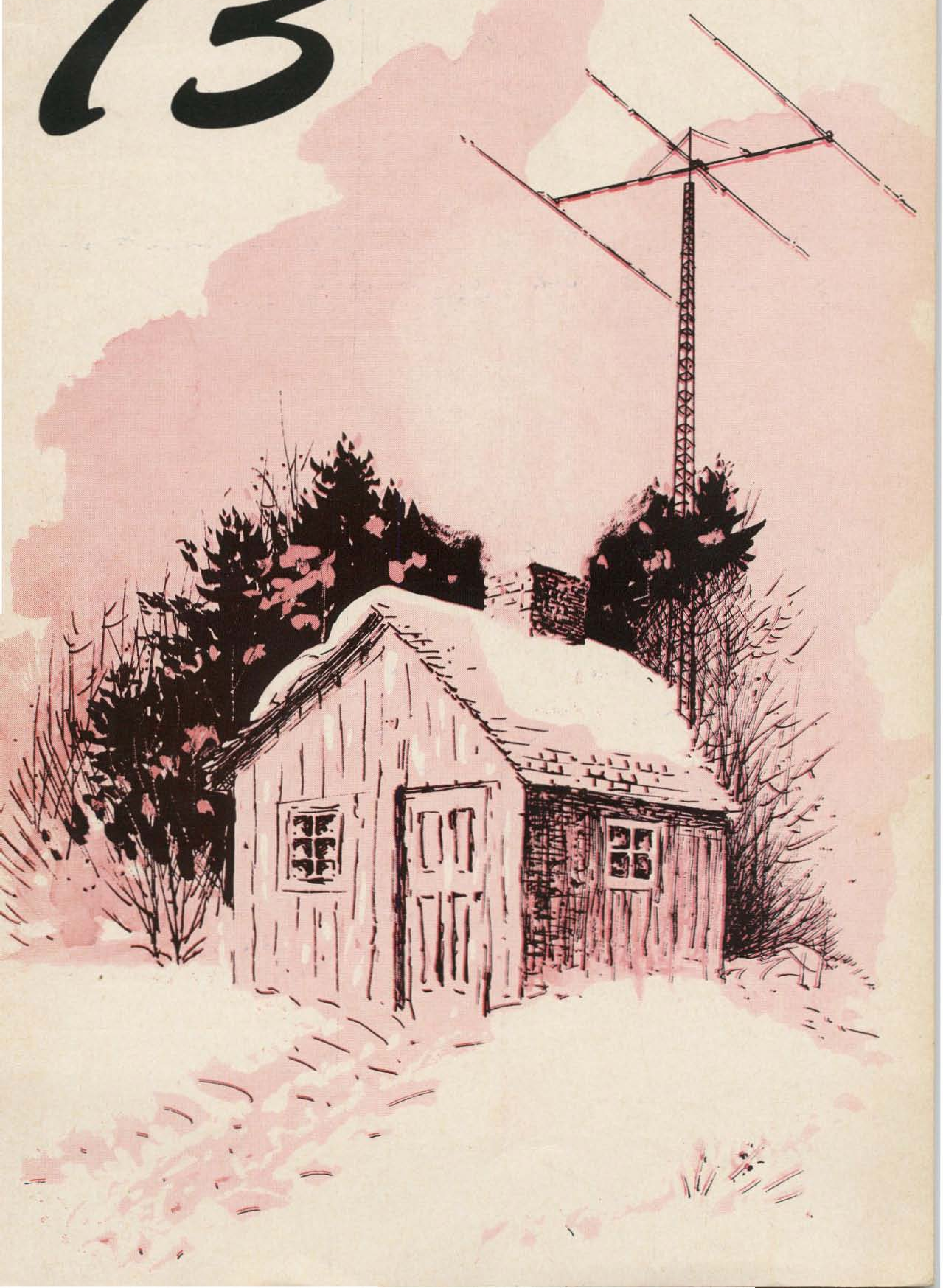
73 AMATEUR RADIO

DECEMBER 1966



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Fast operation

A few months back I devoted a bit of my editorial to my thoughts on techniques for working the most number of stations in the shortest time. Since then I've had several opportunities to do field work and experiment more with the various systems of fast operating.

Don's system is pretty good. He sits down on 14,104 or so and announces the band of frequencies he is tuning. This gives him the latitude to select who he wants to work, though usually the QRM is heavy enough so that even with the stations spread out over twenty or more kc only the really loud stations get through.

My arguments against this system may be small-minded, but there are a couple of things that do bother me. First of all this sort of thing ties up large segments of the band for hours on end. If it is absolutely necessary to do this to run a DXpedition, I suppose we can afford the spectrum now and then, but I don't think it really is all that necessary. Secondly, if you've tried this arrangement you know that the big guns can generally get through in a rather short time, but that some fellows spend hours and even days trying to get through. It doesn't take long before the contact has gone far beyond the limits of fun and the project has become a matter of desperation combined with growing hate and frustration.

Let's say, for example, that at one particular time there are fifty stations calling a DX station. This fifty are spread out over 20 kc of band that is in normal use at the start with fellows working DX and rag chewing. The howling mob crushes all previous activity on those frequencies in short order and the furor on the band attracts more casual tuners and soon the pack grows faster than the DXer can whittle it down. Under the usual conditions it will take our DXer about 25-30 minutes to work that fifty stations, what with repeats of call letters and waits for the more long winded chaps to finally sign their calls and stand by . . . you see, you never know when you tune in a station just how quickly he is going to shut up . . . and you find yourself listening with growing horror as he goes on and on and on calling you. By now you have so many minutes tied up in waiting for him that you hate to tune off and find someone else. Most fellows that call give your call a couple of times and then sign theirs. Often you will hear your call, tune it in and just as the other call is starting to come through someone else swishes down and starts calling you . . . and the minutes drag on.

OK, so that system has some faults, what about the others? Well, I discussed the ET3AC system of listening for a designated time off the transmitting frequency of the DX station for calls. This allows the calling stations to spread out for about two or three minutes and call so the DXer can get their call letters . . . and this is the time consuming part of the whole deal. Then he can work them break-in on his own frequency. This allows the transceive boys to play the game too.

During my trip I tried Don's system several times and, frankly, he can have it. What a miserable job that is sorting out all that QRM. And I couldn't help feeling a bit guilty about what I was doing to the band. Also, the mass of QRM made it virtually impossible to work the weaker stations until the loud ones had all been worked. And I hated to hear fellows tell me that they had been calling for over an hour.

I tried the ET3AC system a few times too. This might work fairly well if you had a band relatively free of QRM. Don's systems flattens all activity in the band he is tuning in short order and he can tune there knowing that almost any signal he hears is calling him. The mob violence to the band every ten minutes or so called for by the 3AC system doesn't chase anyone out, it just mixes everything together with the result that the DXer has one devil of a job getting very many calls written down. I did not find this much faster than Don's system.

Working transceive on your own frequency is usually pretty slow and I have kind of avoided this. I've been in too many of the pileups trying to get through to a DX station myself and know how long that fellows can keep calling in order to be the last one to call and thus be in the clear and get through. And if the DX station is weak the callers can go

(Continued on page 108)

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Editors' Ramblings

Paul Franson WAICCH

Do you own your own business? Yes? Then how would you like to receive a sizeable government subsidy each month while your competition receives nothing? It would be quite a help in competing, wouldn't it? But on the other hand, how would you like to be that unsubsidized competition? No? Well, few would. This type of treatment sounds unfair to most people, yet is quite common in the U.S. It results from some laws passed long ago at a time when no one could foresee this consequence. Here's what happens:

In this country, the government has decided that certain businesses and organizations are better for the citizens of the country than others. These groups are classed "non-profit organizations," which entitles them to two major financial windfalls: they don't have to pay any taxes on their incomes like regular businesses do, and they are eligible for very low rates on much of what they mail. Of course, they have some obligations, too. They're supposed to do good—and not try to influence legislation to any great extent, i.e., lobby. But many of these non-profit organizations seem to have forgotten their main functions. The people who manage these groups, just like the managers of any other businesses, want to increase their prestige, compensation and influence, so they usually try to build empires.

The National Geographic Society is such a favored non-profit group. It is a huge organization with 1800 employees, an income last year of $48 million, and a publication with 4.8 million subscribers. The original charter of the NGS established its objectives: to increase and diffuse geographic knowledge. But its major publication, the National Geographic Magazine, can hardly be considered simply a magazine of geography. Among the recent articles in the NGM have been ones on Winston Churchill, the FBI, former U.S. Presidents, the Air Force and the Navy. It even had the exclusive rights to photo coverage of the marriage of the President's daughter last August. The NGS also publishes many colorful books and what many people consider to be the best general-use maps in the world. But many other organizations publish travel and picture magazines, attractive books and excellent maps. Many people wonder why these organizations should have to pay taxes and higher postage than the NGS when their activities are so similar.

Another non-profit organization is the National Chamber of Commerce. Its magazine, Nation's Business, has about ¾ million subscribers. The Chamber, though classed non-profit (and hence by law, non-lobbying), certainly seems to have done its share of attempting to influence legislation. It is able to do this in the same way many other non-profit groups do, by setting up separate "non-affiliated" committees and organizations to lobby, as well as by depending on individual members and their influence. Its efforts on behalf of its concepts of "free enterprise" are well known to most Americans. It condemns government interference and influence in businesses.

These two organizations pay no income taxes. Yet together with 700 similar non-profit groups, they took in $110 million in ad revenues last year. They obviously have a tremendous advantage over their tax-paying competition. The NGM competes not only with Holiday and Venture, but with Life, Look and dozens of map and globe makers. Nation's Business competes with many magazines, too. One of them is Business Week, published by McGraw-Hill. BW is far superior to NB in every respect (unless you place a high value on obvious propagandizing). But both magazines have about the same ad rates in spite of the fact that NB has about half again as many subscribers as BW. At least one of the reasons for this is obvious: Nation's Business's government subsidy. It's especially galling to see the journal of the U.S. Chamber of Commerce, the guardian of "free enterprise," competing unfairly with a tax-paying magazine by taking a government subsidy.

Another bastion of "free enterprise" is the American Medical Association, a non-profit organization. It publishes not one, but 14-ad-carrying magazines. The AMA fights subsidized medicine, but subsidized publishing is obviously another matter to them. The AMA Journal, its largest publication, carried 5700 pages of advertising ($10 million worth) last year, more than any other professional journal. Yet it pays no taxes and gets very low postal rates.

The Internal Revenue Service has been looking into the finances of these and similar organizations. They feel that at least part of the income from advertising should be liable to taxes. So far, nothing definite has come of it.

(Continued on page 110)

Hank Olson W6GXN
3780 Starr King Circle
Palo Alto, California

Some Thoughts on Transistor Power Supplies

Need a low-voltage power supply for transistorized equipment? This article gives you the practical information you need to keep from over- or under-building.

The power-supply is usually the very last part of the circuit to be built into an electronic design. This is perhaps as it should be, since the circuit designer often doesn't *really* know the exact voltage and current requirements until the design is done. But, because the power-supply *is* last, it often is a victim of the "dollar-short and day-late" effect. Also, the power-supply may suffer at the hands of a designer too well-steeped in the ac-dc broadcast receiver practice, to the point where "power-supply" and "a rectifier and a capacitor" are synonymous.

The author's point of view is that the power-supply should not be an after-thought, but rather should be well designed; since a good power-supply can effect many simplifications in the associated circuit design. Also, in this age of very inexpensive diodes and transistors, the difference between a rough power-supply and quite a nice power-supply is only a matter of a couple dollars worth of parts.

If one accepts the idea that a good power-supply design is desirable, will result in a better overall circuit, and will save design time to boot; how does he approach the total design? Or, which comes first, the chicken or the egg? If one first builds himself a laboratory power supply which has *all* the features of any supply he could want, he can use it to try out each circuit, as it is designed. Then, having a circuit that works well with the lab power-supply, one can design a simpler power-supply that encorporates only the *needed* aspects of the laboratory unit.

See the article, "A Laboratory-Type Power Supply," in this issue for a very useful lab supply.

Transformers can be inexpensive

The design of a power-supply almost invariably requires the use of a transformer. This is for two reasons: isolation from the powerline and obtaining a voltage different from the line voltage. The transformer is likely to be the highest priced single item in the power-supply, so resourcefulness in choosing a power transformer can really save money. Utilization of transformers that are available everywhere avoids buying the special types with their high price tags.

It is almost a truism that any electronic part we can use that is made for an automobile or a TV set is at the rock-bottom price for an item of its type. This is simply because the TV set and the auto represent "essentials" to the American public—everyone has at least one. Further, junk TV's and autos abound, and the price of a part is even lower after its carrier's demise. The large number of amateur transmitters powered by old TV set transformers is witness to this fact. One can find 6.3 Vac transformers in some of the junk TV sets; they were used to provide heater voltage to some or all of the tubes, while plate voltage was obtained using a semiconductor doubled directly from the power line. These 6.3 volt heater transformers can be useful in transistor power supplies used in the full wave bridge or conventional doubler circuits.

The early 12 V auto radios (with tubes that utilized +100 to +150 volts for plate voltage) are another source of a power transformer. If we simply connect the 117 Vac line across half the HV secondary (center-tap to one side), we will get about 12 Vac each side of the primary center-tap.

A surplus 24 V vibrator transformer represents an even more useful find. If the HV secondary is about 100 V each side of center-tap, such a transformer will put out about 24 V each side of the primary centertap. This higher voltage is more desirable in most instances.

Oh yes, don't forget to dig the silicon or germanium rectifiers out of the old TV set; they work just as well for low voltage transistor power supplies as they did supplying several hundred millamperes of B+ to the TV tubes. Although large by modern standards, Sarkes-Tarzian M500's and the like have worked very well in the low-voltage power supplies built by this author.

Rectifier circuits

In the area of 60-Hz single-phase rectifiers, there are five types of circuits that we'll be concerned with. These are "half-wave," "full-

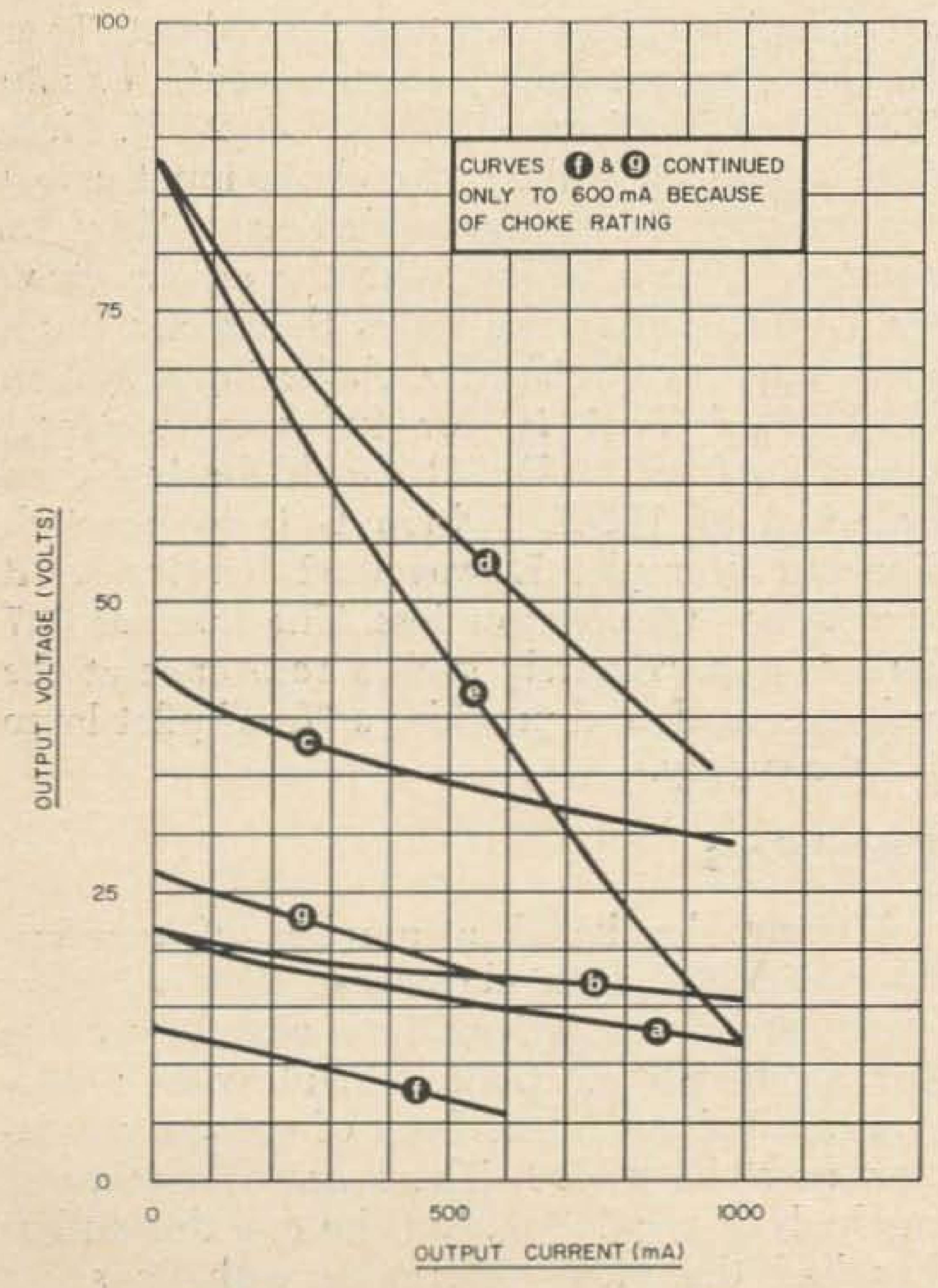

Fig. 2. Performance of the rectifier circuits in Fig. 1.

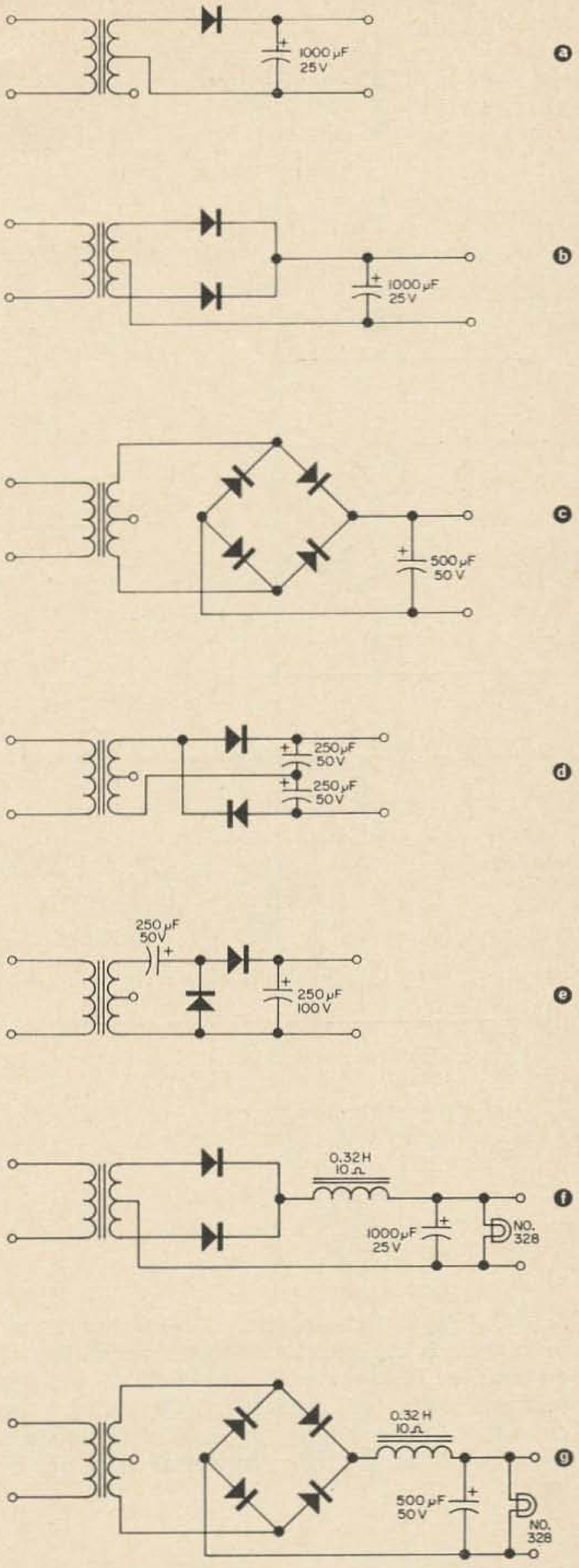

Fig. 1. The six basic types of rectifiers. **a** is a simple half-wave rectifier; **b**, full wave; **c**, bridge; **d**, conventional (full-wave) doubler; **e**, cascade (half-wave) doubler. The preceding are all capacitor input circuits. **f** is a full-wave rectifier with choke input and **g** a bridge rectifier with choke input. Performance of these rectifier circuits can be seen from curves in Fig. 2.

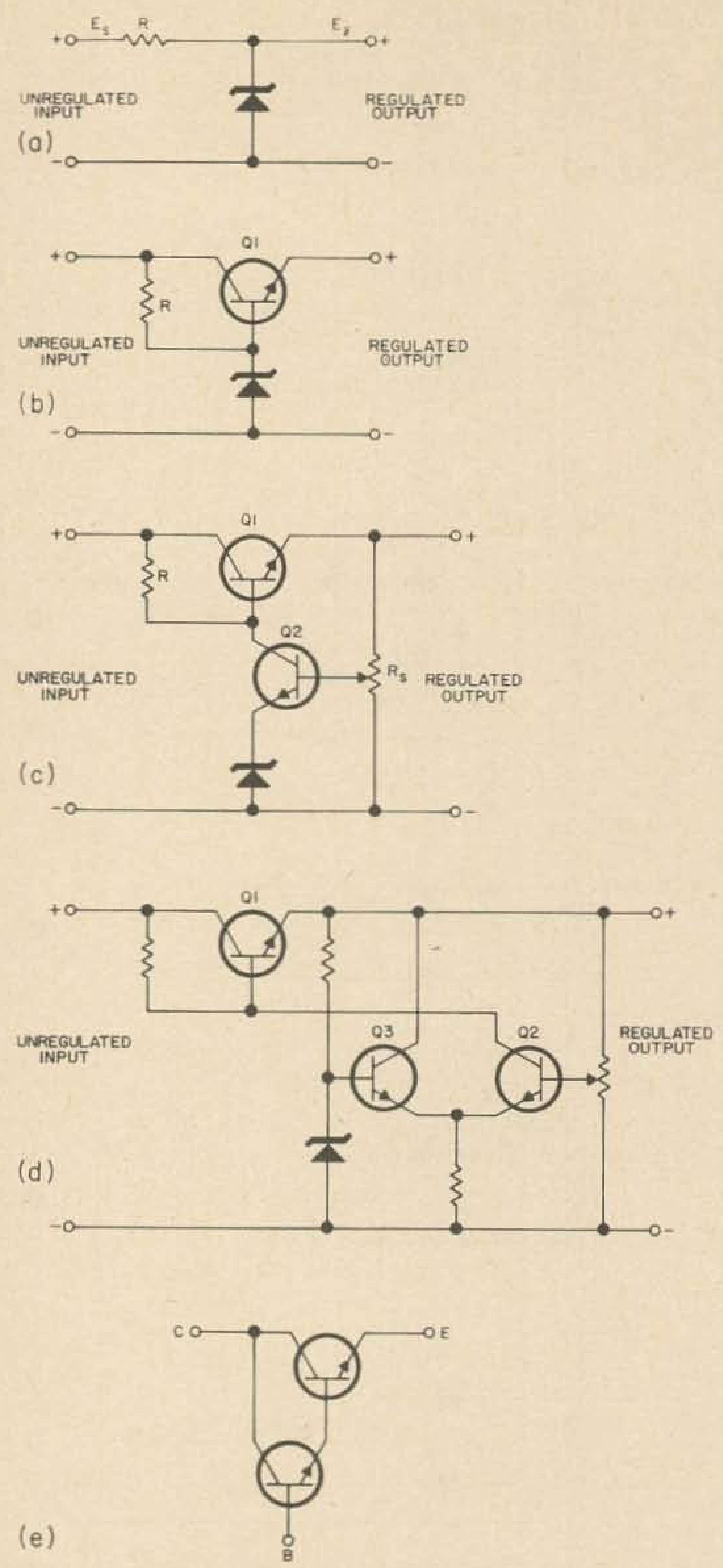

Fig. 3. Regulator circuits. **a** shows a zener regulator; **b**, an emitter follower regulator; **c**, an emitter follower with amplifier; **d**, emitter follower with full differential amplifier. The circuit in **e** is a Darlington Pair of transistors which acts as a single transistor with higher gain.

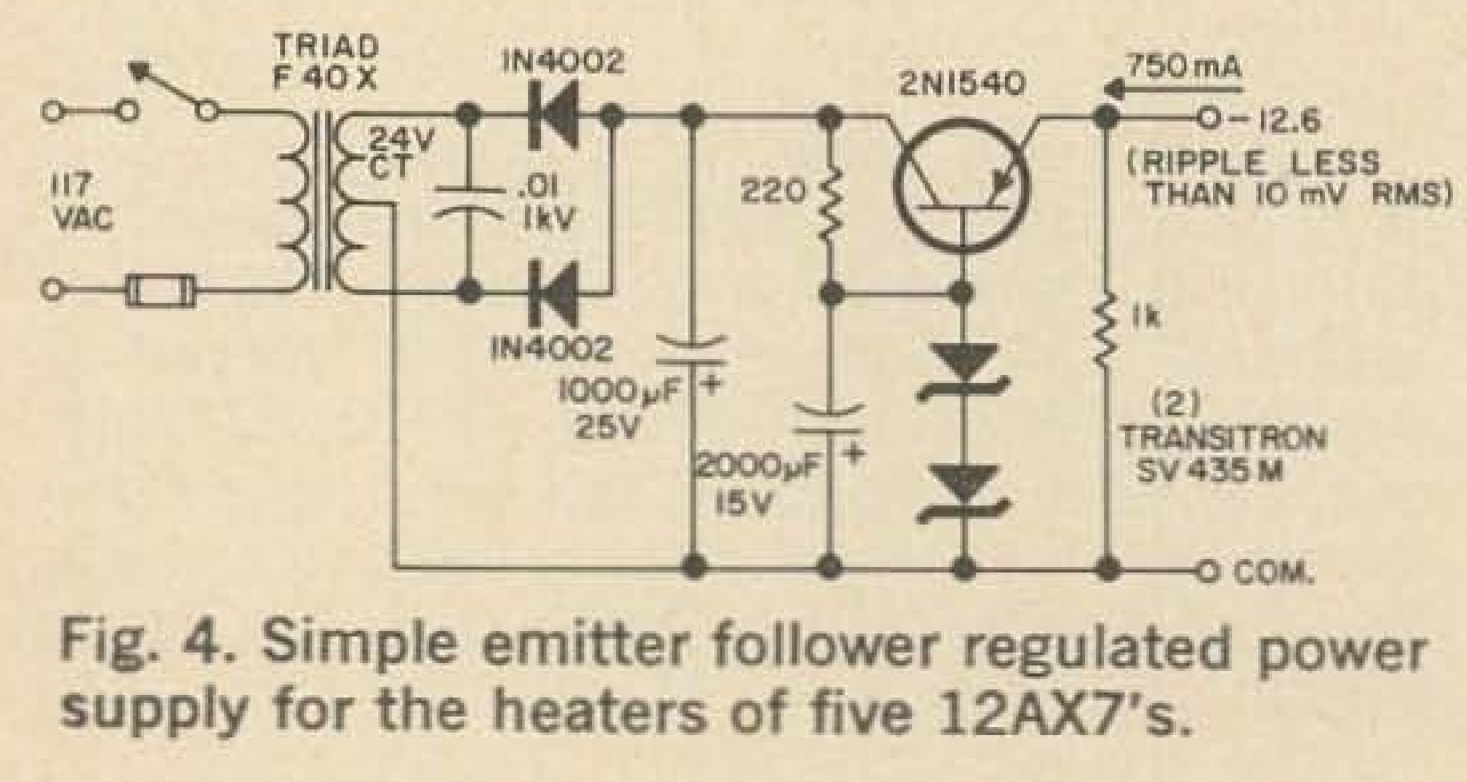

Fig. 4. Simple emitter follower regulated power supply for the heaters of five 12AX7's.

wave," "bridge," "conventional doubler," and "cascade doubler." These are illustrated in **Fig. 1**.

The "full-wave," "bridge," and "conventional doubler" circuits all charge their filter capacitors continuously throughout the 60-Hz period. This continuous type of rectifier output waveform contains no 60-Hz components, but only 120-Hz which is more easily filtered. The "half-wave" and "cascade doubler" circuits, having considerable 60-Hz energy, in their output waveforms, will prove to be the most difficult to filter and will have poorer regulation than the others. However, these relatively less desirable circuits are the only circuits one can use, if one side of the transformer secondary *must* be grounded for some reason.

With all these rectifier circuits at our disposal, *and* with the additional variation of being able to choose either "capacitor input" or "choke input" to our filter section, in full wave or bridge circuits, a given transformer can provide us a variety of dc output voltages.

To illustrate the variations of performance available with one transformer, a Triad F40X 24-volt center-tapped transformer was used in all the seven variations of **Fig. 1**. Then each circuit's voltage-current characteristic was tested; these are shown in **Fig. 2**. To make the circuits comparable, the "capacitor-bulk" (µF x voltage) was kept constant throughout. That is, the constant bulk concept would equate 500 µF at 50 V with 1000 µF at 25 V. Note that in **Figs. 2f** and **2g** (the choke input cases) that a pilot lamp was added as a "bleeder resistor." This is in line with the advice given by Terman, where he states that a minimum load must be furnished a choke input system of 1130L.[2] That is, for full-wave rectifiers operating from 60-Hz, R should be less than or equal to 1130L (where L is in henries). For our example, L was 0.32 henries so R should be 362 ohms or less. The number 327 bulb is approximately such a resistance at the voltages used, and provides a "free" pilot lamp for the supply.

Regulators

Having developed a number of rectifier-filter circuits, it is clear that they *all* have some lack of regulation. If we wish to provide our associated electronic circuit with a very constant voltage, some form of voltage regulation must be added. There are a number of methods of regulation, but the one this author has had the most experience with, is series regulation.

The series regulator can be easily developed,

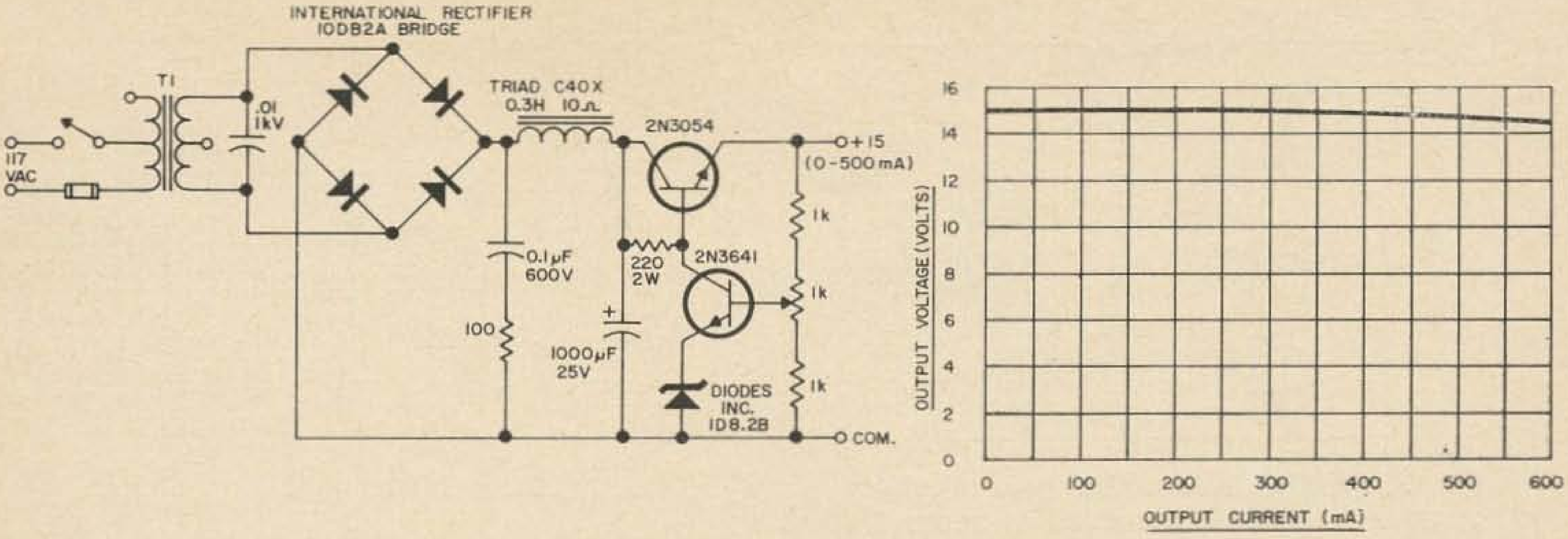

Fig. 5. Circuit and performance of a regulated power supply using the basic circuit of Fig. 3c. T1 is a surplus vibrator transformer marked 25.2 Vdc input and 135 Vdc, 118 mA output, vibrator frequency 115 Hz. Half of the high voltage winding is used in this circuit.

for understanding, as follows. Consider first of all a simple zener-regulator, as in **Fig 3a.** The output voltage characteristic is that of the zener diode, providing that the load current doesn't exceed $(Es - Ez)/R$. A capacitor can be added in shunt with the zener diode, to afford additional ripple filtering. Note that the addition of this capacitor *will* work in a zener diode circuit whereas it will often *not* work in a VR tube circuit, since the zener diode has no region of negative resistance. One serious drawback of the zener regulator is that the zener voltage *does* change somewhat with zener current. See the article on zener diodes by W2DXH in the October 73 for more information on zeners.

A better regulator is the "emitter-follower" type, wherein a transistor is used as a series resistance, as in **Fig. 3b.** The base of the transistor is held at a constant voltage by a zener diode which derives its current through R from the unregulated input. Since the current flowing into the base is Ic/h_{FE}, the zener current can be much less than in the simple zener regulator. If we make R small so that the zener current is large compared to the maximum base current the transistor will ever draw, the percent variation in zener voltage can be made fairly small. Again, a capacitor can be put in shunt with the zener, giving the ripple reduction of the well-known "capacitive multiplier."

Perhaps the next step, in sophistication, is to add dc gain to our series-regulator as in **Fig. 3c.** In this circuit one is not tied down to the zener voltage to determine the output voltage. In fact, the output voltage is adjustable, over a few percent, with the output sample-pot, Rs. The circuit still suffers somewhat from variations in zener current with load current, however.

Finally, then, we add the full differential amplifier for our gain stage as in **Fig. 3d.** Now, since the zener diode derives its current from the output side of the regulator, the zener current is nearly constant and so is the zener voltage. As in **Fig. 3c,** the output is adjustable over a few percent.

In all the circuits **3b, 3c,** and **3d,** it is possible to replace the series transistor (Q_1) with a "Darlington Pair"; That is, replace one transistor with two as in **Fig. 3e.** This com-

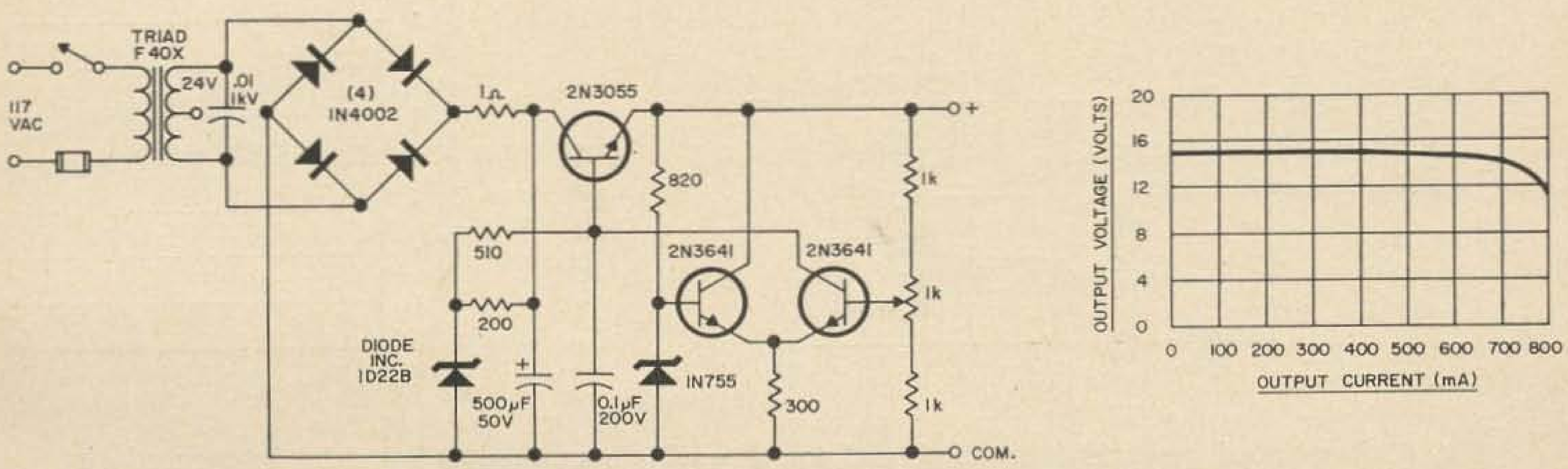

Fig. 6. Practical supply using a differential pair amplifier.

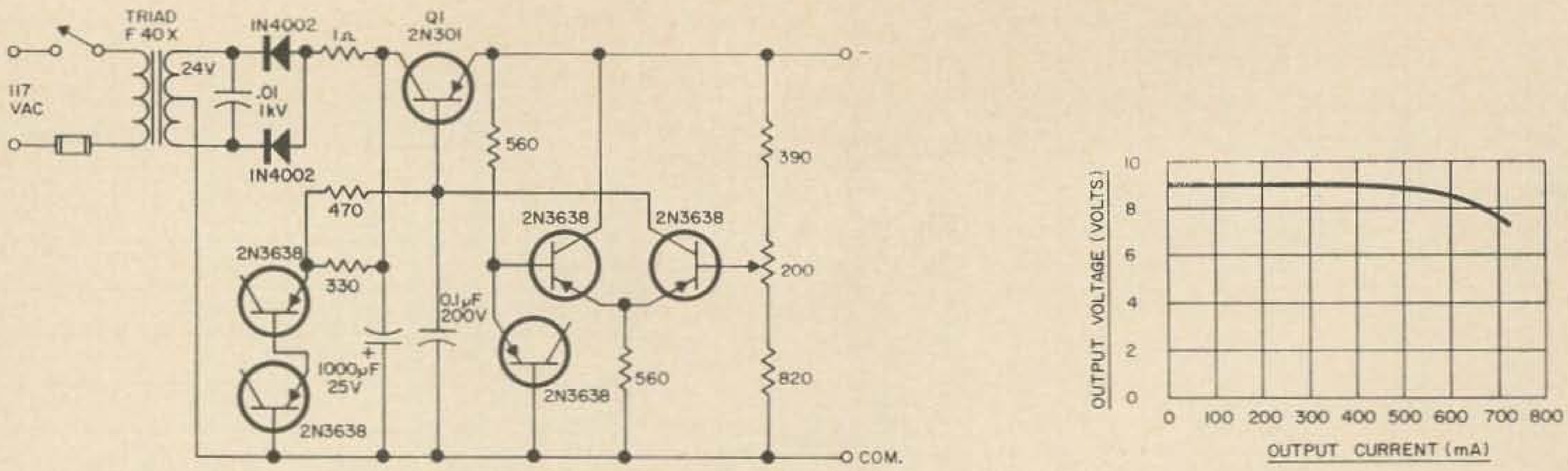

Fig. 7. Another differential pair regulated supply. Here the base-emitter junctions of inexpensive transistors are used as zener diodes.

bination yields the equivalent of a transistor with the product of the h_{FE}'s of the two component transistors. This will allow us to use higher dc gain in the regulator system, affording better performance. The Darlington pair method is a way of obtaining a high-h_{FE} power-transistor for use as Q_1.

Examples of practical circuits

Having looked at a variety of series-regulators, a selection of real-life examples to illustrate them may be in order. These are presented in **Figs. 4, 5,** and **6.** The circuits are not so-designed to make value judgments between types, but are simply examples from the author's back file.

Another differential regulated supply is presented in **Fig. 7** to illustrate a trick in substituting the base-emitter junctions of inexpensive silicon transistors, for zener diodes. Note that in both **Figs. 6** and **7** a "pre-regulator" zener diode is used to supply half the differential amplifier with collector voltage. This "pre-regulator" and series regulator system is quite extensively covered in the Texas Instruments book *Transistor Circuit Design.*[3]

One will also notice that in the examples of **Figs. 4, 5, 6** and **7** that there is added, across the transformer secondary, a 0.01 μF 1 kV disc ceramic capacitor. This is a line transient suppressor which is to "kill" any line spikes that may otherwise exceed the PIV of our rectifiers. Another type of transient suppressor is useful in choke-input filter systems; a 100-Ω resistor and 0.1 μF capacitor, (in series) are put ahead of the choke, as if to provide capacitor input. This serves to dampen the voltage created by the choke field-collapse when the supply is turned off. This technique is used in **Fig. 5.**

Fig. 8 is a regulated power-supply for use with the inexpensive epoxy-encapulated Fairchild integrated circuits. These epoxy IC's are specified for +3.5 to −4.5 volts. This regulator utilizes one of the old 2.5 V filament transformers that was put in the junk-box when you replaced the 816's or 866A's with silicon HV rectifiers. The Fairchild μL923 (a J-K Flip Flop) takes about 20 mA, so this power supply will run up to 15 of them.

This design, a low-voltage one, brings out several of the worst points in series-regulator design. Since the difference between rectifier voltage (point A) and the regulator output voltage (point C) is only a few volts at most, the (small) voltage drop of the base-emitter junction becomes appreciable percentage-wise.

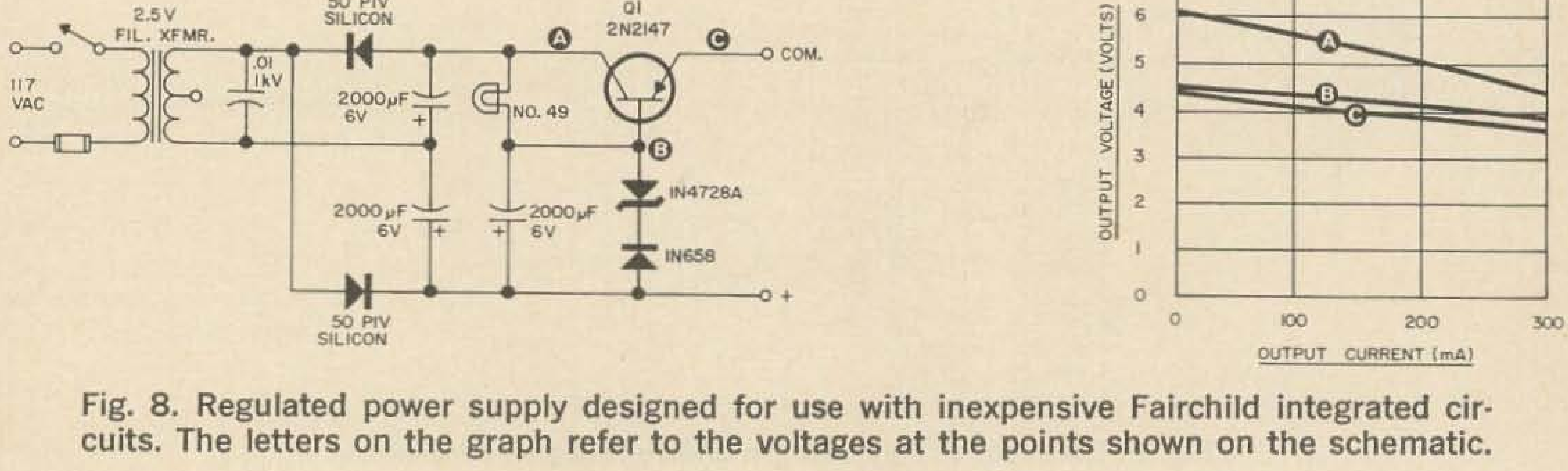

Fig. 8. Regulated power supply designed for use with inexpensive Fairchild integrated circuits. The letters on the graph refer to the voltages at the points shown on the schematic.

Since germanium transistors have lower emitter-base drop, a germanium unit is used here; a high h_{FE} germanium type was chosen, the 2N2147.

Fig. 8 is similar to the regulator of **Fig. 3b**, except that R has been replaced by a #49 (2 V, 60 mA) pilot lamp. This trick was necessary to help hold the zener current more nearly constant. The bulb acts as a nonlinear resistor, increasing its resistance as the voltage across it increases. The 1N658 diode in series with the 1N4728A was simply used to "jack-up" the reference voltage about 0.7 V, over what the zener alone turned out to be. In this circuit, this forward-biased diode *does not* effect a temperature compensation.

Also, low-voltage brings out the worst in zener diodes. This is illustrated in **Fig. 9.** Notice that for zener diodes with voltages below about 6 volts, the "knees" do not have a sharp "break," but are quite rounded. This phenomomenon is associated with the different mechanism of breakdown at the lower voltages. (To be really correct, one should only call regulator diodes that break down below about 6 volts "zeners" since this is in the zener region. Similarly regulator diodes that break down above 6 volts should be called "avalanche" diodes. However, the technology has come to call them *all* zeners.) The "soft-knee," as this rounding-over at breakdown is called, can be coped with by running more zener diode current, within the dissipation limits of the diode.

This "soft-knee" behavior of low-voltage zeners is not all as bad as it might be. It turns out that the "zener" and "avalanche" regions of breakdown have opposite temperature characteristics. So that at about 5 volts (see **Fig. 9b**) the two opposite temperature coefficients cancel, yielding a ready-made temperature-compensated reference diode.

At breakdown voltages above 5 or 6 volts, we are operating with a positive temperature coefficient, in the avalanche region. Since the temperature coefficient of an ordinary silicon diode or rectifier, when forward-biased, is negative; the arrangement of **Fig. 10** can be used to help temperature-compensate higher voltage breakdown diodes.

