if you are not used to handling responsibility plus night and day work, forget it.

QUESTIONNAIRE

Back in February we ran a little quiz. Perhaps you'll be interested in the results. Manufacturers certainly will be.

1) 40.5% of the readers answering the questionnaire indicated that they may be trying out six meter sideband this year. I was a little worried about all those companies going into the manufacture of sideband gear for six, but obviously I needn't.

2) 29.2% felt it likely that they would be going sideband mobile this year. Manufacturers please note: based upon the present circulation of 73 this would indicate that our readers will be buying over 22,000 sideband mobile rigs. This should keep everyone in business.

3) 12% indicated that they might go on our flight. Since we can only possibly handle two tenths of one percent of our readers on the trip I hope that there is a decided bias in this figure.

4) 75% wanted more emphasis on VHF. OK fellows, write more VHF articles. We'll print 'em.

5) 38% felt it likely that they would buy a tower this year. Do you have any idea how many towers that is? Good grief. Our special tower feature section in May should be of considerable interest.

6) 82.4% have purchased some surplus during the last year. We'll have to run a special surplus issue this summer. No wonder 73 has more surplus advertising than any other magazine.

. . . Wayne

73 Products

Peterborough, N. H.

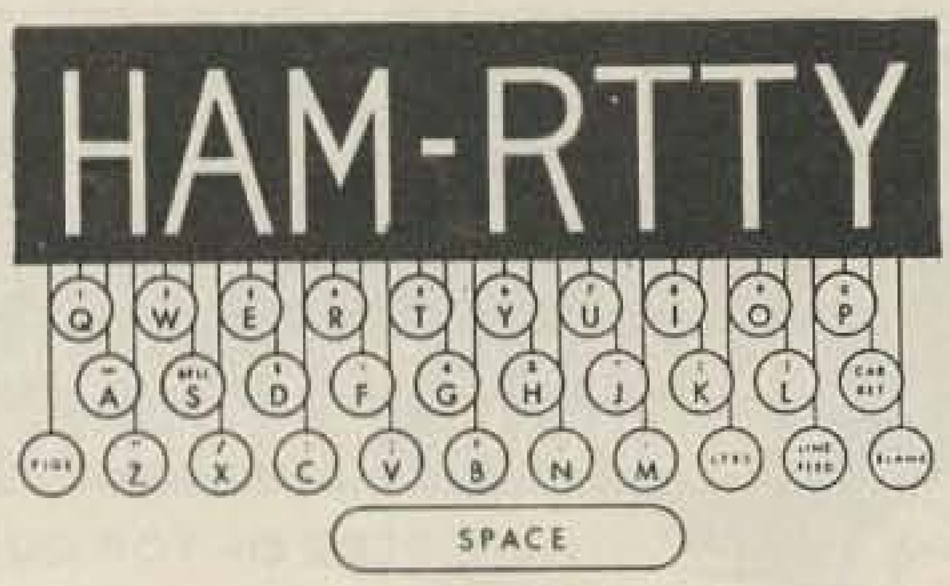
MICKEY MIKER 50c

Complete and exhaustive construction project for building a precision capacity tester. Very thorough.

IMPEDANCE BRIDGE PRINTS $1.00

A complete set of full scale prints (15) of all parts of the precision impedance bridge which originally appeared in the August 1961 issue of 73. Comes complete with a reprint of the original article.

NEW RTTY BOOK $2.00



This handbook is written for the beginning RTTY op, but due to the profusion of info, pictures, circuits, etc., it will be valuable to all RTTY'ers and those who may RTTY themselves. If you don't know what RTTY means don't buy it. For $2 what can you lose? It's worth almost that much in paper.

". . . wealth of info . . . a great help here in this shack . . ." W3AJD

". . . you should be congratulated on a fine job. It contains a great amount of the detailed sort of information that is useful in establishing Civil Defense circuits . . . I am suggesting it to the people that I work with as *recommended reading* . . ." W6QLB

"How on earth did you ever get pictures of so many different types of RTTY equipment? This book was worth its weight many times over just for knowing what is what . . ." WA6EXU

"Boy, does your new RTTY book make the 'other' one look sick. Congratulations . . ." BJK . . . NY.