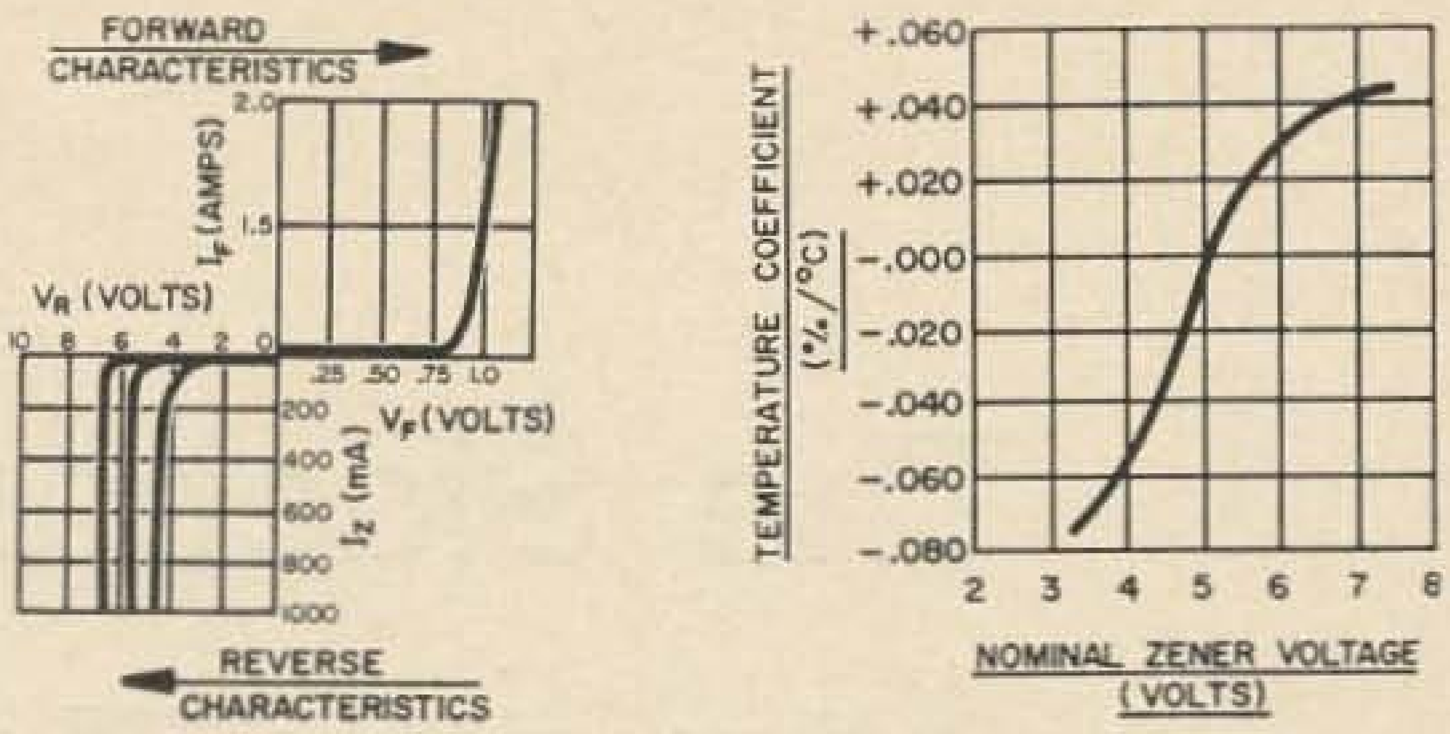

Fig. 9. **a,** on the left, gives the reverse characteristics of low-voltage zener diodes. **b,** on the right, shows how the temperature coefficient of zeners is lowest at about 5 volts.

There is certainly a lot more that could be said on power-supplies and regulators, and the author knows he has only touched on a vast subject. For more detailed coverage of the subject, the first three reference have much more material. Also, Kepco Electronics has put out a very useful little paper-bound book on regulators.[4] Another useful reference is the easy-to-use (complete with graphs) article in Electronic Products, on rectifiers and filters.[5]

I'd like to thank Don Powers, WA6NJD, for his helpful discussion in preparing this manuscript.

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[2] Terman, F. E. *Electronic and Radio Engineering*, Fourth Edition: 1955. Page 715

[3] Texas Instruments Staff, *Transistor Circuit Design*. McGraw-Hill, 1963. Chapter 9.

[4] Birman, Paul, *Kepco Power Supply Handbook*, 1965, Kepco Inc., Flushing, N. Y. 11352.

[5] Blais, P. D., "Applying Semiconductor Rectifiers in Power Supplies," *Electronic Products*, April 1965 page 26 and June 1965 page 46.

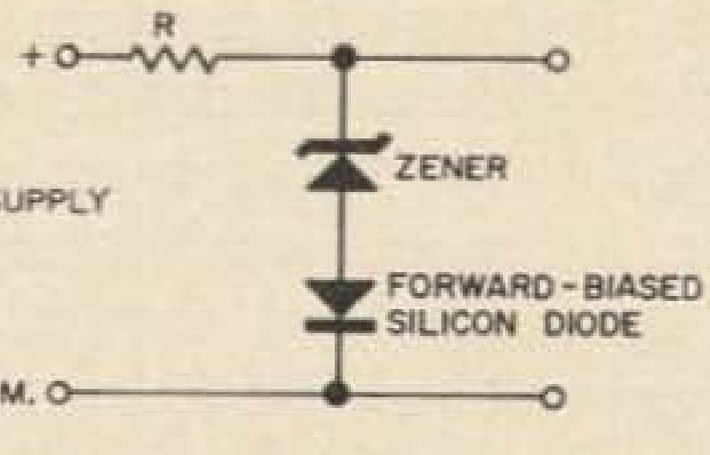

Fig. 10. Temperature compensation of a zener diode (for use with zener diodes of greater than 5 or 6 volts).

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The Sideband Escalator

Have you tried SSB speech clipping lately?

The first known successful amateur application of speech clipping in single sideband service was made by Squires and Clegg who incorporated it in the Clegg SS Booster as an aid to their Venus six meter transceiver with interesting results.[1] The effect of adding the booster unit was found to be comparable to adding a linear amplifier to the SSB exciter by raising the average power output of the signal relative to its peak power.

Although audio clipping had, in the past, been employed in AM transmitters with varying degrees of success in attempting to add talk-power to the radiated signal, its use in single side band service is not feasible because the output envelope pattern (as viewed on an oscilloscope) is not a replica of the original audio wave form, as Squires and Clegg clearly emphasize.

Since average radiated power can be increased with rf speech clipping almost up to the peak power level, the plate efficiency of the final tubes is thereby increased with consequent reduction in plate dissipation. Hence, the tubes run cooler. The plate supply must be capable of furnishing the additional current demands made on it.

Briefly, this is how the system works. The rf signal in the SSB exciter unit (employing a high amount of audio gain) is extracted at the output of the balanced modulator or *if* stage following it and coax-fed into the outboard speech clipper unit where it enters a narrow bandpass filter similar to the one in the exciter unit. After the rf signal has been properly wave-shaped into a SSB signal by the filter, it is then fed into a remote cut-off pentode with adjustable gain in order to recover the insertion loss of the filter and to provide the necessary clipping gain. The output of the pentode is transformer coupled to a pair of positively biased crystal diodes which amplitude-clip the resulting wave form. A second remote cut-off pentode with variable output gain provides transformer coupling of the output signal from the speech clipper unit by way of coax cable back into the input of the original bandpass filter of the SSB exciter. The second *if* transformer, and principally the filter in the exciter, remove the objectionable frequencies generated by the clipping action of the diodes.

The circuit diagram of the rf speech clipper is shown in **Fig. 1**. Provision is made (1) for internal switching of the signal within the SSB exciter for inboard or outboard service (2) for switching the clipper itself in or out with separate gain controls, whether in or out (3) for varying the threshold bias on the 1N34A diodes with the peak limiting control and (4) for varying the output gain to prevent overloading of the succeeding stages in the SSB exciter.

Construction

The layout of the principal components appears in **Fig. 2**. The power supply and the speech clipper are each constructed on a 2"x4"x6" aluminum chassis. This permits the power supply to be placed out of the way. The speech clipper is placed next to the exciter unit.

The 455 kHz mechanical filter, **F1**, is mounted underneath on a small rectangular aluminum plate large enough to accept two transistor sockets for inserting the filter. The plate, itself, rests on two metal stand-offs. The filter's input and output circuits are shielded from each other by means of a small baffle plate at the midway point. The filter employed should be similar to the one used in the exciter.

A sub-miniature ceramic switch, S1, is

[1]QST, July 1964, p. 11; QST, August 1964, p. 117. "Acknowledgement must also be given to Don Stichler, KL7EBK, whose successful use of the Squires-Clegg type of clipper prompted the writer to duplicate his efforts, although each of us employed different modifications of the original circuit."

placed as close as possible to the output of the exciter's balanced modulator or first *if* amplifier. In this instance, in which the exciter was a Collins 32S-1, the lead was cut between the coupling capacitor, C140 and R106(22kΩ) at the entrance of the mechanical filter, FL 1. The small hole for the switch was drilled in the left bottom corner of the black border line inscription carrying the serial number. Small size RG 174/U coax cable connected the switch contacts to the two jacks at the rear of the exciter, the spare jack and the converter output jack, J18. (The lead from J18 was disconnected, since two meter operation is not contemplated). In different exciters, provision will have to be made for the addition of two rf phono jacks if spare jacks are not available. Two one-foot lengths of RG 58A/U coax cable with rf phono plugs at each end were used to connect the clipper unit's input and output with those of the exciter unit.

Adjustment

1. The speech clipper is first tested separately on the bench as follows. With the switch, S2, in noclip position, apply an rf signal of the appropriate frequency from an rf signal generator to the grid of the 6DC6 tube and peak the signal with the trimmers on T1 and T2 with the aid of a vacuum tube voltmeter and rf probe or oscilloscope connected at the output jack, J2. Check to see if the output control, R4, is working properly. Adjust the coupling screw on T1 for critical coupling (a single peak of maximum intensity —not a double-humped peak). It will be necessary to swing the rf generator frequency a little to observe the coupling action.

2. With the rf generator signal somewhat attenuated (so as not to damage the filter) apply the signal at the input of the filter at J1 and note the output reading. It may be necessary to swing the generator frequency slightly in order to peak the signal. Compare the signal output when the rf signal is applied at the input of V1 and at the input of the filter, and note the considerable improvement in sharpness of response and insertion loss of the filter. Finally, re-peak the *if* trimmers to obtain maximum output.

3. Test to see if the gain controls in the clipper and no-clipper modes are working by observing the rf output voltage. Check the

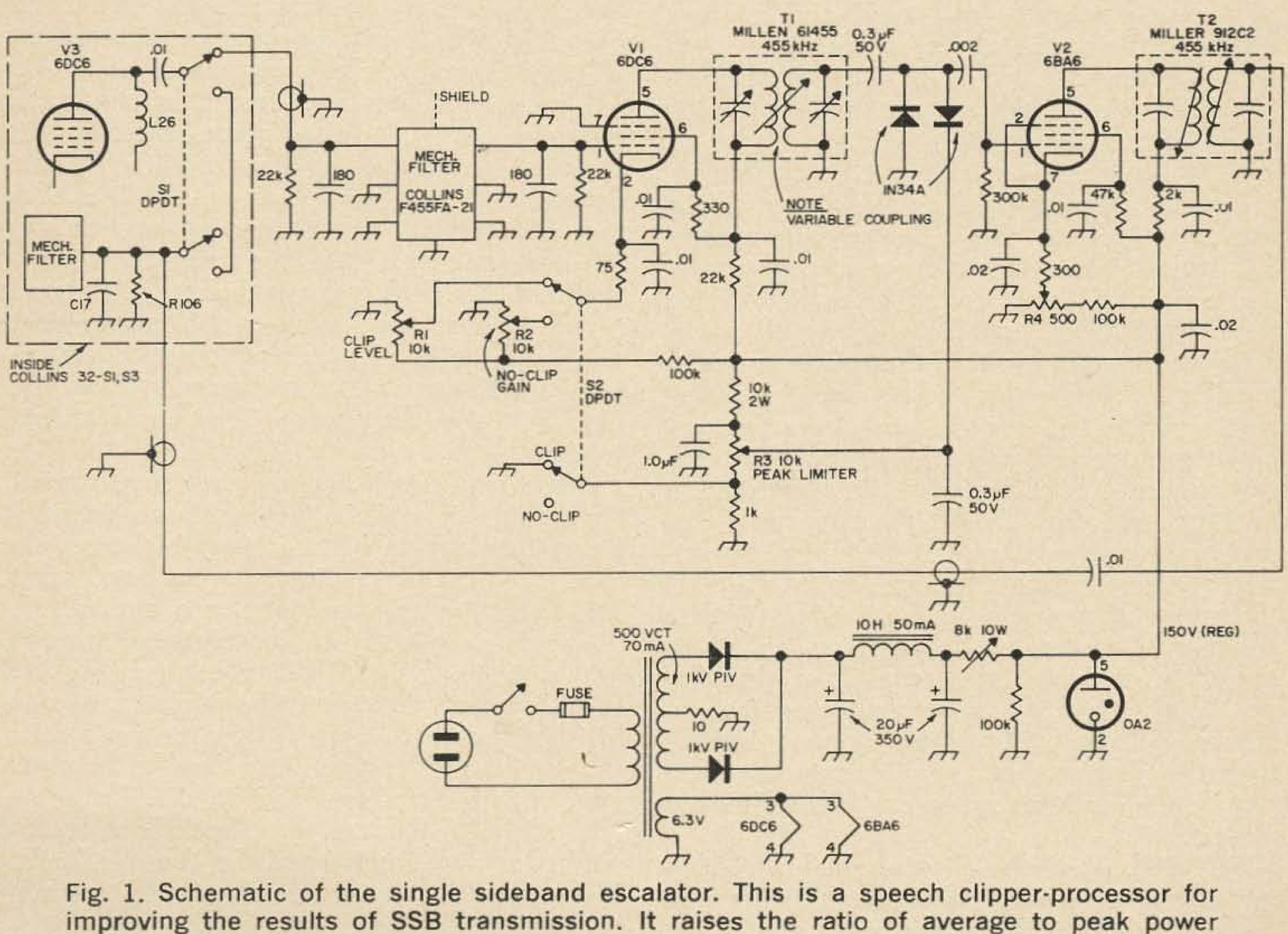

Fig. 1. Schematic of the single sideband escalator. This is a speech clipper-processor for improving the results of SSB transmission. It raises the ratio of average to peak power transmitted.

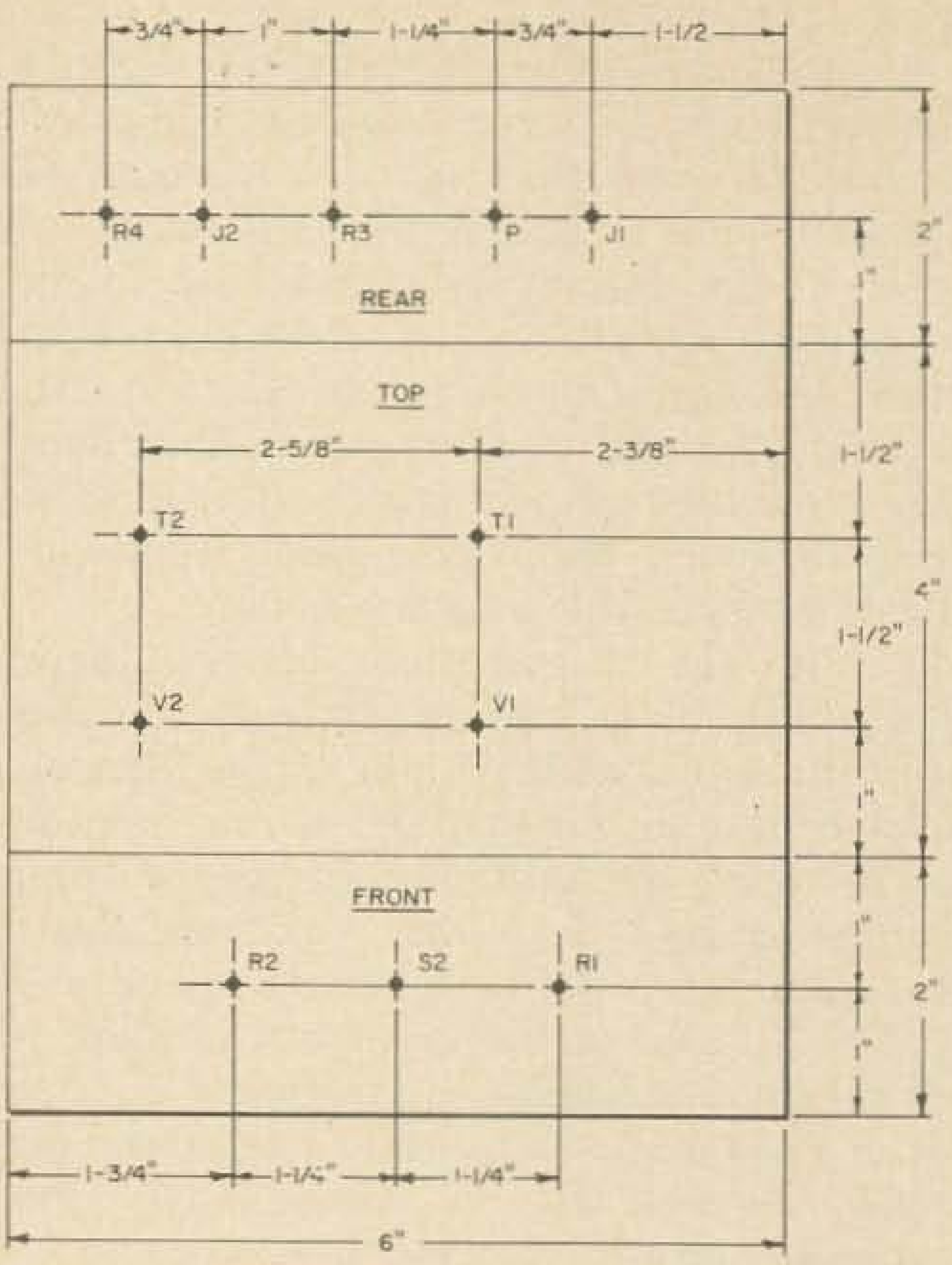

Fig. 2. One-third size layout of the escalator.

action of the peak limiter control by measuring the voltage change at the diodes. An oscilloscope with a sufficiently high horizontal frequency sweep should reveal the clipping action of the amplified sine wave signal from the rf generator when R3 is rotated from minimum to maximum position with the switch, S2, in the clipping mode.

4. Attach a dummy load and Heathkit monitor scope (or whatever) to the output of the exciter unit. First check the ceramic switch, S1, to see if the exciter tunes normally without the clipper in the circuit. Next switch S1 to the clipper. Place switch, S2, in noclip mode, advance the audio gain of the exciter as far as possible without overloading the preceding stages. With the exciter loaded in the key down position, advance the noclip gain control slightly while observing the SSB pattern in the oscilloscope. Adjust the *if* trimmers for maximum carrier output. Also adjust the output gain control, R4, so as not to overload the succeeding stages in the exciter. With a nominal amount of noclip gain and proper attenuation of the output signal from the clipper, one should get a satisfactory voice envelope pattern without flat-topping just as with the exciter alone. Audio control is exercised by R2 and not by the exciter's audio gain control.

5. Switch S2 to the clipping mode; set clipper gain at maximum. Adjust peak limiter control, R3, so that the voice peaks are at the same output level as in the noclip mode as observed in the monitor scope. The clipping level gain control establishes the degree of clipping. Notes the definite increase in average plate current of the exciter and more nearly filled in wave envelope scope pattern between no clipping and various settings of the clipping control. This difference is plainly audible in your receiver. With the system working properly, the increase in average output power should so register on most receiver S meters and definitely in talk power.

Summary

On the air tests have amply demonstrated the superiority of the rf speech clipper over a three-tube audio compressor pre-amplifier which could be switched in and out for comparison purposes. The operator at the other end invariably reported that the rf clipper supplied more "muscle" than the audio compressor. If the audio gain is increased under audio compression, in an attempt to raise the average-to-peak power ratio, the final plate current meter will show this increase at the expense of flattening the wave form with consequent distortion and undesirable new frequencies.

On the other hand, with rf speech clipping, the peak limiting control sets the maximum output power available without flat-topping for any amount of clipping up to about 30 dB, no matter how loud one talks or shouts. Even under maximum clipping, there is still sufficient intelligibility though with definite distortion. It was found from on-the-air checks that about 15-20 dB of clipping was usually the best; at this setting, the voice characteristics remained relatively unchanged compared to noclip operation. Even in the no clipping, or normal position, there is the added advantage in having a second narrow bandpass filter active in the system. Who would object to that?

Some final words: your power supply must be capable of making the additional sacrifice necessitated by speech clipping. Make certain that the carrier is nulled out and that hum and extraneous noise are minimized. There may be a fly in the ointment for the kW operators. The FCC regulation relative to DC power input may be violated due to increased average power input unless proper precautions are taken, even though the peak envelope power remains at 2 kW. To those who aspire to the kW class, but whose equipment does not quite have the "muscle," take heart, for here is the opportunity to upgrade yourself at relatively little cost.

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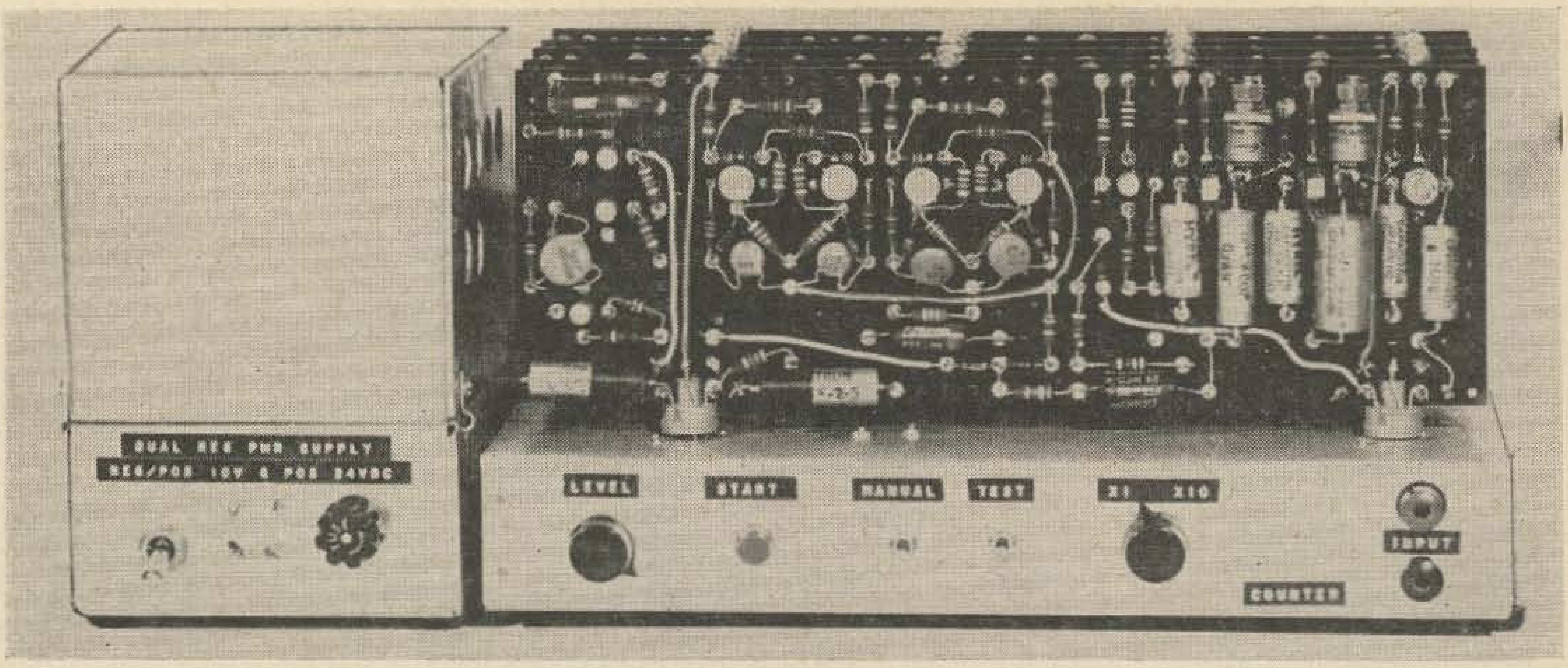
W8GCD
Goodwill towards men
is the essence
of amateur radio
David W. Nurse, W8GCD
President, Heath Company



General view of the counter with attached power supply. The control panel is shown here. Some components have been eliminated and certain design changes have been made since this photo was taken.

An Electronic Counter for Amateur Use

This counter gives a very accurate frequency count for low frequencies. It's neither expensive nor hard to build.

Numerous magazine articles appearing from time to time, call for a digital counter to perform exact (or nearly so) frequency measurements. One specific instance was in the January 1966 issue of 73.*

This instrument, like my Lampkin Frequency Meter is indispensable when needed. Whereas the LFM is used for high frequencies, this counter covers the lower ones, from one hertz to 250 kHz. Though the digital counter can not be employed as a signal source, its capability for determining a frequency is remarkable.

It is entirely automatic in operation. The signal to be counted is connected to the input terminals of the counter. The start button is pressed and one second later the "coded" frequency is read from the lighted lamps. The "code" will be explained later.

*A Signal Generator for the RTTY Man Page 36, Adjustment

Philip is a retired warrant officer (USN) and retired member of the civil service. He has written a number of articles for various magazines, and is interested in ragchewing and code.

Uses of counter

Sometime ago trouble was experienced with my audio generator. It had been unstable from the beginning. Without going into details, stability was secured at the expense of a reduction in frequency coverage, which of course meant recalibrating the scales. With the aid of the counter this was accomplished in a very short time, and with great accuracy.

If you find that your 10 kHz multivibrator doesn't synchronize at a 10-1 ratio with your 100 kHz oscillator, readjustment is quite easy. Feed its output into the counter and check its frequency. Change the value of the cross-coupling resistor until the correct frequency reading is obtained.

The two oscillators in a two-tone generator can be set very accurately in a similar fashion.

If you wish to check the lower dial graduations on your rf signal generator, you can do so if it's output is amplified. A simple solution was found by using a one-stage preamp feeding a 9 V 360 mW audio amplifier. A volume control, hooked up as recommended with these units will minimize distortion if it should present a problem, though the pulse shaper of the counter will accept almost any type of pulsed signal.

It is possible to pick up a signal off the plate lead of the *if* tube in low level stages of your receiver. A capacitor of the proper voltage rating may be used in series with the counter input. The signal generator is connected to the grid of the preceding mixer tube in the usual manner. As a rule these low stages are aligned by an unmodulated output from the signal generator.

Theory of operation

The simplified electronic counter will do all of the above things and more. It is stripped of all non-essentials, though completely automatic in operation, and can be built inexpensively by utilizing surplus sources for most of the materials. Commercial counters run in the $300 up, class. This unit will cost about one-quarter as much.

Fig. 1 is a block diagram of the decade counters and the control circuitry. Four indicating decades give visual readout to 10 kHz. Above this frequency the x10 decade is switched in to multiply all indicating numbers by ten. In either case, the number of cycles made by the counter is determined by noting how many times the last lamp in the series flashes; extending the count beyond that actually indicated.

Counting can be done to one hertz, but this is seldom realized in practice due to unstability of signal sources, voltage and frequency excursions and the simplified design of the timing and control circuits. With a 10kHz crystal controlled signal source this unit will give repetitive accuracy of 3 hertz, and at 100 kHz, within 50 hertz.

The start button has two functions. Pressing it resets all flip-flops and extinguishes all lamps. Operation begins by releasing this button.

The input signal is fed to the pulse shaper whose output is tied to the count gate. The signal is then passed to the counter. Counter operation is continuous as long as the count gate remains open. (or by-passed with the manual switch). This gate opens and closes in sequence to signals from the #1 control flip-flop whose state depends upon pulses from the timing generator. To limit the number of pulses to this multivibrator, a second flip-flop receiving its signal from the first and working at one-half the speed, closes the pulse gate after the second pulse from the timer. This shuts off the counter. The lamps that remain on in the decades, indicate the count.

The manual and test switches are shown in dotted form since they are not needed for normal operations. The test switch is placed in series at the point marked X. In their "off" position, the test switch contacts are closed and the manual switch contacts are open.

The bistable multivibrator or flip-flop, **Fig. 2**, is made with two transistors cross-coupled to form an oscillator having two states, on and

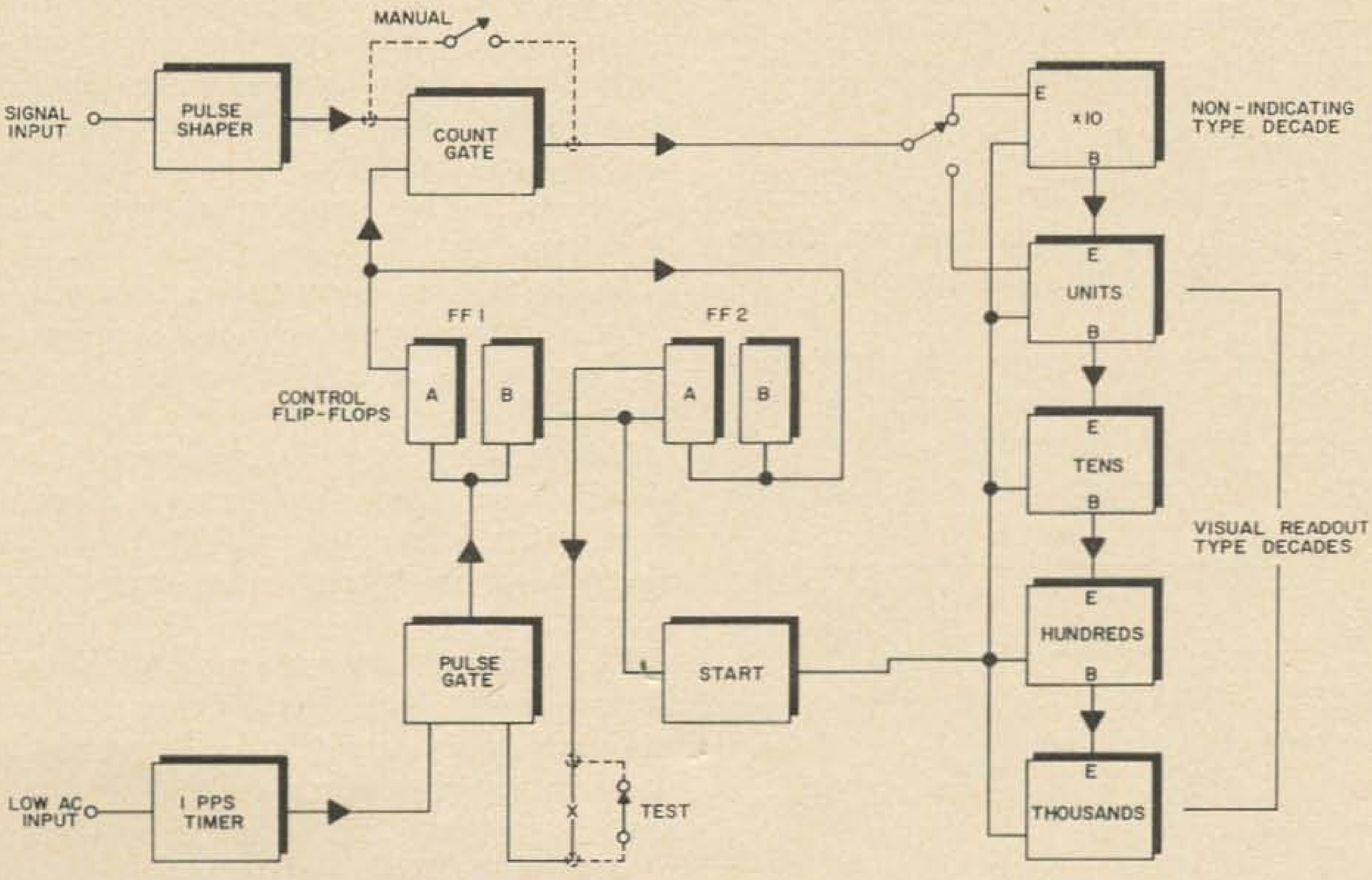


Fig. 1. Automatic counter control.

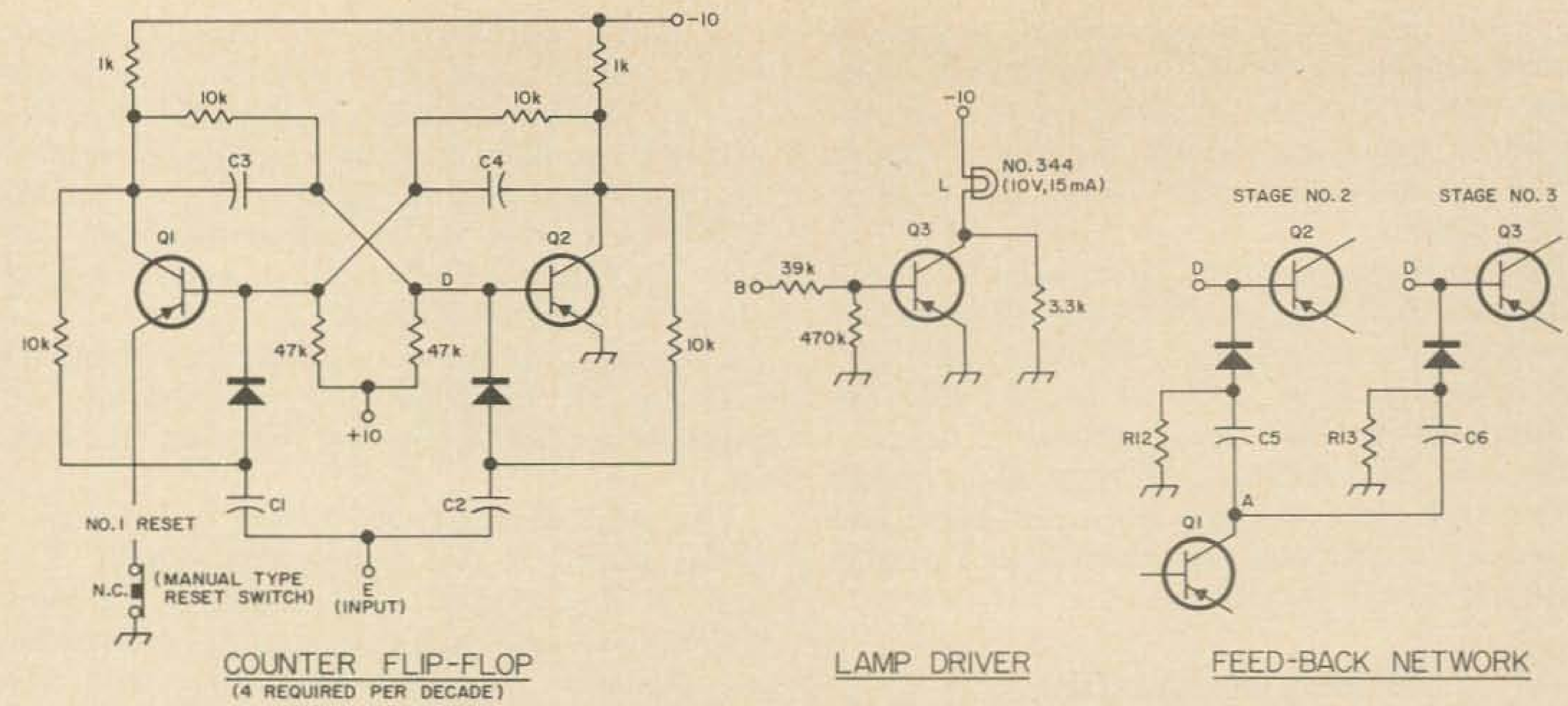


Fig. 2. Counter flip flop, lamp driver and feedback network.

off. When Q1 is on or conducting, its collector potential is almost zero. Q2 is then off with about −8 volts on its collector. (Table, Q conditions)

Q Conditions — Nominal voltage at collectors

State	Q1	Q2	Q3	Lamp
1	off −8	on 0	−9	off
2	on 0	off −8	0	on

Reset switch places all flip-flops to state 1.

To obtain visual readout a lamp driving transistor is connected to the collector of Q2 of each stage. As Q2 turns off a bias is placed on the base of Q3, causing it to conduct. The resultant voltage drop across the lamp turns it on. The 3.3-kΩ by-pass resistor allows a few milliamps to flow through the bulb at all times, keeping it warm and adding to the stability of the circuit.

The Q1 emitters of all decade flip-flops are placed on the #1 reset line to the starting relay. Opening the ground connection turns off these transistors and consequently, all lamps.

The multivibrator design provides satisfactory operation with transistors having a beta of 25 or more, though excessive leakage will cause failure. The cross-coupling and collector load resistors can be increased somewhat for tighter control, but loading requirements and component tolerances must be considered when doing this.

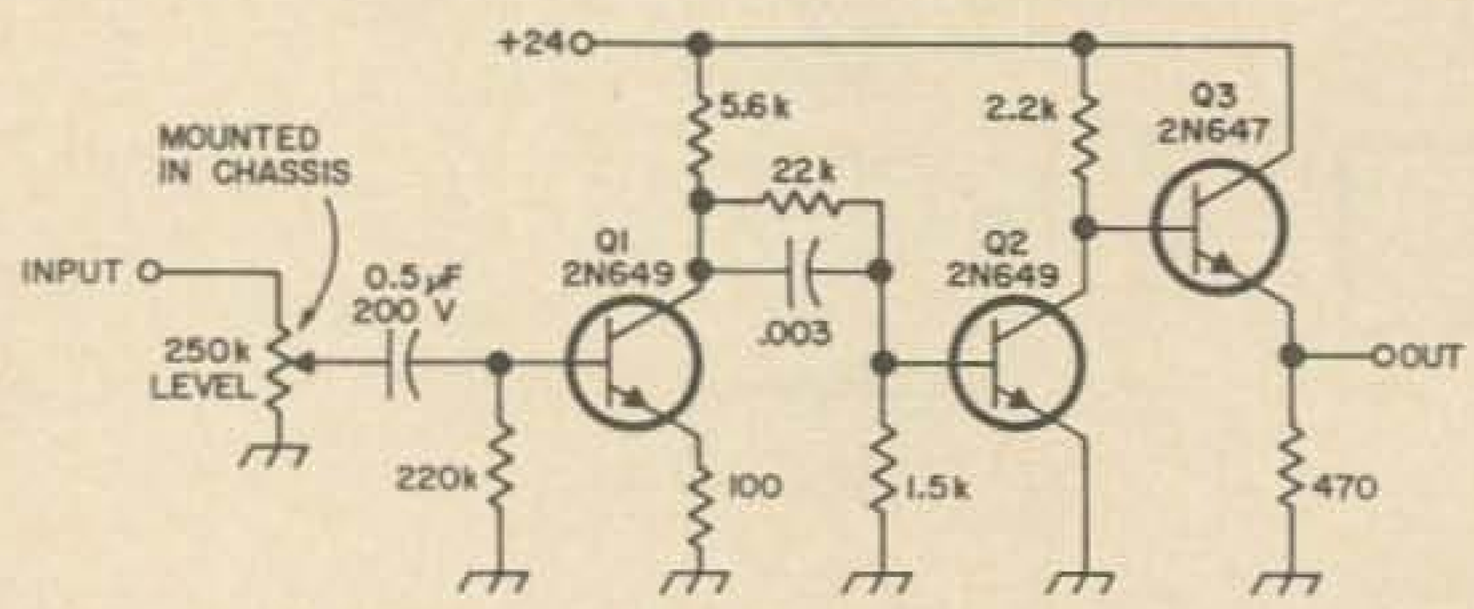


Fig. 3. Pulse shaper.

Feedback is introduced from Q1 of the fourth stage to Q2 of stages 2 and 3 to provide decade operation. This type of feedback is easy to adjust and has proven reliable. One resistor and capacitor form a differentiating network and defines the amplitude and shape of the pulse to its respective stage.

Finding the correct resistance value is not too difficult with a scope. Feed a sine wave signal of 5 kHz to 10 kHz into the counter. Set the scope controls for a ten hertz display of the input signal. Five hertz will appear on the collector of Q2, stage 1 and one hertz at Q2, stage 4. One can reverse this procedure, obtaining one hertz on the 4th stage, then if three hertz or an unsteady waveform is seen on the first stage, the resistance should be changed accordingly. The feedback pulse is observed at the junction of the resistor and capacitor.

At very low frequencies beyond the response of the scope, the feedback can be verified by visual examination of the lamp sequence.

Counting is actually performed by division of the unknown frequency. Each decade divides the frequency in a 10-1 ratio. Decades are placed in series to extend this division process.

The readout system employed here utilizes lamps. Each stage has a lamp and with nine numbers to interpret, a code system must be used in which one or more lights will represent a certain digit. Four decades can show a total of 9999. An additional input pulse will cause all lamps to go out, inferring the count as 10,000. An orderly readout scheme is needed to prevent confusion. Lamps are arranged left to right for stage designation and the decades, front to back, for units to thousands. Since the decimal equivalent of all decades are evaluated in like manner, a glance at the lighted lamps will reveal the total.

The decade code is shown in **Table 1.** A number such as 1057 will appear as follows: fourth decade, stage 1; third decade, none; second decade, stages 1 and 3; first decade, stages 1, 2, 3.

With a little practice this becomes as natural as interpreting the numbers in the Morse code.

The frequency response of the pulse shaper **Fig.** 3, is set to accept sine wave signals of 150 mV and up, from 100 Hz to 100 kHz and produce constant amplitude pulses to the counter. Input signals to 25 V rms have been used without resorting to the level control. Above this, some resistance must be used. The low frequency response falls off fairly fast until at 20 hertz a 3 V signal is required. This is in part determined by the value of the input capacitors in the first stage of the counter. The emitter of Q3 is directly connected to the count gate and provides isolation for Q1 and Q2 against gate action.

The 1 PPS timing generator **Fig. 4** is composed of three UJT frequency dividers. The first acts as a saw-tooth generator and set to a 1-1 ratio with the 60 Hz ac input signal; taken from T2 of the power supply at points X-X through the two 1 μF capacitors. The 10-1 and 6-1 dividers operate as free running oscillators and are locked into synchronization by the pulse from the saw-tooth generator. The .022 μF capacitor determines the strength of this signal. Q4 is an emitter follower and gives isolation from the pulse gate.

The timing circuits are fairly critical, dependent on the components and UJTs used, and due to their load sensitivity, the entire assembly should be temporarily put together

Table 1
Decade Conversion Chart

	Decade Code			
Digit	**1**	**2**	**3**	**4**
0				
1	+			
2		+		
3	+	+		
4			+	
5	+		+	
6		+	+	
7	+	+	+	
8		+	+	+
9	+	+	+	+

Crosses indicate lamps on at end of counting period.

during preliminary tests and adjustments. At this stage, R2 should be adjustable and replaced later with a fixed resistor. The value of C7 is formed with two parallel capacitors.

A 1-1 ratio is easily attained on the scope, but when adjusting R5 for a 10-1 ratio relative to the outputs from Q1 and Q2, it may be more difficult. The same results can be accomplished with 5 and ½ hertz waveforms, though the ½ Hz trace is not easy to recognize until nearly stabilized.

The adjustment of R9 should wait until after the decades have been completed. An approximation can be made by counting the pulses on the CRT.

The output from a 100 kHz crystal oscillator is fed to the counter and R9 set to obtain a count of this frequency. As mentioned previously, there is a certain inherent instability which will show up in repetitive counts, so an average is taken from several tests.

Another method utilizes the output pulses from Q1 of the control flip-flops. A jumper is placed from its collector to the counter input. Turn on the test switch. The lamps will start flickering at a one second rate. These pulses come from the timer (and could be used). Reduce the load on FF1 with the level con-

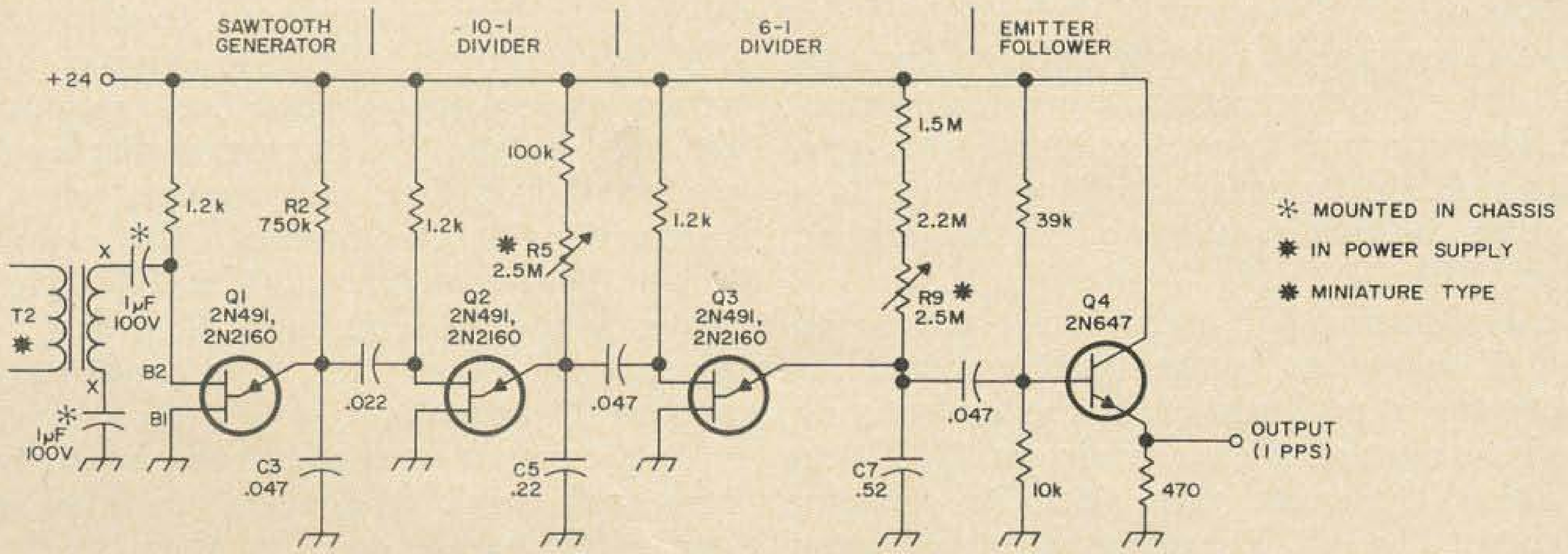
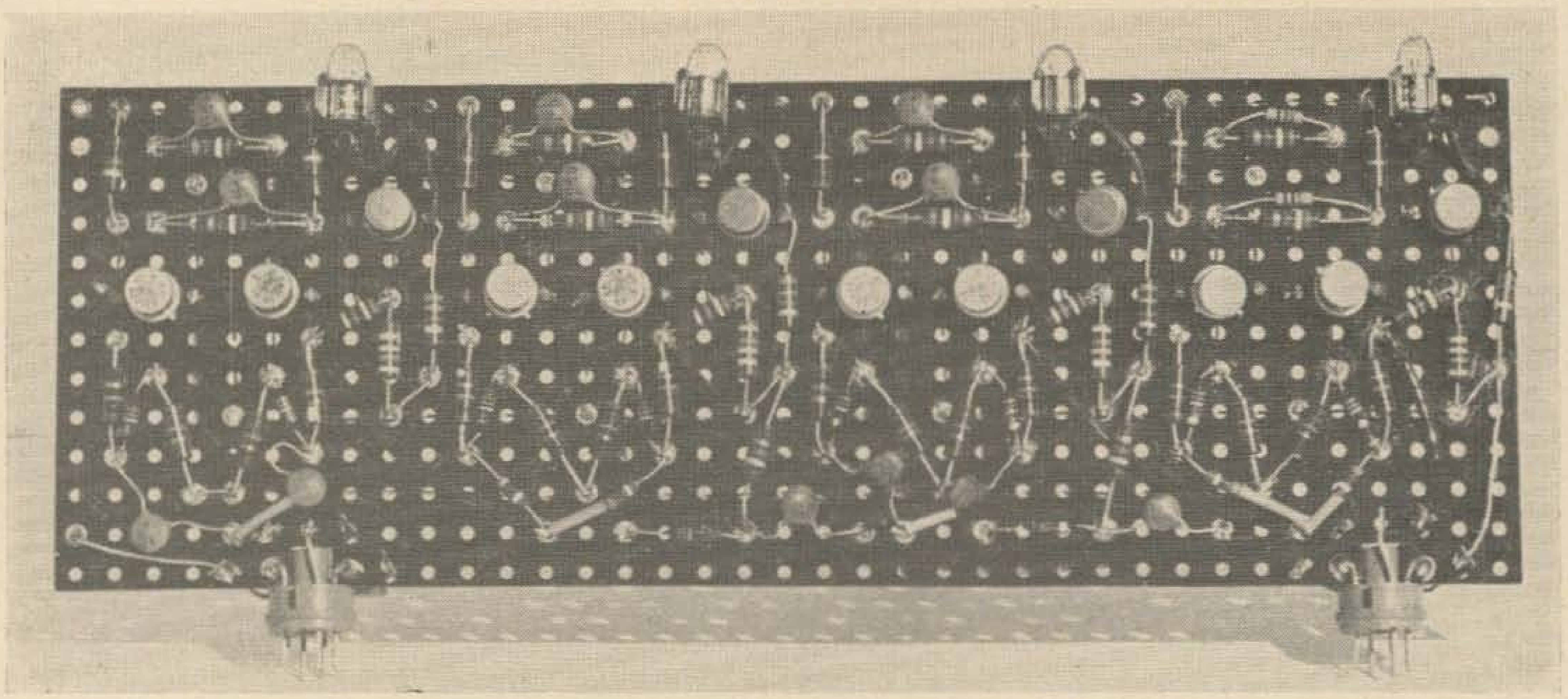


Fig. 4. One pulse per second generator.



Electronic counter decade panel contains four stages with their respective lamp and driver transistor. The feedback network is at the bottom, center, toward the right.

trol until it starts oscillating. These pulses are preferred since they are of high amplitude and produced at half the rate of the timer. Actuate the start button to begin the timing period. The count is observed at definite intervals and R9 set accordingly. The intervals are lengthened to an hour or more to achieve extreme accuracy.

The gate control circuit correlates the functions of the pulse shaper and timer. The diode gates can best be understood by referring to **Fig. 5**. Notice that D5 and D6 of the count gate have their anodes back to back and biased by the +24 volt supply to form an "AND" gate. In operation D6 has a constant +5 dc potential on its cathode. D5 though, can have either +8 or 0 volts on its cathode, depending on the condition of Q1.

When Q1 is conducting, the voltage at D5 is near ground level shunting the bias current in this direction. This lowers the gate potential to where it is insufficient to maintain a signal level high enough to actuate the counting flip-flops. In effect, the gate is closed.

Input pulses to the bases of the bistable multi-vibrators will change their state in a sequential manner. A pulse is directed through the diode of the conducting, transistor, turning it off. The opposite transistor, turning on, produces a pulse at its collector. Thus Q1 initiates the pulse necessary to trigger the second flip-flop. (**Fig. 5**)

The emitters of Q2 and Q3 are connected to the #2 reset line to the starting relay. Depressing the start button lifts the emitters off ground, turning off these transistors. Q3 therefore opens the pulse gate since its collector voltage rises to +8. Releasing the start button allows action to proceed. The first pulse from the timer is directed to Q1, opening the count gate. Processing of the unknown frequency commences. The second pulse from the timer turns Q2 off. And as explained in the preceding paragraph, Q1 actuates the second flip-flop, closing the pulse gate. The count can now be taken.

Construction

The four indicating decades and the control circuitry are mounted on 3½" x 9⅞" x 1⁄16" perforated boards. Two Vector P7 plugs are fitted to each panel. The long pins are bent and soldered to Vector T9.4 terminals. When done properly this makes a very strong assembly. The panels then plug into 7 pin miniature tube sockets fitted to the chassis. The lamps are mounted in standard 3AG fuse clips, which are secured to the board by hollow rivets. Soldering lugs are used in this assembly on the reverse side of the panel to connect the lamps to the −10 volt line. The center contact of the bulb presses against a Vector T9.4 terminal inserted in the hole below the clip. A flexible lead is soldered to this terminal. This mounting method is simple and has proved adequate, though not recommended for hard useage. A front panel display may be preferred and there are enough unused plug connections to accommodate this change.

The chassis measures 6" x 10¼" x 1½" and made from 1⁄16" aluminum. The first panel is placed 1¼" from the front and the others spaced 1" apart.

If a cover is used over the panels, two stay rods with insulated spacers are fitted on each end of the panels to align them so the lamps will clear the holes in the cover.

THE RECEIVER THAT PERFORMS THE WAY <u>YOU</u> EXPECT A RECEIVER TO PERFORM

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Get the receiver that does the job!
Feature for feature the DR-30 is your best buy.

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All of the advanced capabilities ever wanted in a receiver are now available at a price within the range of every serious amateur. The all-transistorized Davco DR-30 is a compact (4"H X 7⅛" W X 6"D) amateur-engineered receiver designed to provide exceptional performance under extreme environmental operating conditions. Sensitivity you won't believe, superior image rejection and extreme freedom from cross-modulation and overloading on strong signals are only a few of the reasons why the DR-30 is the receiver that does the job! Ask the ham who is using one now, check the many features included at no extra cost and you'll discover why the Davco DR-30 should also be your receiver. Many professional and commercial users have already discovered for themselves.

DAVCO DR-30 $389.50

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For further information and illustrated brochure, write:

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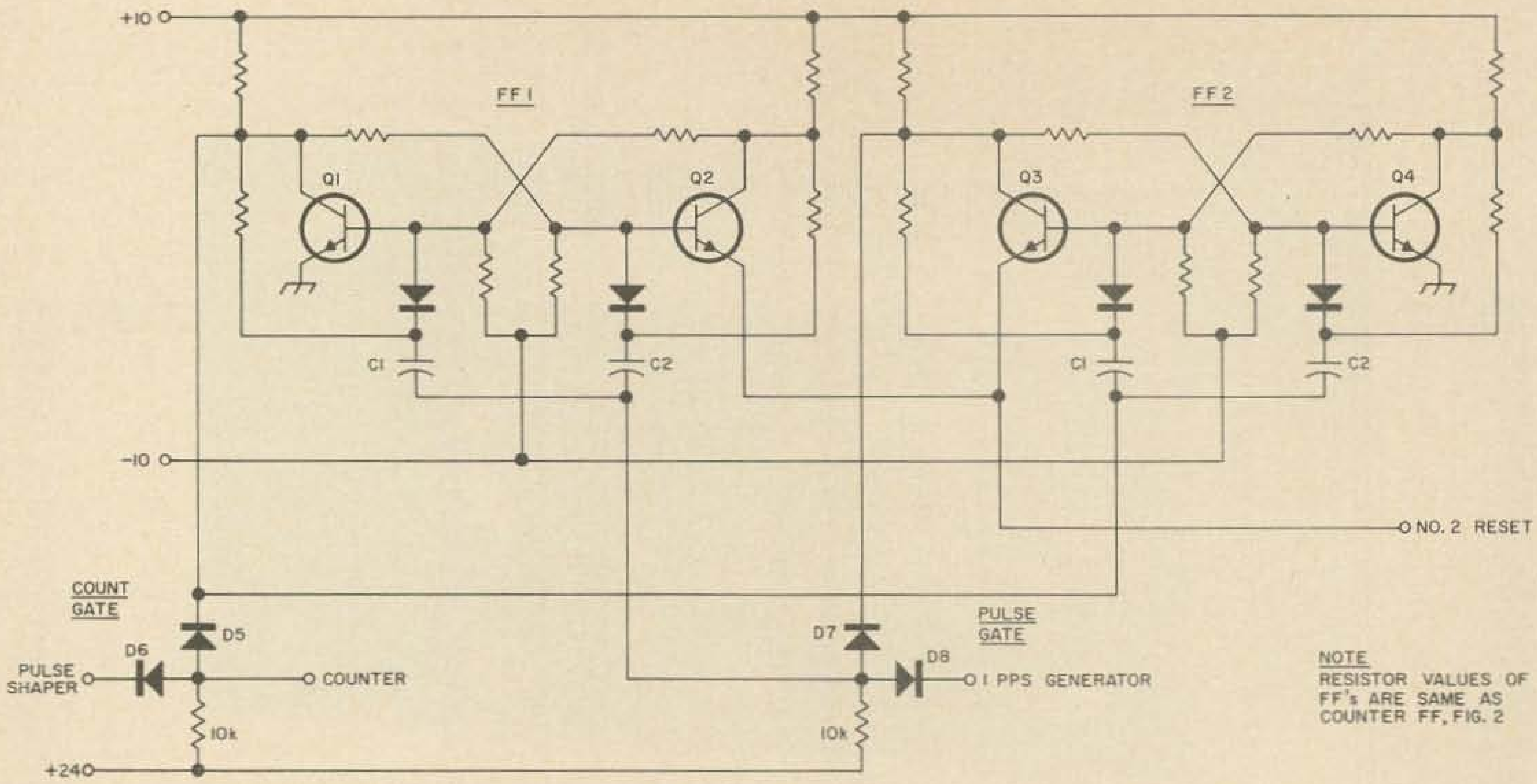


Fig. 5. Control flip flops and gates.

The x10 decade is built on a 3⅜" x 5⅞" board and mounts under the chassis on standoffs. The .01 μF input capacitors of the first stage of decade 1 presents a heavy load to the output of the x10 decade. Place a .001 μF capacitor in series with this output.

No difficulties should be experienced making the decades if components are tested prior to final assembly. Each decade can be considered as a single project, whereas the control panel may be separated into three, before combining them.

Some individuals may wish to substitute a double pole micro push switch for the relay. This may work satisfactorily but one must note that if the control flip-flops are grounded before those in the decades, an inaccurate count could result.

The timing generator utilizes the 60 hertz ac line frequency as a standard. This assumes the frequency is relatively stable. More refined methods can be employed but will add to the complexity, size and cost of the unit. Some difficulty was experienced at first in

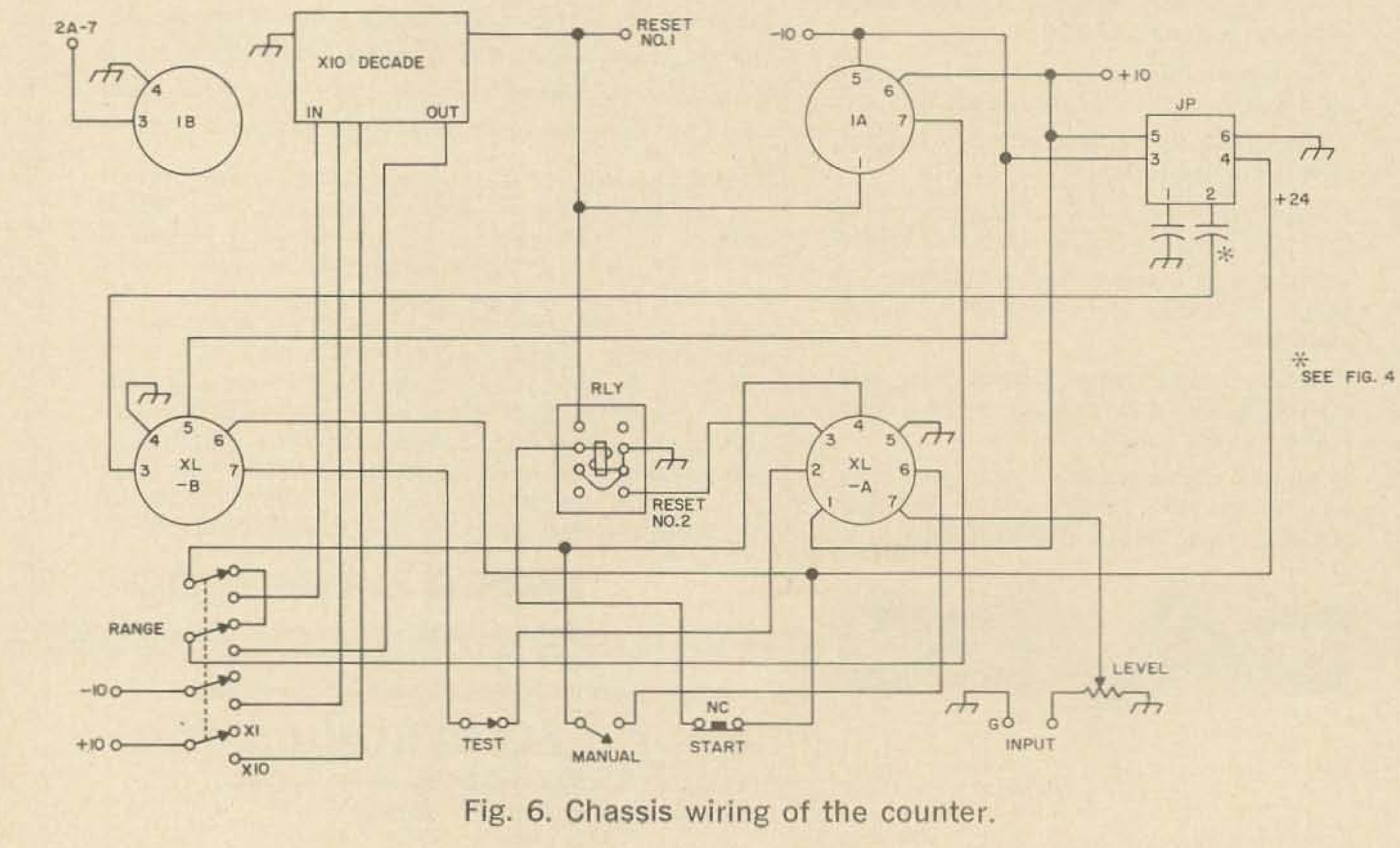


Fig. 6. Chassis wiring of the counter.

obtaining these frequency divisions. The problem appeared to be a matter of proper selection of component values and synchronization. The two 1 µF capacitors reduce the signal input to the sawtooth generator to about 17 V p-p. The signal, taken from T2, is not a true sine wave. For more information on UJT frequency dividers, refer to the G. E. Transistor Manual.

The 344 lamps are the most expensive item in the counter, though in lots of ten their price is competitive with other types that require a separate transformer supply, special driving transistors etc. There is a lower cost lamp available from one of the radio supply houses that you might consider as a substitute.

Due to differences in lamp and transistor characteristics and other factors, some lights may appear brighter than others. Exchanging driving transistors will contribute toward more uniform lighting conditions.

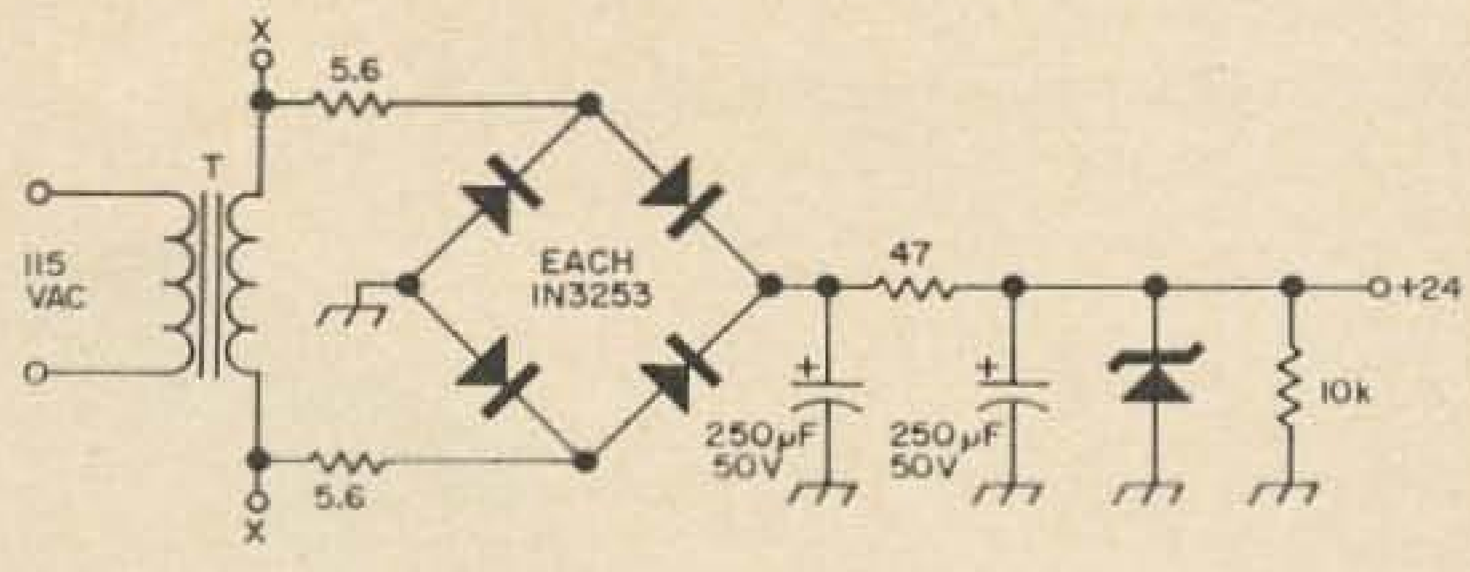
The power supply for the counter was adapted to this unit, serving a dual purpose and would be of little value to the reader. Voltage regulation of the −10 volt and +24 volt (if a relay is used) lines is recommended.

The following power requirements of the counter will permit the builder to design a supply to suit his personal preferences. The figures show only power drawn by the load.

- −10 volt at 280 mA idle *, to 420 mA, all lamps on.
- +10 volt at 30 mA, constant load.
- +24 volt at 45 mA, plus 38 mA for the relay.

* includes approximately 50 mA through the 3.3kΩ resistors.

When first turning on the counter warm up the power supply and charge the timing generator capacitors. This is done as follows: Use a signal input to the counter. Turn on test switch and let counter "free run" for a minute or so before taking a count. . . . K7UDL



NOTE
T = BURNSTEIN-APPLEBEE 18B506 115/24 V, .3A
FOR 10V SUPPLY SEE TEXT
FOR "X-X" SEE FIG. 4

Fig. 7. 24 volt supply.

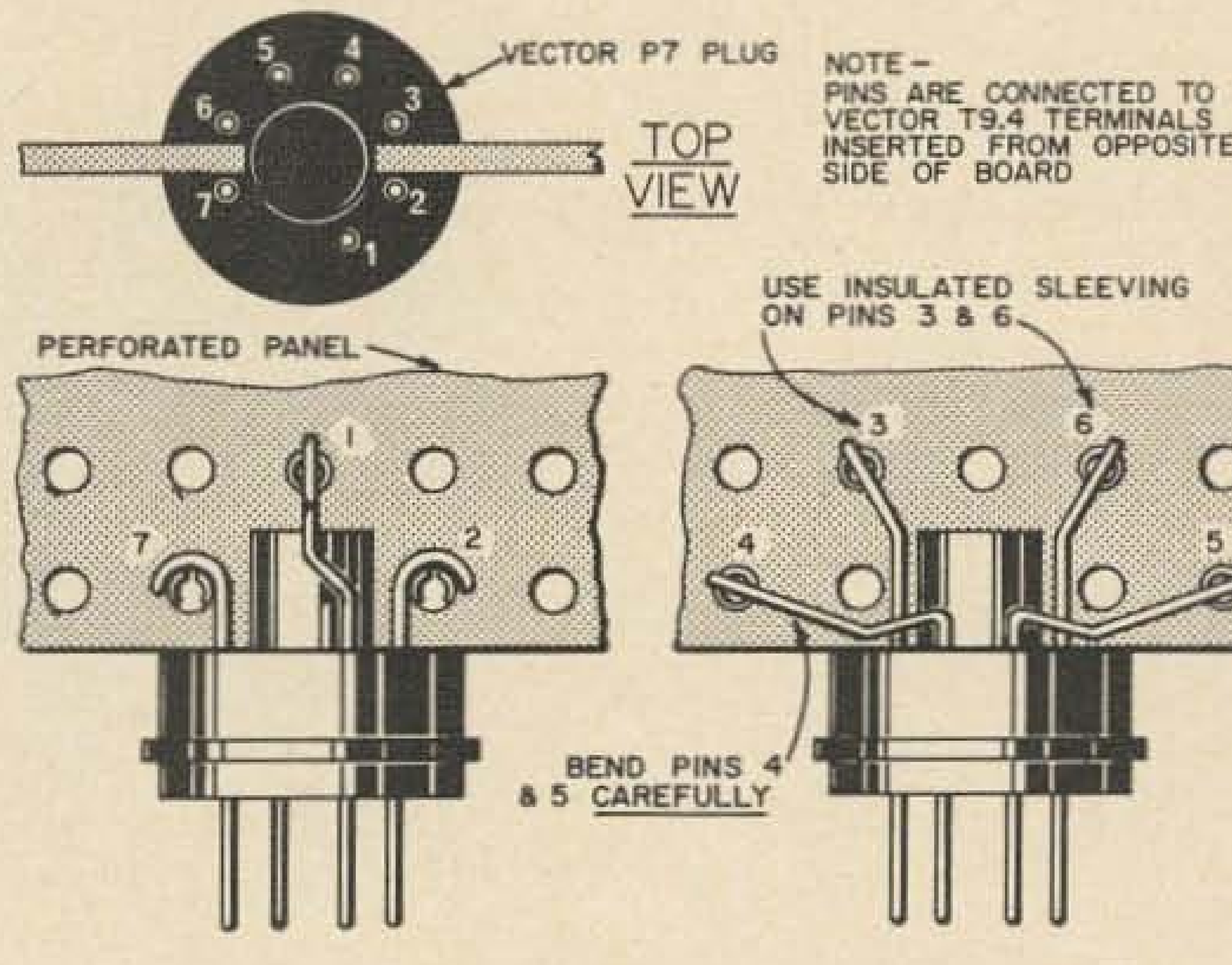


Fig. 8. Connections to the boards.

Parts List

C1, C2	
Control FFs	.005 µF
Decade x10, FF1	220 pF
Decade 1, FF1	.01 µF
Others	470 pF

C3, C4	
Control FFs	not used
Decade 4	150 pF
Others	47 pF

C5, C6	
Decade x10	220 pF
Others	330 pF

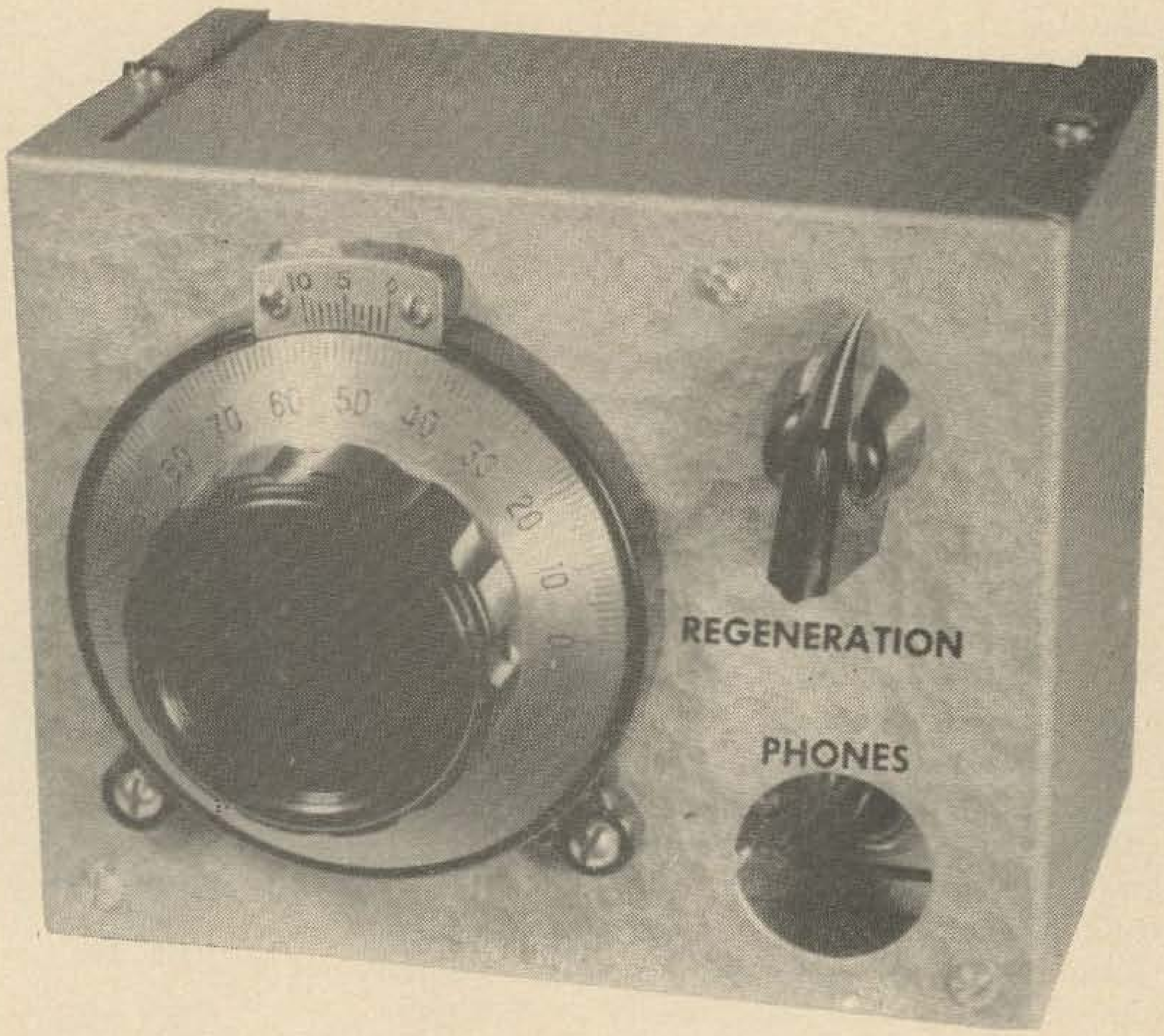
R12, R13	
Decades x10 & 1	100 kΩ
Others	1.5 MΩ to 2.2 MΩ

Transistors	
Counter FFs	2N1305, 2N525
Control FFs	2N1304
Q3 (Driver)	2N43, 2N109, 2N408 etc.
Diodes	1N277, 1N457, 1N489 etc.

Relay 26vdc Allied Control KHJX-115 or similar

Other parts as shown in text or drawings.

Novice 80-meter transmitter



Bob Corbett W1JJL
46 Prospect Street
Torrington, Conn.

The Novice Pair

An inexpensive transmitter and receiver for the 80-meter Novice band

One of the first things a prospective Novice notices about ham equipment is its cost. Even inexpensive shortwave receivers cost over $50 and they're not very useful for hamming. Most specialized ham receivers cost far more. This may not seem like much to the established ham, but it's a huge amount to the young ham still in school. Yet it's not hard to make a useful ham receiver and transmitter at reasonable cost if you're willing to accept a few compromises in convenience and performance.

The simple receiver described in this article will cost about $12 if you buy all the parts—including the etched circuit board, battery, and case—new. All of the parts (except the circuit board) can be found in the Lafayette, Allied, WRL and similar catalogs. Careful shopping and a few parts from surplus equipment or old TV sets can reduce even this low price.

The receiver covers the part of the 80-meter band normally used for code, including the 3700 to 3750 MHz Novice band. It does a good job, too, and can easily receive stations hundreds of miles away with a simple antenna. It separates the signals surprisingly well, but naturally can't compare with the more expensive receivers. I've worked stations over 200 miles away with this receiver and its companion transmitter. Both are completely transistorized for low power drain, reliability, low cost, compactness and simplicity.

The receiver is an up-to-date version of a circuit very popular in the early days of hamming: a regenerative detector with an audio amplifier. The detector is quite sensitive and selective. It receives not only code signals but also SSB and AM phone. Anyone who uses a complex receiver normally would be pleasantly surprised at the performance of this simple receiver.

The transmitter is equally simple and uses only three inexpensive transistors. It costs about $16 complete except for the power supply. The power input (and consequently the power output) depends on the voltage supplied to it. Six volts input to the power terminals gives 1.2 watts total input. Power output is about half the input. Twelve volts gives 4 watts output; 24 volts, 10 watts; and 40 volts (the maximum safe voltage), 20 watts. The circuit of the transmitter is very simple. It's a crystal oscillator operating at 3725 MHz followed by a class C final amplifier. No heat sinks are required. There are only two controls: oscillator tuning and output tuning. Both simply need to be adjusted for maximum reading on the meter.

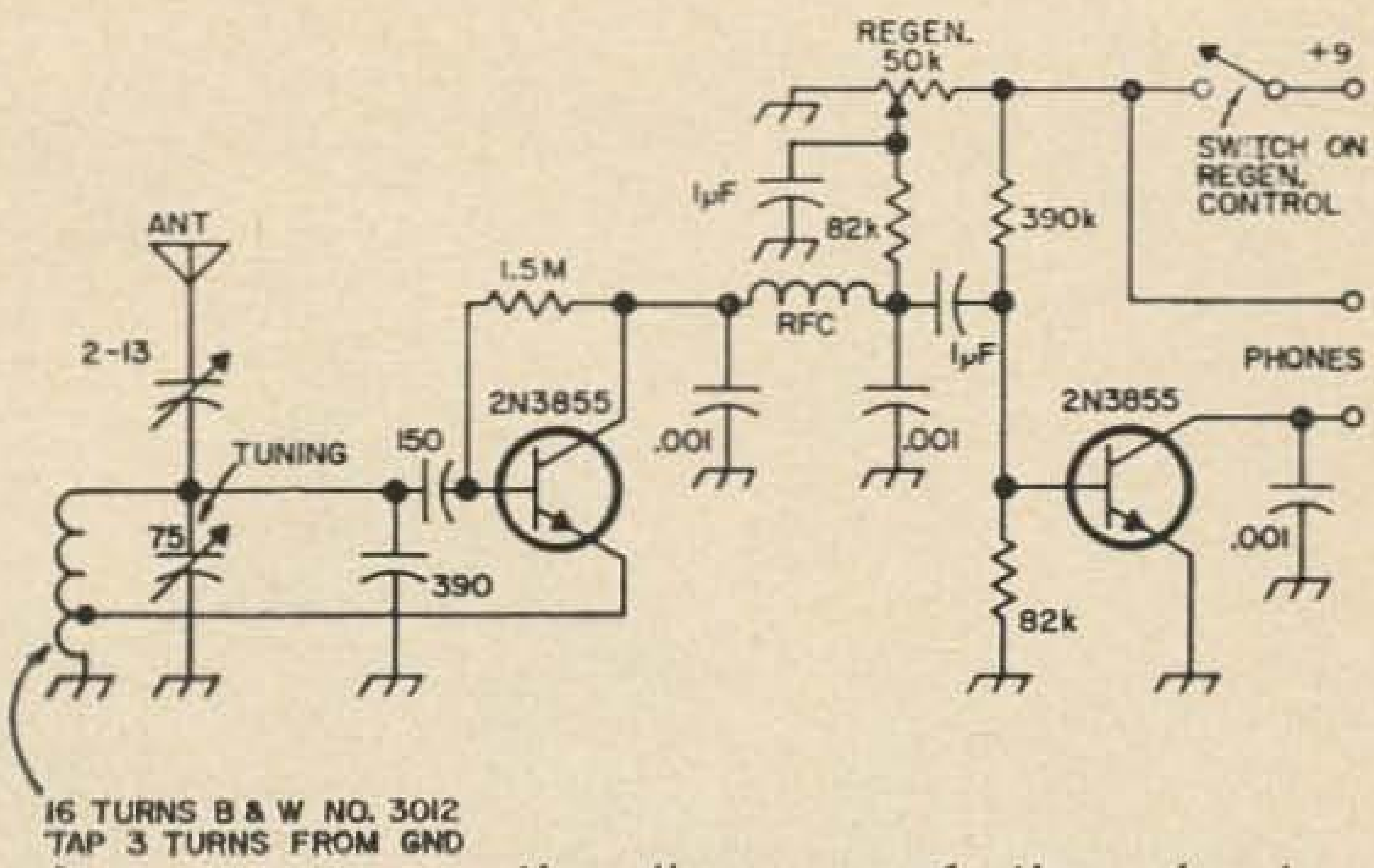
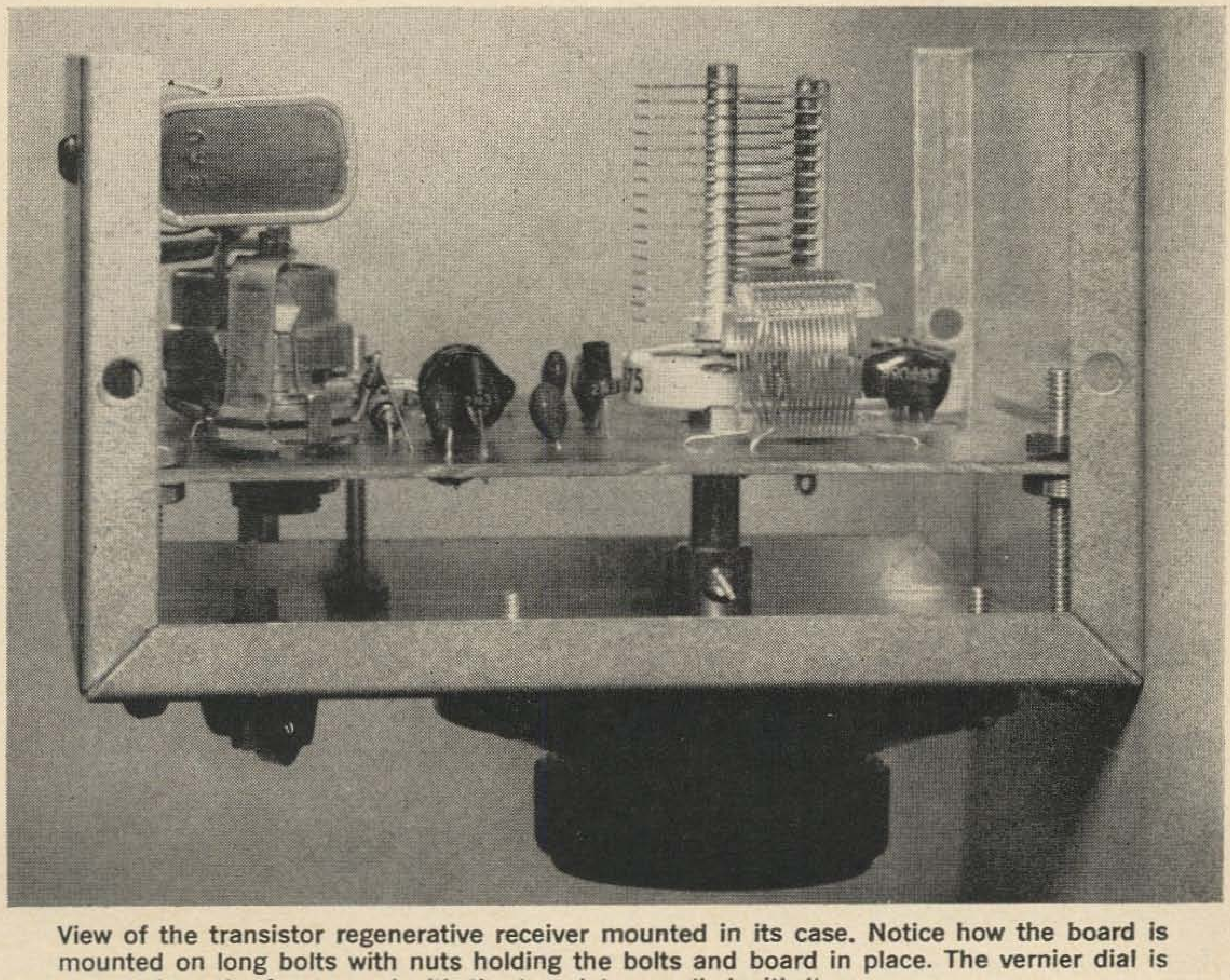
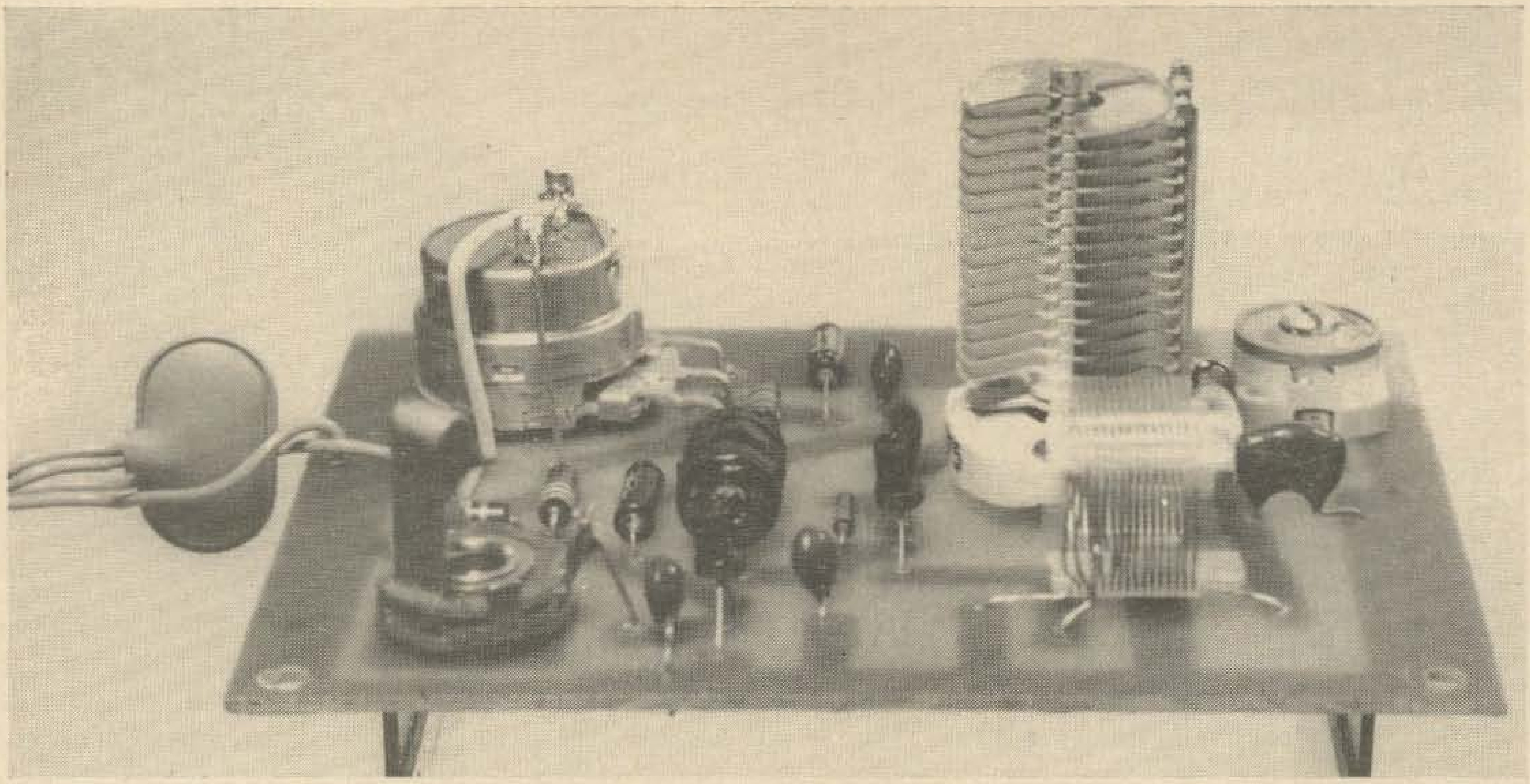


Fig. 1. Schematic diagram of the simple Novice receiver.

Building with etched circuits

These projects were designed for etched (printed) circuit board construction. You could build them on conventional chassis, on Vector board or Veroboard, or even on an old piece of wood, but the etched circuit boards have a number of advantages: they're neat, uniform, and almost error-free. The boards used in the receiver and transmitter can be bought already etched and ready to drill from the Harris Co., 56 E. Main Street, Torrington,


View of the transistor regenerative receiver mounted in its case. Notice how the board is mounted on long bolts with nuts holding the bolts and board in place. The vernier dial is mounted on the front panel with the template supplied with it.



Etched circuit board for the Novice transistor receiver before it's mounted in the case. The regeneration pot and phone jack are on the left, with the tuning capacitor, coil and antenna trimmer capacitor on the right.

Connecticut, for $2 each. If you buy both, the cost is only $3.50.

If you'd prefer, you can make your own board. It's neither hard nor expensive. You'll need copper-clad board, resist and etchant. These materials are available separately or in complete kits such as the Ami-Tron EZ-Etch Kit, which you can buy from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California. Both the individual parts and kits can be bought from many large dealers such as World Radio Labs, Allied and Lafayette. They come with complete instructions, but here's a quick explanation of what to do:

Place the template for the copper side of the board you want to make over the copper-clad board you want to prepare. Prick through each white circle to make a small hole in the copper. Then life off the template and use the holes as a guide to trace in the black lines with the resist according to the directions furnished. After you've put in all lines so that the board looks like the template, place the board in the etching solution as the directions specify. When all of the unwanted copper has been eaten off, wash the board thoroughly and clean off the resist with fine steel wool or household cleanser. Check the board carefully for short circuits or other possible problems.

Next drill the holes for the components. Use a sharp, high speed drill for best results. Most of the holes are for component leads.

Insert the components from the plain side of the board using the component layouts shown. Solder the wires quickly with a hot, clean iron and when the solder has hardened, clip off the extra wire sticking out on the copper side.

Final assembly

The photos tell most of the story on assembly of the units. After all parts are soldered on the boards, the boards are mounted in their cases with long machine screws and nuts.

Very few parts are not on the boards. In the receiver, the vernier tuning dial is mounted using the template supplied with it. The battery is held in a clip made from a piece of aluminum or tinplate, and an antenna terminal is mounted on the side of the case. This terminal can be a simple feedthrough insulator or a phono or rf coax connector.

The transmitter is assembled similarly. The meter is mounted on the front panel, two insulated battery jacks on the back, and a coaxial jack on the side. There's no real need for a regular coax connector as a phono jack works as well.

Receiver operation

The receiver is very simple to use. Use magnetic headphones of 500 to 10000 ohms impedance. Low impedance headphones for pocket transistor radios and crystal head-

(Text continued on page 34)

SMALL PAIR BEATS A FULL HOUSE

One particular pair, **SB-34** sideband transceiver/exciter and **SB2-LA** gallon linear amplifier—are small enough to beat a full house. Or, for that matter, any no-room-for-passengers KW mobile installation.

Proof. Photograph shows **SB-34** and **SB2-LA** together as a complete 1KW, 4-band sideband station (including receiver of course) beating a full house handily. The two units placed end-to-end occupy less than 2 linear feet—just over 1 foot in depth, less than 6 inches high!

But SBE didn't set out to produce a miniature transceiver at the expense of undue component crowding—transistors and diodes aided by advanced bilateral circuits did it with room to spare.

SB-34 specifically, is advanced equipment—predominantly solid-state—in pace with the trend toward elimination of all tubes in a host of electronic gear. The SB-34 SSB transceiver costs only 395.00 (**with** 12V DC and 117V AC built-in power supply) and uses 23 transistors, 18 diodes, a zener, a varactor—and only 3 tubes!

Highlights: **SB-34:** 4-bands: 3775-4025 kc, 7050-7300 kc, 14.1-14.35 mc, 21.2-21.45 mc. • 135W p.e.p. input (slightly lower on 15) • Built-in dual 117V AC/12V DC supply (negative ground) • Collins mechanical filter • Panel selectable USB-LSB • 11¼"W, 10"D, 5"H. Weight: 19 lbs.

SB2-LA: 80-40-20-15 meters • Input SSB: 1KW p.e.p. AM: 300W. CW-FM-FSK: 400W. • Built-in 117V AC power supply • 12"W, 12½"D, 5¾"H. Weight: 40 lbs.

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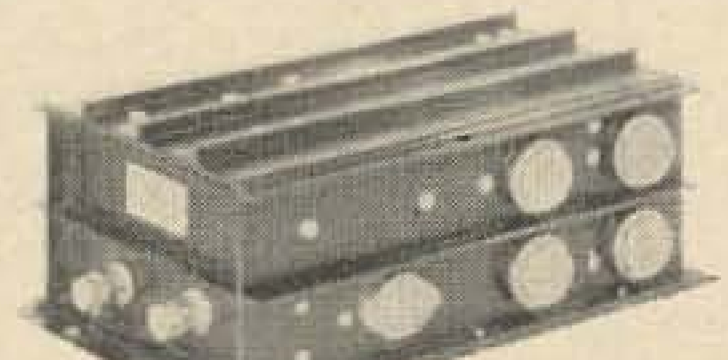
Heavy-duty transistorized inverter for mobile operation of SB2-LA linear amplifier at 1KW input. Input 12-15V DC, negative ground. Output @ 13.5V DC input, 150 volts AC peak square wave at 250 cycles. 6"W, 12"D, 3¾"H. Weight: 17 lbs.



Write for new brochure describing SBE line.