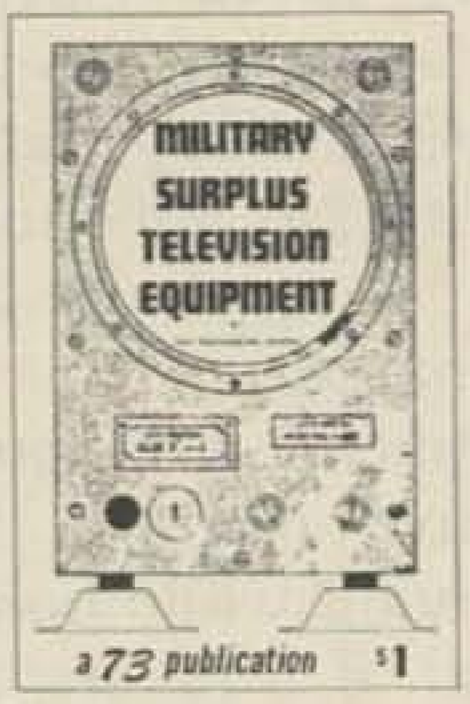
"It is . . . ah . . . ah great pleashah to read a book that has been written with such vig-gah . . ." JFK . . . DC.

In stock, immediate shipment, send Money. ONLY – $2.00.

SIMPLIFIED MATH 50c

This booklet takes you gently by the hand and leads you through the mysteries of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc., and does it by an amazingly new method.

SURPLUS TV SCHEMATICS $1.00



TV'ers who are interested in saving a lot of construction time and still want to have elaborate TV gear will do well to watch those surplus ads and invest in this booklet, the only source of the diagrams you'll be needing.

CW $1.00

Written by an expert. One of the best methods for learning the code yet devised. Lays in a good foundation for later high speed CW ability. CW can be a lot of fun if you go about learning it the right way. This book will be invaluable to the beginner and the ham who wants to really increase his code speed.

AN/VRC-2 CONVERSION $1.00

CONVERSION
OF THE
AN/VRC-2
by
Lloyd Hanson, W9YCB

Exhaustively complete instructions on converting the surplus and inexpensive VRC equipment for six meter wide band FM ham net operation. Get thyself on 52.525 mc and join the national wide band FM activities.

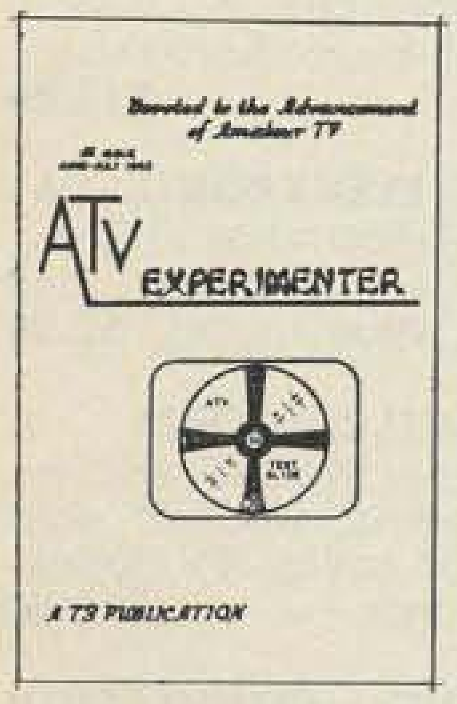
HAM-TV $3.00

This book gives you a blow by blow description of how to get on the air on TV for under $50. This book is the reason that hundreds of hams are now going on TV. This is not the usual theory book, just a how-to-do-it manual.

SSB TRANSCEIVER $1.00

Extra large schematic diagram of this terrific little transceiver. Published originally in November 1961 issue of 73. Schematic comes complete with extra November issue.