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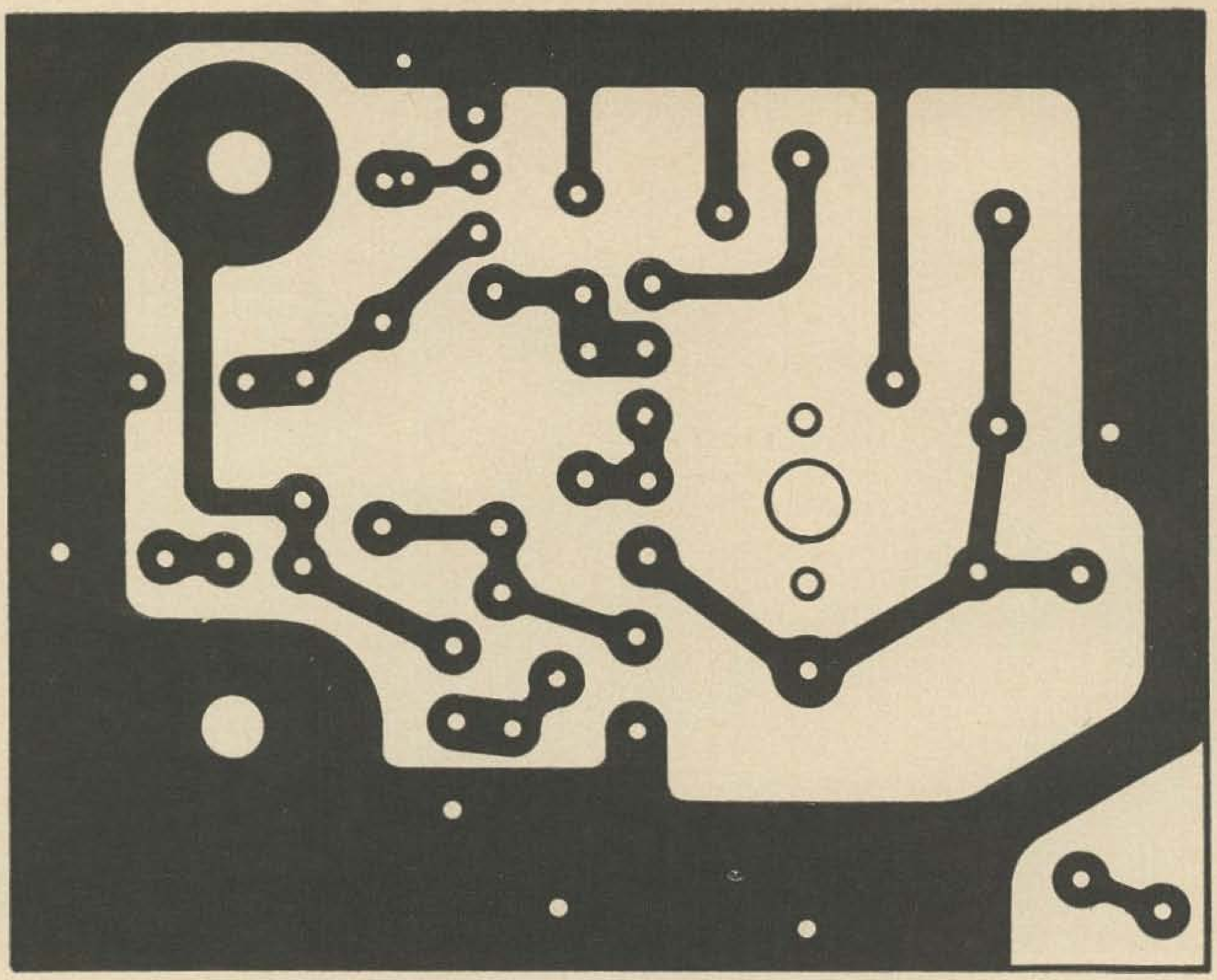
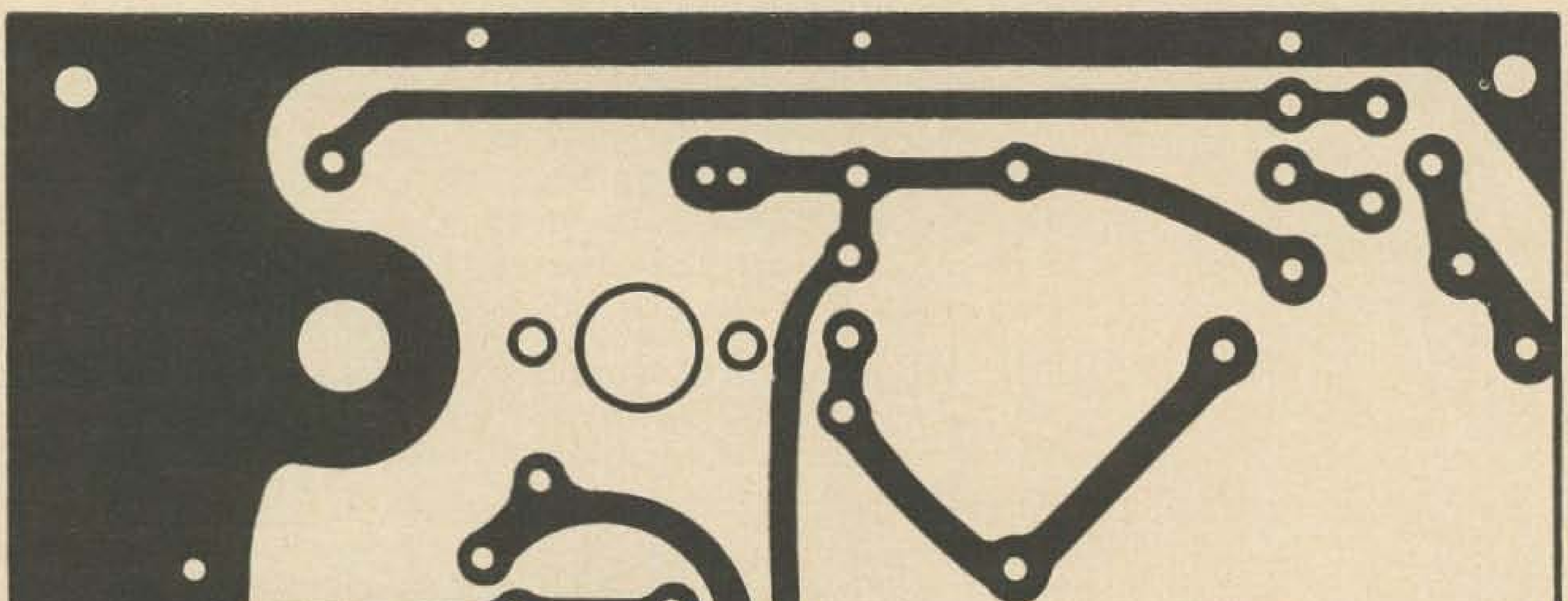
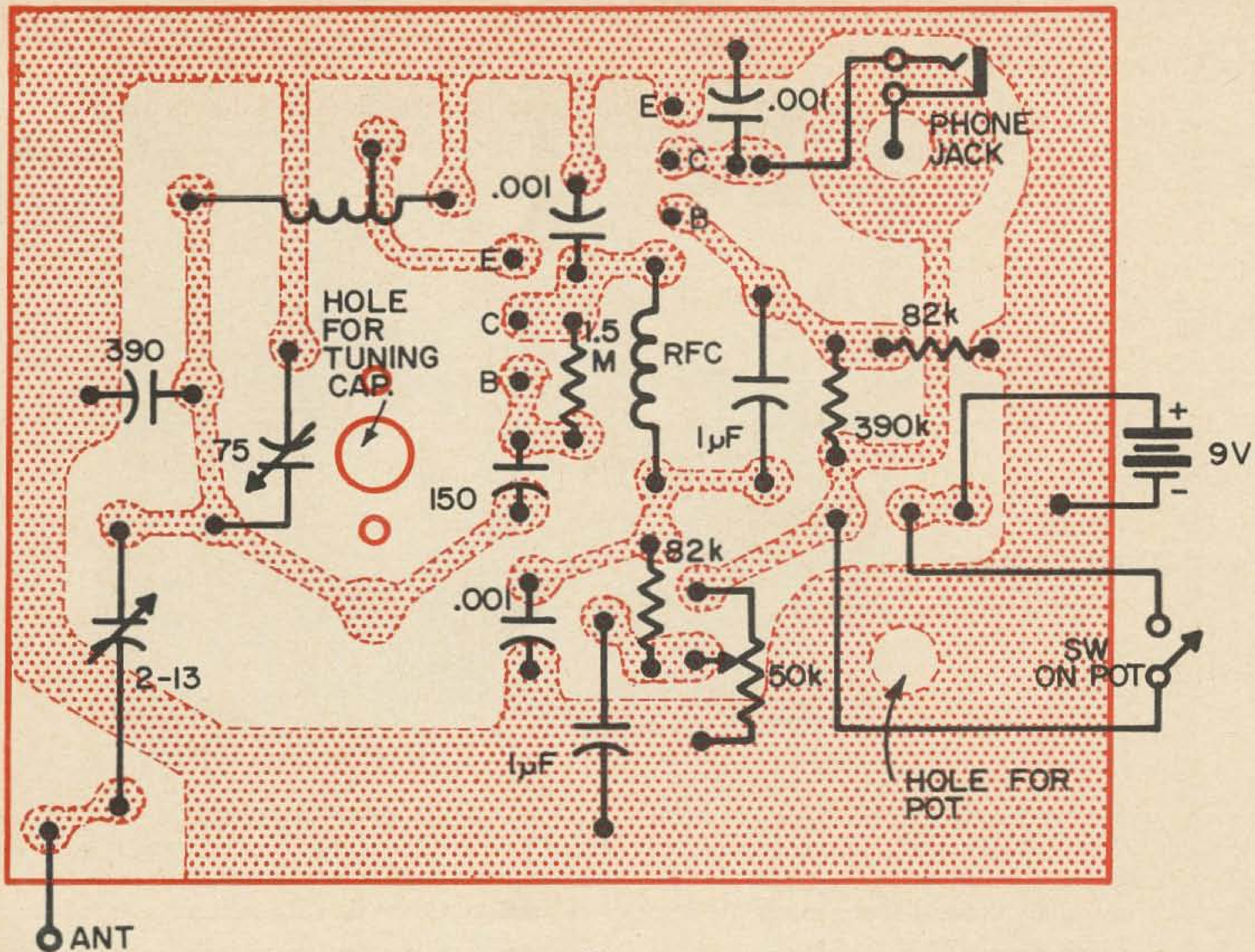


Above: Copper conductor layout for the Novice receiver. Opposite: Component layout.



Above: Copper conductor layout for the Novice transmitter. Opposite: Component layout.



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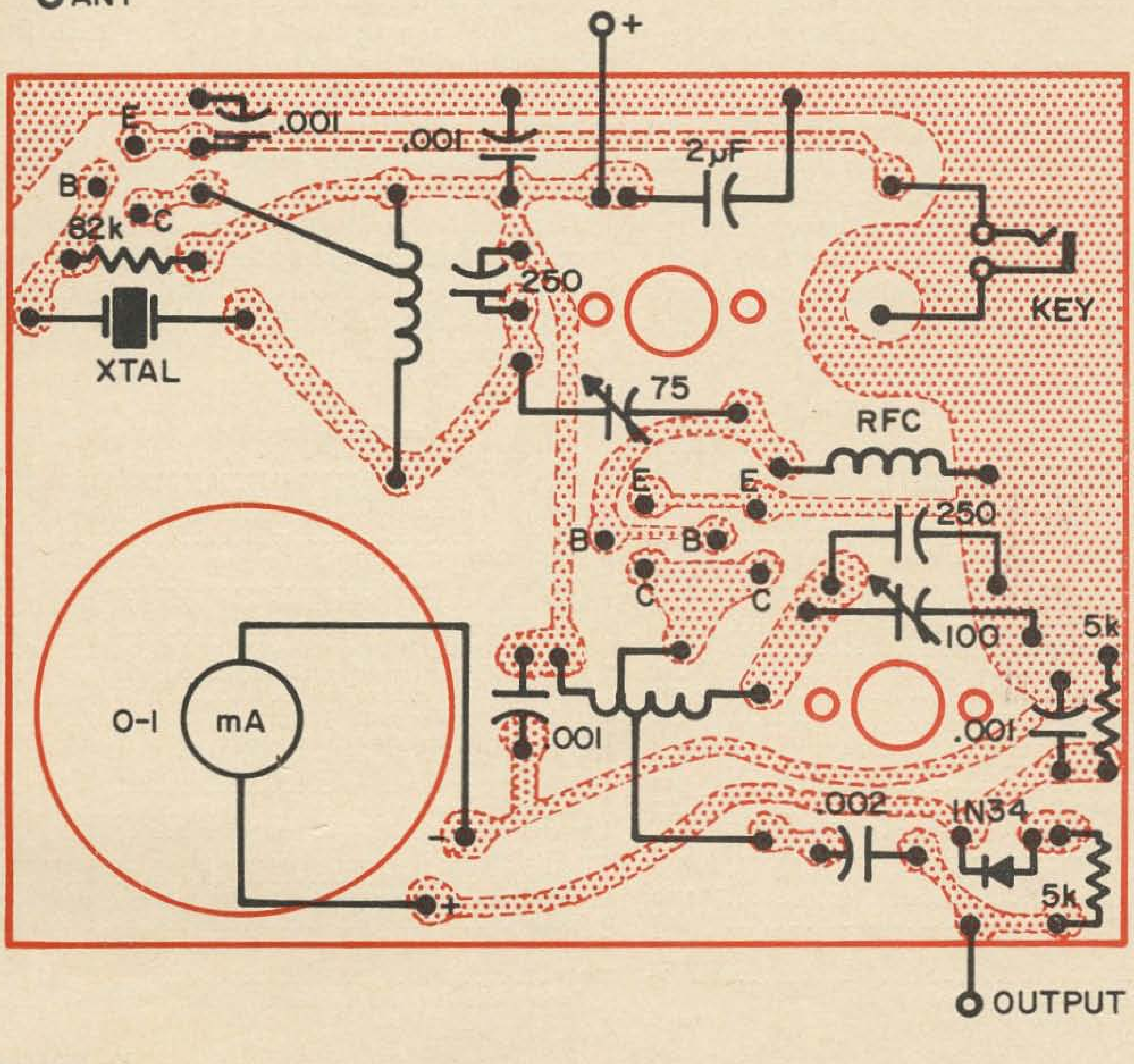

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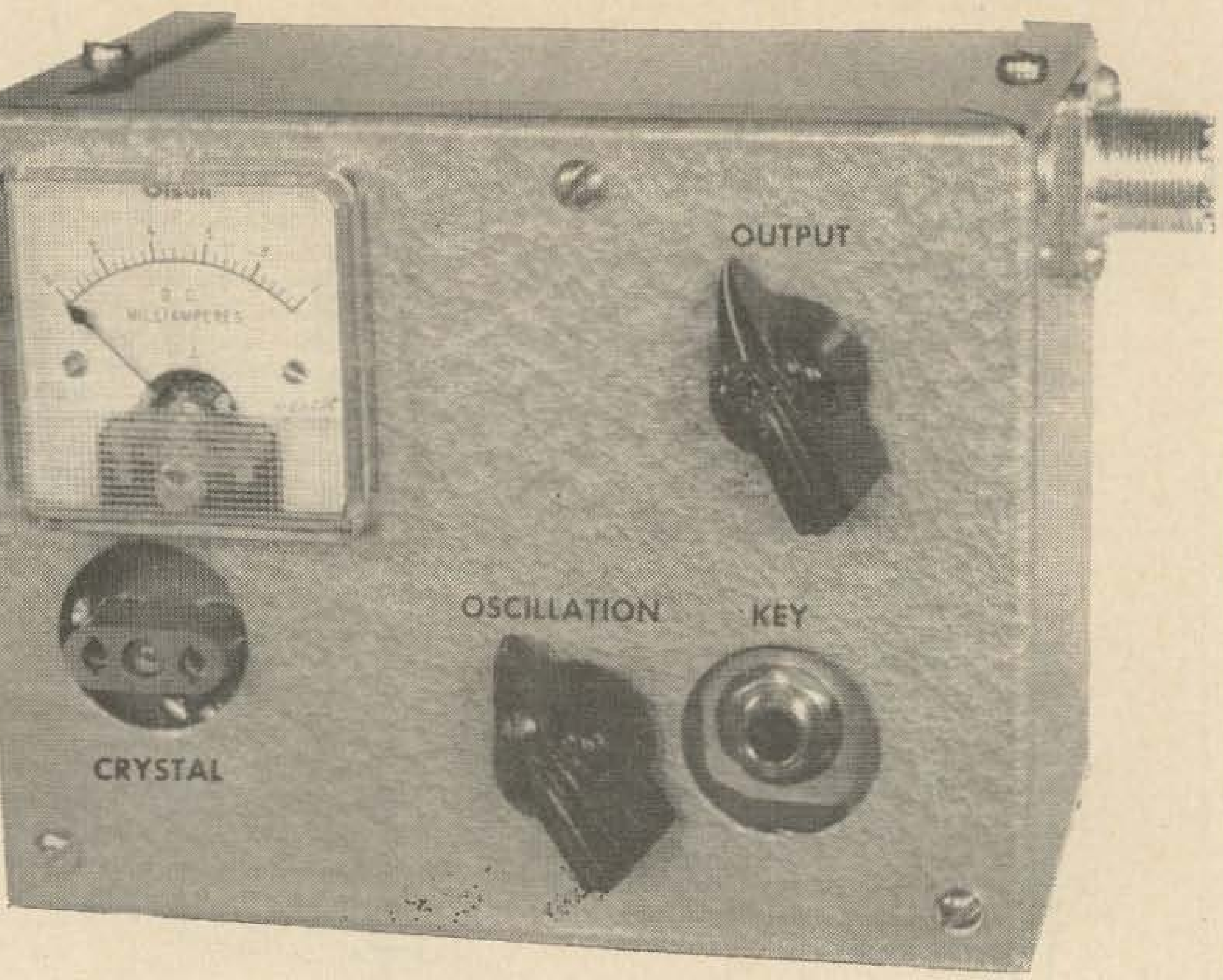


Novice 80-meter receiver

phones won't work properly. A piece of wire either 30, 90 or 125 feet long makes an excellent antenna. Though it's not shown on the diagram, a good ground connected to the case is recommended for best results.

Turn on the receiver by twisting the regeneration control clockwise, past the switch click, until you hear a slight whistle. Tune around and you'll hear some stations. It's best to do this at night so that you'll be sure to hear plenty of them. Code stations are best received with the regeneration control set so that the detector barely oscillates and each dit and dah is loud and clear. You should hear many very slow stations near the center of the tuning range. These will be the Novice stations. If you have a crystal in the Novice band, you can locate your own signal by transmitting with your transmitter.

Voice stations on 80 meters are of two types: AM and SSB. AM is best received by setting the regeneration control so that the detector almost oscillates, and SSB can be tuned in much like the code stations, with the detector oscillating. If they're not tuned properly, SSB signals sound peculiar, almost like ducks quacking.

The small variable capacitor connected between the antenna and tuning coil can be any value from 2-13 to 3-40 pF. It's not critical, but should be varied if the receiver won't oscillate properly.

Novice Receiver Parts List

1	Premier 3"x4"x5" Minibox	$ 1.15
1	50 kilohm potentiometer with SPST switch	1.38
1	Length B&W 3012 Miniductor or Illumitronics 632T Air-Dux coil stock. ¾" diameter, 32 turns per inch. (only part used)	.62
1	5-75 pF variable capacitor, Hammarlund APC-75B	1.47
1	2.5 mH choke, National R-50	.42
2	1 μF/15 V electrolytic capacitors @ 29¢	.58
3	.001 μF disc capacitor @ 8¢	.24
2	82 kilohm/½ watt resistors @ 12¢	.24
1	390 kilohm/½ watt resistor	.12
1	1.5 megohm/½ watt resistor	.12
1	phone jack	.19
1	trimmer capacitor, 3-12 or 3-30 pF	.30
1	9 volt battery	.48
1	battery connector	.27
2	NPN high frequency transistors, GE 2N3855 @ 50¢ (or Motorola HEP-50, 79¢)	1.00
1	2-⅞" vernier dial	1.39
2	knobs @ 12¢	.24
1	antenna connector (pin jack)	.15
Total		$10.36

Printed circuit board (optional) $2.00

Novice Transmitter Parts List

1	3"x4"x5" Minibox	$ 1.15
1	75 pF variable capacitor, Hammarlund APC-75B	1.47
1	100 pF variable capacitor, Hammarlund APC-100B	1.67
1	length B&W 3012 Miniductor (use part of receiver coil stock)	.62
1	length B&W 3015 Miniductor coil stock, 1" dia.	.16
	turns per inch	.68
3	RCA 2N2270 NPN transistors @ $1.16	3.48
2	5 kilohm/½ watt resistors @ 12¢	.24
1	82 kilohm/½ watt resistor	.12
4	.001 μF disc capacitor @ 8¢	.32
1	2 μF/50 volt electrolytic capacitor	.54
1	2.5 mH choke, National R-50	.42
1	.002 μF disc capacitors	.08
2	250 pF ceramic capacitors @ 8¢	.16
1	crystal socket for FT-243 crystals	.36
1	1 mA meter	2.95
1	phone jack for key	.19
1	coax connector, SO-239 is 48¢. RCA phono jack	.15
2	knobs	.24
2	battery jacks (binding posts) @ 25¢	.50
Total		$15.34

Printed circuit board (optional) is $2.00

Transmitter operation

The transmitter is almost as easy to use as the receiver. Connect a resonant antenna to the antenna jack. A suitable antenna is a half wave dipole (125 feet long and split in the middle by an insulator) fed by 50-ohm coaxial cable such as RG-58. Attach a 6 to 40 volt dc power supply good for up to 500 mA (half an ampere) to the power terminals, being careful to connect the positive and negative leads properly. Plug a crystal in the 80-meter Novice band (between 3705 and 3745 kHz), which you can buy from many 73 advertisers, in the crystal jack and a standard key in the key jack. Push down the key and adjust the two controls quickly for maximum meter reading and you're on the air!

A suitable power supply is easy to build from inexpensive parts available from many 73 advertisers such as John Meshna. See the article on transistor power supplies by Hank Olson W6GXN in this issue for more information on low voltage power supplies.

The easiest way to use the transmitter and receiver together is with separate antennas. The transmitting antenna must be resonant at the frequency of operation, but the receiving antenna isn't so critical.

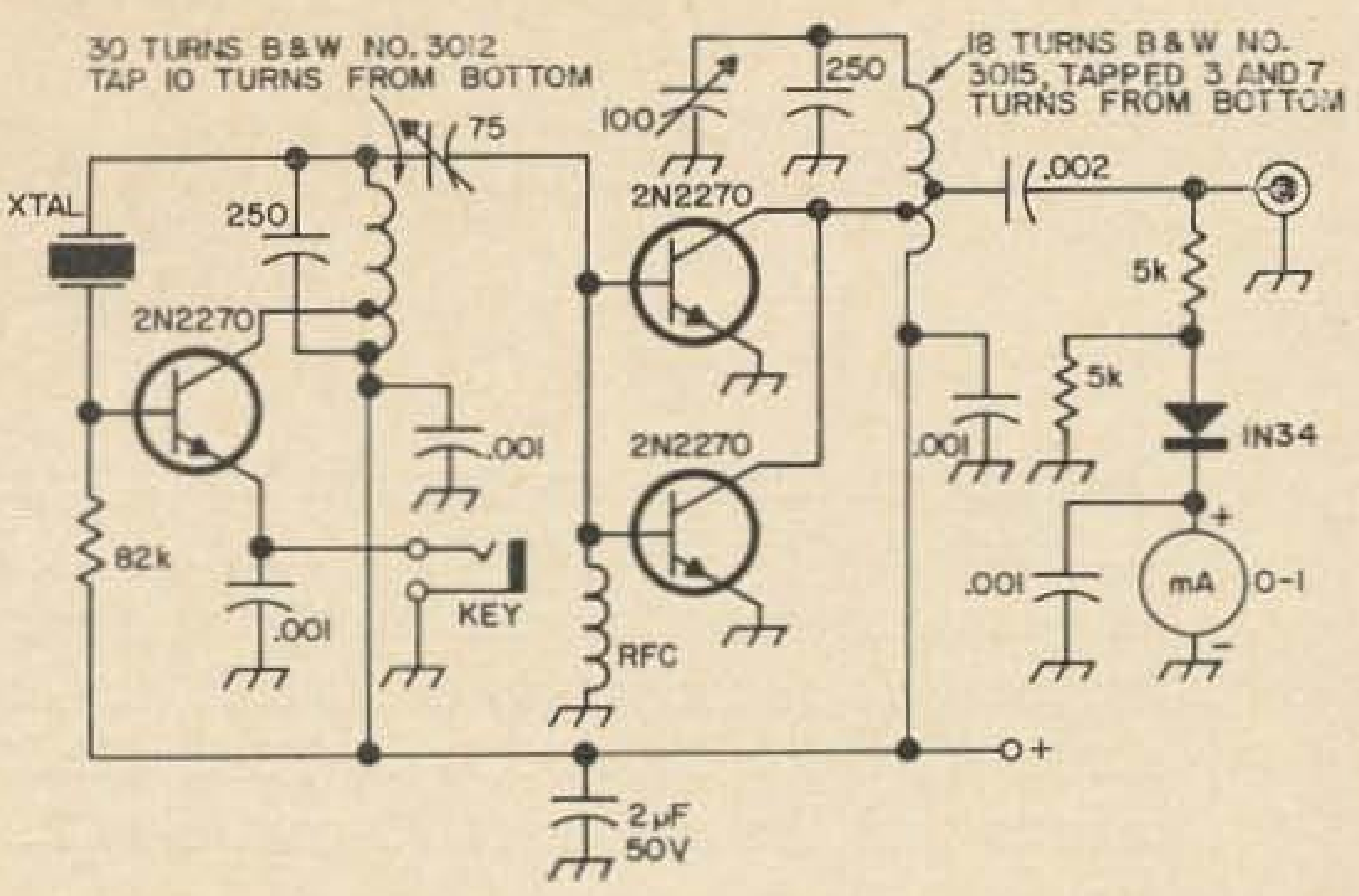
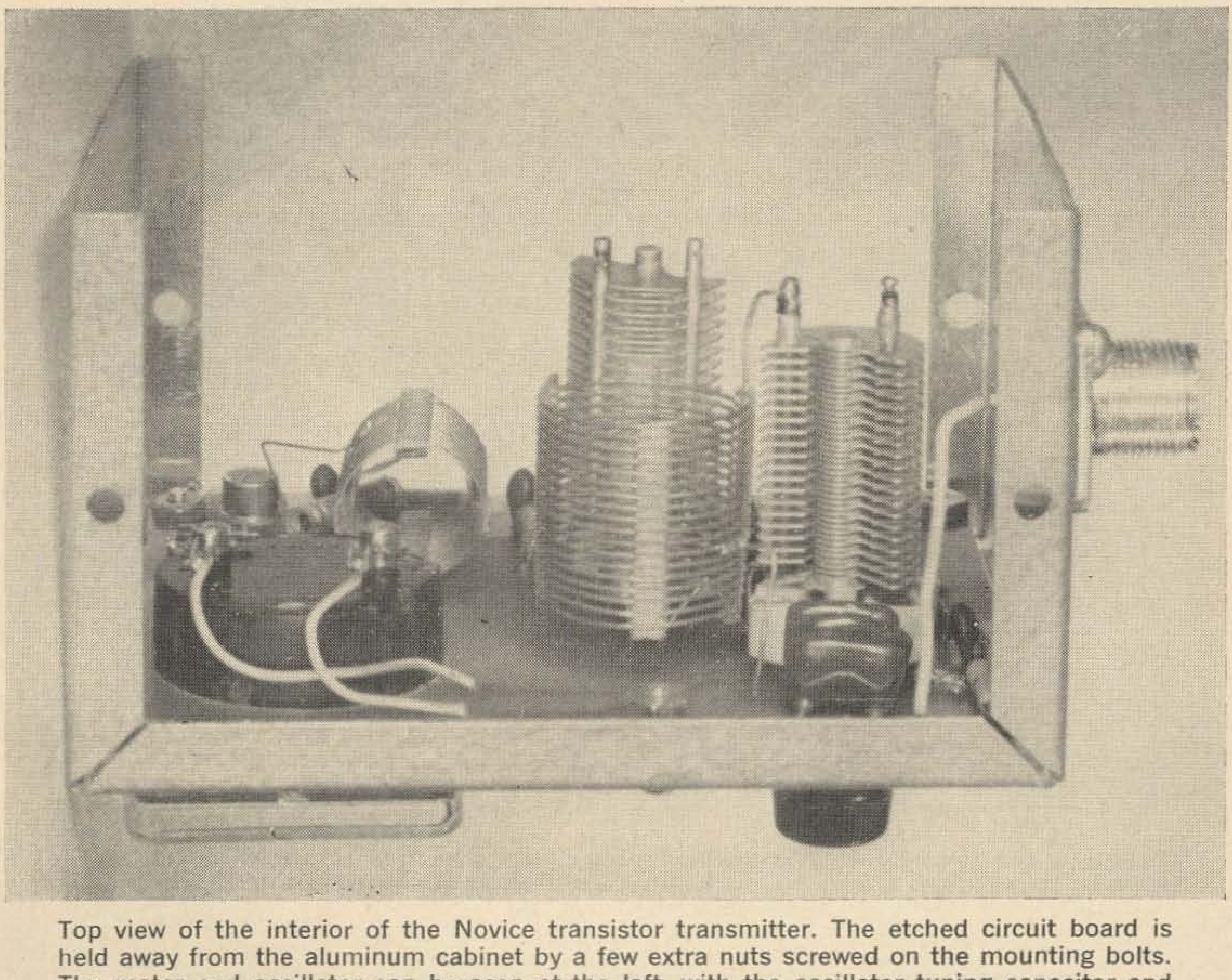


Fig. 2. Schematic of the simple Novice transmitter.

Have fun with your receiver and transmitter. When you move up to more complicated equipment, you'll find this pair fun for contests and portable operation.

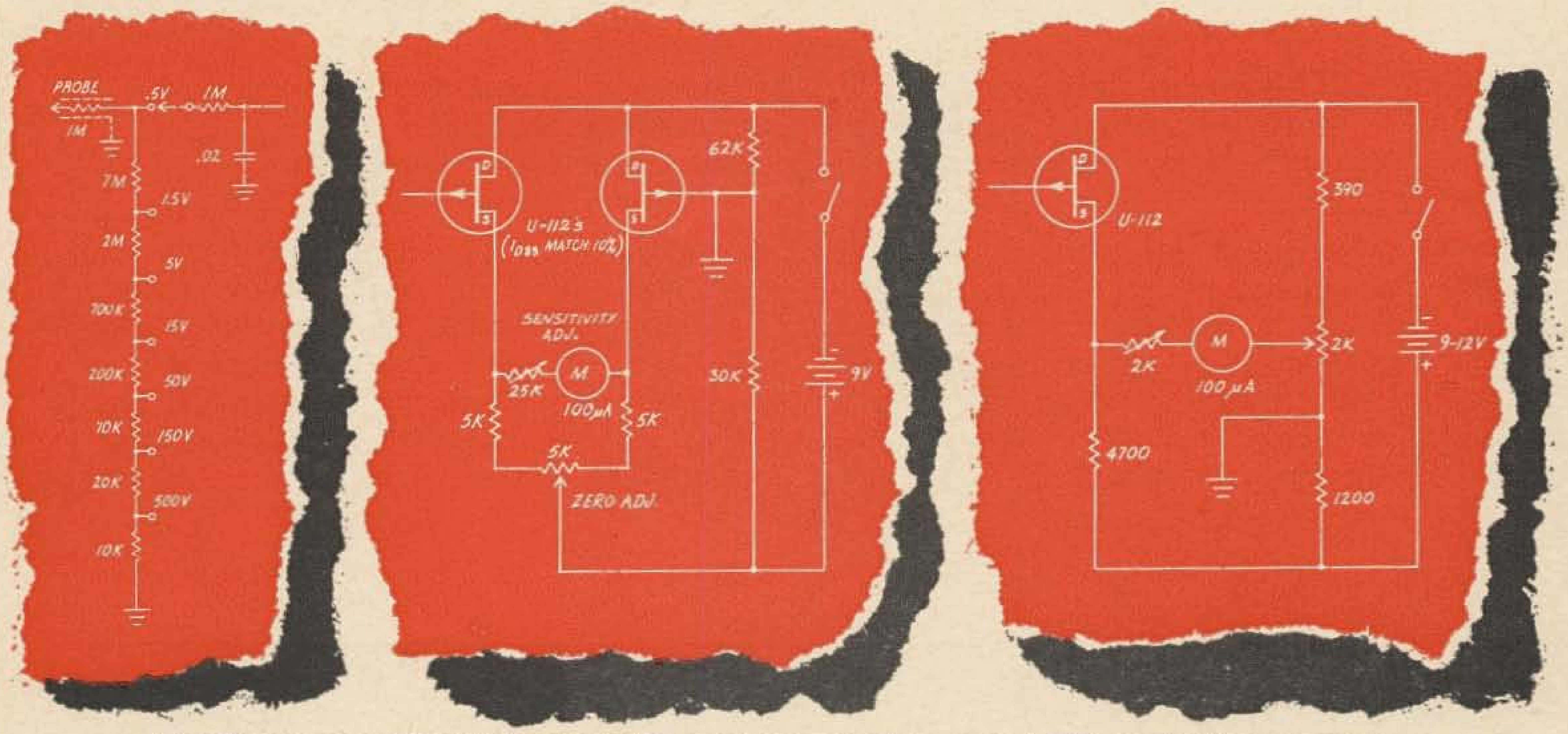
. . . W1JJL



Top view of the interior of the Novice transistor transmitter. The etched circuit board is held away from the aluminum cabinet by a few extra nuts screwed on the mounting bolts. The meter and oscillator can be seen at the left, with the oscillator tuning capacitor and final coil in the center of the unit. The capacitor on the right is for tuning the final tank circuit. The coax connector is mounted on the left of the cabinet.

How To Build A FET Voltmeter

Take the VT out of VTVM with the transistor that behaves like a tube.



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The voltage divider on the left works with both; in the middle circuit, the matched FET pair means no re-zeroing with temperature changes. If you're willing to re-zero try the one on the right. Either circuit with a 100 μa meter gives a full scale sensitivity of 0.5v and better than 1% linearity. For AC add a diode peak detector and change the multiplier resistors. To modify your present VTVM for instant warmup and portability just remove the tube and all the power supply business. Change a couple of resistors, then install a FET and a battery. The battery should last a year, even with daily use.

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Enclosed is
- ☐ $1 for one U110 FET and data
- ☐ $2 for one U112 FET and data
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This power supply is ideal for the ham who experiments with transistors. It features variable voltage output, current limiting, excellent regulation and low impedance.

A typical laboratory power-supply will have variable voltage output, low internal impedance, good voltage regulation with a variety of loads, freedom from output changes with line-voltage fluctuations, adjustable current limiting, low ripple and noise voltage in the output, and accurate metering of output voltage and current. Clearly all these features are not needed for *every* system, but several of them will be suited to each particular circuit under test. Having tested the circuit with our laboratory supply, we can then vary the supply voltage around to test the circuit sensitivity to input voltage change. We can also, put resist-

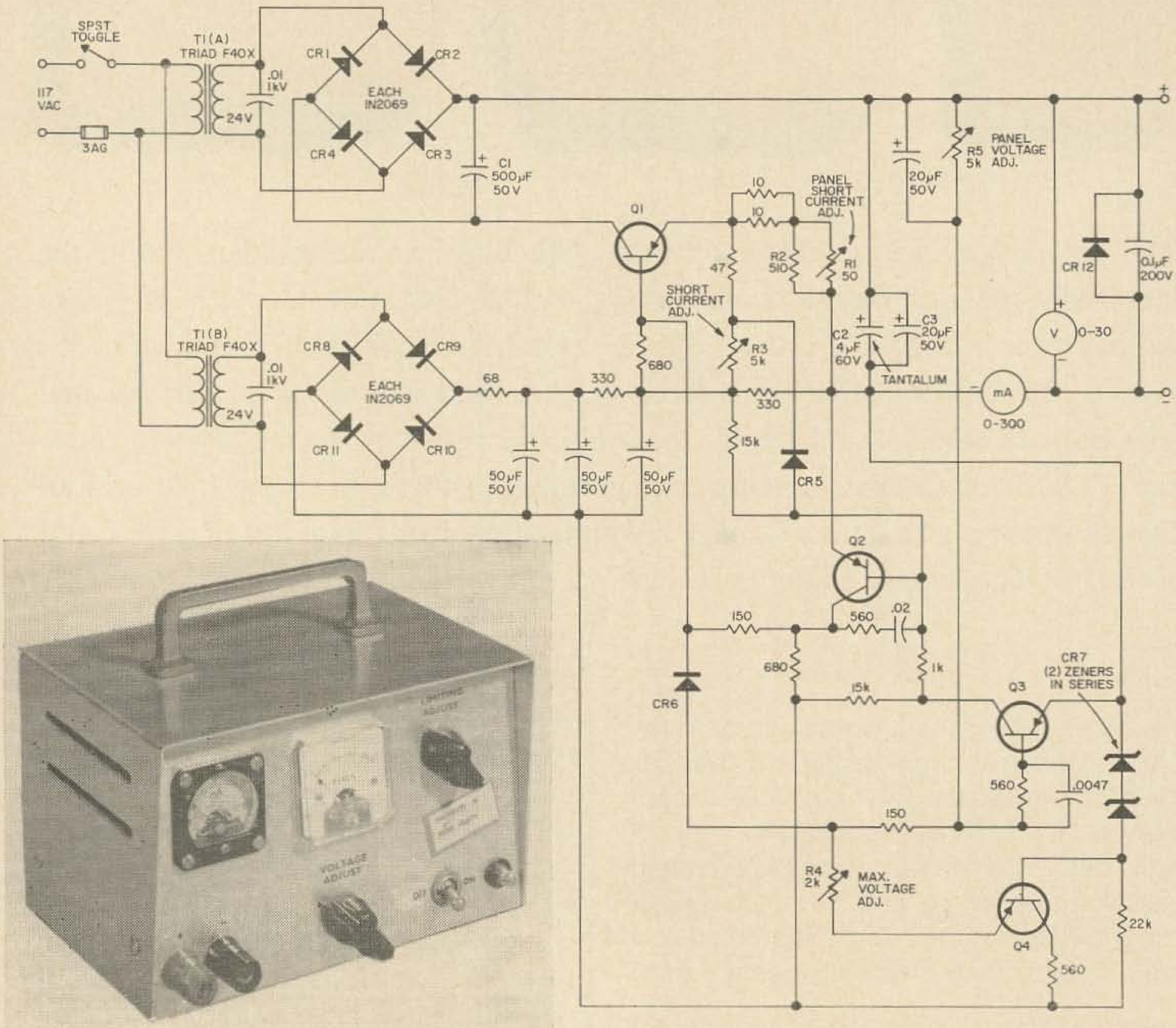
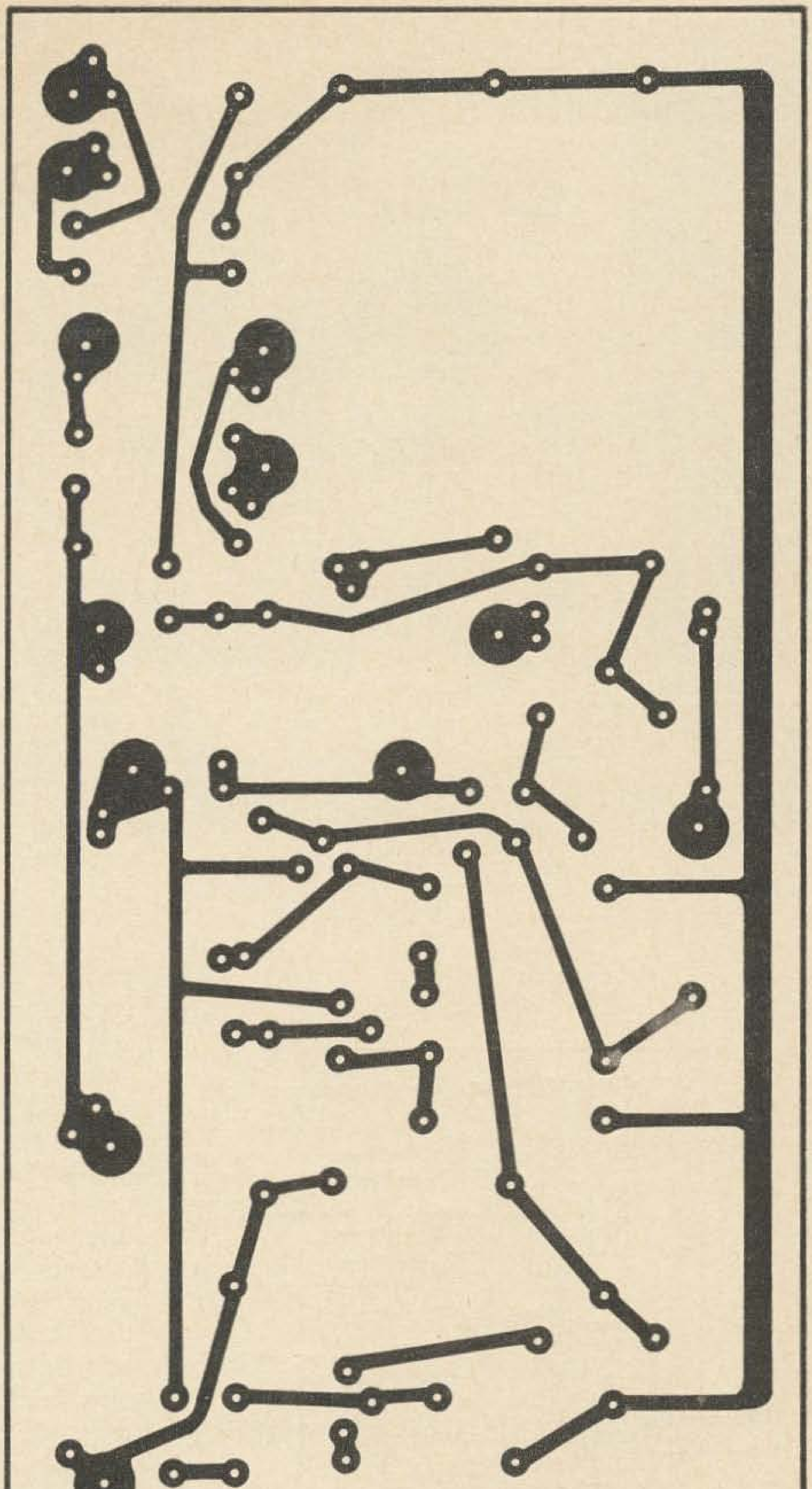


Fig. 1. Laboratory-type power supply. Q1 is a 2N375 or 2N1542A; Q2, Q3 and Q4, 2N508; CR1, 2, 3, 4, 8, 9, 10, 11, 12, 1N4002 or 1N2069; CR5 and CR6, HB5 or FD1135; CR7, 1N755 or two 1N468's in series.

Fig. 2. Circuit board layout for the laboratory power supply shown in Fig. 1. This board is available from the Harris Co., 56 E. Main Street, Torrington, Conn., for $2.



ors in series with the lab power-supply to check the circuit dependence on the power-supply internal impedance (has your high gain audio amplifier ever 'motorboated'?)

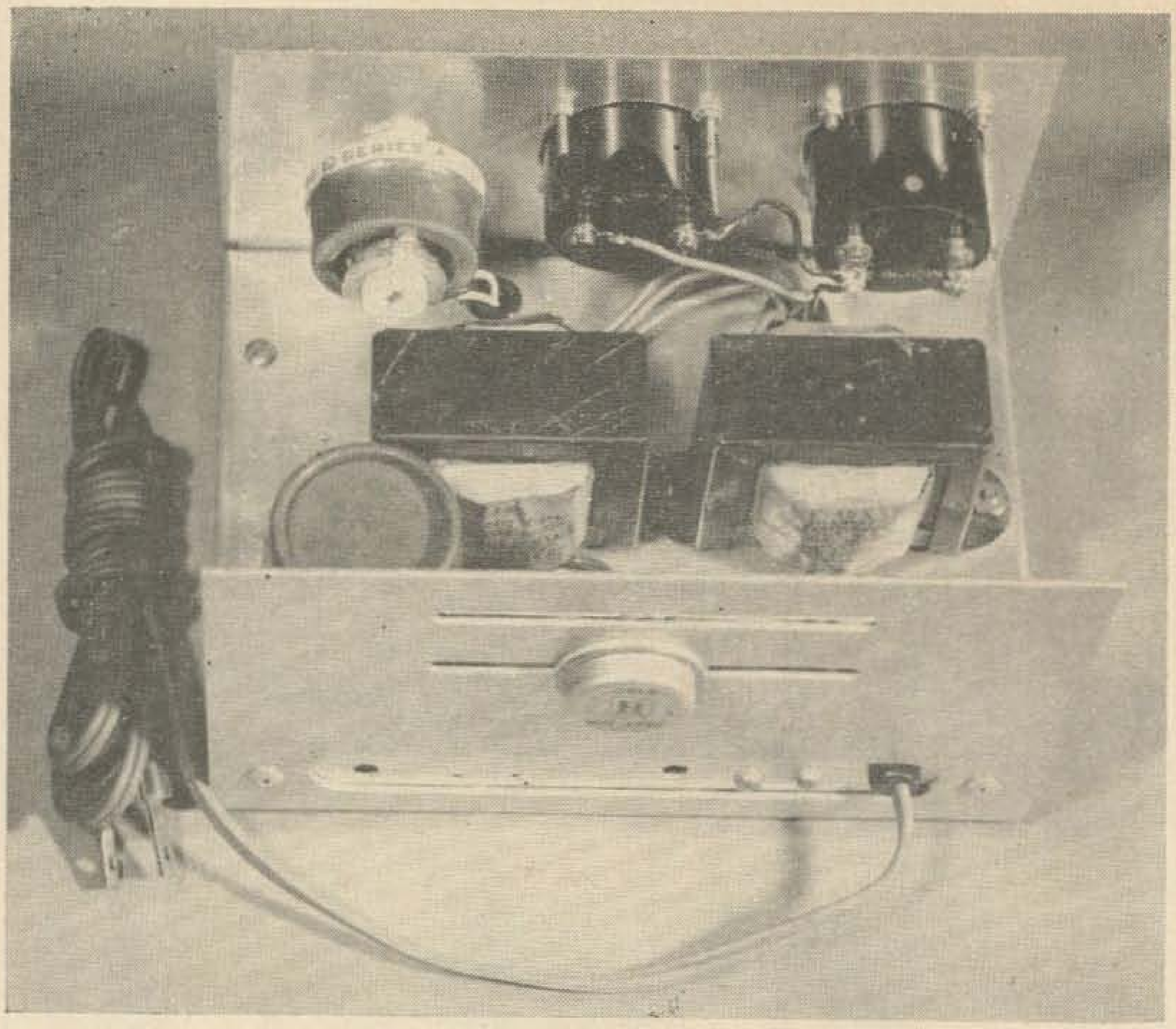
Then with complete knowledge of the voltage, current, internal impedance, and voltage stability requirements, we can proceed to build a simpler power-supply for our circuit.

One very satisfactory laboratory power-supply has been described in the *Handbook of Selected Semiconductor Circuits.*[1] Although not so identified, this circuit appears to be that of an early model of the Hewlett-Packard 721. The laboratory power-supply circuit, as modified to make it possible to build with readily obtainable parts, is shown in **Fig. 1.** As presented in the *Handbook of Selected Semiconductor Circuits,* it had several special components in it, and equivalents had to be found for these. The power transformer T_1 was replaced by two Triad F40X's, both operated in the full-wave bridge configuration. The series of three resistors and a switch, comprising the current-limiting selector, was replaced with a 50-Ω rheostat having a 510-Ω fixed resistor across it, which gives continuous current-limiting adjustment. Also, the meter switching and associated resistors were done away with, and separate meters used. CR5 and CR6 were originally of a type not readily available and can be replaced by Hoffman HB5 silicon diodes, or any similar general purpose silicon types. CR7, another obscure type, was replaced with either two 1N468's or one 1N755 (but nearly *any* zener of about 7 volts will do). The series transistor (Q1) is listed as a 2N375, but a number of other 80 volt power transistors have been used in its stead, including the 2N174 and 2N1542.

Most of the circuitry is laid out in a simple etched circuit board as shown in **Figs. 2** and 3, and so wiring is very fast. The supply is housed in a standard LMB-W1A cabinet. The series regulator (power) transistor is heat-sink mounted on the back plate (with a mica insulator, of course).

One of the units the author built was made entirely of MARS-supplied semi-conductors; a large percentage of the other small components were also MARS-supplied.

A silicon rectifier was added across the out-



Top-rear view of the lab supply with cover removed. A Triad F45X has been substituted for one of the F40X transformers.

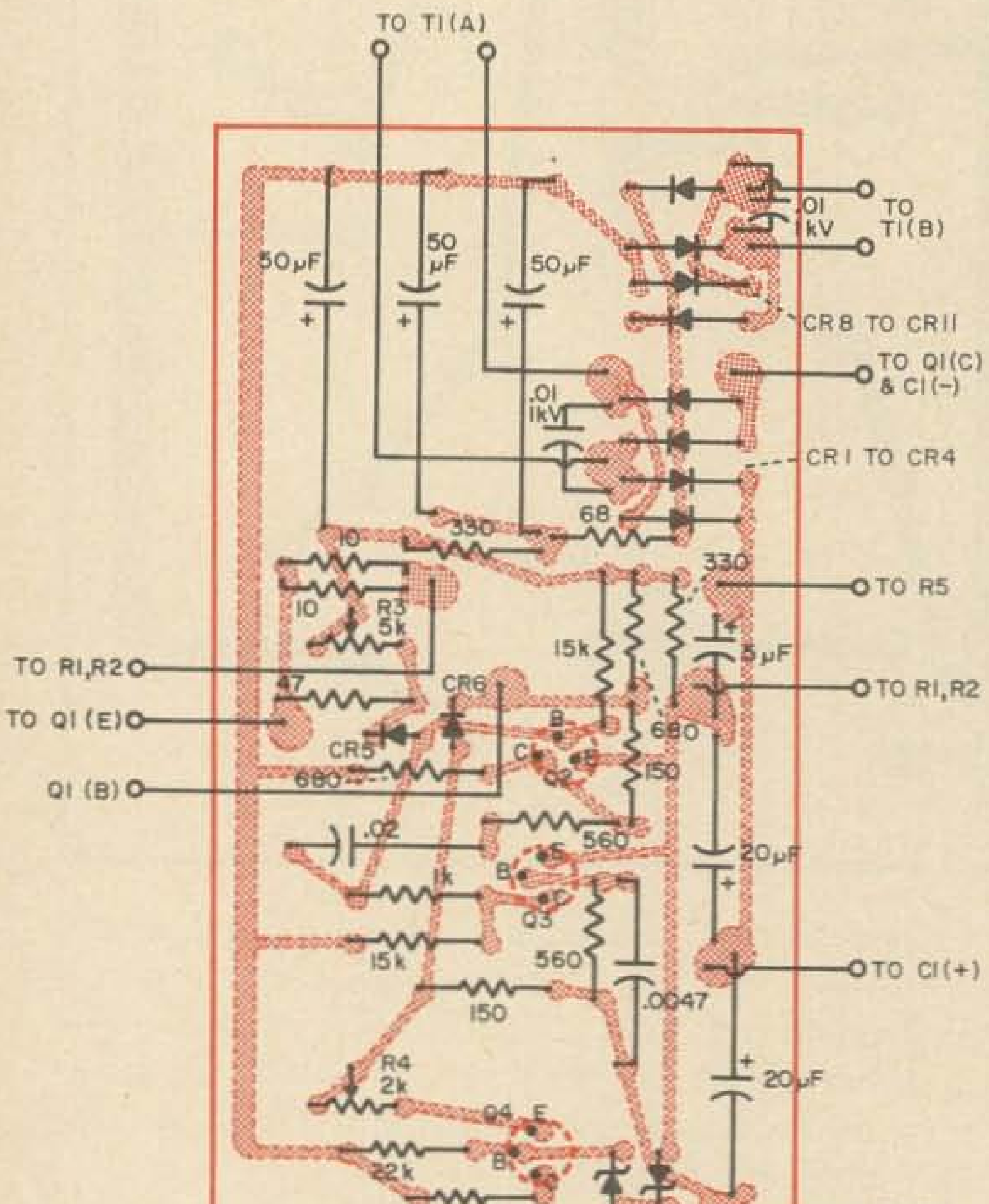


Fig. 3. Component side of the circuit board shown in Fig. 2.

put of the supply in addition to the 0.1 μF capacitor to help kill any transients (from the equipment being run by the supply) that are opposite to the supply polarity.

The meters used are the inexpensive Japanese-made miniature types available under many U.S. names including "Calrad", "Monarch", and "Lafayette". Their accuracy seems adequate for this application.

One will note that C1 and C2 are in parallel. The original purpose of this apparent duplication was to assure that the 20-μF electrolytic was a low impedance for low frequencies, and the 5-μF tantalytic was a low impedance for higher frequencies. However, if one has a 25-μF to 50-μF tantalytic, the single unit will do by itself.

When the power supply is finished, just plug it in, adjust the two screw-drive adjustments: "max. voltage adj." and "short circuit current adj." for the 0-30 V range and 25 to 225 mA range of the front-panel controls.

The author wishes to thank Hewlett-Packard for permission to use Fig. 1. I'd also like to thank Curt Roche, W6ZMW, for his helpful discussions in preparing this manuscript.

. . . W6GXN

[1]Sherrill, P. N., "Small Lab Supply with Current Limiting," in *A Handbook of Selected Semiconductor Circuits* (NObsr 73231); Available from U. S. Govt. Printing Office.

Nothing halfway about the

DRAKE L-4 LINEAR AMPLIFIER

built for continuous duty at full capacity

- 2000 watts PEP SSB—1000 watts DC input power on CW, AM and RTTY. Massive plate transformer, large heavy duty plate tank components and voluminous cooling system insure continuous operation at these ratings.
- High efficiency Class B Grounded Grid circuit uses two 3-400Z or 8163 zero bias triodes. These two tubes have a total plate dissipation rating of 800 watts and their rugged construction withstands abuse.
- A broadband tuned input circuit is employed on each band for minimum distortion, higher efficiency and a 50 ohm input impedance.
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Plate Input: 2000 watts PEP-SSB, 1000 watts DC on CW, AM, RTTY and Tune.

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Input Impedance: 50 ohms.

Output Impedance: Adjustable Pi-Network matches 50 ohm line with SWR not to exceed 2:1.

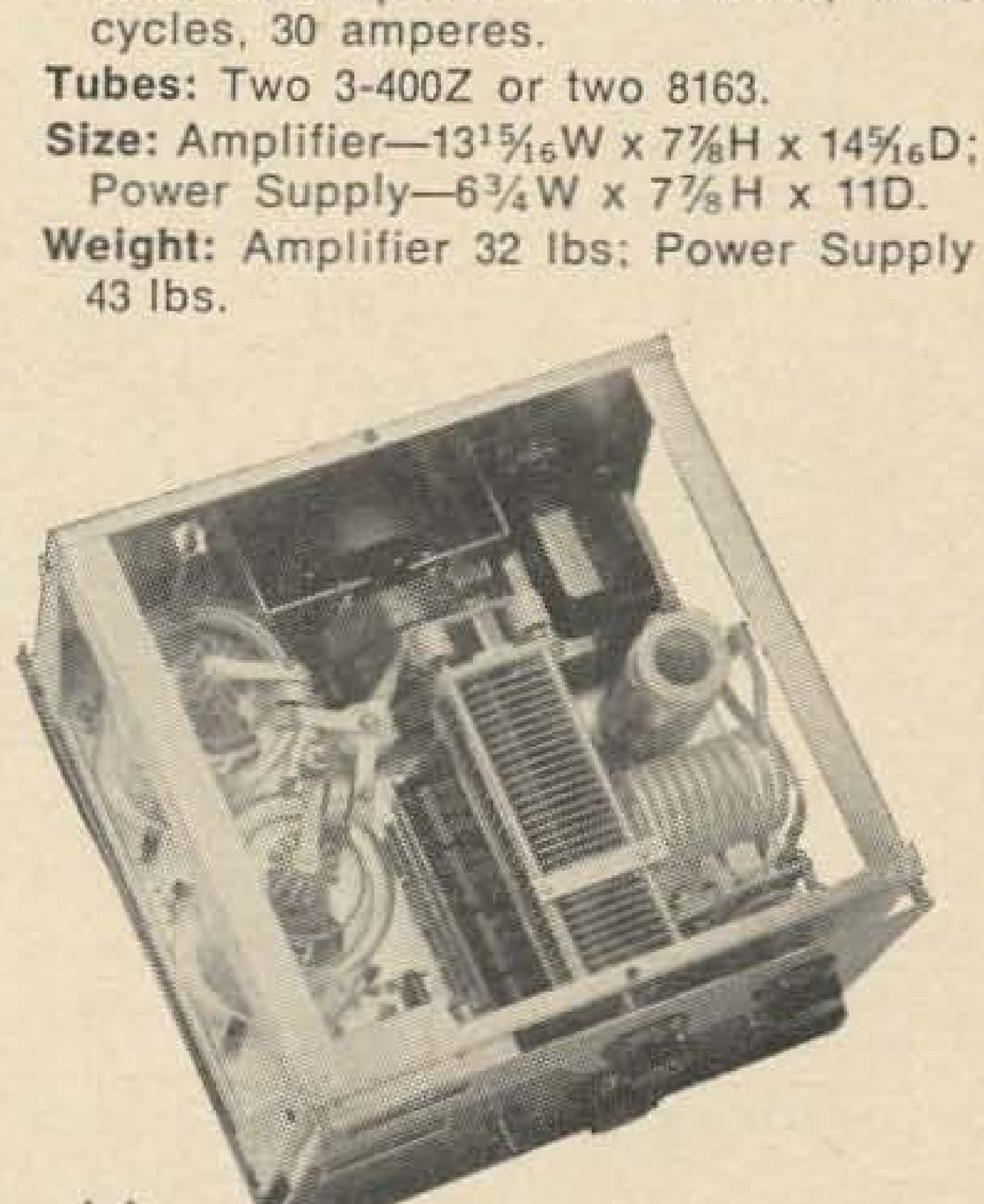
Power Requirements: 230 volts, 50-60 cycles, 15 amperes or 115 volts, 50-60 cycles, 30 amperes.

Tubes: Two 3-400Z or two 8163.

Size: Amplifier—$13\frac{15}{16}$W x $7\frac{7}{8}$H x $14\frac{5}{16}$D; Power Supply—$6\frac{3}{4}$W x $7\frac{7}{8}$H x 11D.

Weight: Amplifier 32 lbs; Power Supply 43 lbs.

◀ The solid state Power Supply provides excellent dynamic and static voltage regulation. The Power Supply is separate to keep the weight off the operating desk and to make a more flexible installation.



L-4 Linear Amplifier with cover removed. ▶

For more information, see your distributor, or write:

R. L. DRAKE COMPANY, Miamisburg, Ohio 45342

Merritt Franken WA6JNI
3714 Mount View Ave.
Studio City, Calif.

QRZed the YL

or, Don't Ever Let Your Wife Become a Ham

Lotsa times, in the course of a QSO, I mention to the op I'm working that my wife is also a ham. Her name, I tell him, is Charlotte and her call is WA6JNO, ex-WA2AVB.

The reaction is invariably the same. The other station will say something like, "Boy are you lucky. Sharing the hobby with the XYL. That sure must be great. Bet she never gives you a hard time about getting a new piece of gear or putting up an antenna farm."

Or words to that effect.

Well, fellas, I got words for you. Don't let your wife become a ham. Belt her a few first; threaten to get a divorce; tell her *you'll* go home to mother. Tell her anything. Give her Arpege, if you have to, but buddy, don't let her become a ham.

Drawing by K3SUK.

You will admit a grocery is a kooky place to buy ham gear . . .

Think I'm kidding? Let me reconstruct and you'll see I never knew when I had a good thing going, when my little woman didn't know a QSY from a Mandarin's queue.

Ten-twelve years ago the ham bug bit me. Actually, it was the second infection. The first time was in 1941 and while I was working toward getting a ticket the War came along and that was that. The second time, though, there was this new FCC deal called a Technician's ticket. Hooray, the five wpm cw was easy and I started studying dits, dahs and theory.

Meanwhile, Danny, a friend of mine in New York City where we were then living, who runs a radio and TV repair shop and who knew of my interest in the hobby, told me of a chap down the street who had some ham gear for sale. This man was a grocer and my friend said he had a complete station for sale. I go over and look at the goodies and wind up buying his NC125. He also had a Harvey Wells TBS50D, but I held off on that.

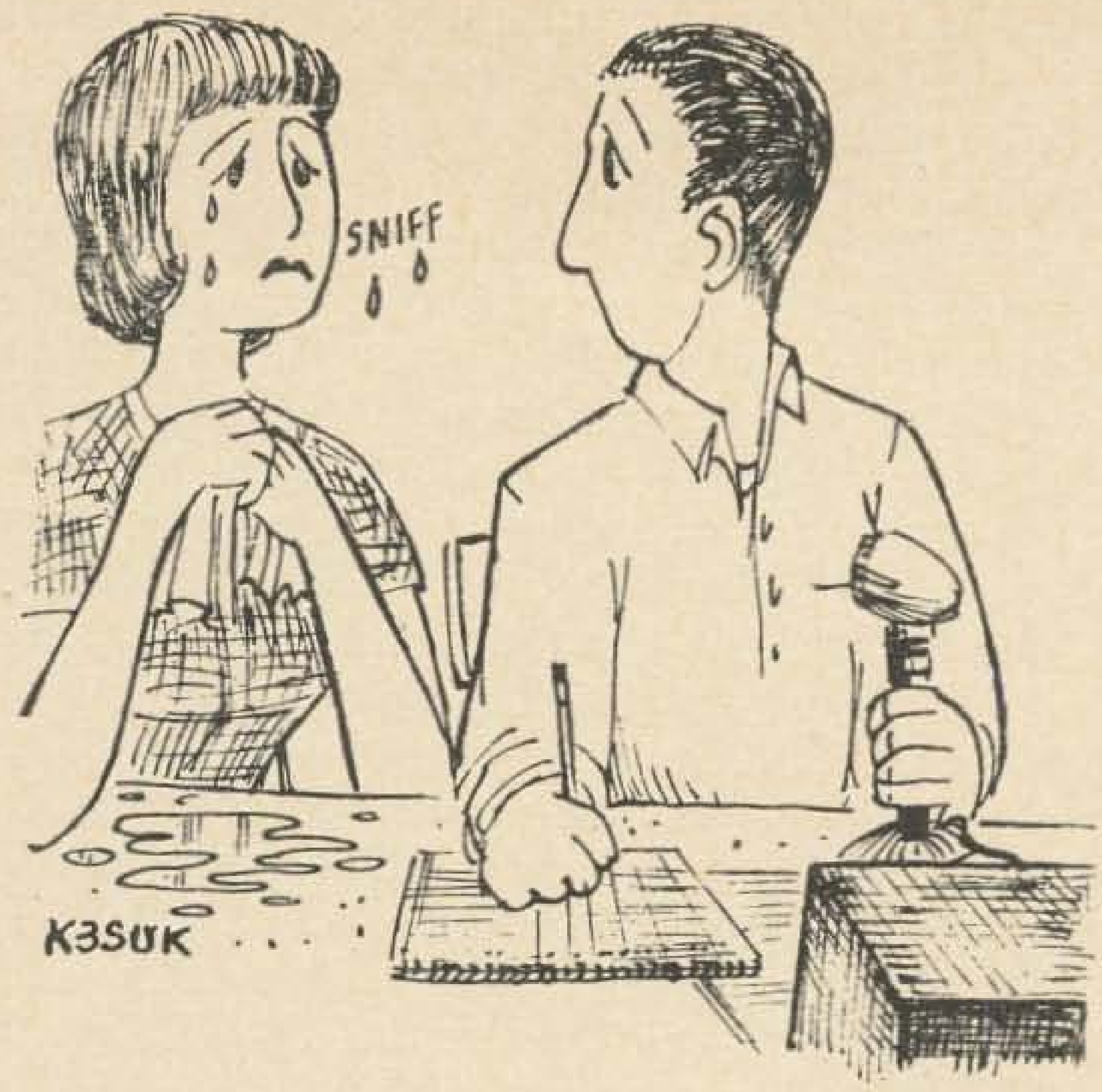
So I trudge on home, set up the NC125, hang a wire out the window and start listening. Man, I sat there enthralled; I had the world at my finger tips. Without doubt this was the greatest thing since sliced bread. 'Bout an hour or so later the little woman comes home and, of course, she hears this startling short wave stuff.

"What's that?" she asked, and I told her.

"How much was it?" was the next question.

I looked her smack dab in the eyes and said, oh so casually, "It was $25."

And she believed me. She didn't question me once. She believed me; she didn't see my fingers crossed behind my back and still less



"Nothing," she said, "It's so wonderful."

could she see the large twinges of conscience that kept stabbing my innards.

So, I kept studying and kept listening and one day I paid another visit to the grocer. (You will admit a grocery is a kooky place to buy ham gear). We talked about the Harvey Wells and the special power supply he'd built with big fat oil-filled condensers and a foot switch to go from high to low power and that if I got a Tech ticket it would work on six meters and I bought it. Had no ticket yet but I bought it and put it in the trunk of the car and covered it with a blanket, and took the power supply over to Danny's and had him hold it for me.

Then I got my ticket. I was K2KEH.

Happened the next night was my helpmeet's bridge night so while she was out, I brought up the Harvey Wells and the monster power supply and a six meter converter I'd just happened to acquire and put them all together. I still had no six meter beam and no mike but that stuff looked real pretty and I was sitting there admiring it when Charlotte came home.

"What's that?" she asked.

"A transmitter," I said.

"Does it work?"

"Well, I hope so. I won't know until I get an antenna tomorrow."

"How much was the transmitter?" she asked.

And I looked her smack dab in the eyes and answered, "It was $25."

"Ok," she said, "I just don't want you to spend a lot of money on that silly stuff. How much will your antenna cost?"

"Not much," I said. "Few bucks. Depends on what kind I get." I didn't say anything about co-ax cable or a co-ax relay or a microphone and I double sure as hell didn't say what six meters would probably do to TV reception in a Manhattan apartment house.

Two days later my station was lashed together and of course the antenna, rotator, cable, low pass filter, mike and all cost only $25. I told Charlotte that, scared as I was of talking into a mike, I was gonna try. She came into the shack (once a nice, pleasant den type room but now a nice pleasant mess), sat down in a chair behind me and I called CQ.

And a station came back to me and I'll remember his call and name, K2YCB, Carl, long as I live. With my voice shaking with mike fright I talked and had my first QSO. Then I signed, and full of pride, turned around to look at my wife.

She was crying. She was sobbing. Tears streamed down her face.

"What's the matter?" I asked.

"Nothing," she said. "It's so wonderful. My husband sits here and talks into that thing and a man from New Jersey comes back and it's wonderful. It's thrilling. Do more."

And stupid me, I never saw the danger signs.

Few days later I came home and I find Charlotte listening to my receiver. NC125, did you say? No sir. I had traded that. I didn't like the single conversion and the outboard converter. The receiver was an HQ110.

And buster, that HQ110 also cost $25. Brand new, it only cost $25.

But what I started to say was that first I found Charlotte listening and then I found her studying the license manual and other books I had bought and then I found her using the code oscillator and then I was informed, one night, that she'd enrolled in a ham course at the Delehanty Institute. Three nights a week.

Now if you're not from New York you probably don't know about Delehanty. It's an old, old institution. It's in one of New York City's most unprepossessing semi-slum areas, near the Bowery. The dark, dingy section gives you the feeling that any man walking along the street at night is a cutpurse. Delehanty's is best known for training firemen and police and teaching them judo and all like that. It just didn't strike me as a place I liked for my wife to be at come nightfall or any other time.

And my wife is a student there. At night. But she goes, and I drive down to pick her up, and whammo, she has a general ticket and I'm still a Tech. Not only is she a general but she is now a reader of QST and CQ and so she knows all about this phony "It was only $25" stuff. Need I describe what happened when that bomb burst?

Well, there's not too much more to tell, but what there is is sad indeed, men. For weeks and weeks and weeks I come home. No dinner. Why no dinner? Because the little woman has been standing over a hot rig instead of a hot stove. On top of that, my pride is lower than a snail's hangnail; my wife's a GENERAL and I'm a Tech. In time I rectified that and got my general, but this leads to another interesting development. I hear a nice hunk of DX and join the pile-up and call for the DX station. Does he come back? 'Course not. So the XYL calls him—and he comes right back—they always do when they hear a YL's voice. They always say, "QRZed the YL. QRZed the YL." Score another hunk of DX for the YL—my XYL, to be specific.

Eventually, things settle down. We work it out so that Charl operates days—just so long as I get a nice hot dinner preceded by a nice cold 807 and none of this TV dinner stuff. I operate evenings and week-ends. As an extra added precaution I work CW and wear cans. Since she can't hear the CW monitor because I'm wearing the cans we don't get into this routine where, if DX does come along, she'll come in and inquire sweetly, "Want me to give him a call, darling?"

And the Drake TR4 and the Heath compact linear and the TO Keyer and the Waters dummy load and the tower and the beam and the rotor and the 40 and 75 dipole only cost $25. You don't believe me? Ask my wife.

. . . WA6JNI

Howard Pyle W7OE
3434-74th Avenue, S.E.
Mercer Island, Wash.

Climbing the Novice Ladder

Part I: The Ham Bug Bites

"Larry, I'm sold. I've been to three meetings of your club now and I've been reading up a bit on ham radio. There's a heck of a lot that's way over my head now but I think I can catch on; how do I get started?" Joe Blake was serious as he put the question to his recently found friendly ham on their way home from club.

"Well Joe, *wanting* to be a ham is half the battle. You like the club, you've met some nice guys and a few gals, or 'YL's' as the hams call 'em, meaning young ladies. Next meeting you'd better bring your dollar entrance fee and get signed up as an associate member. When you get your Novice license you'll be entitled to full membership; it'll cost you another buck then which will cover your club dues for a year and you'll get the club paper every month. After that, a dollar a year keeps you an active member." Larry Saunders himself was a relatively recent newcomer to the ham fraternity; his General class license was barely nine months old but he had won his way up through the Novice ranks and was now accepted as a full-fledged member of the 'charmed circle.' An electrical engineering sophomore at State College, his interest in amateur radio had stemmed from occasional visits to the ham stations of a number of his fraternity brothers and he had, like Joe, followed this by attendance at several meetings of the local ham club. Remembering the friendly college ham who had guided him through the early pit-falls, Larry too decided to be a 'nice guy' and take Joe under his wing. After all the kid was a likable chap . . . a senior in high school who was top man in his science class and now showed an increasingly eager interest in becoming a ham.

Follow Joe Blake monthly in these pages as he progresses from a raw apprenticeship in ham radio, through the various stages leading to successful completion of his Novice class license examination.

They stopped at the malt shop for a bedtime snack and, in a quiet corner booth, Larry gave Joe a bit of background on his own early days as a radio amateur beginner. "The first thing you'll have to do Joe," Larry concluded "is what most guys consider the hardest . . . learn the radiotelegraph code. It really isn't hard at all once you get your teeth in it. You'll find that in only a few weeks you'll be saying words in radio code that it took you two or three years to learn to say as a baby!"

"But Larry," Joe replied, "how come I have to learn the code? Most of the hams I've visited have just talked normally into a microphone; that's what I'd like to do too! I don't know whether I want to learn to telegraph or not."

"Let's face it Joe," Larry returned, "whether it appeals to you at this time or not, learning the radio code is a must if you're going to be a licensed ham and expect to talk to others on the air. And to do that, Federal law says that you must have a license and that means answering a few simple questions in a written examination and passing a radio telegraph code test at five words a minute. Don't let it worry you though . . . at that speed you can almost take a nap between letters." Thus Joe was introduced to his first hurdle; while Larry made it seem easy, Joe wondered with a bit of misgiving, just how easy he was going to find it. Thus pondering, Joe was suddenly brought back to the fascination of hamdom by an exciting sugestion from Larry.

"Say Joe, tell you what. One of the best ways to get a start in ham radio is to know a real 'old timer,' visit him often and listen to his suggestions and advice. We're lucky in this town for we have an old guy here who's been a ham for more than fifty years . . . he must be close to seventy by now . . . and he really knows the ropes. While he's hammed all that time just for pleasure, he's made his living in the radio game for that long also! He's been a commercial radio operator both at sea and ashore, a Navy operator, held a lot of government radio jobs; he's been just about everywhere and done about everything in radio. Nice part is that he's worked with a lot of young fellows all his life and actually likes to give 'em a hand if they're serious about wanting to be hams. And boy . . . the stories he can tell and they're all true too! Here's what we'll do; tomorrow's Saturday and if you've got nothing particular to do what say we run over and see old 'FN' in the morning?"

Joe *really* sparked on that one; "Gee Larry, that would be great . . . I'd sure like to."

"OK lad, I'll pick you up about ten thirty tomorrow then" and with that they paid their tab at the malt shop and putted homeward in Larry's old jalopy.

At a little after ten the following morning the squeal of worn brake bands on Larry's old Chevy announced his arrival. Joe, who'd been eagerly awaiting the planned excursion, dashed from the house, jumped in the heap of bolts and nuts and they were off. During the seven mile trip Joe sprang a question which had been puzzling him since last night. "Larry, you call this old guy 'FN' . . . I don't get it . . . that's not his *name* surely?"

"Ha," Larry came back, "I was wondering when you'd get around to that! No, his name is Dwight Mansfield . . . 'FN' is what he prefers to be called though and I'll tell you why. Seems that almost since the Morse telegraph was invented, telegraph operators were required to sign a 'receipt' so to speak, for every telegram they received over the wires. You can't sign your name with a telegraph key like you would with a pen or pencil . . . you had to send every letter of your name in the telegraph code. This got to be pretty much of a time-consuming chore and it wasn't long before operators began to use their initials which shortened it a lot. A bit of confusion sometimes resulted though where two or more operators working the same wires happened to have the same initials. Where this occurred, one or the other would simply choose an arbitrary letter or two which would serve to distinguish him as the one receiving a message. This letter group was known as their 'sine,' the spelling being simply a variation of the word 'sign.' It took fewer dots and dashes to say 'sine' than to use the correct spelling when you asked the operator at the other end for a receipt. The use of these sines soon became standard telegraph practice and when 'wireless' telegraphy, or 'radio' as we now call it came along, many Morse telegraphers were recruited for this new field; invariably they took their sines along with them. So Dwight . . . oh yes, among his many accomplishments he too had been a pioneer Morse telegrapher . . . followed suit and carried 'FN' along to the new communication field that he had chosen . . . get the picture now? Most hams don't have or use sines now."

"Yes, but Larry, how come Dwight took 'FN' as his sine . . . they're not his initials?"

"Gosh Joe, you could fool me . . . never thought about it; let's ask him." And so saying Larry skillfully wrestled the wheel of 'old Nellie' and wound up in the driveway of a neat little home set in deep timber.

"Boy," Joe exclaimed as he clambered over the jammed door, "just *look* at all the antennas!"

"Yeah, old FN has quite an 'antenna farm' Joe; he's a nut on separate antennas for every frequency both on his transmitters and receivers and he's got 'em all. He's lucky . . . we don't all have such a lot of space to hang our skywires in."

Ignoring the conventional entrance door, Larry led his protege around to the back of the house and knocked on a basement door on which a set of amateur radio call letters were prominently displayed. "FN is down here in his shack or shop most of the time . . . this is where we'll probably find him" Larry explained.

Sure enough, his knock brought immediate response; "Yeah . . . come on in" and the door swung open.

"Hi, FN" was Larry's greeting to which the old gentleman, removing a battered corn-cob pipe from his lips responded with, "Well, if it isn't LS himself; where you been these past few weeks and, who's your friend?"

"Up to my ears cramming for quarterly

exams, FN; I've brought a new convert to ham radio . . . Joe Blake . . . how's to show him your shack?" "Howdy Joe . . . glad to meet ya; sure, come on in if you can wade through the mess."

Walking to the back of the open basement behind FN, Joe paused in the shop area and said, "Mess? . . . what mess? How can you keep a shop so neat, FN?"

Evidently pleased, their host chuckled and replied, "Wal, let's just say you caught me at a good time; I'm just doing a bit of simple modification to a piece of gear and it don't create much rubbish; you should see this place when I'm working on a really major project. I don't find it hard though to keep 'er in reasonably decent order if I clean up every evening or, if I'm too tired, first thing in the morning . . . it don't pile up that way."

Joe made a mental note of this against the time when he too, would set up shop, and the boys followed FN to a partitioned off corner. Opening a glass-panelled door, their host waved them in saying, "There she be, if you can squeeze in." 'Squeeze' was right; the entire shack was only six feet square and simply *loaded* with gimcracks and gadgets which were completely strange and mystifying to Joe; Larry had made many previous visits to this 'dream shack.' Briefly explaining the general layout FN said, "Four transmitters, four receivers, all on separate antennas and a lot of this and that to control 'em with."

Joe pretty well understood that all of this was electronic gear having to do with advanced amateur radio operation but one item he could not quite reconcile. Above the typewriter shelf against one wall was a conventional Morse telegraph sounder mounted in a wedge-shaped wooden enclosure which in turn was mounted on a swinging metal arm. As it seemed a bit incongruous in a radio shack, Joe was prompted to ask, "What's the telegraph hickey doing here? Looks like those I've seen in railroad ticket offices."

"It is son and it's for the same thing; the Morse telegraph code. You see, I used to be a telegraph operator many years back and there are quite a few of us old Morse men who are also ham operators. When we get together on the air, we like to work the Morse code to just sorta keep our hands in. Morse doesn't sound like it should, when you get it in whistles on a speaker or in a pair of phones so I've rigged me up a little 'converter' deal so that the output of any of my receivers will work the telegraph sounder; much better!"

This brought a further question from Joe; "In the Morse code any different from the radio code . . . I thought they were the same?"

"No lad, there's quite a bit of difference; where the Continental or radio code is all dots and dashes, the Morse code has a number of letters with spaces in them as well. The figures too are all different except the '4,' but you'd better forget about the Morse code until you've licked the radio code first."

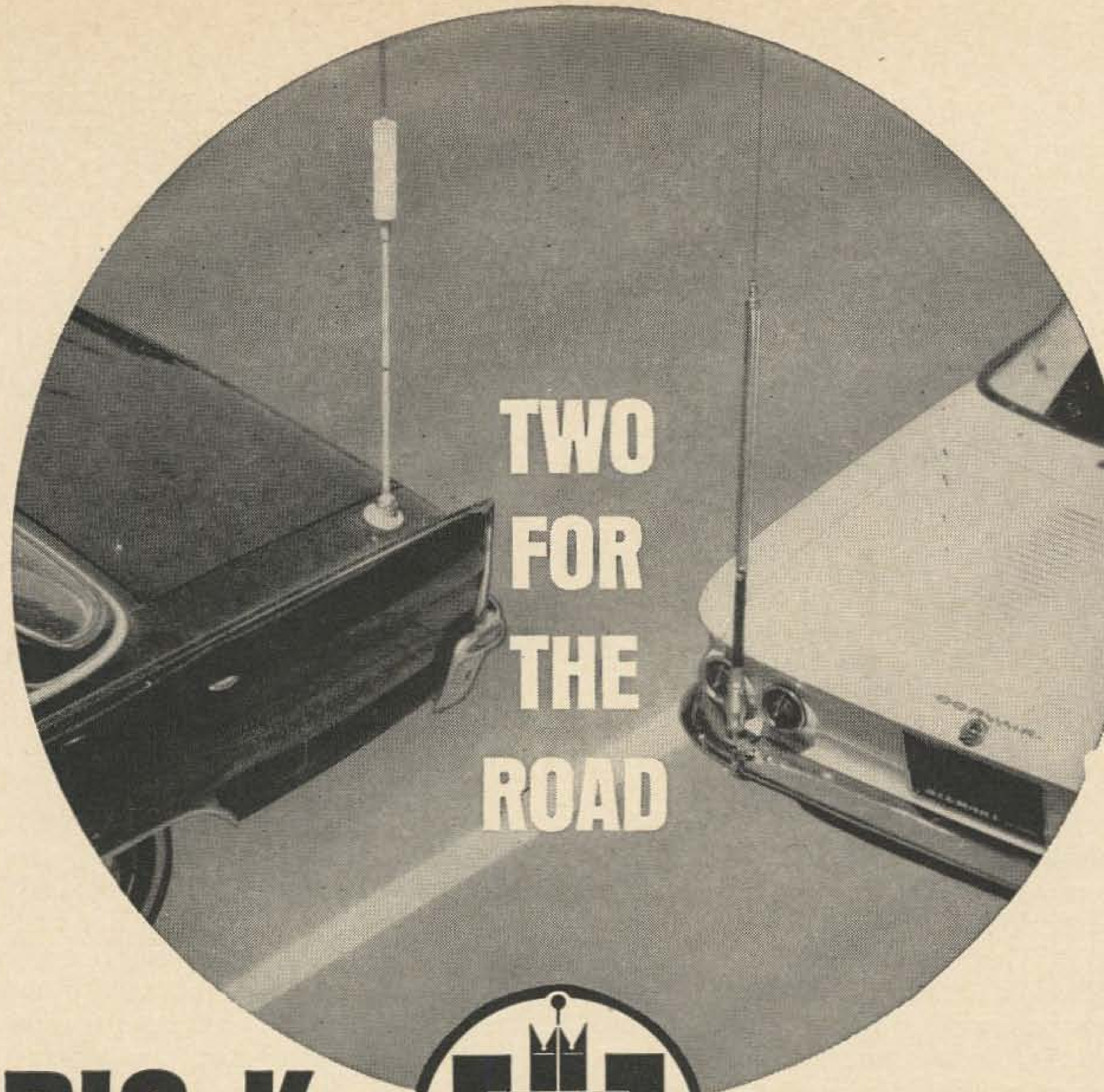
This was the opening Larry had been waiting for. "Speaking of codes FN, I've told Joe that's his first chore. So far, he hasn't started his code practice and he can use a few tips from an ol' timer like you. They sure helped me when I first started."

"Well boys," the pioneer ham came back, "I've taught a l-o-t of code to beginning amateurs, Navy and commercial operators in my time and in all these years nothing has been invented to teach the code overnight, in a day or in a week. There just isn't any substitute for practice, practice and *more* practice. Of course there are lots of helpful little hints and tips which will make such learning *easier* and if I can pass on some of them to you Joe, I'll be glad to help you get started. I've got a dental appointment coming up right after lunch today though and I'm not going to feel too chipper this afternoon but tell you what . . . why don't you come back about nine o'clock next Saturday, Joe and you can use my bench and tools and build yourself a little code practice oscillator; you'll need it for your practice. I've got all the parts in my junk-box and it's a simple little building job; give you a change to get your feet wet in 'home-brew' ham construction too."

Oh boy! Did Joe ever jump at *this* chance! Thanking FN profusely and assuring him that his help would really be appreciated, both boys said their 'farewells' . . . Joe even timidly chanced a "73" . . . hopped into ol' Nell and hit the road for home. "Brother, you've struck it rich" said Larry on the way; "FN doesn't take everybody under his wing for in spite of his retirement he seems to be busier than he ever was when he was working and he doesn't waste time with those who show little interest. You went over all right, Joe, and you'll really get a ham education now." Joe beamed all over, leaned back and day-dreamed. Suddenly he said, "Say . . . we forgot to ask him why he picked FN for a sine!"

"By Golly Joe, that's right" Larry replied, "guess you'll have to worm it out of him next week."

Next month: Joe does a bit of home-brewing and gets started on learning the code with helpful tips from FN and a 'surprise' fellow student! . . . W7OE



BIG-K

1000 watt (p.e.p.) mobile antenna at a mini-power price! Quick-connect high power inductors for 160*-80-40-20-15-10 meters have exceptional figure of merit—"Q"—that measures approximately 230 on 80, rises to 350 on 15 meters. **Webster invites comparison of this sky power antenna** particularly its high efficiency space-wound coils, **suspended**—not molded—inside a protective all-white tenite housing. **Compare** also the precision machined hinged column assembly that releases coil/whip for right-angle laydown—forward or to the rear. Lockup into operating position is equally fast. **Install BIG-K**—give your mobile signal a real sendoff. Two column sizes for bumper and deck mounting with overall lengths, respectively, of 93" and 77". And use the money you save to buy a fine Webster mount.

*160-meter coil 300W p.e.p.

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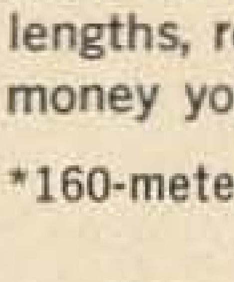
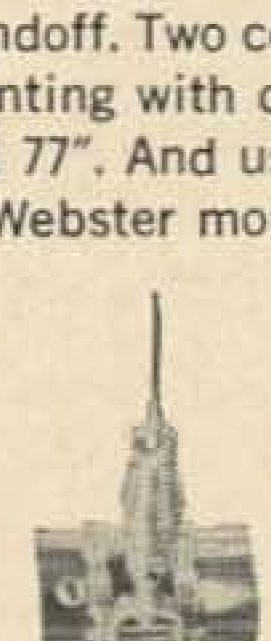
Want a fully streamlined car antenna that will handle 500W p.e.p.? **Buy Band-spanner** as thousands have over the past sixteen years. One clean-cut antenna—nowhere over $1\frac{1}{8}$" in diameter—that delivers big sky power on 80-40-20-15-10 meters plus MARS. Band-change in seconds too just by raising or lowering the top whip (which contacts a section of any of the internally exposed inductor turns) and exact resonance on any in-band frequency. **Band-spanner**—truly streamlined—de-emphasizes the appearance of a fair size antenna on a new car. It has a two-tone fiberglass column and an attractive, epoxy-sealed loading section that blends both with car and surroundings. Two column lengths: Model ABB, 117" overall extended, 63" telescoped and Model ABD, 93" overall extended, and 60" telescoped.



Model THMD, de luxe 3-hole mobile mount.



Model BCM, bumper chain mount. (spring not supplied)

Model SHM, single hole de luxe mobile mount.

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Bob Baird W7CSD
Oregon Technical Institute
Klamath Falls, Oregon

How to Re-Fill the Box

Here's a straight-forward linear using 6JB6's.

The December 1963 73 contained a little article I wrote entitled "How to Fill a Box." For some reason or other we got more fan mail on this little jewel than any article I have published yet. This little amplifier worked fine as long as I was on AM or NBFM but I finally broke down and went SSB. As noted in the original article there was no space for a neutralizing capacitor. On 20 meters the amplifier seemed perfectly stable when excited but in the no excitation condition of SSB, when you aren't talking, it showed some erratic tendencies. As a result the "Box" hadn't been used for a couple of years.

Recently I decided to refill the box. What with several commercial outfits coming out with linears using the 6JB6 or 12JB6, I decided to give them a try. The simplicity of the multi-grid grounded grid amplifier has been long known. Such amplifiers using 807's or 1625's appeared in handbooks ten years ago. The -JB6 series however is much more com-

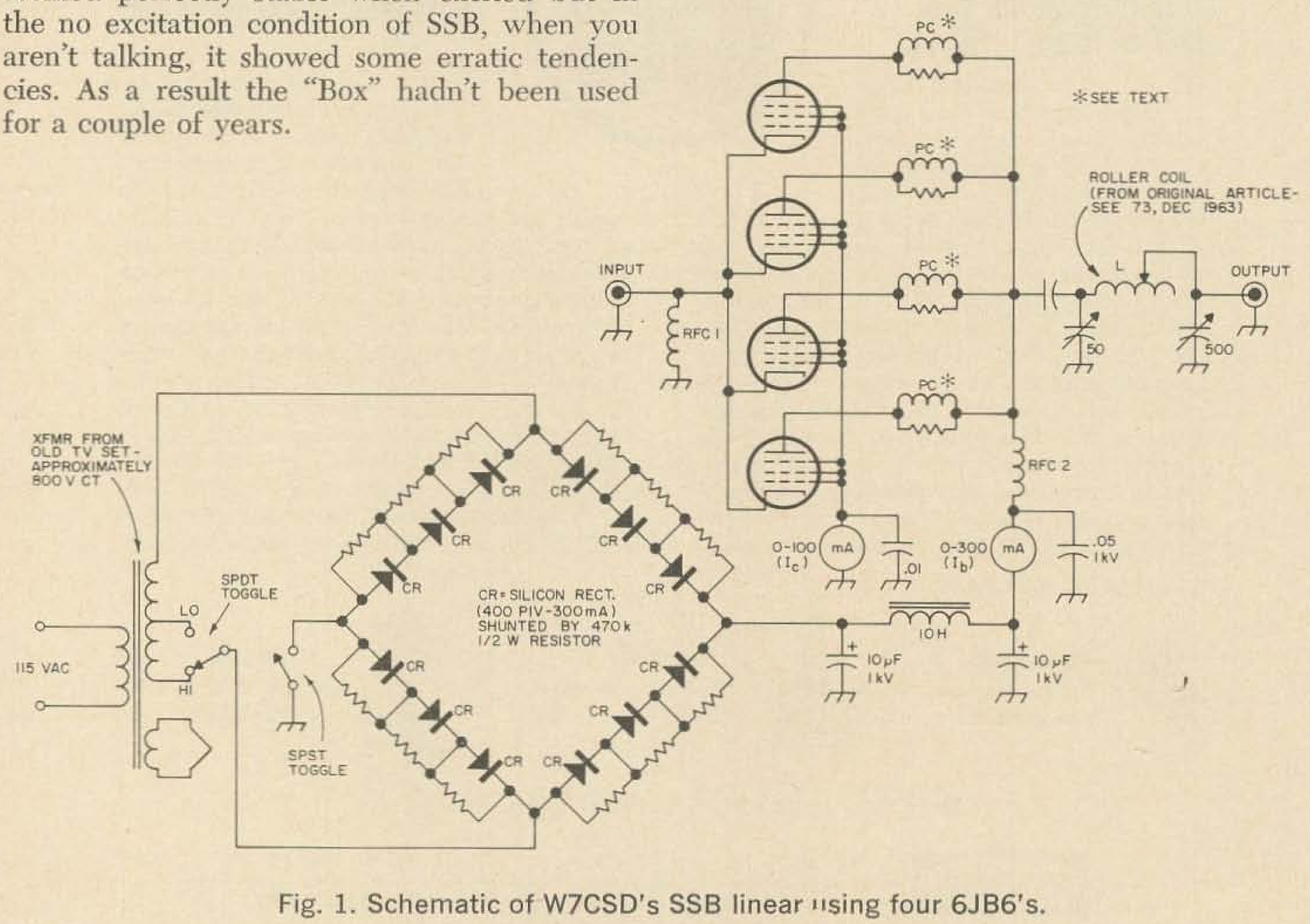
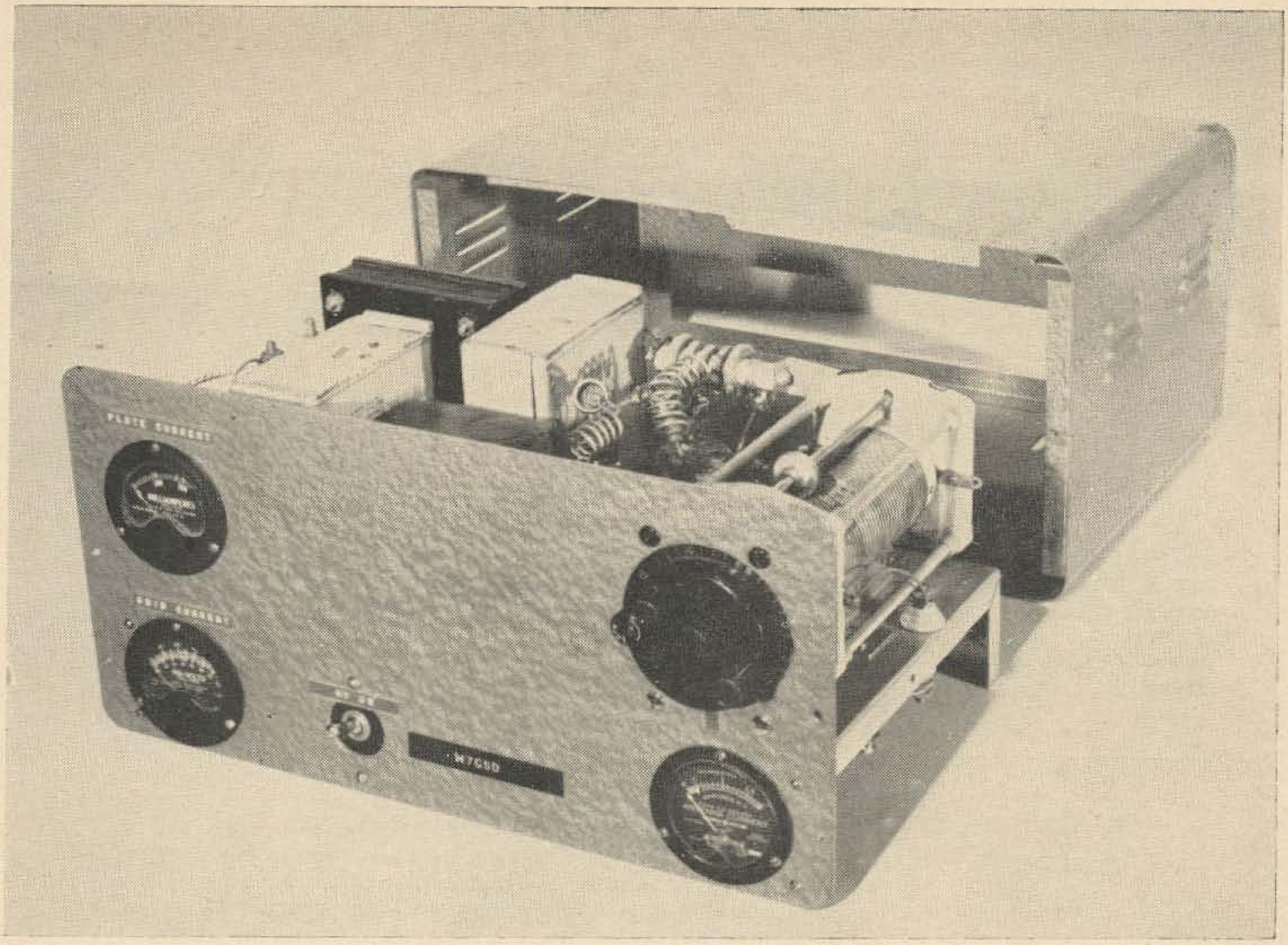


Fig. 1. Schematic of W7CSD's SSB linear using four 6JB6's.