AMATEUR TELEVISION EXPERIMENTER $1.00 per year

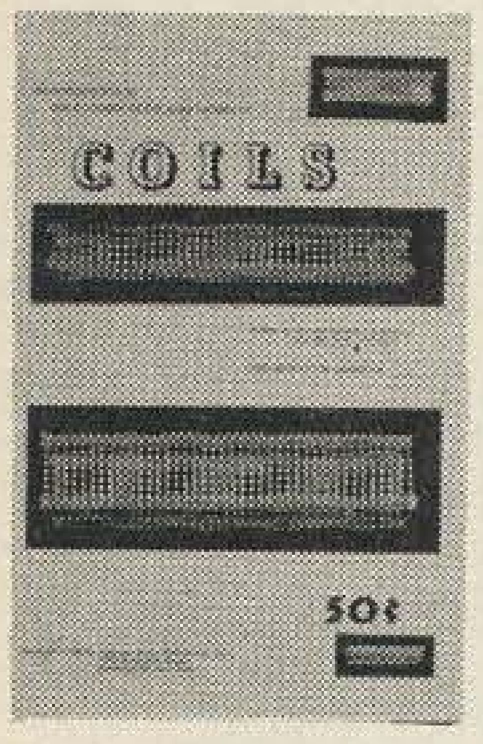


The first five issues of this invaluable bulletin are now in print. Each one is worth more than the year's subscription. Send $2 for complete set from #1 up through #12. Quantity limited so don't wait.

CARE AND FEEDING OF HAM CLUBS $1.00

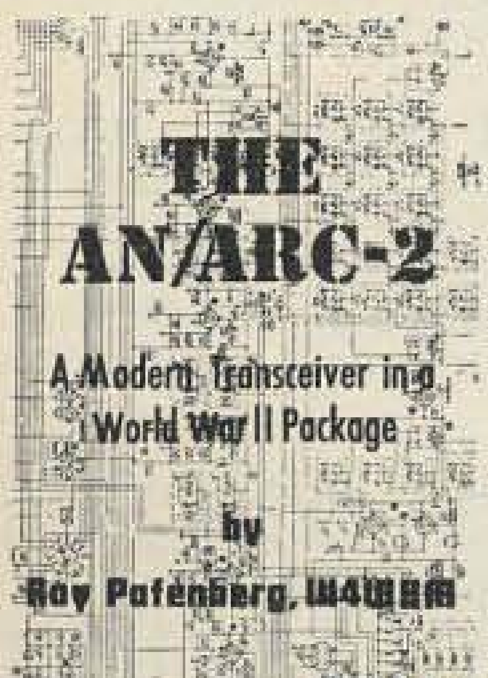
K9AMD's interesting book on all aspects of forming and holding together a ham club. This is the result of exhaustive interviews with many club officers and will be invaluable to every club going.

COILS 50c



Well illustrated basic book which describes all of the different types of coils to be found in radio work. Covers theory and practical aspects.