The 6JB6 linear built in the case first used for an 813 amplifier described by W7CSD in the December 1963 73.

pact and very fortunately fits in the space vacated by the 813. The final result was fewer components and is more stable than the 813 stage. The power out is about the same.

Modifications

There were two major modifications. First the voltage doubler type power supply was changed to a full wave bridge. This required two additional silicon 400 PIV rectifiers with accompanying shunt resistors and a rewiring of the stack. The high-low voltage switch was left in for tune-up procedures. And the filter capacitors were rearranged. Second, of course, the 813 was removed along with its grid circuit. Four novar sockets were mounted for the 6JB6's and all the grids tied together and grounded (through the grid current meter and a by-pass capacitor). Filament voltage was available from the TV power transformer. We put a junk-box RFC in the cathode circuit and tied all of the plates together and fed back to the original pi network. Unfortunately the amplifier took off on a VHF parasitic frequency and we had to install parasitic suppressors in all plate leads. These were made out of 5 turn ½" diameter coils shunted with 100 ohm 1 watt resistors. After this was done very stable and excellent operation was obtained on all bands from 15 to 80 meters. We didn't try 10 as it would be about one turn on the tank coil.

With the TV power transformer the power in is limited to about 200 watts dc. The plate current goes up to between 225 and 250 mA and at this current the voltage is between 850 and 900 volts. One commercial linear using six 6JB6's with 1200 volts claims a gallon PEP —I assume this means 500 watts dc. If one were to go for higher voltage, additional negative bias would be needed on the grids. Resting current of the amplifier as is runs about 90 mA. Possibly the input RFC could be replaced with a cathode resistor of appropriate size. Anyhow once again we wind up with a pretty powerful box full. The measurements of the box (same as before) are 7½" x 8½" x 15". Weight is 25 pounds. Any SSB exciter with a 25 PEP output will drive the linear very nicely.

. . . W7CSD

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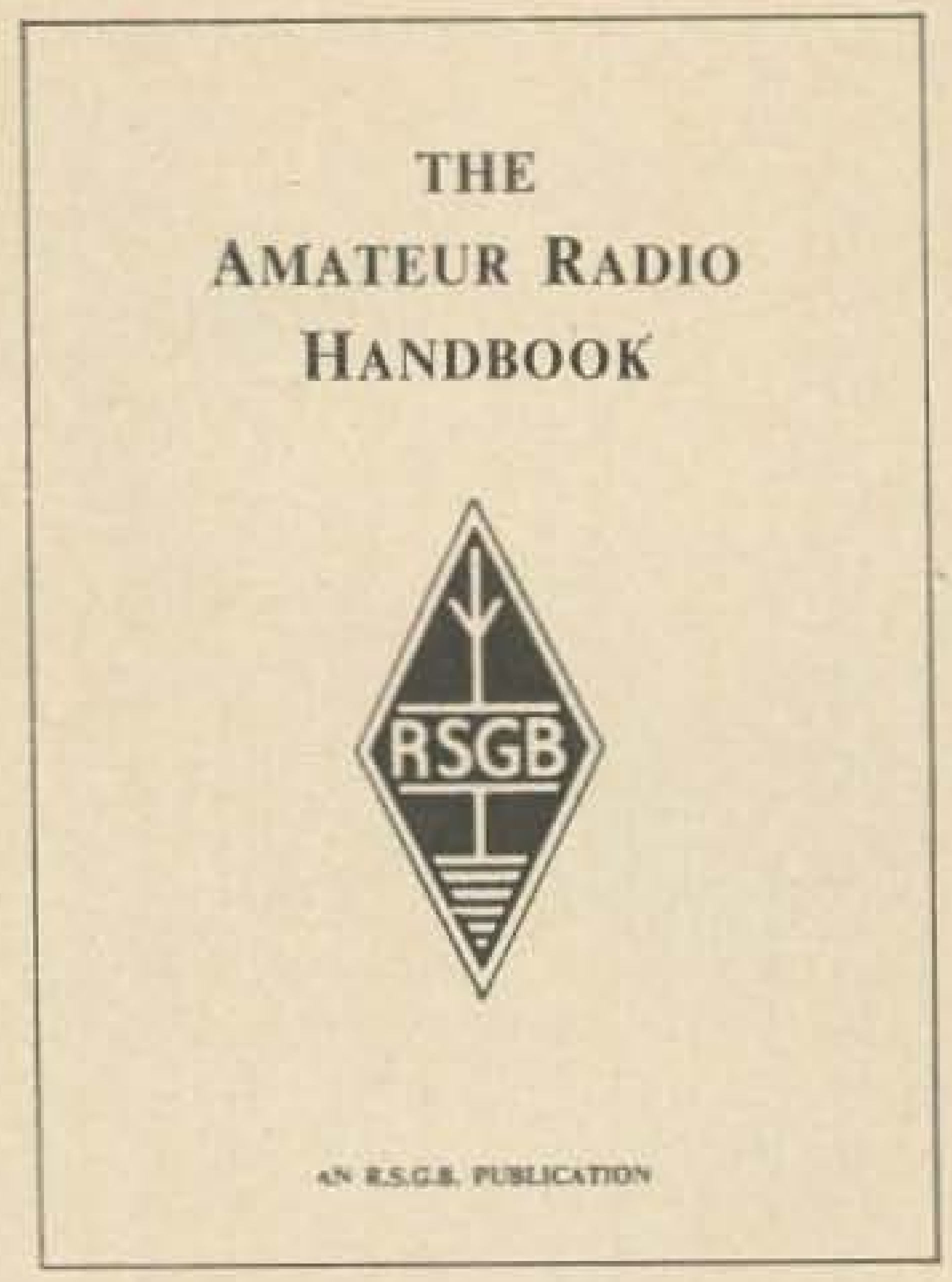
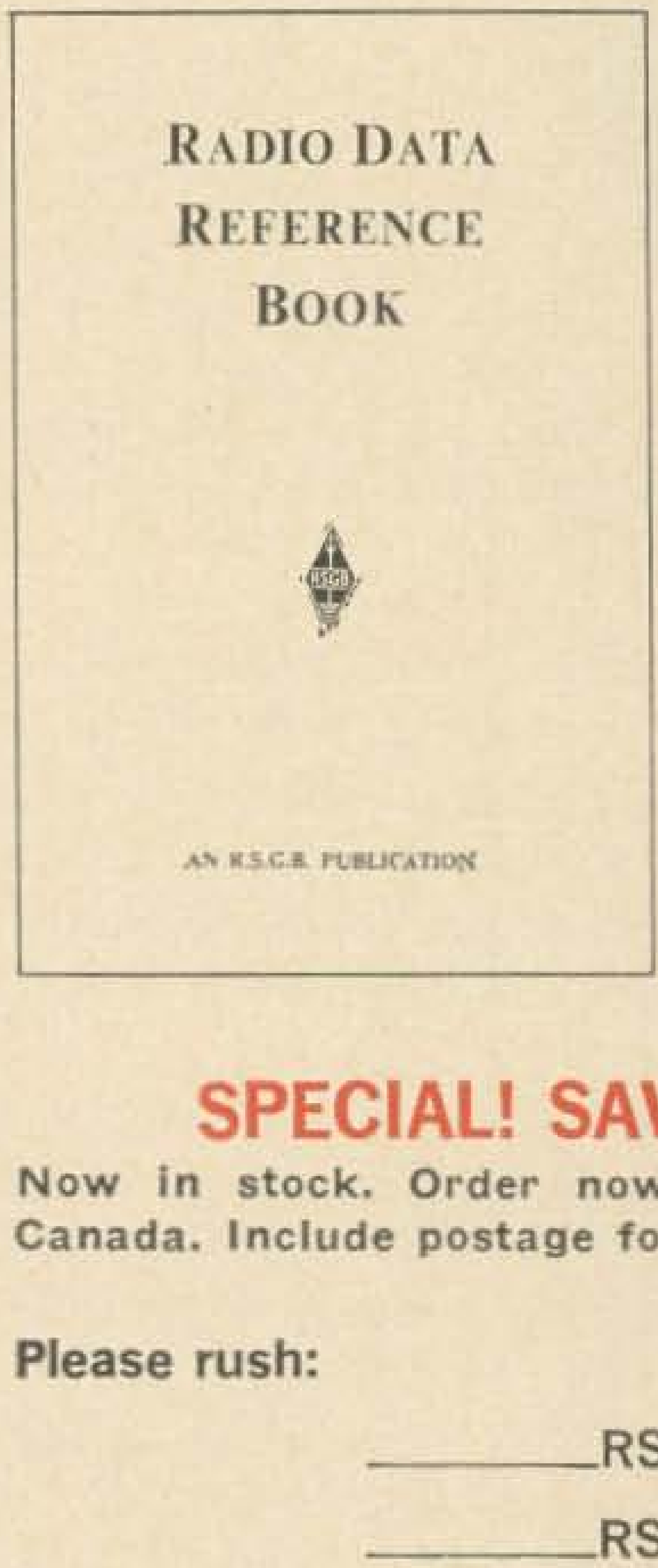
The RSGB Amateur Radio Handbook

This fabulous 540 page hardbound handbook completely and thoroughly covers every aspect of amateur radio; tubes, transistors, receivers, transmitters, vhf gear, antennas, sideband, FM, mobile equipment, noise and interference, propagation, keying, modulation, power supplies, measurements, operating and station layout and much, much more. It is completely illustrated with photographs and drawings. This handbook is very well written and completely understandable. This RSGB tries to help hams improve themselves, so it includes much necessary technical data that some American handbooks ignore. For instance, suppose you want to design a linear for SSB. The Brand X Handbook devotes about four pages to description, including a table of typical values of popular tubes. The RSGB Handbook gives 13 pages to them, plus many pages of construction, etc. The RSGB Handbook is a necessity for the building, technically minded ham. Even if you don't build, this book will help you understand your equipment and radio better. **$5.50 postpaid**





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This fine RSGB Radio Data Reference Book is the best reference book for amateurs we've seen. It contains almost everything you might need to look up: formulas of all types, rf power amplifier design, pi network design, wide-band couplers, tuned resonators, plate and grid circuit design, filters, TVI diagnosis and correction, antenna design, transmission line data, pads, coils, power supplies, modulation, reactance charts, conversion factors, math tables and much more. It's hard bound with traditional English quality, so won't fall apart after a few months as paper-bound books often do. If you build your gear, or want to really understand your equipment, you need this inexpensive but valuable book.

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EICO 753 TRANSCEIVER

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Although the modern sideband transceiver is a very complicated piece of equipment, it is not difficult to assemble the Eico 753. The engineering of this transceiver leaves little to be desired, and the step-by-step instructions are clear and easy to follow. At a time when so much amateur equipment is being bought factory wired, the Ham who constructs this set can feel well satisfied for he will be one of a relatively small group of operators who really know what is inside of their rigs.

The full-band coverage of the 753 actually goes beyond the band edges: 3490-4010 Kcs., 6990-7310 Kcs. and 13890-14410 Kcs., with LSB on 80 and 40, and USB on 20. The VFO is solid state, voltage stable on fixed or mobile operation. VOX is built in, with VOX threshold, VOX delay, VOX sensitivity and Anti-VOX sensitivity controls on the rear of the set.

The power output, 120 watts PEP, is ample to drive any linear amplifier, and when used barefoot will give an excellent account of itself. ALC is high level dynamic, and will control splattering and flat-topping as well as linear amplifier loading. The 6:1 ratio dial makes it easy to go from one end of the band to the other, and the 30:1 ratio is available for vernier tuning anywhere in the band.

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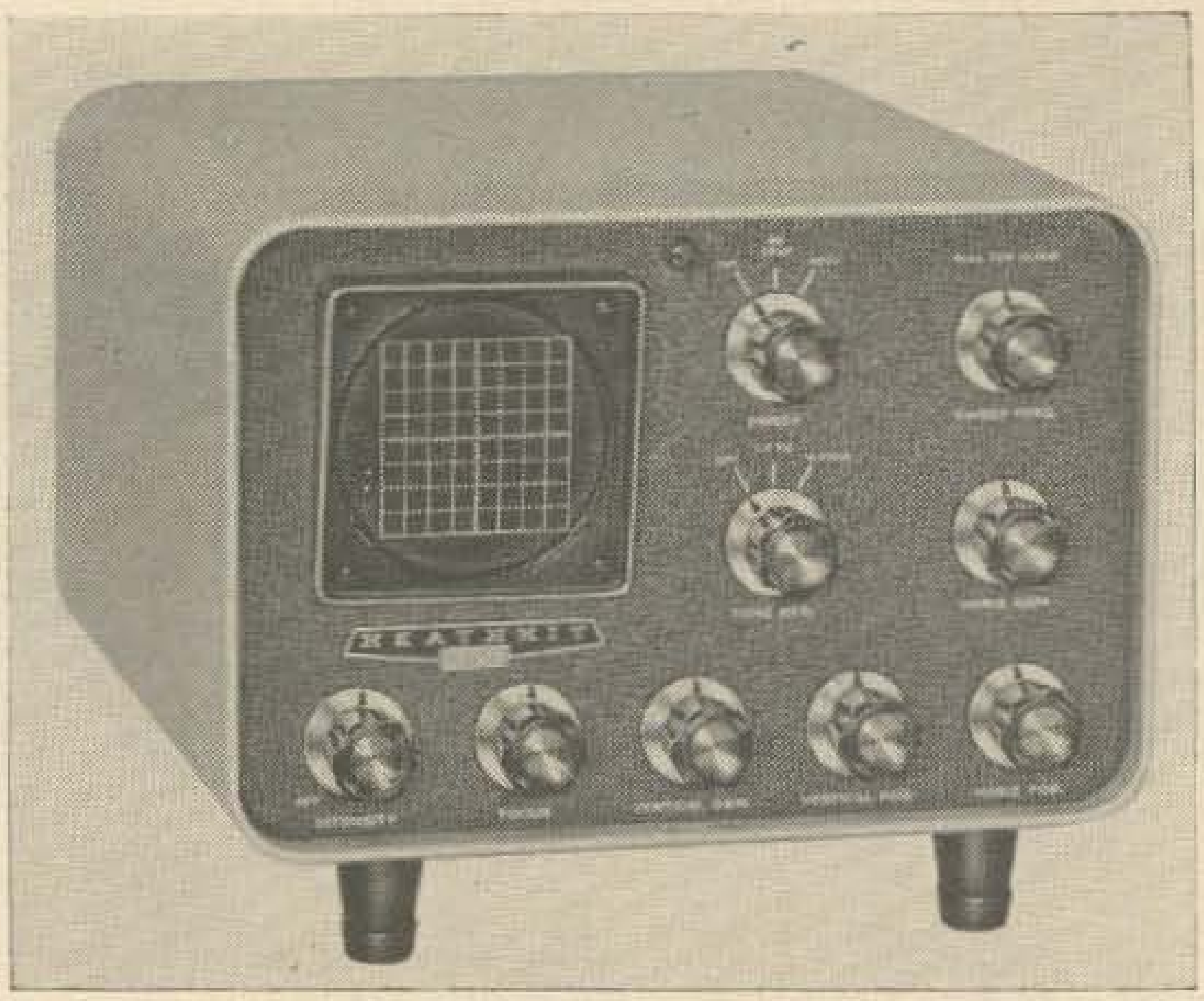


Jim Fisk W1DTY
RFD 1, Box 138
Rindge, N.H. 03461

Heathkit SB-610 Monitor Scope

Are you interested in what your transmitted signal really sounds like at the other end? Is your new linear amplifier really linear or is it generating a raucous racket that is interfering with other stations on the band? And if it is nonlinear, what is the cause, improper grid bias, incorrect loading, regeneration or parasitics? Well, there is no *one* magic black box that will give you all these answers, but the correct interpretation of the patterns produced by the Heathkit SB-610 Monitor Scope come very close to it.

The SB-610 has proven to be extremely valuable around my shack and its versatility appears to be limited only by the ingenuity of the user. The engineers at Heath planned way ahead when they had this little jewel on the drawing board. Besides monitoring the behavior of your favorite linear, it will give you some insight to almost any type of transmitted signal, be it AM, CW, RTTY, or SSB. You can also check the other fellow's signal by connecting the Monitor Scope to your station receiver. Additional parts are included in the kit so that the vertical amplifier section of the scope may be tailor made to fit your own particular requirements.

For monitoring RTTY signals and with receiver *ifs* up to 150 kHz, the vertical amplifier is an untuned arrangement with a resistor as the plate load. For *ifs* of 455 kHz and above, the necessary *if* transformers and tuning capacitors are included in the kit. By changing these components, the Monitor Scope may be used with just about any *if* from 455 kHz up to 6 MHz.

In addition to monitoring duties, when the vertical amplifier is wired for use to 150 kHz, the Monitor Scope may be used as a conventional oscilloscope. Its vertical sensitivity is somewhat limited in this applicaton, but for many purposes it is perfectly suitable. Here again the design engineers have come through with flying colors, providing much of the circuitry found in many bench-type oscilloscopes, including adjustable sweep and synchronization.

The Monitor Scope is easy to build and a snap to use. With the excellent guidance pro-

SB-610 Specifications

Vertical Amplifier
Input resistance: 100 kilohms
Sensitivity (for 1 inch deflection):
Untuned: RTTY, 1 volt nominal
20 kHz–455 kHz, less than 500 mv
Tuned: 455 kHz, 70 mv nominal
1600-2500 kHz, less than 200 mv
3000-3400 khz, less than 500 mv
5000-6000 kHz, less than 700 mv

Horizontal Amplifier
Input resistance: 1 megohm
Sensitivity (for 1 inch deflection): 800 mv
Frequency response: ± 3 dB from 3 Hz to 15 kHz
Tone Oscillators
Frequencies: Approximately 1500 and 1950 Hz
Output voltage: 50 mv

Miscellaneous
Frequency coverages: 1.8 MHz through 54 MHz, 50-75 ohm coaxial input
Signal power limits: 15 watts to 1 kilowatt
Power requirements: 120 Vac 50/60 Hz, 35 watts
Dimensions: 6 H x 10 W x 11⅛ D.
Price: $69.95

vided in the instruction manual, even the inveterate novice can make some pretty sound deductions about signal quality. The manual is liberally illustrated with typical scope patterns; each is discussed in detail and if it is indicative of poor signal quality, some of the probable causes are listed. For monitoring with the station receiver, a series of patterns in the manual show the effect of receiver bandpass and avc action on the received signal. These should be considered when making on the air checks.

Although designed for use on the ham frequencies from 1.8 MHz to 54 MHz, excellent results may be obtained up to 100 MHz. The Monitor Scope can be used on two meters, but there may be some distortion of the pattern. The unit will safely take a full kilowatt and will operate properly down to about 15 watts. A step attenuator on the rear panel provides up to 24 dB attenuation when adjusting the scope with a particular transmitter or linear amplifier.

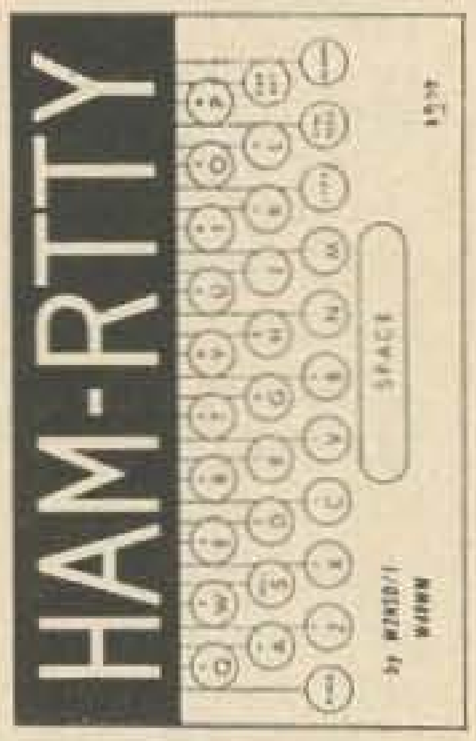
For testing single sideband transmitters, a two tone test generator is built in. The frequencies of this generator, approximately 1500 kHz and 1950 kHz, have been chosen so that their second harmonics fall outside the normal audio passband of modern ssb transmitters. It is the attention to small details such as these that really make the difference when making qualitative measurements.

One of the problems with many monitoring scopes is that during receive periods the scope trace remains stationary in the center of the CRT. If the trace is not turned off to one side of the face of the CRT it will eventually burn a hole in the phosphorus. In the Monitor Scope however, the Heath engineers have come up with a neat solution to this problem. In their circuit a *clamp* tube is used to move the trace over to one side of the CRT. This clamp tube may be controlled manually, or automatically when the scope is operated in either the RTTY or RF Trapezoid mode. In the automatic position, a sample of the transmitter rf power is rectified and used to turn the clamp tube off, thereby restoring the trace to the center of the CRT. Usually about 100 watts is necessary to provide enough rf for this purpose; for lower input power levels it is necessary to use the manual mode.

For monitoring or checking any type of amateur transmitter, it is hard to beat the SB-610 in performance and cost. Whether it is used at the bench in testing equipment or in your shack for on the air checks, you will find it to be a very useful and worthwhile addition to your station. . . . W1DTY

73 BOOKS FOR CHRISTMAS

HAM RTTY



RTTY is growing very fast. Like to get on and join the fun? This thick (112 page) book tells you what you need to know to get started and get on the air. Written by W4RWM and W2NSD. **$2**

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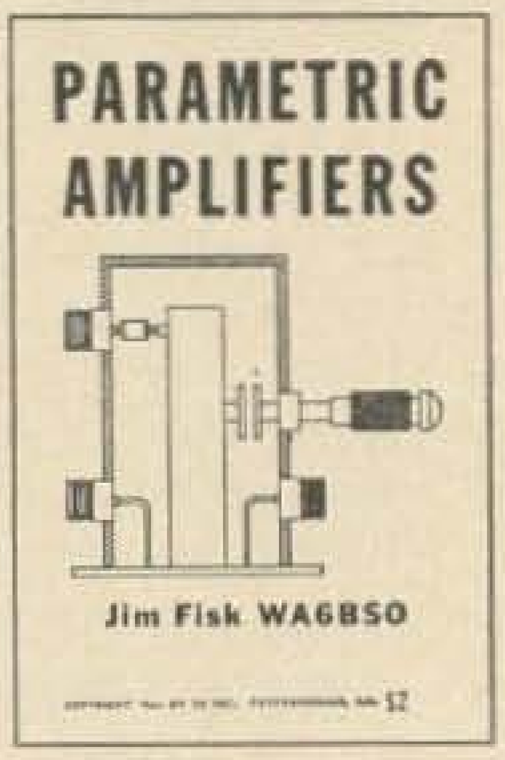

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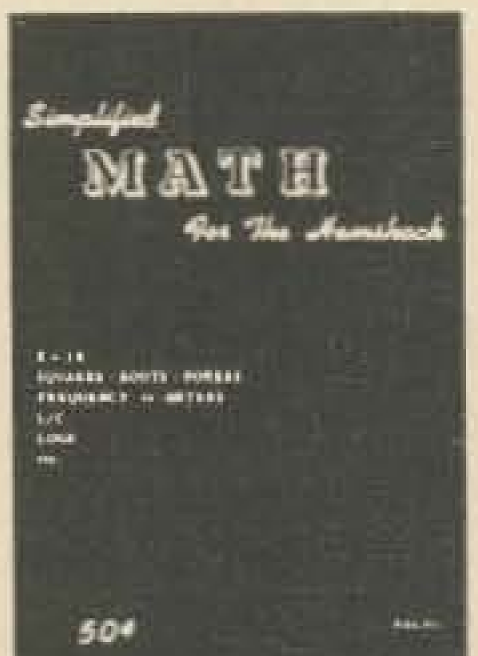
SIMPLIFIED MATH



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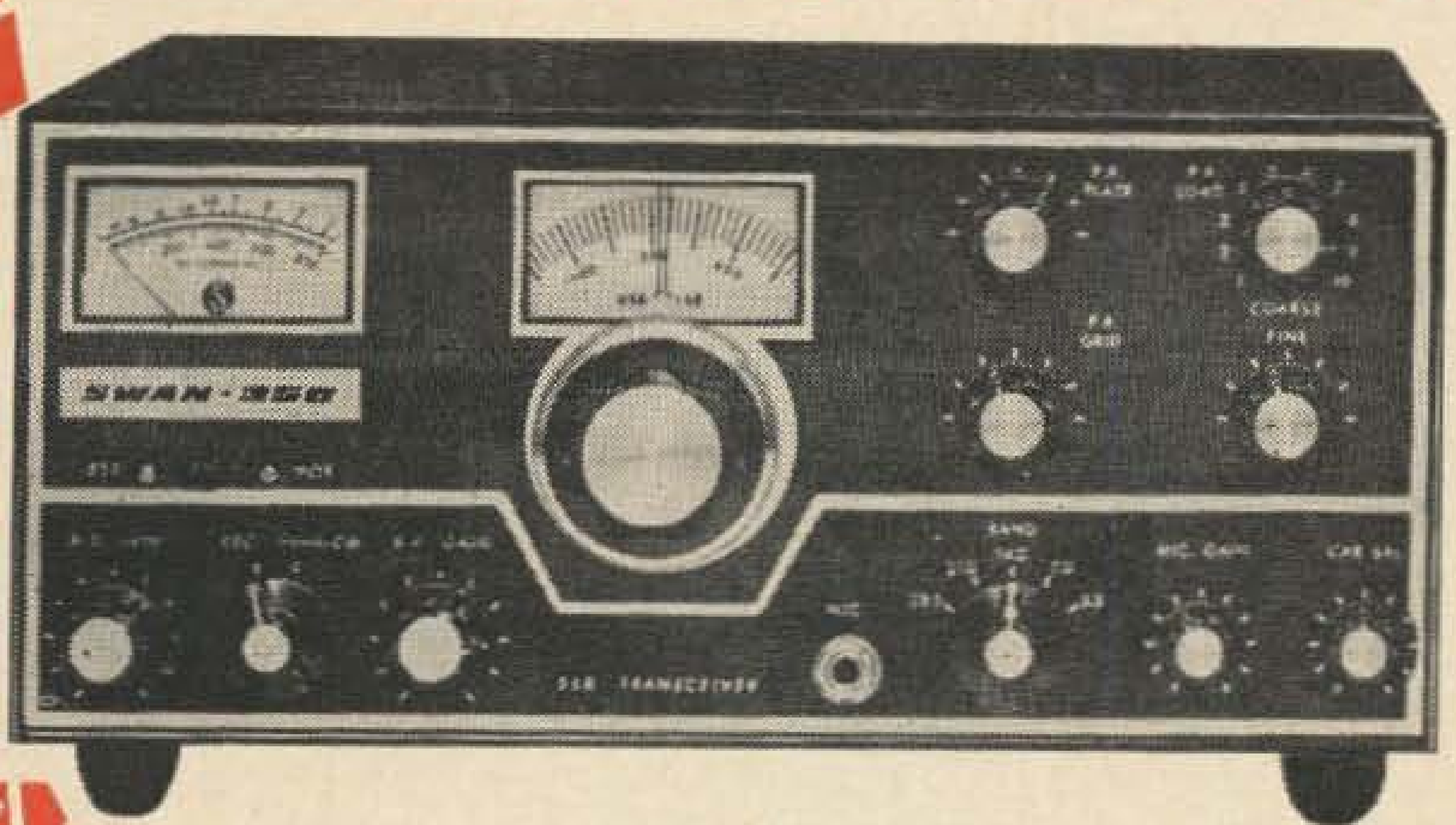

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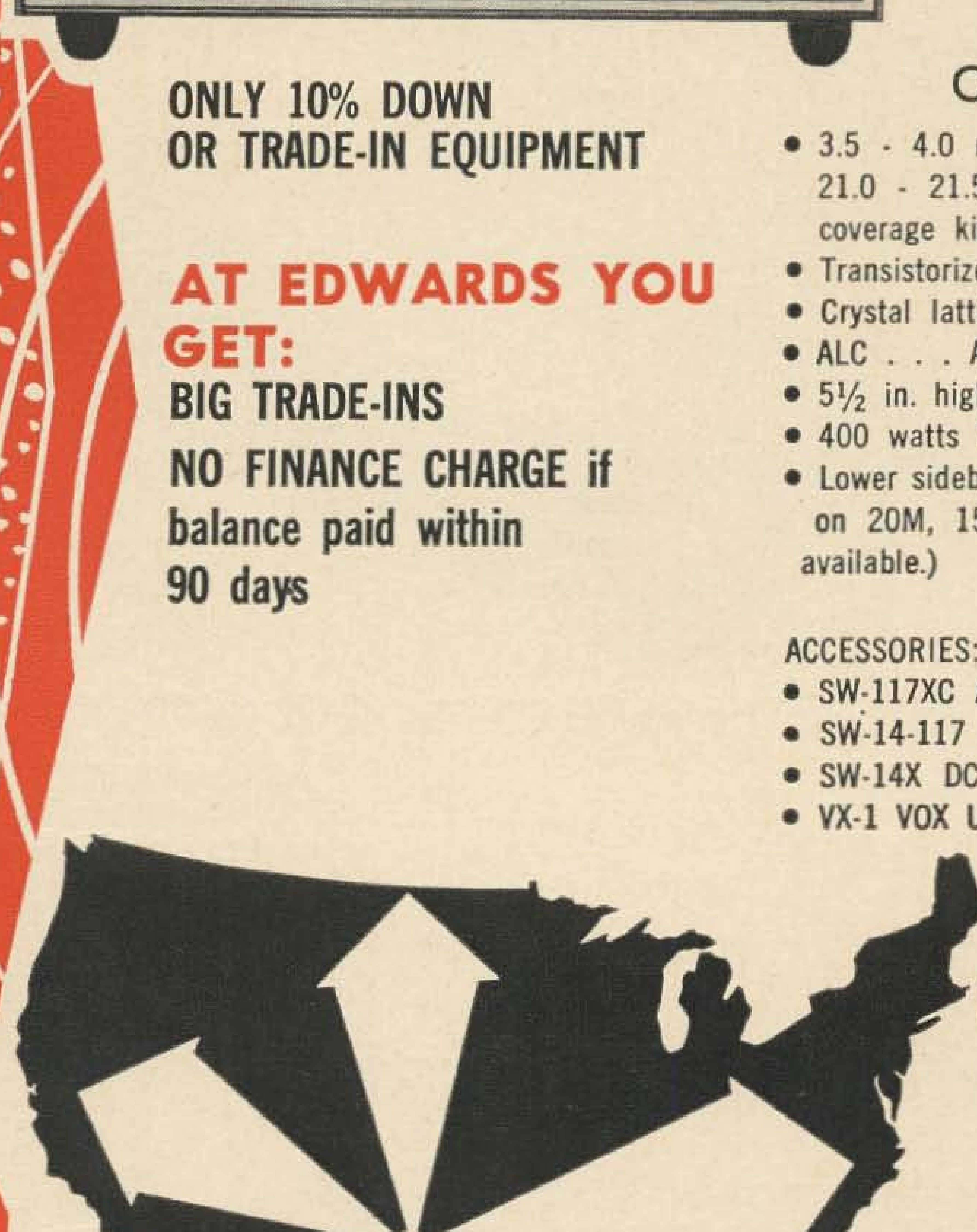

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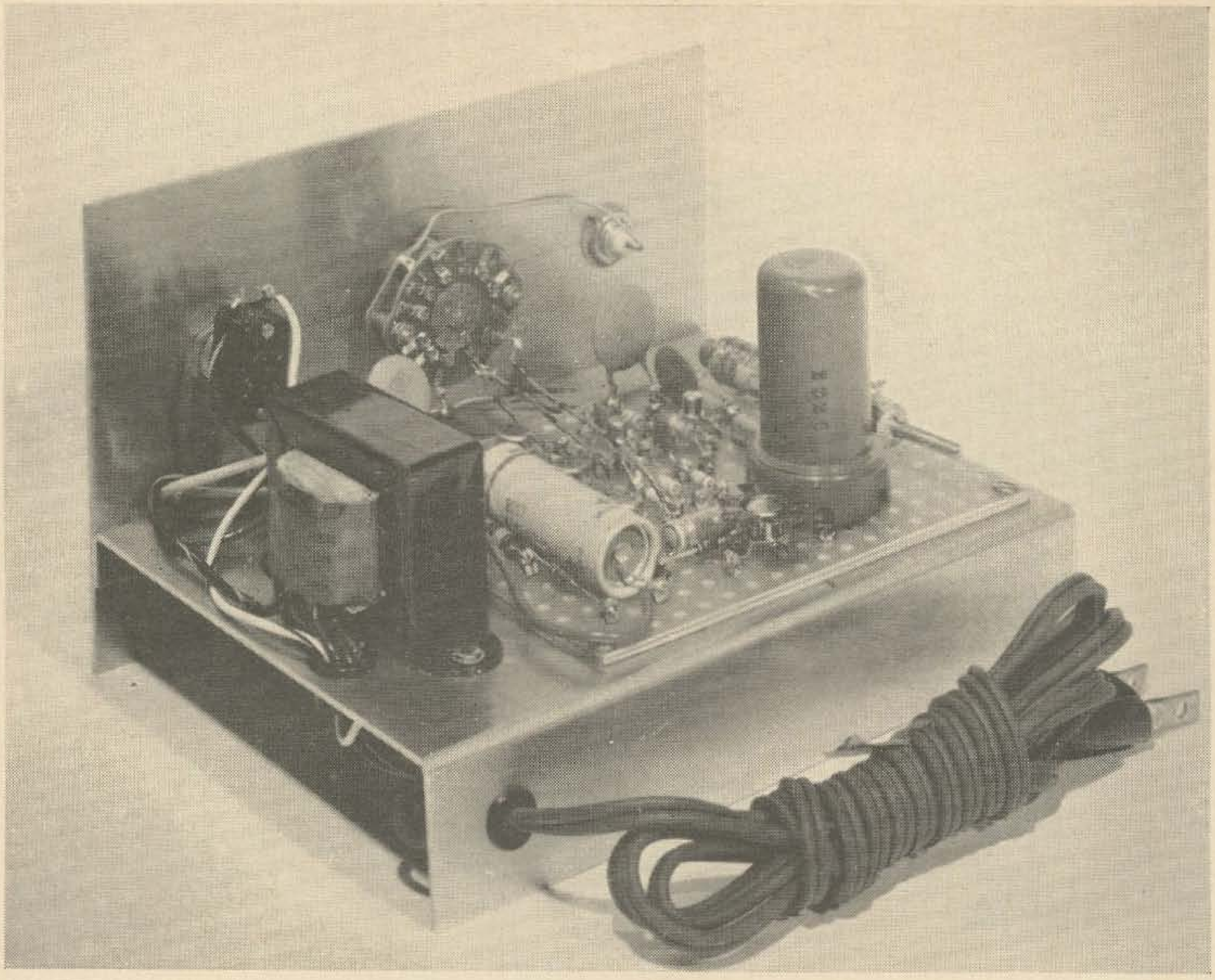

Back view of the Mark II crystal calibrator. It puts out markers every 25, 50 and 100 kHz.

Hank Olson W6GXN
3780 Starr King Circle
Palo Alto, California

The Mark II Calibrator

Use readily-available integrated circuits in this useful marker generator. It puts out strong signals every 25, 50 and 100 kHz up to the six meter band.

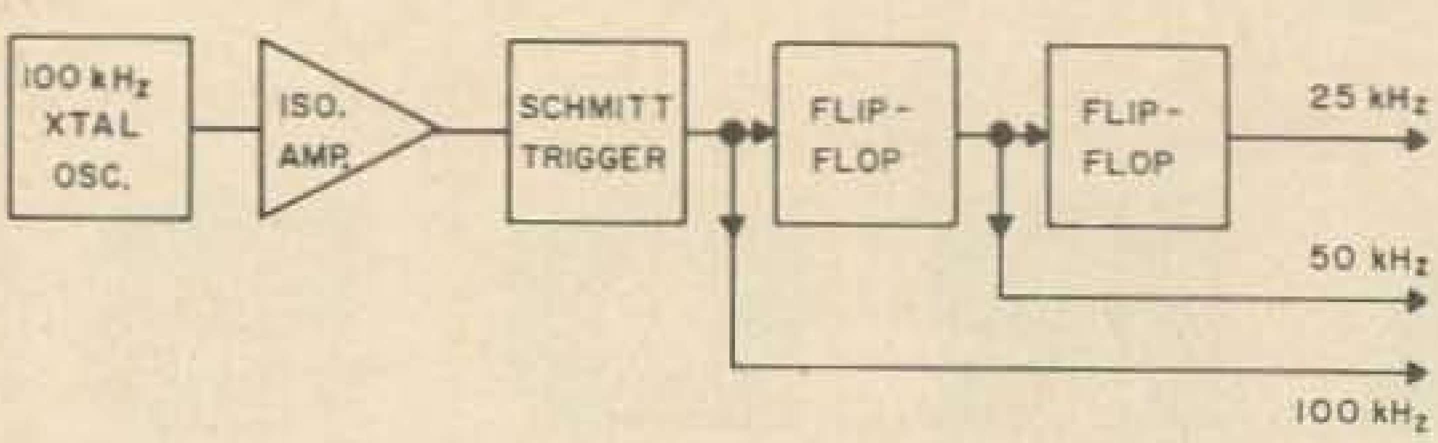

Fig. 1. Block diagram of crystal calibrator with integrated circuit frequency dividers. W6GXN calls it the Mark II—the Mark I was described in the August 73.

In the August '66 issue of 73, a crystal calibrator was presented which utilized a flip-flop to provide 50 kHz interval frequency marks.[1] The reasons for using digital circuits for the frequency division were developed in that article. It was also pointed out that a second flip-flop could be added, if one were to desire 25 kHz interval markers.

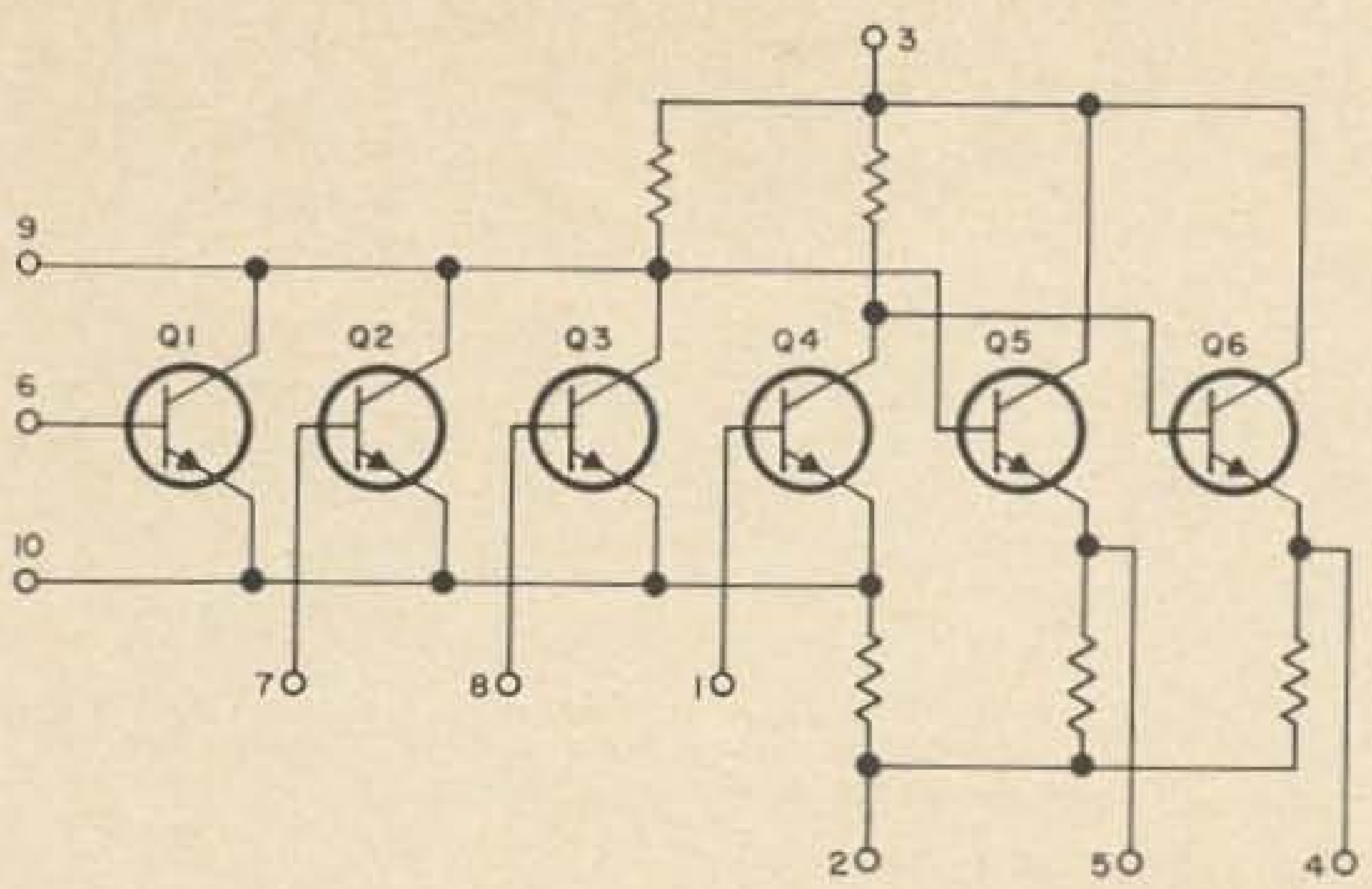

Fig. 2. Circuit diagram of the HEP 556 "three input gate."

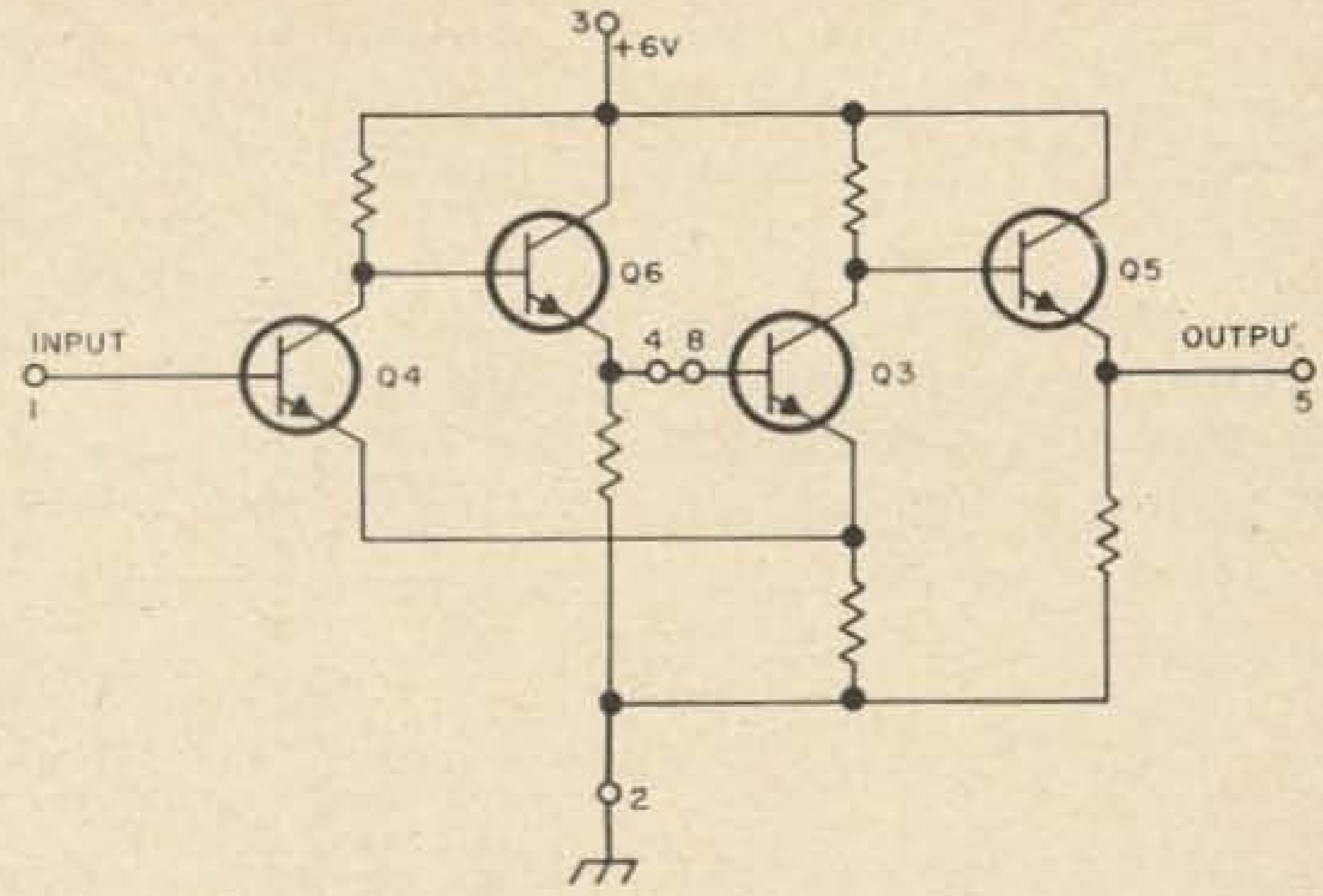

Fig. 3. Three input gate as modified to form a Schmitt trigger.

In the Mk II, herein described, use is made of the relatively new integrated circuits (IC's) for the digital circuits. IC's allow for a great simplification in the calibrator construction; in fact, the Mk II circuit board, with two flip-flop is significantly smaller than the original calibrator board with only one flip-flop.

1966 has seen the IC field literally *explode*, as described in a recent issue of Time Magazine.[2] The prices during this period have finally fallen to levels at which amateur radio experimenters can get interested in IC's. Also, the Motorola Company—the first to do so, to this author's knowledge—has added a number of digital IC's to their HEP (Hobby Experimenter Products) line. This means that, now, at least several IC types are available, at reasonable cost, nearly *anywhere* in the USA.

It is around the Motorola HEP line of semiconductors that the Mk II calibrator is designed. The basic block diagram of the Mk II is shown in **Fig. 1.** It consists of a crystal oscillator, an isolation amplifier, a Schmitt Trigger, and two flip-flops. The Schmitt Trigger is a HEP 556 "Three Input Gate" and the flip-flops are both HEP558 J-K types. The crystal oscillator is a standard Colpitts type with the crystal in the series-mode. This particular crystal was removed from a surplus ARC-2 aircraft transmitter, and was apparently cut for series-mode operation. The isolation amplifier is of ordinary design.

The problem of which digital IC to use as a Schmitt Trigger was rather interesting, since none of the HEP line was specified for that application. The circuit of the HEP 556 is shown in **Fig. 2** since it is the unit decided upon for the trigger. The individual transistors have been labeled Q_1 through Q_6 for discussion. Q_3 and Q_4 are to be the basic two transistors of the Schmitt Trigger, since they both have collector load resistors and have a common emitter resistance. Cross coupling from the collector of Q_4 to the base of Q_3 is through the emitter-follower Q_6. The "Three Input Gate" as wired for trigger service is then as in **Fig. 3.** One will note that transistors Q_1 and Q_2 were "wasted" and that the output is obtained through the second emitter-follower Q_5.

The J-K Flip-Flop, as represented by the HEP 558, is a far more complicated device than the simple flip-flop ordinarily encountered by the ham. The fact that the J-K contains some 16 individual transistors is an indication of the complexity. The J-K is a very versatile unit in the digital service for which it is intended, which justifies its complexity. We are to use each J-K simply as a divide-by-two stage. A group of these same J-K's can be connected so as to divide by many other whole numbers (not to exceed 2 per J-K) including the very useful number: 10. Dividing by prime numbers like 5 can be done with such an array of J-K's *without* critical feedback networks of capacitors and resistors; only the method of inter-connecting wires must be

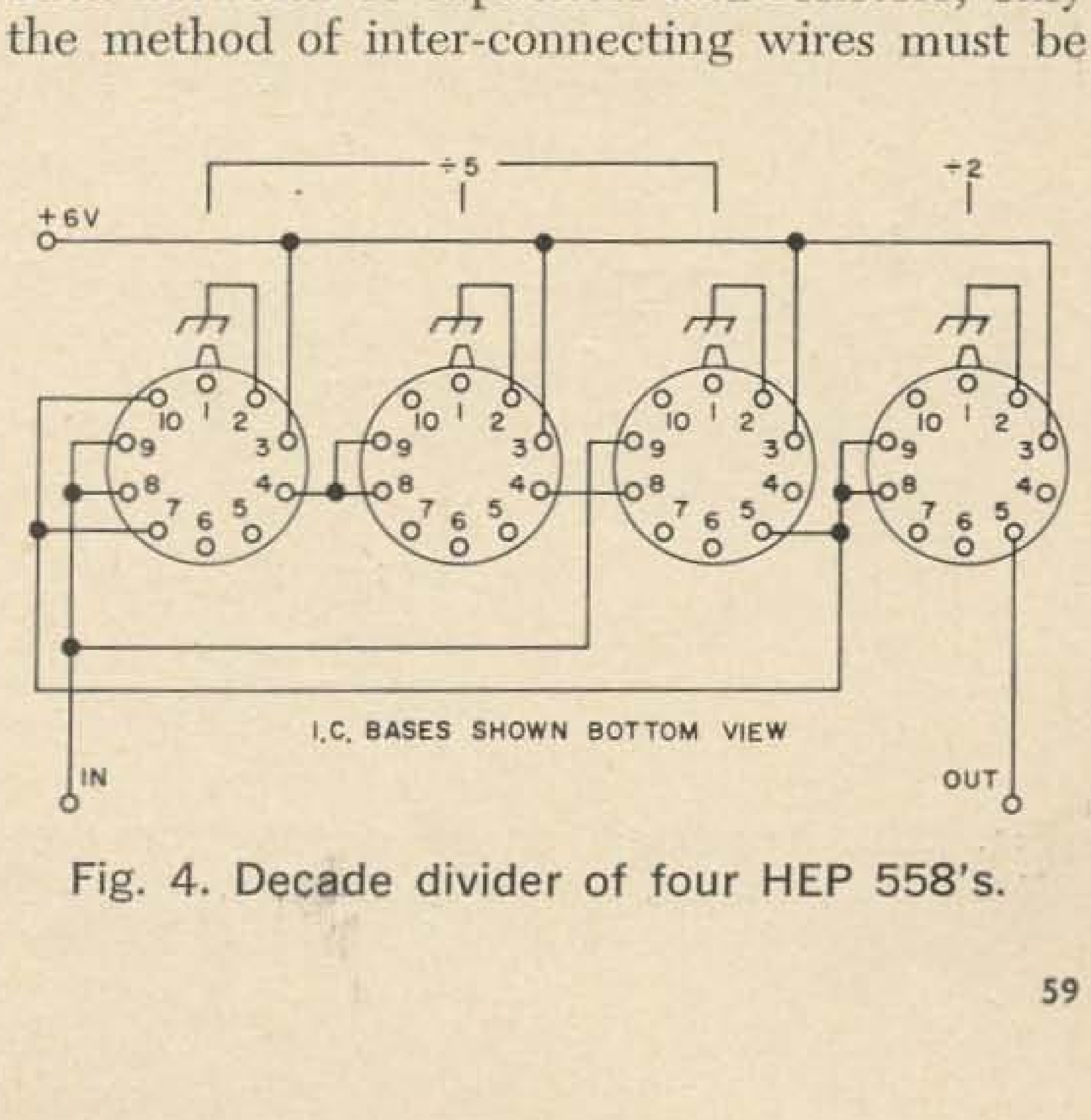

Fig. 4. Decade divider of four HEP 558's.

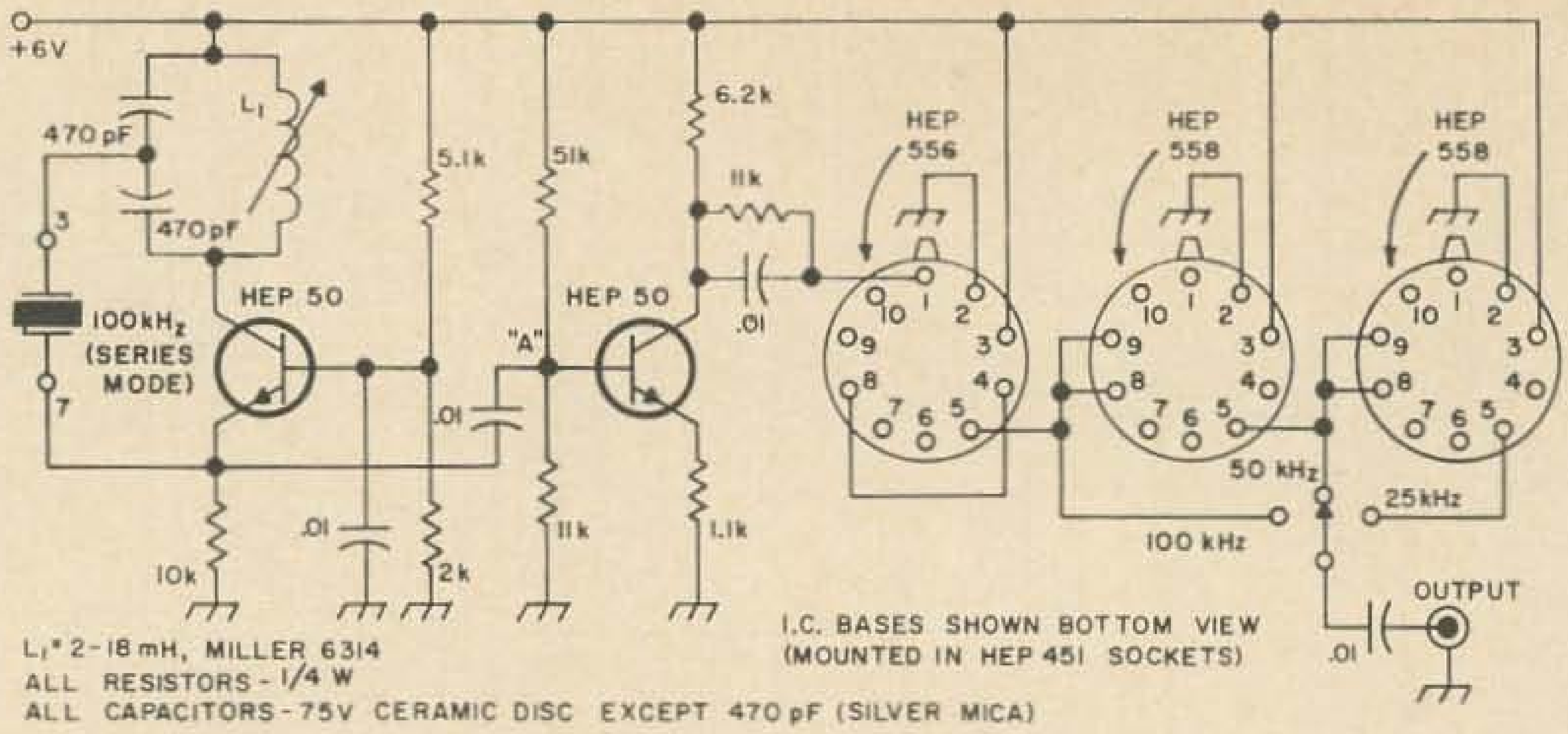

Fig. 5A. Mark II Calibrator. Power supply section of the calibrator is shown in Fig. 5B.

changed. Dividing by 5 takes three J-K's, dividing by 10 takes four J-K's, and so on.[3] The method of connecting HEP 558's for division by 10 is shown in **Fig. 4.** Note that this is accomplished by first dividing by 5 and then dividing by 2. More information on the HEP 558 and other IC's in the HEP line is contained in the Integrated Circuits Project Manual.[4]

Putting all the building blocks together into a unit, we have the Mk II Crystal Calibrator. The circuit is shown in **Fig. 5.** The circuit was constructed on Vector board, which in turn was mounted in a square hole on a metal chassis. Power transformer, fuse, switches, and output jack were mounted on the metal chassis and panel.

In operation, the calibrator produces good mark intervals up to the six meter band, which should be adequate for most ham purposes. The calibrator, of course, is coupled to the receiver antenna input via a 5-pF capacitor or a capacitive "wire-gimmick". One interesting phenomenon is noticed, when using the Mk II calibrator on 50 kHz or 25 kHz. The "even" harmonics of either of these frequencies are much weaker than the "odd" harmonics. This should come as no surprise, since the Fourier analysis of a perfect square wave contains *only* odd harmonics in theory. In other words, the J-K Flip-Flops produce such symmetrical square waves that the Fourier analysis theory is approximated. The output of the Schmitt Trigger is not so nearly symmetrical, and all the harmonics of 100 kHz are quite evident. The fact that the "even" 50 kHz marks may not be easily heard is no problem, since *these "even"* marks are given to us by the 100 kHz position. And similarly the "even" 25 kHz marks are given to us by the 50 kHz and 100 kHz marks.

If one is going to use a 100 kHz crystal of the commonly available type like the CR37/U, an FET crystal oscillator circuit may be substituted for the crystal oscillator circuit. One for use with a crystal that is resonant at 100 kHz with 20 pF in parallel is shown in **Fig. 6.** The whole subject of which crystal to use with which oscillator circuit is covered in reference number 4.

. . . W6GXN

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3. Irwin, J. "Using the J-K Flip-Flop in Small Modulo Counters," EEE, Nov. 1965, p. 80.
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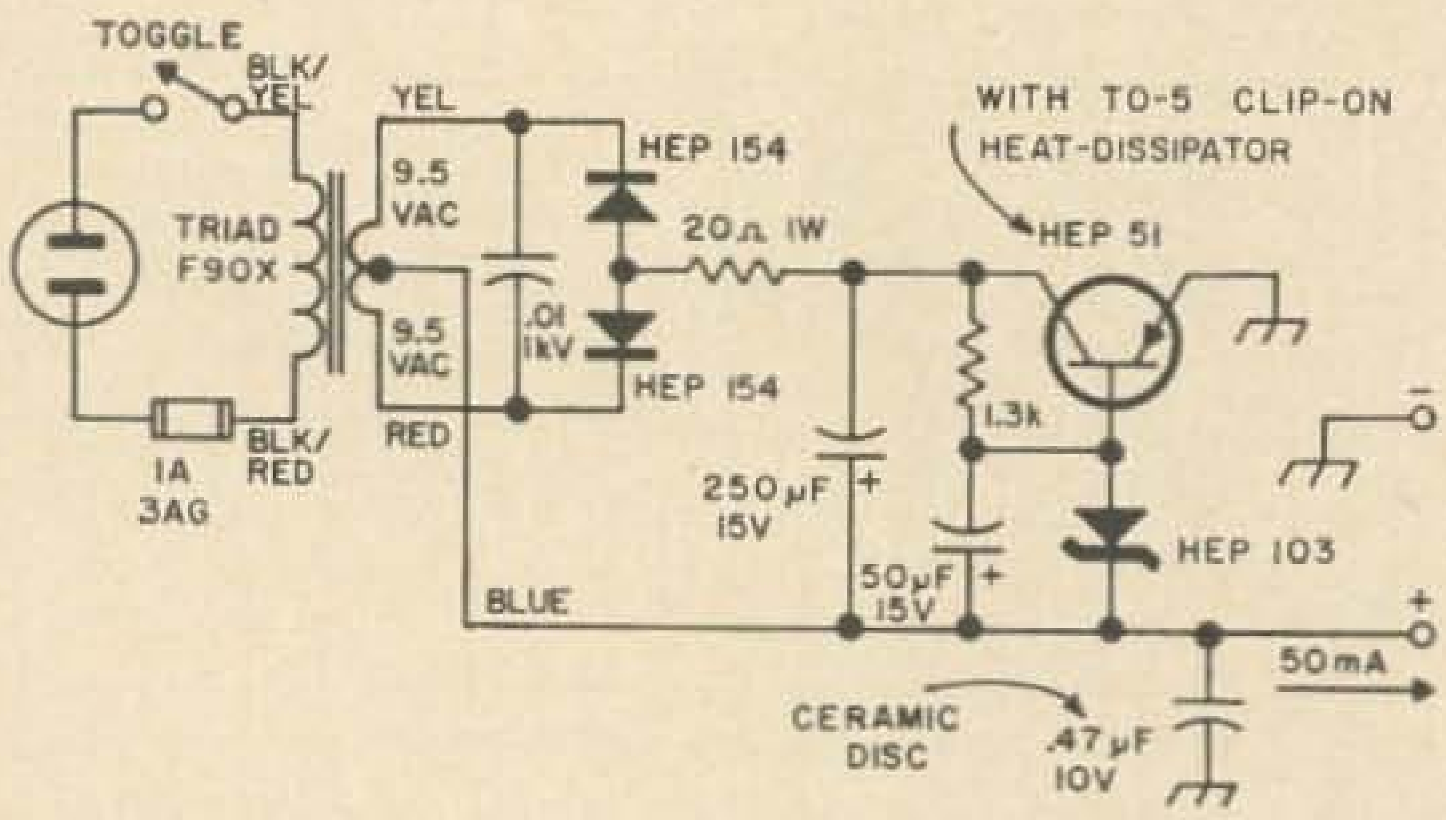

Fig. 5B. Regulated power supply for the Mark II calibrator. Output is 6 volts.

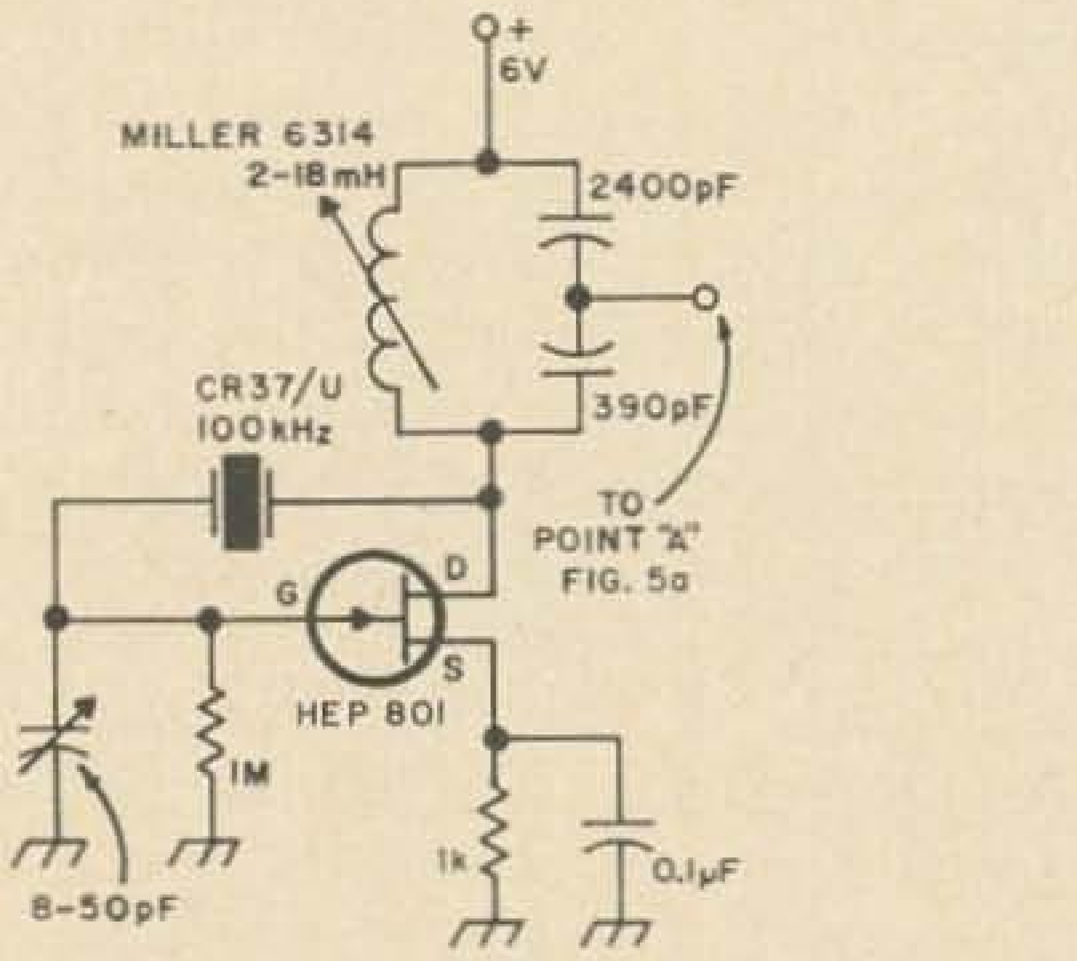

Fig. 6. Alternate crystal oscillator for use with 100 kHz crystal designed for 20-pF parallel resonance.

Karl Thurber K2IKZ
2971 Portsmouth Dr.
Rancho Cordova, Cal.

LORAN

Interloper on 160

Most amateurs and SWL's are well-familiar with the strange, rasping static-like signals which all but crowd out the once-proud 160-meter band. And crowd out 160 they have, so that at present relatively few countries allow any operation at all on 160 and those that do severely restrict the type of emission, frequency band and power limits. A complex system authorizes limited top-band operation in the U.S., with some areas near coastlines allowed only 25 kHz and other areas night-time powers as low as 25 watts.

LORAN, which is military jargon for "LOng RAnge Navigation," is the villain responsible for that empty notch on the band-switch where 160 used to be. But what is it, and why is it so important?

This system—developed semi-secretly by the British during World War II but expanded considerably after the War—is a complex one which provides the ship or aircraft navigator with "lines of position" on which he can know his craft lies. Before its development, traveling over water for long distances, the navigator had few methods for accurately determining his position and was generally limited to celestial observations and radio direction-finding sets.

The LORAN receiver electronically "reads" the difference in arrival times of signals from two known ground transmitting sites, a "master" station and its "slave." The two signals are presented on a CRT—the whole receiver resembling a cross between an oscilloscope and a radar set.

Since radio energy travels at a constant speed and the transmitters' locations are known, the exact arrival-time differences between master and slave can be calculated and printed on a map-like chart in hyperbolic curves around the stations. The time-differences read-out from the receiver counter dials indicate the hyperbola or line of position on which the aircraft or ship is located.

Despite the very long range of LORAN, up to about 900 miles during daylight and 2000 miles after dusk, amazingly accurate results are possible. Operating on four channels, 1750, 1850, 1900 and 1950 kHz, an accuracy of ⅛ mile on groundwave and a few miles on E or F-layer skip is not extraordinary.

The big "hitch" comes in from the effects of sky waves. Waves reflected off the ionosphere take longer to travel the same ground distance and would cause tremendous errors if they were not identified as skywaves rather than groundwaves and the proper corrections applied. Fading and wave-cancellation has a

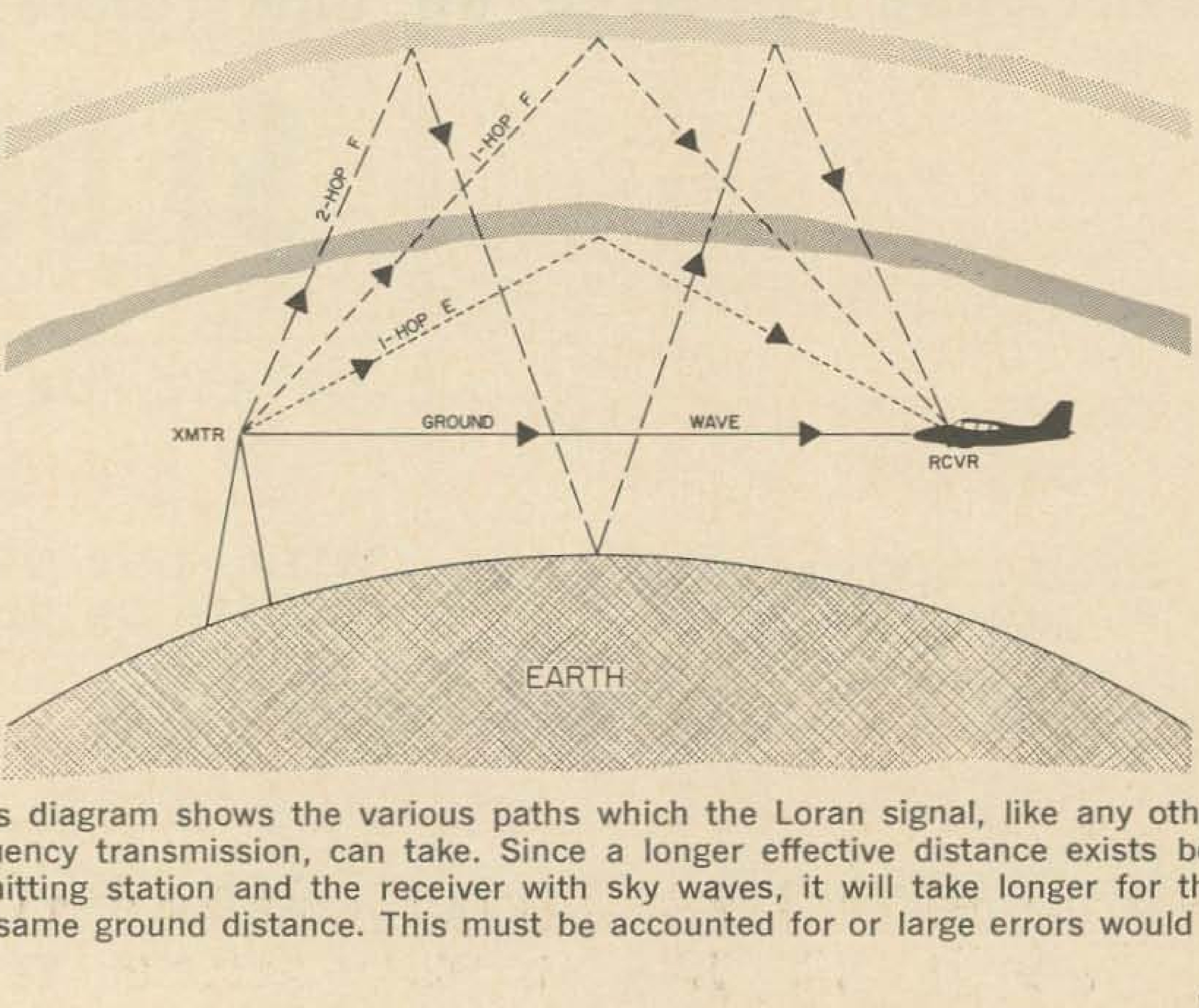

Fig. 1. This diagram shows the various paths which the Loran signal, like any other medium frequency transmission, can take. Since a longer effective distance exists between the transmitting station and the receiver with sky waves, it will take longer for them to travel the same ground distance. This must be accounted for or large errors would result.

similar effect on LORAN as it does an RTTY—reception is garbled and erroneous.

Once the navigator has identified whether he is receiving groundwave, or single or multiple-hop E or F skip, he can perform a few quick calculations and establish his line of position, then crossing this with another line of position (LOP)—such as from another LORAN station or a celestial body—to get an actual position or "fix."

LORAN stations are usually constructed to dot one end of an important coastline to the other, such as our East and West Coasts, which accounts for the limited amateur operation on the Coasts. To ensure adequate coverage, pairs of master and slave stations are strung out in-line to form an unbroken station chain along the coastline. Interestingly, the stations may even operate on the same frequency channel without interfering with one another since each has its own characteristic pulse rate.

Unfortunately, LORAN is susceptible to atmospheric interference and, more seriously, to co-channel interference (i.e., we hams) and to enemy jamming and deception in which the enemy sets up his own false stations to 'con' the navigator into thinking he is where he isn't. To counter this sort of thing, it is possible to set into the stations an "extra" time delay so that the values printed on the navigator's chart do not jibe with what his set reads. Only those knowing the code-of-the-day could use the signals and would not be deceived.

What is the future of LORAN and how will

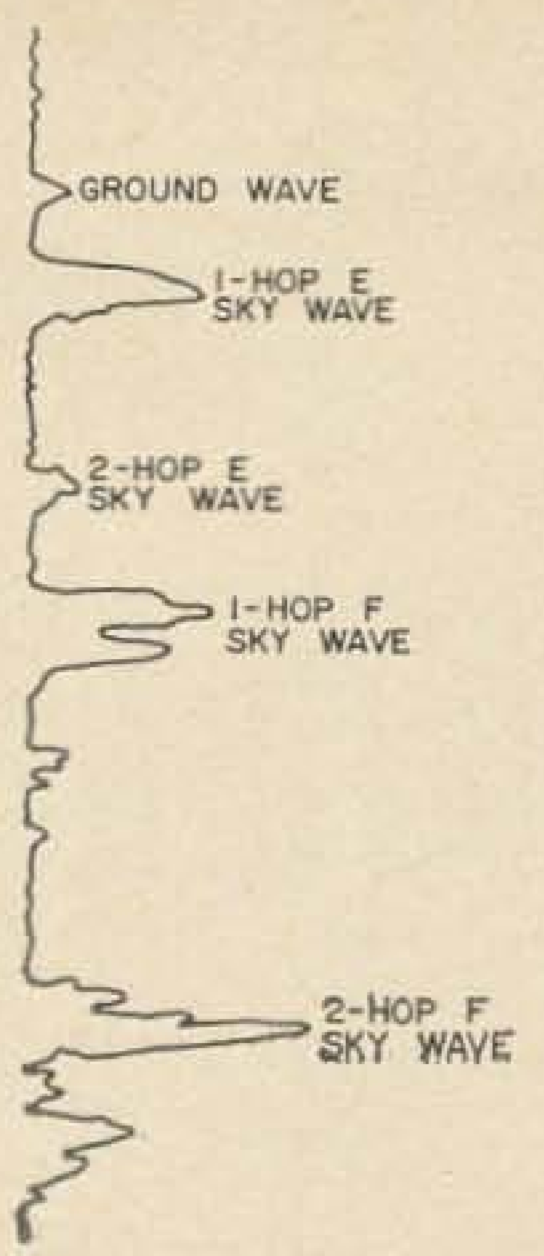

Fig. 2. Typical train of Loran pulses as they might appear during night-time hours on the navigator's set. The ground wave, if close enough to the station, always is seen first with the various sky waves following.

it affect amateur 160-meter work? Newer VHF and UHF navigation systems, such as TACAN, VOR and even navigation satellites, will slowly spell the doom of LORAN. Also, experiments have begun to transfer LORAN to the 100 kHz area (which is considered a more "reliable" operating frequency than 160), but it will doubtless be a number of years before all trans-oceanic aircraft and seagoing vessels convert over to the newer system, and the present 160-meter LORAN would probably remain in operation as a back-up, amateurs sharing it still on a non-interference basis.

This, then, is LORAN, interloper on 160, but to the navigator some two thousand miles from familiar shores, his best friend.

. . . K2IKZ

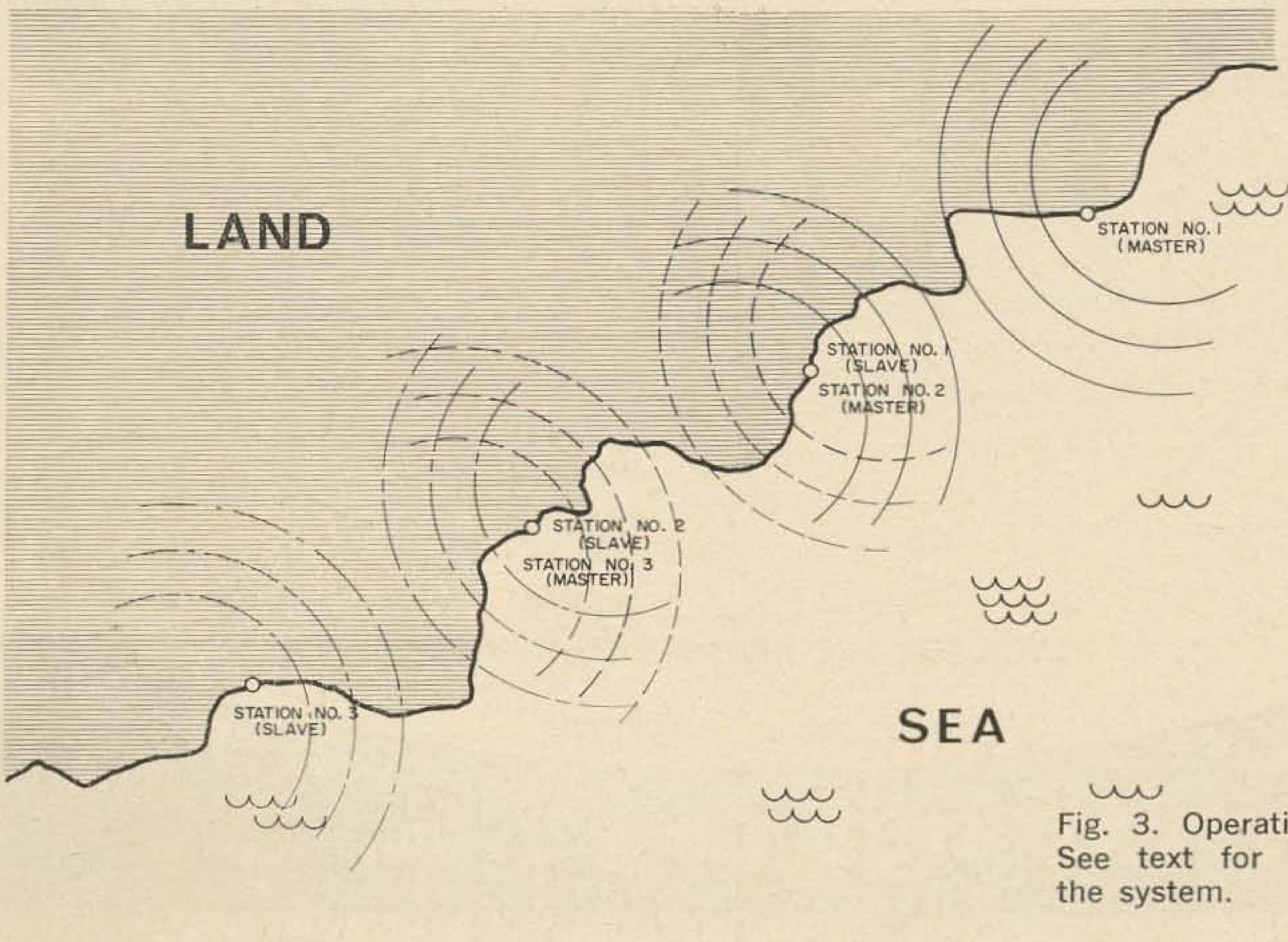

Fig. 3. Operation of LORAN. See text for explanation of the system.

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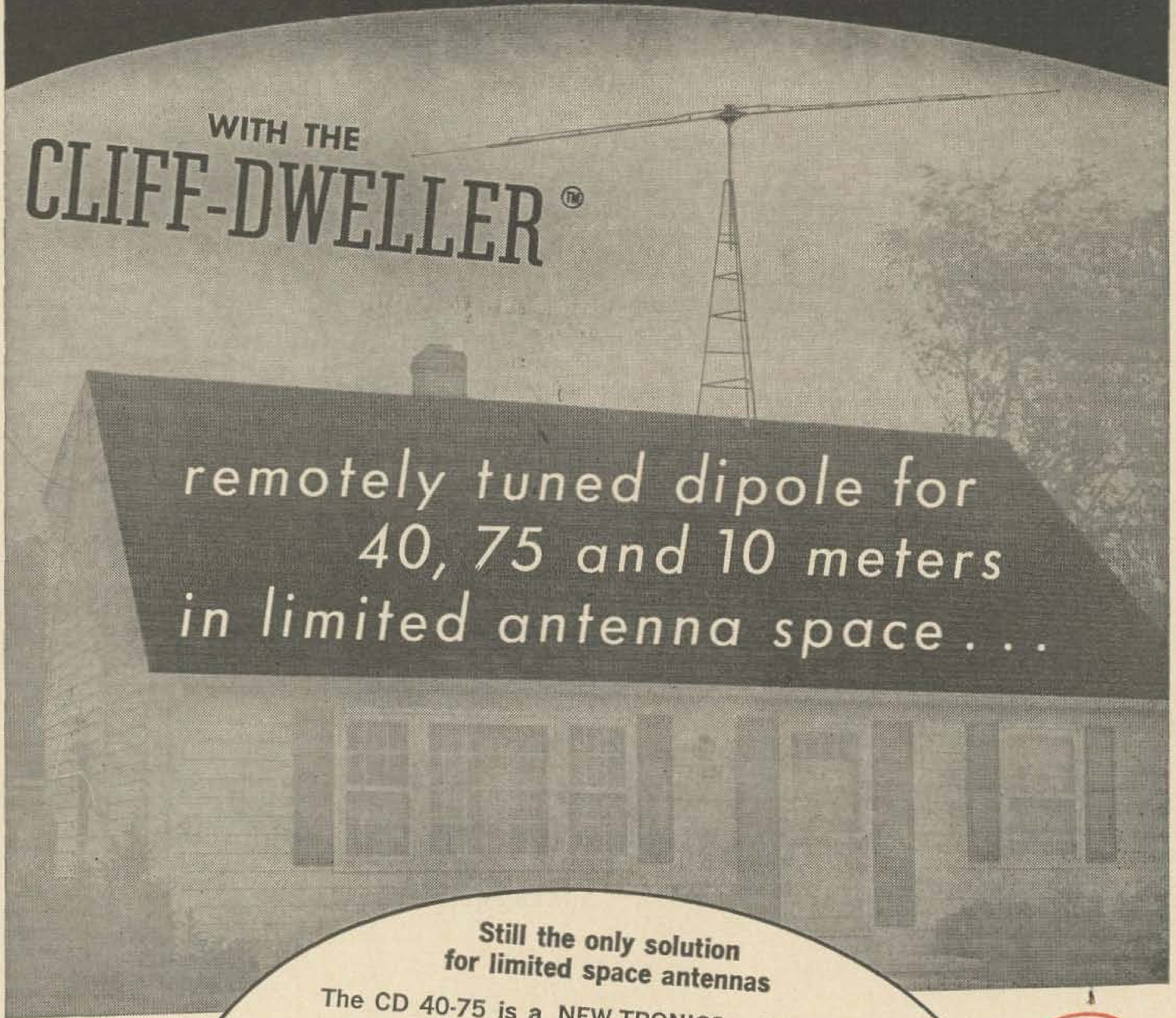

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PAK—The Portable Automatic Keyer

A keyer to be useful for portable operation must be designed so that its power drain is low. This will allow its battery to be conveniently small, but still have long life. The PAK (Portable Automatic Keyer) excells in this area. The grid block keying model has the key up current drain of 0.2 mA and the key down drain of 3.6 mA. The cathode keying model also has the key up current drain of 0.2 mA, but the key down current is necessarily higher —10 mA. The PAK is a relayless keyer but special care was taken to be sure cathode keying DX-40 owners and 6146 homebrewers can update their rigs with an automatic keyer. It has sufficient flexibility designed into it so the builder will be able to make good use of his junk box, also, the parts are few and all can be economically purchased if desired.

The PAK, instead of containing a relay to switch the transmitter keying circuit, uses very low cost transistors in series (grid block keying) or parallel (cathode keying). By this method the cranky relay problem is eliminated and, at the same time, we gain almost unlimited substitution possibilities. The series circuit raises the keying voltage capabilities to a useful value and increases the key open resistance to a fantastically large figure. The parallel circuit increases the current handling capabilities and the key up resistance remains high enough for most grid block keying circuits. Both models are self completing and are identical except for the high voltage switch. The cathore keying model will be treated as a modification to the grid block model, because it requires fewer parts and is a bit less complicated.

When the PAK is constructed with the grid block keying switch it presents a key up resistance so great that no current flow can be detected on a 50 microamp meter when 250 Vdc is impressed across its terminals. Its key down resistance is very low, about 53 ohms. When using Poly Paks equivalent 2N498's currents of up to 30 mA can be switched. This all boils down to: the PAK can easily short the 250 Vdc to ground through a 25-KΩ resistor and there will only be about a half a volt left over across its terminals. The resistor can even be reduced to 10-KΩ with perfectly safe operation. When using 2N333's the voltage handling capabilities of the unit is reduced to 125 Vdc and the current to 25 mA. This means that the 25-KΩ and 10-KΩ resistor still can be shorted out with the same safety as long as the blocking voltage does not exceed 125 Vdc. The Pak's low voltage drops along with its capability to switch to high voltages make it ideal for grid block keying a couple of 6146's plus a VFO, using the 2N333 transistor switch. If your rig uses a higher blocking voltage for larger tubes, the equivalent 2N498's will do the job for you. You can determine the value of your blocking voltage by measuring across your key with a VTVM when the key is open. The maximum value of the voltage in a cathode keying system can be measured in the same manner. The current can be measured by connecting a milliammeter across the open key. This will cause the transmitter to go on so be sure that it is loaded at the output.

When the PAK is constructed with the cathode keying switch its key resistance depends upon the quality of the transistors. With half good transistors its key up resistance will be great enough not to effect the keying of the low impedance cathode circuit. The key down resistance will be about 10 ohms. With the 2N498's key up voltages can be up to 100 Vdc, but with the equivalent transistors this figure must be derated to about 75 Vdc, a value compatible with DX-40. Either of the two kinds will handle key down currents of up to 150 mA.

The timing section of the PAK consists of normally off or on switch circuits using transistors also available from Poly Paks. This design permits reliable operation in the presence of large rf signals, very low battery drain and an easy-to-understand easy-to-maintain circuit. It is a simple solution to the not-too-difficult problem of making dots and dashes, and it is hard to see where complicating the solution with blocking oscillators, count down flip-flops and several types of gates is necessary. The PAK also has a fine range of speeds, and when the components shown in **Fig. 1** and **Fig. 2** are used, it will operate from about 10 to 25 wpm.

An examination of the schematic (**Fig. 1** and **Fig. 2**) reveals that the PAK circuit is built around six transistors. Q1, Q2, and Q3 compose the high voltage switch. Three transistors are used in series (**Fig. 1**) to permit reliable operation with potentials across the output terminals up to 250 Vdc, or three are connected in parallel (**Fig. 2**) to assure reliable operation with keyed circuit currents up to 150 mA. The timing circuit is alike for both the grid block and cathode keying models. Q4 and Q5 are normally off switches while Q6 is normally on. When the key is closed, C1 or C2 will discharge through Q6 biasing Q5 on, which in turn, drives Q4 and Q1 through Q3 on. The positive signal from the on Q4 is fed back through C3 to decrease the circuit rise and fall time and back to Q6 biasing it off. This event disables the key lever and allows the timing capacitors C1 or C2 to charge through the Speed Control R6 and determine the period that the high voltage switch will be on. Thus, the circuit now acting independent of the key lever, is self completing. The Speed Control not only regulates the duration of the on time, but also controls the effectiveness of the space capacitor C4 which must discharge before the key lever again becomes active. By making dual use of R6 the ratio of space to chactor is very linear over a wide range of speeds.

The PAK is made of easily obtained low cost materials but no compromise is made with reliability. A quick glance at the unit might mislead one into thinking construction is a complicated job, however, no special tools or skills are required. The key and electronic components are mounted upon a piece of Vector brand breadboard 3" x 3¹³⁄₁₆" (the full board width). The key is a bent-up assembly made from aluminum cut out of a .025" thick cookie sheet, with the contact insulators and handle made from small pieces of Vector board. The contacts are bolts which have had their ends cut very smooth, and the knob is whittled out of soft wood, then painted. Construct the base by melting two pounds of fishing sinkers in a can and pouring the molten lead into a mold the size of the circuit board. After it has cooled cement an insulating card to the top and rubber pads to the bottom. Mount the circuit board to the base using spacers to prevent crushing the components. A battery case is made out of cardboard ce-

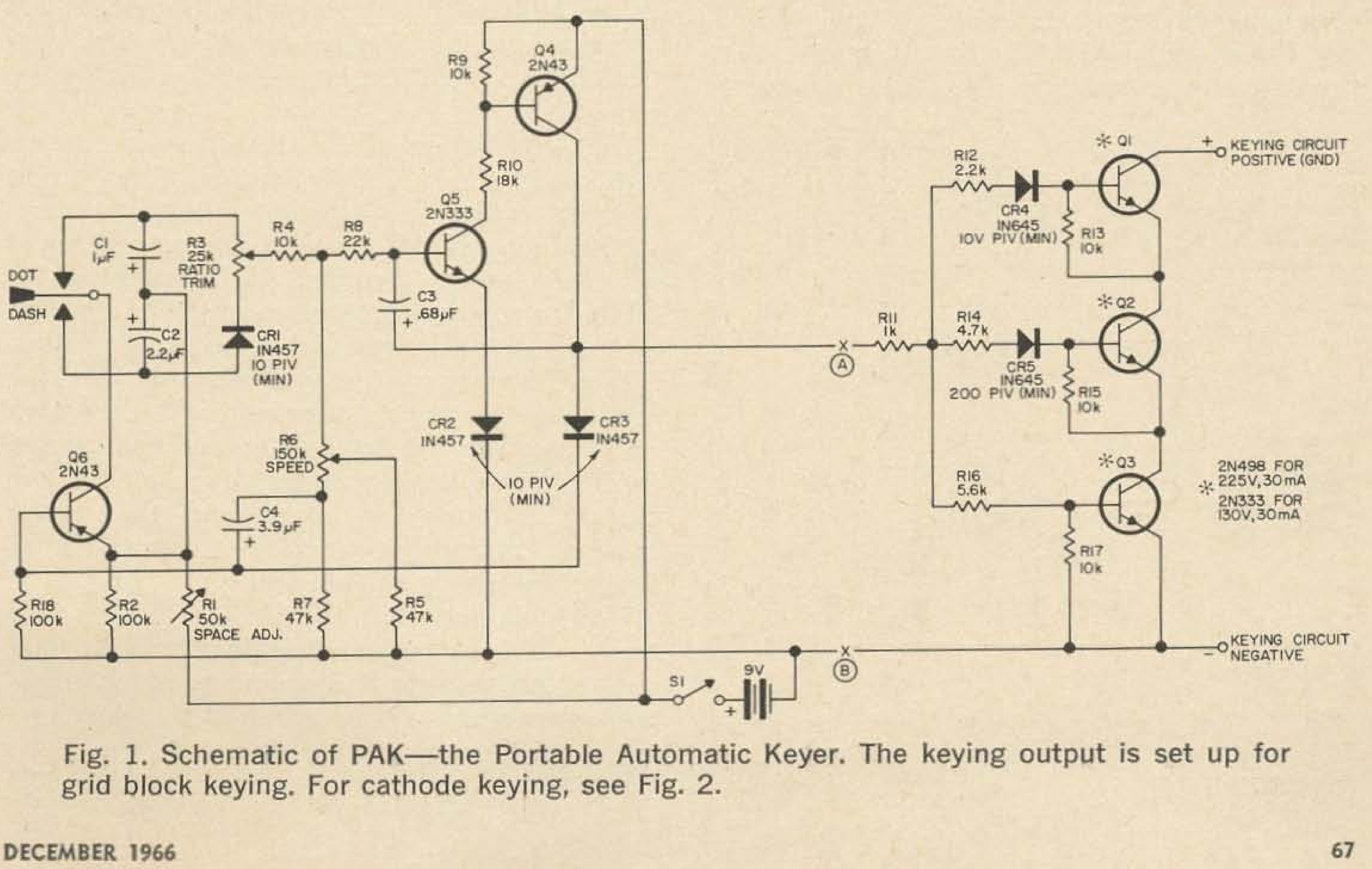
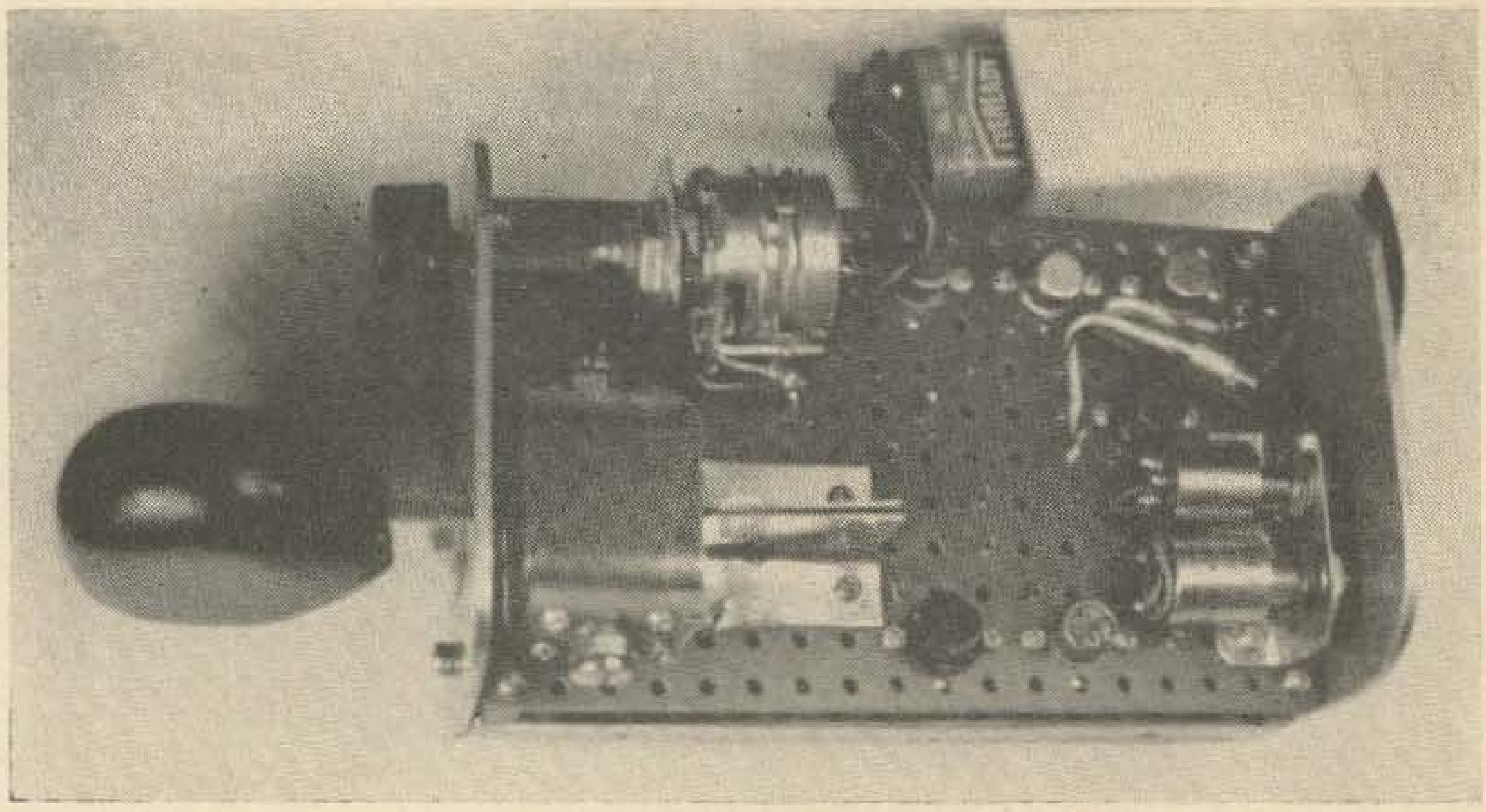


Fig. 1. Schematic of PAK—the Portable Automatic Keyer. The keying output is set up for grid block keying. For cathode keying, see Fig. 2.