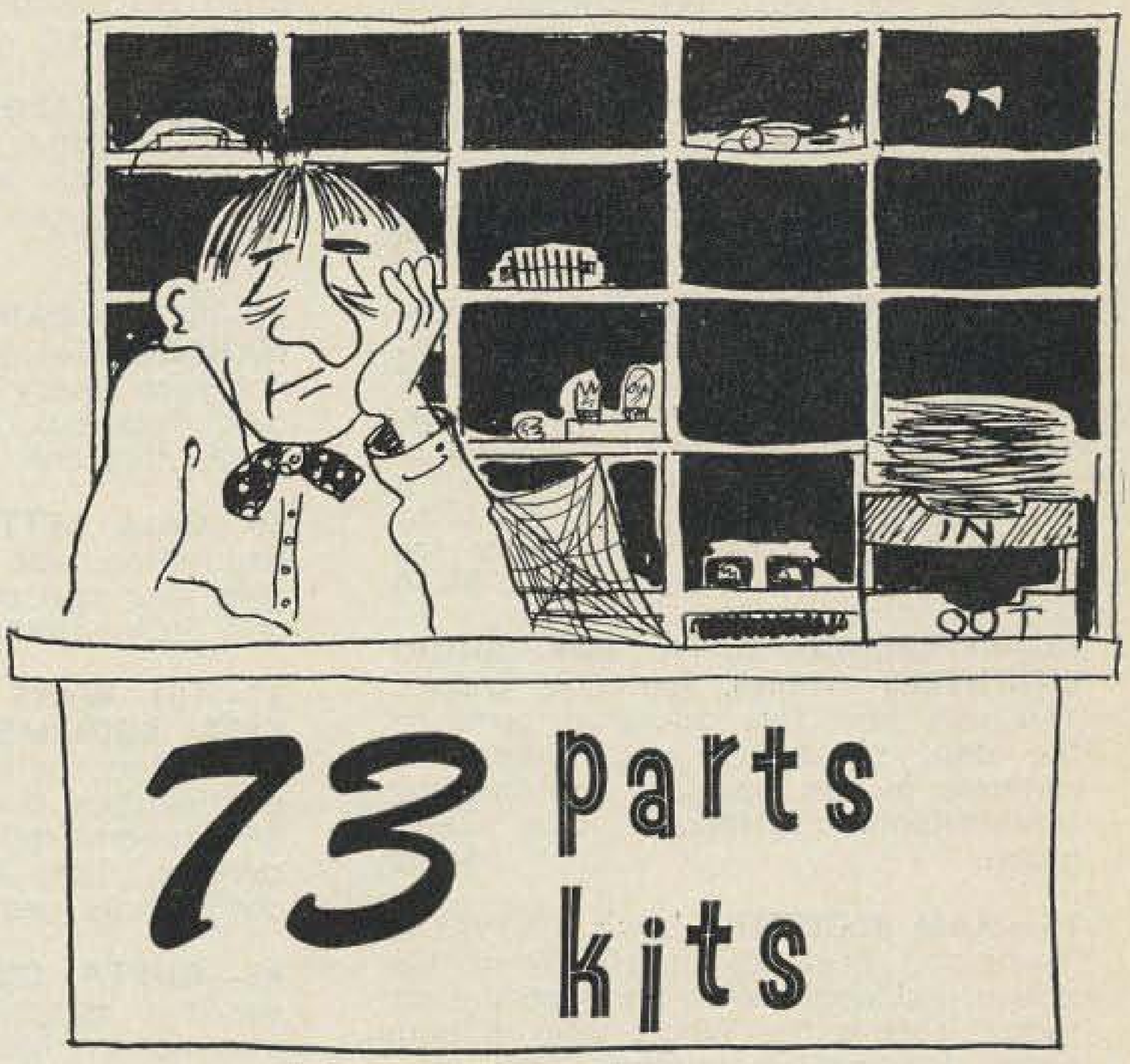
AN/ARC-2 CONVERSION $1.00



Complete schematics and thorough conversion details on this modern transceiver which covers 2-9 mc (80-40 meters . . . and 160). This unit now sells for $40 to $50 surplus and is easily converted into a terrific little transceiver.

WORLD GLOBE (plus subscription for one year) $16.95

Every visitor to the 73 HQ shack is taken aback by the beautiful world globe next to the operating position. We find this invaluable for figuring out beam angles and planning world tours. It is 18" in diameter, normally sells for $19.95 (via CQ), is nearly five feet around the equator. Canadians please allow a little extra for Diefendollar exchange.



In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER THREE NUVISTOR PRE-AMPLIFIER for perfectionists, complete with self-contained power supply. Kit contains nuvistors, sockets, all condensers, resistors, potentiometers, power transformer, rectifier, switch, antenna coax connector, etc. See article in March 73 page 8. Everything you need, complete with full scale drilling template.
Kit W9DUT-1 . . . $18.50

PORTABLE RAGCHEWER RECEIVER. Simple little 40M regen receiver, but it works and is a lot of fun to build. Very portable. Kit contains all parts needed. See article in March 73 page 14.
Kit K6LJY-2 . . . $16.50

PORTABLE RAG CHEWER TRANSMITTER. 6AU6-2E26 rig for 40M. Nice little 20 watt rig, VFO operated.
Kit K6LJY-1 . . . $24.50

QRP TRANSMITTER. One tube (1S4) ½ watt 40M rig. Fun to build and really works. See article in March 73 page 22. We've built a lot of 'em here.
Kit W1MEL-1 . . . $6.00

Radio Book Shop

Peterborough, N. H.

OK, how many times a year do you wish that you could look something up and frustrate yourself trying to find it in the back issues of ham magazines? . . . You need a handbook. The newest and bestest is the 16th Radio Handbook by Bill Orr W6SAI. This is terrific. It not only provides one of the best known ways to smarten up on your theory, but is jammed full of great construction projects. Look over this list and start building up your reference library.

1—ELECTRONICS & RADIO ENGINEERING—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. **$15.50**

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$12.00**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

16—HAM REGISTER—Lewis (W3VKD). Thumbnail sketches of 10,000 of the active and well known hams on the air today. This is the Who's Who of ham radio. Fascinating reading. Only edition. Now only **$2.50**

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ). Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable.. **$2.95**

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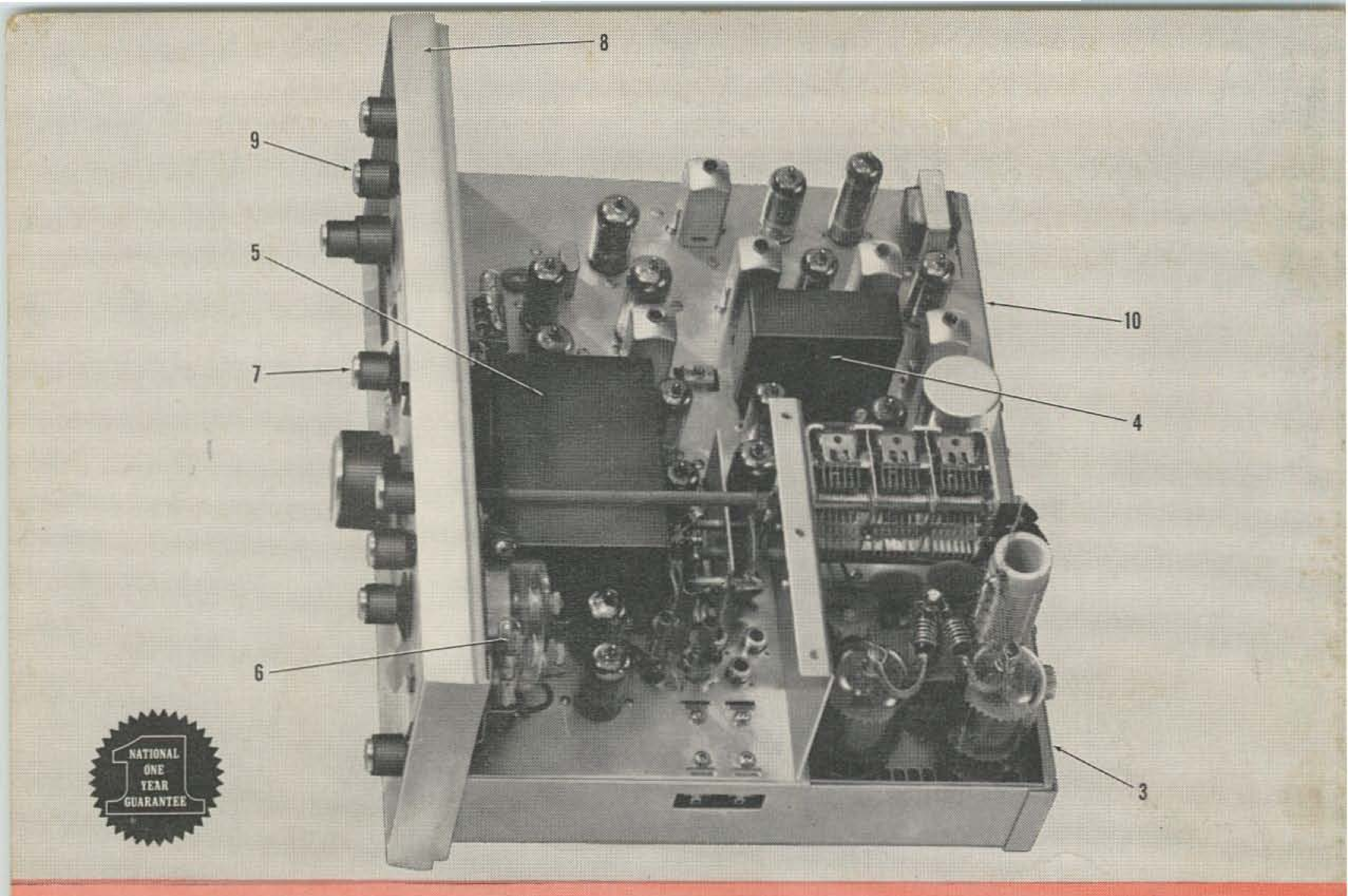

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