Inside PAK's case.

mented in the corners to form something like a little box. The plug can be the top off a dead transistor battery. The front and rear panels along with the cover are held in place with screws that fit into holes tapped in the base edges. Cementing your call and QTH, which can be cut out of your QSL card, to the top cover gives the keyer a real custom appearance, especially if the color of the knob and letters match.

Adjustment

Adjustment of the PAK's trim controls is identical for the grid block and cathode keying models. If an oscilloscope is available, set the scope "Y" input to the dc mode and connect it to the Q1 side of R11. Connect the scope ground to the 9 V battery negative line. Adjust all keyer controls to midposition. Turn S1 on and hold the key to the dot position. Watching the scope adjust R1 for a square wave presentation. Alternately place the key lever to the dash and then the dot side while watching the scope and adjusting R3 until the ratio of the dashes to the dots is about three to one. Readjust the space control, R1, for a square wave, and check the keyers performance throughout the range of the speed control, R6.

Without an oscilloscope all is not lost. You can use the audible signal produced by an audio oscillator, or one produced by your VFO or dummy loaded transmitter in a receiver. After all, the final test of any keyer is whether it sounds right. Because the PAK uses transistors in the output switch, it will be necessary to connect a diode in series with one lead of the audio oscillator. Connect the diode so that its cathode is fastened to the keyer positive output and its anode to the oscillator. The other lead from the oscillator will have a speaker or earphone in series with it and be connected to the keyer negative output. When using an audible signal, adjust the trim controls in the same sequence as when using the scope.

The connection of the PAK to your transmitter requires a little attention. Considering first connecting to a grid block keying system. In this case you will have to connect the keyer positive output terminal (Q1 collector) to ground, and the negative output terminal (Q3 emitter) to the keying line. Connection into a cathode keying system will require that the keyer positive output terminal (Q1 collector) be fastened to the keying line and the ground to the keyer battery negative buss. In both cases the base, the cover, and the panels (chassis assembly) must be connected to ground for safety and shielding.

You will find that the PAK will give you many hours of outstanding service with only one battery and its fine operation plus its custom appearance will be admired by every one who gets the opportunity to use it.

. . . K3QKO

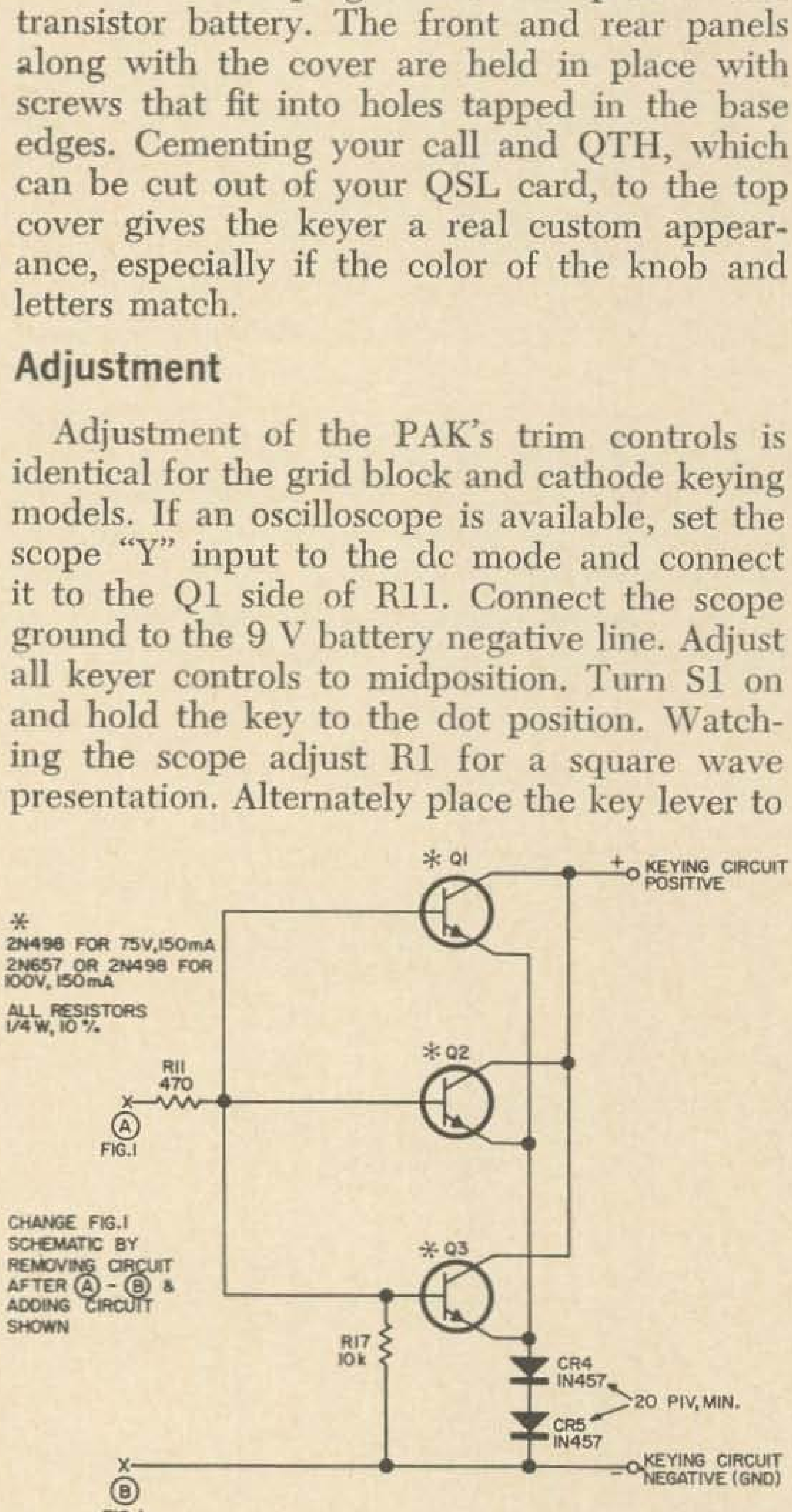


Fig. 2. Adapter for cathode keying. Replace the portion of Fig. 1 right of A-B with this circuit.

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To start on the right path, and have fun doing it, as soon as you get the February issue of any magazine, measure one inch and a half from the top and the bottom—punch holes with an ice pick, starting a file as in **Fig. 1.**

Jim is 71. He's been a ham continuously since the wireless days of 1908. He was a pioneer broadcaster in the West with KFFR and still likes to build. Almost all of his ham equipment is home made, as are his desk, benches, files, color TV and electronic organ!

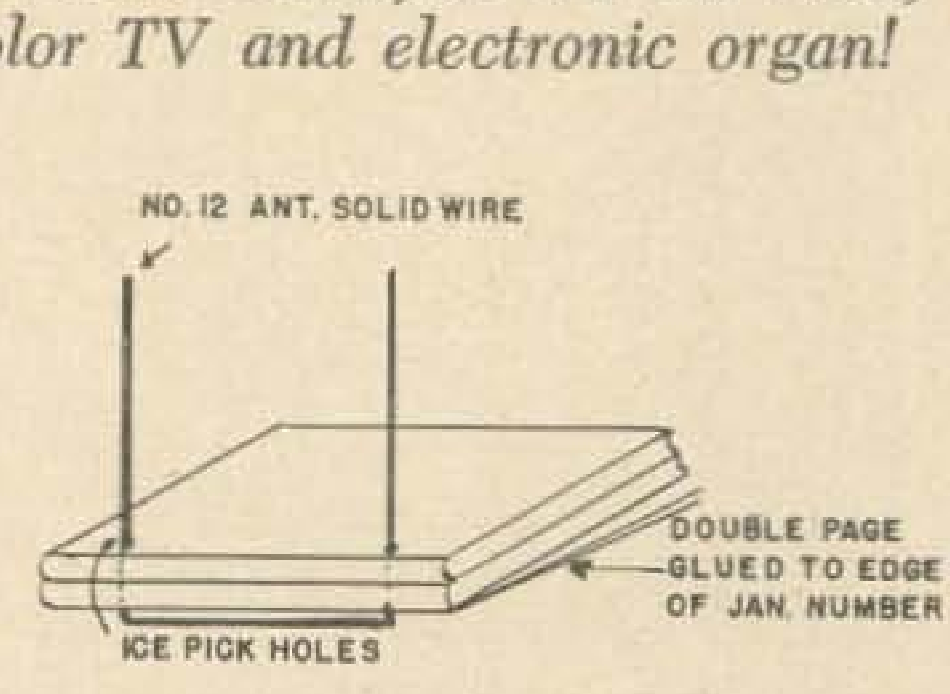

Fig. 1. Temporary magazine file.

When you receive the December issue, you have material for a book, complete with index. You can be your own bookbinder, and turn out neat volumes, improving with practice. A tip here, take an old book apart to see how it is made.

To make a book from magazines, first remove the wires you used for a temporary file, then remove the staples. A magazine such as 73 is a cinch to bind, because it consists of only one folio, stapled in the middle. Magazines put together as QST are, are more difficult, because they consist of a bunch of folios, stapled on the ends and glued together. They are not impossible, though. You remove the staples, and then separate the folios. The front cover and back of QST are one piece. I cement the cover to the first folio and throw the back away. It only contains an ad. (Forgive me, RCA).

The next step is the construction, and use, of a sewing frame (See **Fig. 2**). Glue a folded piece of heavy wrapping paper (you can get it free) to the front of the January issue and

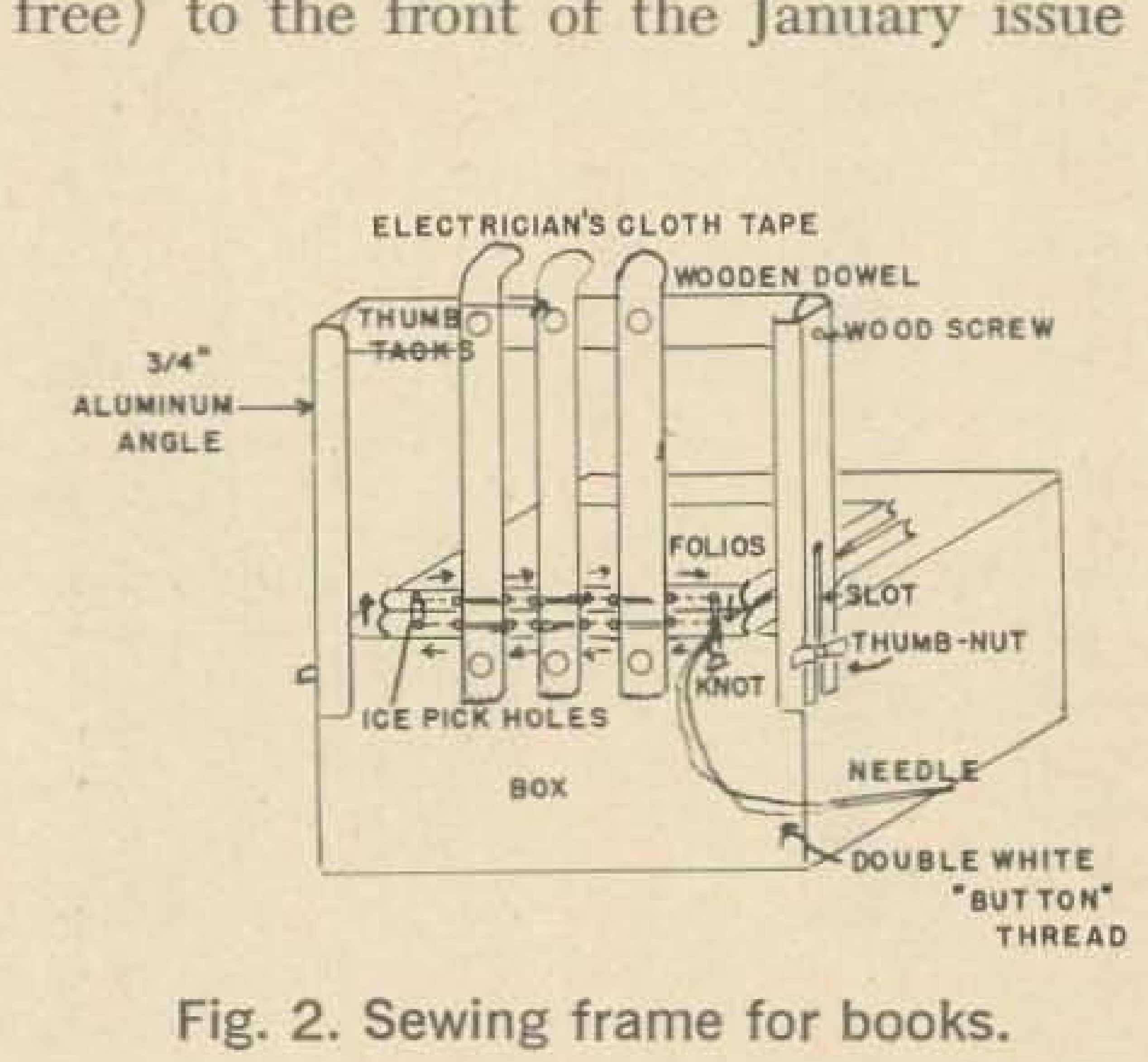

Fig. 2. Sewing frame for books.

to the back of the December issue. If you want to be fancy, an art store will sell you pretty designed paper for this purpose, although the main idea is to *buy* as little as possible. Let your motto be—Use materials at hand.

Place the first folio on the box under the frame, and punch holes in the folio with an ice pick. Sewing it with white "button" thread is easy. After you have sewed a year's issues together, place the "book" in a home made clamp, and glue the ends together, placing a bit of cloth or heavy paper to make it more solid. The glue can be glue flakes sold by hardware and art stores. You dissolve it in water and heat it on the kitchen range. (When the XYL is out) See **Fig. 3.**

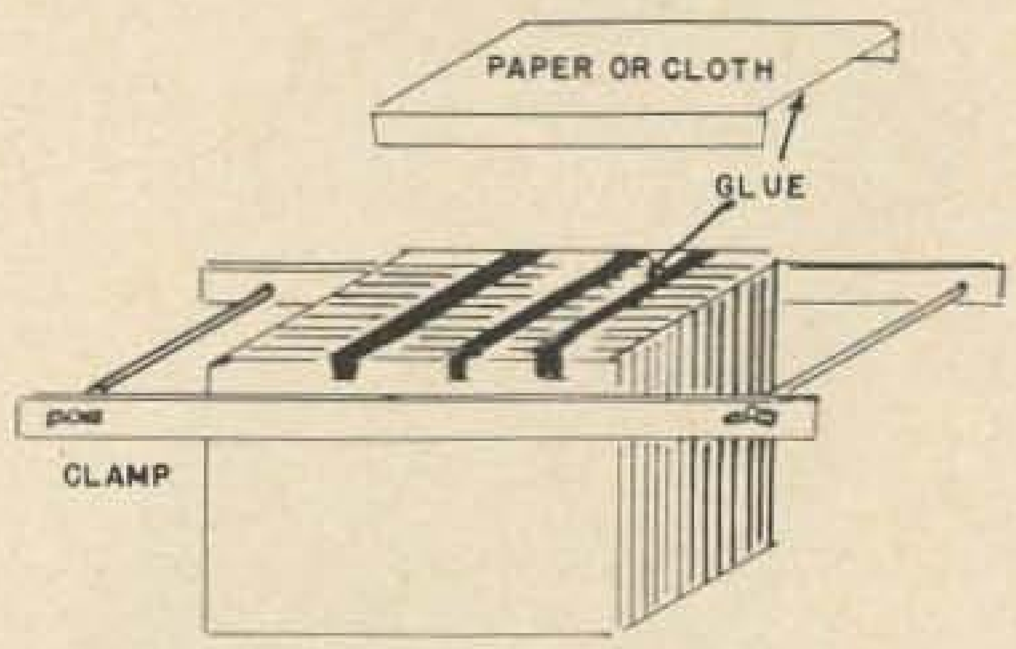

Fig. 3. Forming the book.

Buy an inexpensive piece of ⅛" cardboard (called "chipboard" in art stores). Buy black upholsterer's leatherette at a supply house. Use the thin cardboard the laundry puts in shirts for the center. (See **Fig. 4.** Take your book from the clamp, when the glue is set, and place it on the covers and glue the front and back. The book can then be pressed under some heavy surplus equipment.

When the book is done, an added refinement would be to draw the name of the book and the year, and have a glossy negative photostat made. Cement ths label on the back, making your book easy to identify. A further refinement that is extremely helpful, is to go through your book, marking articles of exceptional interest (such as this one!) with a little cardboard tab cemented to the page. This will be helpful in reviewing subjects.

. . . W6DEG

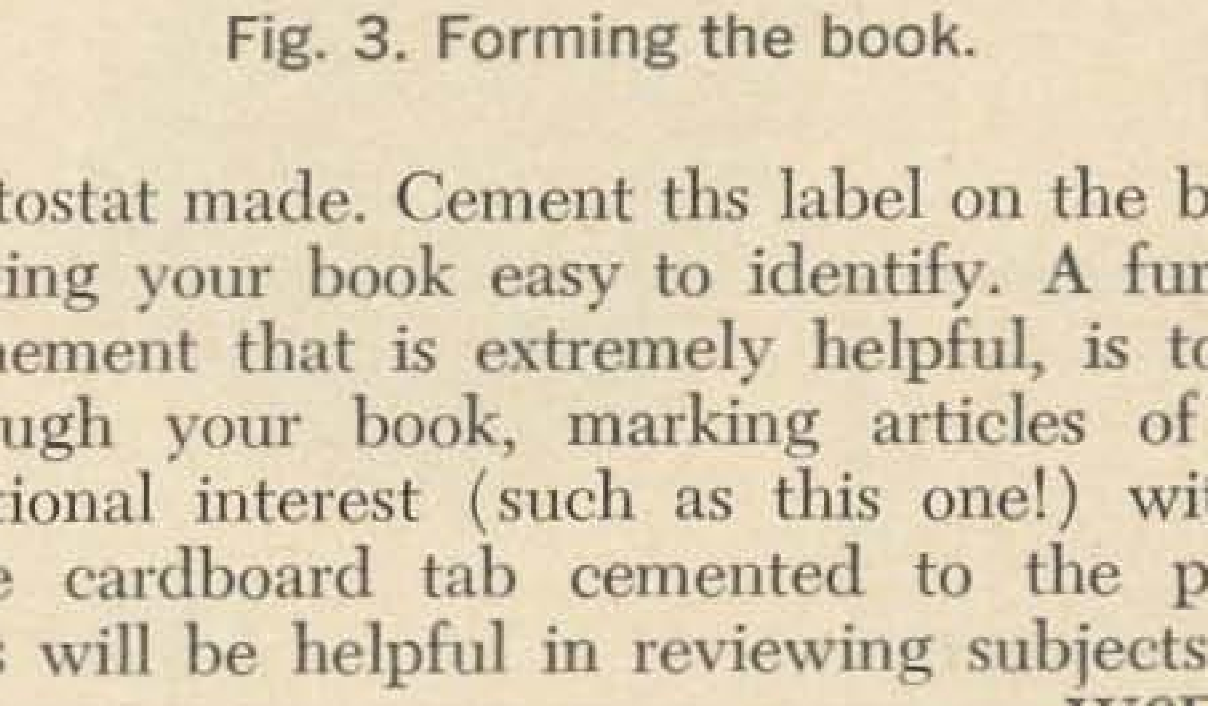

Fig. 4. Back of the book.

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A Coax Coaxial Antenna

Here are two extremely simple and inexpensive methods for constructing a coaxial antenna, which may be used for home station or field-day use.

The use of coaxial antennas has usually, except for some 10 meter commercial versions, been restricted to the VHF range because of constructional difficulties. The antenna has the same low-angle radiation characteristics and lack of feederline radiation qualities as a ground plane but is less conspicuous in appearance because of the lack of radials.

The usual base-supported coaxial antenna, made from tubing, is shown in **Fig. 1**. However, a number of "field-day" type coaxial antennas can be made using only coaxial cable. Such construction is as inexpensive as possible and allows easy suspension of the antenna from a tree or other support.

One of the earliest types of field-day coaxial antennas was a form used by the Army and called a "limp" antenna **(Fig. 2)**. The coil on the bottom of the antenna was resonated to the antenna frequency and served to decouple the shield of the coax above it, thus allowing the shield to act as the skirt of a coaxial antenna. The coil was resonated either using a calculated chart or with the aid of a grid-dip meter. The difficulty of constructing a support for the coil plus the fact that the resonance of the decoupling coil was fairly sharp detracted somewhat from the usefulness of the antenna as a military field expedient. Dimensions are given for coils for 10 and 15 meters. By the way, if anyone knows the derivation of the term "limp" antenna, I would appreciate hearing about it.

Another expedient method of coaxial antenna construction I heard about was to remove the jacket from a length of coax, loosen the shield, and then push the shield over the jacket on the remaining length of cable—thus using the shield to form a skirt **(Fig. 3)**. The idea sounds extremely simple but when I tried it, I found it to work only with the larger cables (RG-8) and then only with a great deal of effort.

In the frustrating process of trying the above method, I developed another extremely simple method of forming the skirt. Basically, the shield is slipped off from a larger size coax (RG-8) and then the shield is slipped over the jacket of a smaller size coax (RG-58 or RG-59) and used as the skirt of a coaxial antenna. The shield, when it is placed over the RG-58 or RG-59 should be stretched smooth so it will "hug" the cable jacket. This process will elongate the shield somewhat and it should be remeasured and trimmed as necessary and then taped every few feet to prevent it from changing dimension.

For a quick "field-day" setup, the jacket and shield can be removed from a piece of RG-58 to the required radiator length and the skirt (RG-8 shield) soldered directly to the RG-58 shield. However, flexing will, over a period of time, tend to break the relatively small solid conductor of the RG-58 inside the dielectric where the skirt and shield join. Therefore, for

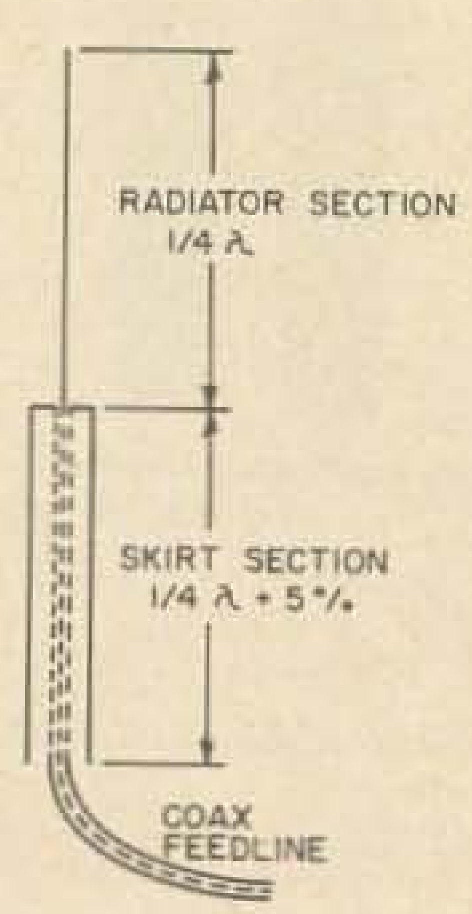
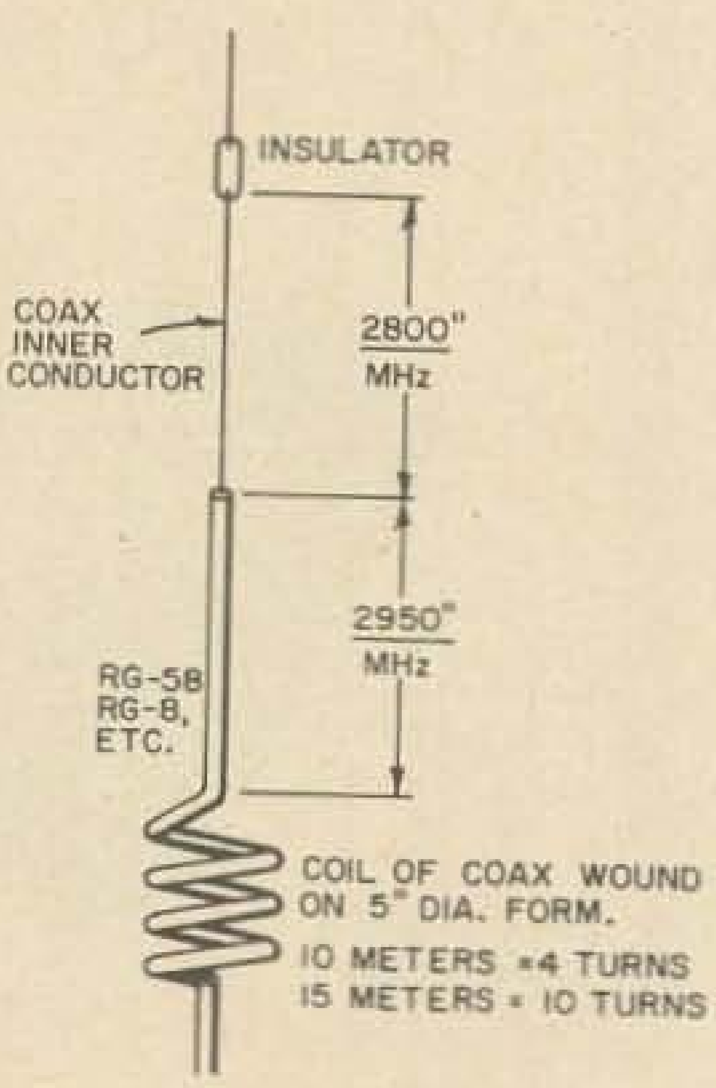


Fig. 1. Basic coaxial antenna. Making the skirt 5% longer than the radiator improves bandwidth.

Fig. 2. "Limp" type of coaxial antenna. For best results, the decoupling coil resonance should be checked with a grid dipper.



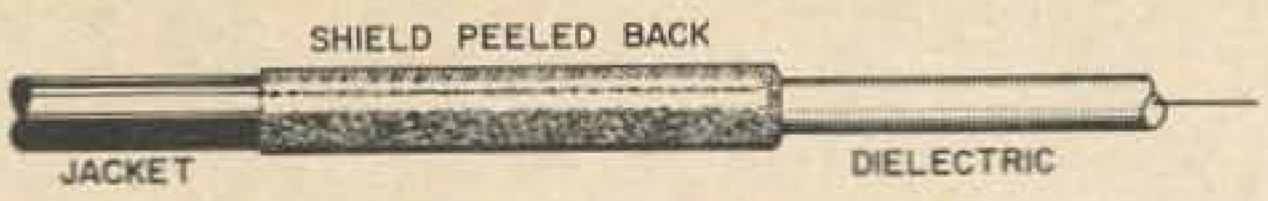


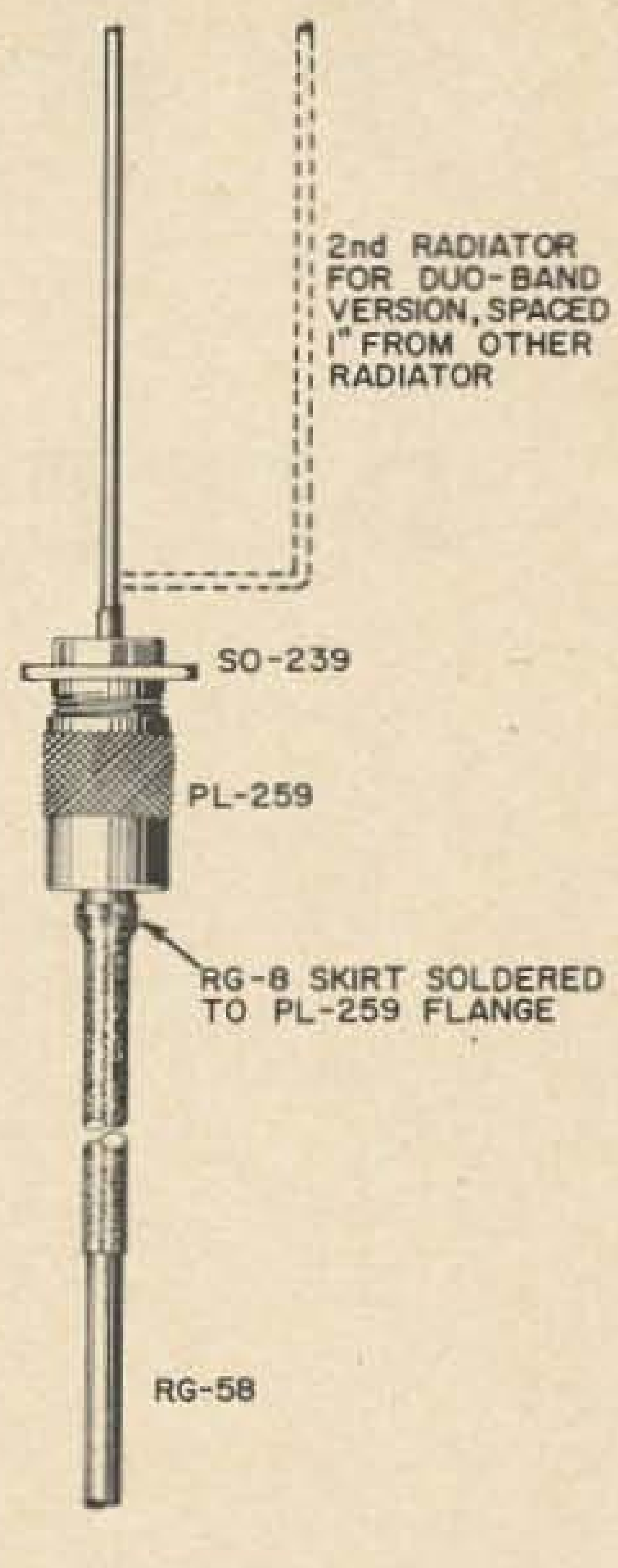
Fig. 3. Peeling the shield of RG-8/U back over the jacket makes a fine skirt—if you have a great deal of patience!

a more permanent installation, the use of a PL-259 plug and SO-239 receptacle should be used to make the joint between the radiator and skirt. The RG-58 can be connected to the PL-259 in the usual manner, using a reducer insert and the skirt soldered directly to the rear flange of the PL-259. A large solid or stranded conductor (the center conductor of the length of RG-8 from which the shield was removed or #14 copperweld) is soldered to the SO-239 to form the radiator section (**Fig 4**).

After using an antenna of this type on 15 meters for some time, I decided to make a dual-band version for 10 and 15. My first thought was to place another skirt for 10 insulated from and over the 15 meter skirt and add a 10 meter radiator section in parallel with the 15 meter one. Although coax is available to do this type of construction, I first tried adding only the 10 meter radiator section. The SWR was low (1.7 to 1) on 10 and the antenna performed well enough that I completely forgot about adding the additional skirt. For perfectionists, however, RG-14 seems to provide the next usable shield size!

The coaxial antenna should, of course, be vertically mounted for an omnidirectional pattern. However, there is no reason why it can't be used horizontally also as a temporary

Fig. 4. Use of a PL-259 and SO-239 to make connection between skirt and radiator. Dimensions are as shown in Fig. 2.



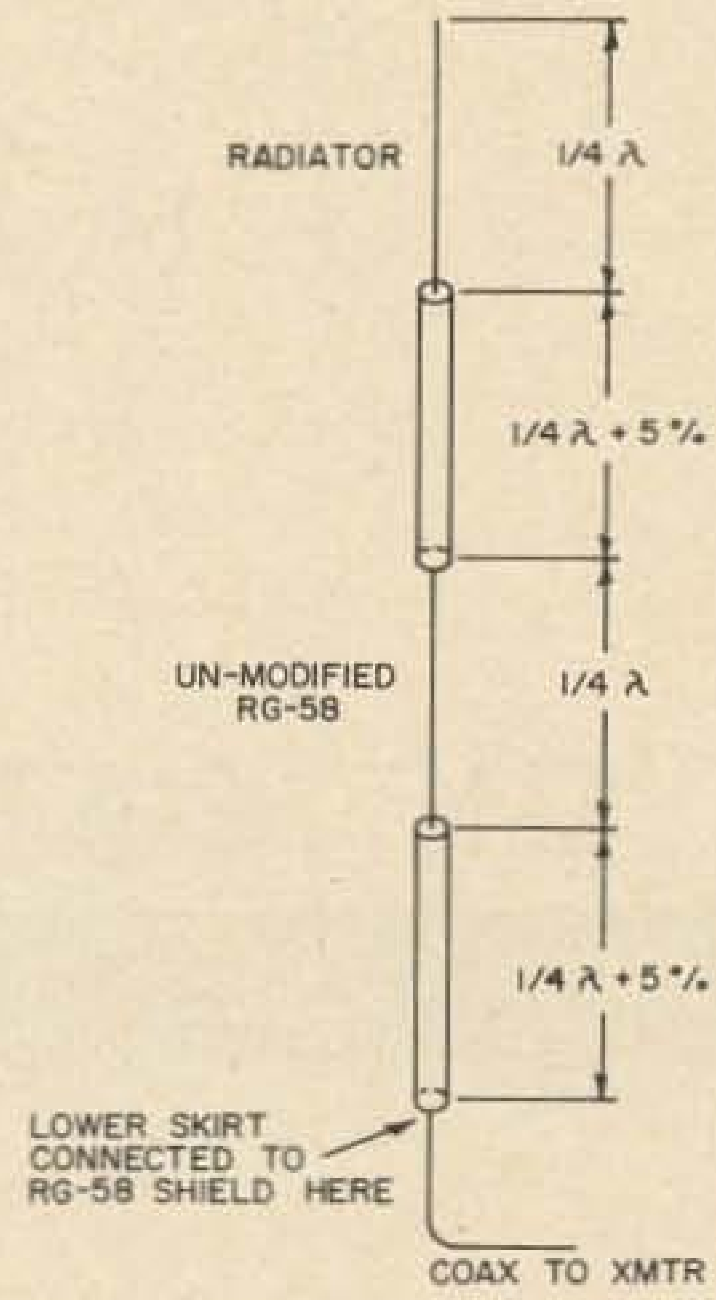


Fig. 5. Basic details of the double-coaxial antenna.

antenna. The pattern will then be basically the same as a center fed dipole at the same elevation. For experimenters who have a bit of space, there is always the double coaxial antenna which will further improve low-angle radiation (**Fig. 5**). Note that the *lower* skirt is connected to the RG-58 at its *lower* end.

... W1DCG

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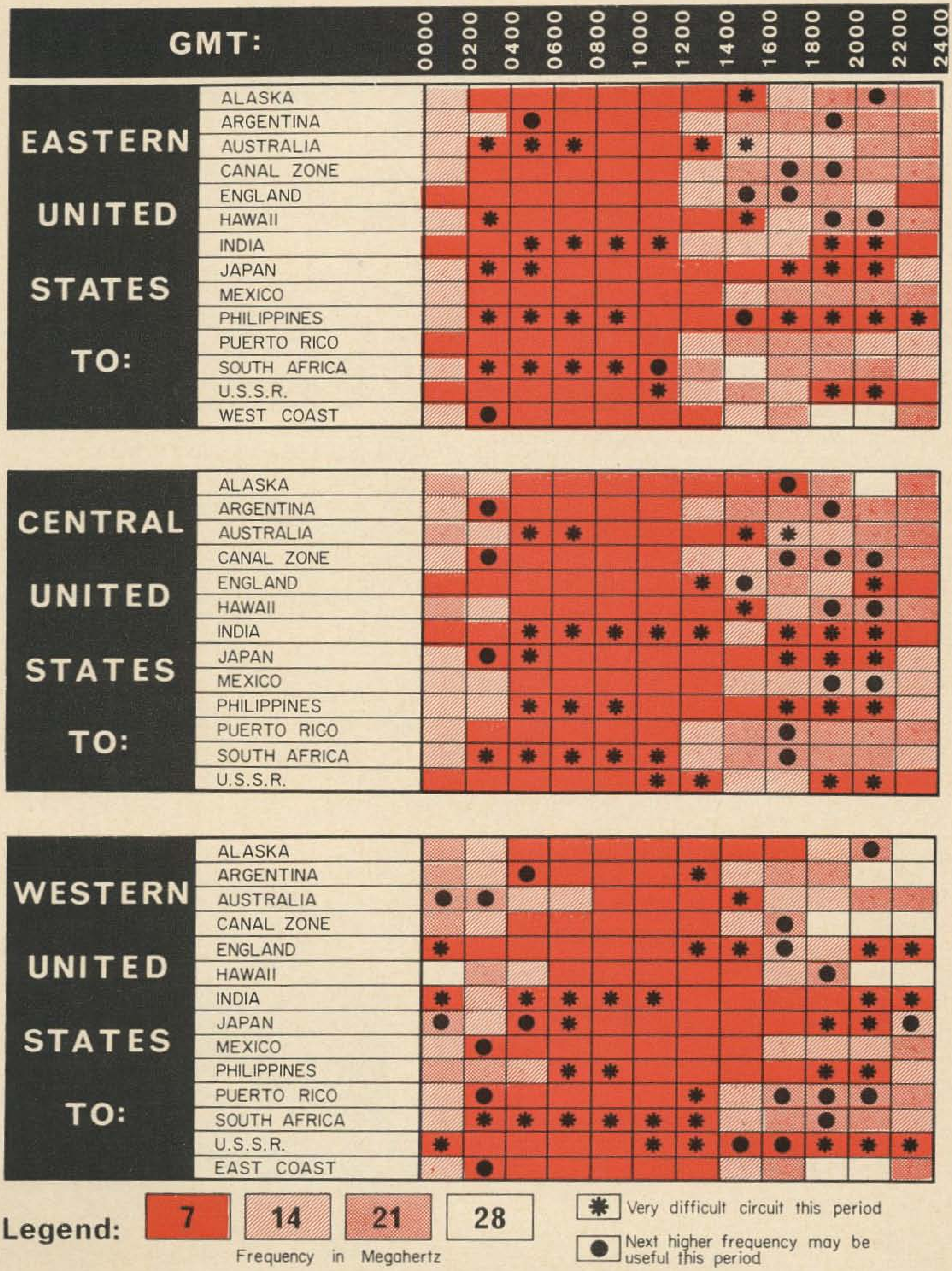


Richard Factor WA2IKL
115 Central Park West
New York, New York

Cheap DC To DC Conversion

Need about an amp at 24 volts in your car? Like to run your 12 volt radio in your Volkswagen? This is for you.

In mobile operation, it is frequently desirable to increase the battery voltage to some higher value. Although this article will specifically describe a unit for converting 12 V to 24 V, the circuit can be used for other voltages up to about 35 with a power limitation of about 125 watts. The particular unit described is being used to power a transistorized transmitter which wouldn't draw sufficient current with 12 V input. A smaller unit could be built to run a 12 V receiver in a Volkswagen, a larger one to power some of the surplus 28 V equipment on the market. The circuit is unusual in that it uses no rectifiers to change the ac to dc. In fact, it can be made to work with only three components!

When I said that the circuit uses no rectifiers, I was being somewhat misleading. In actual fact, the transistors that do the oscillating also do the rectifying. To see how this can come to pass, let's look at the circuit: Assume Q1 has just been turned on. There is a current in the upper half of the primary and 13 volts is being developed in each half of the feedback winding. Summing voltages around the circuit, we have 13 volts between A and B, −1 volt between B and C (because of the forward conduction of the emitter diode), and 12 volts (the supply voltage) between C and D. This gives a total of 24 volts between A and D. Although there is 13 volts developed in the other half of the feedback winding, it is not conducted because the emitter diode of Q2 is reverse-biased. When the core saturates, the current in the feedback winding reverses and turns on Q2.[1] The relative polarities remain the same, so there is 24 V dc between A and D, with the two transistors acting as a full wave rectifier. C1 is a filter ca-

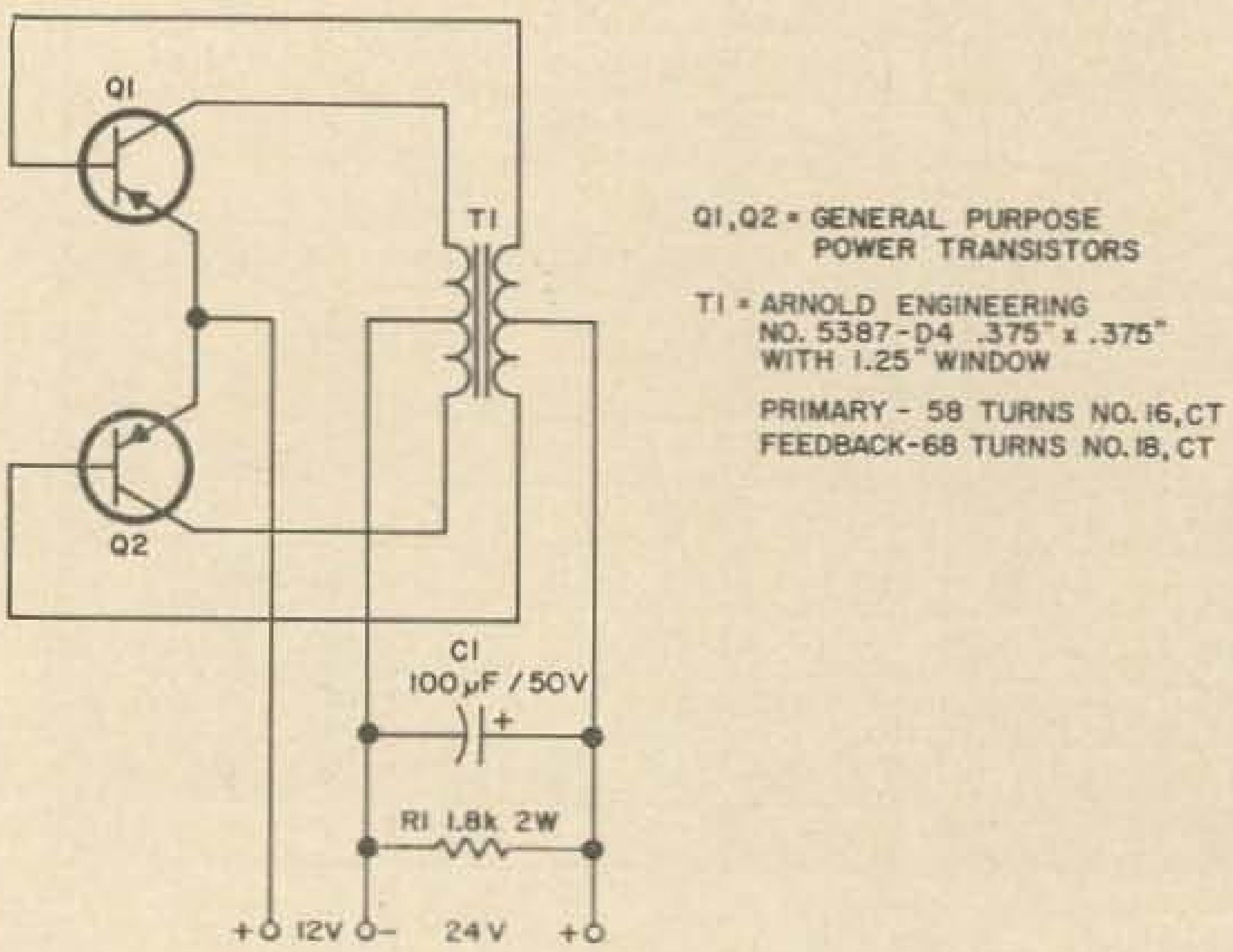
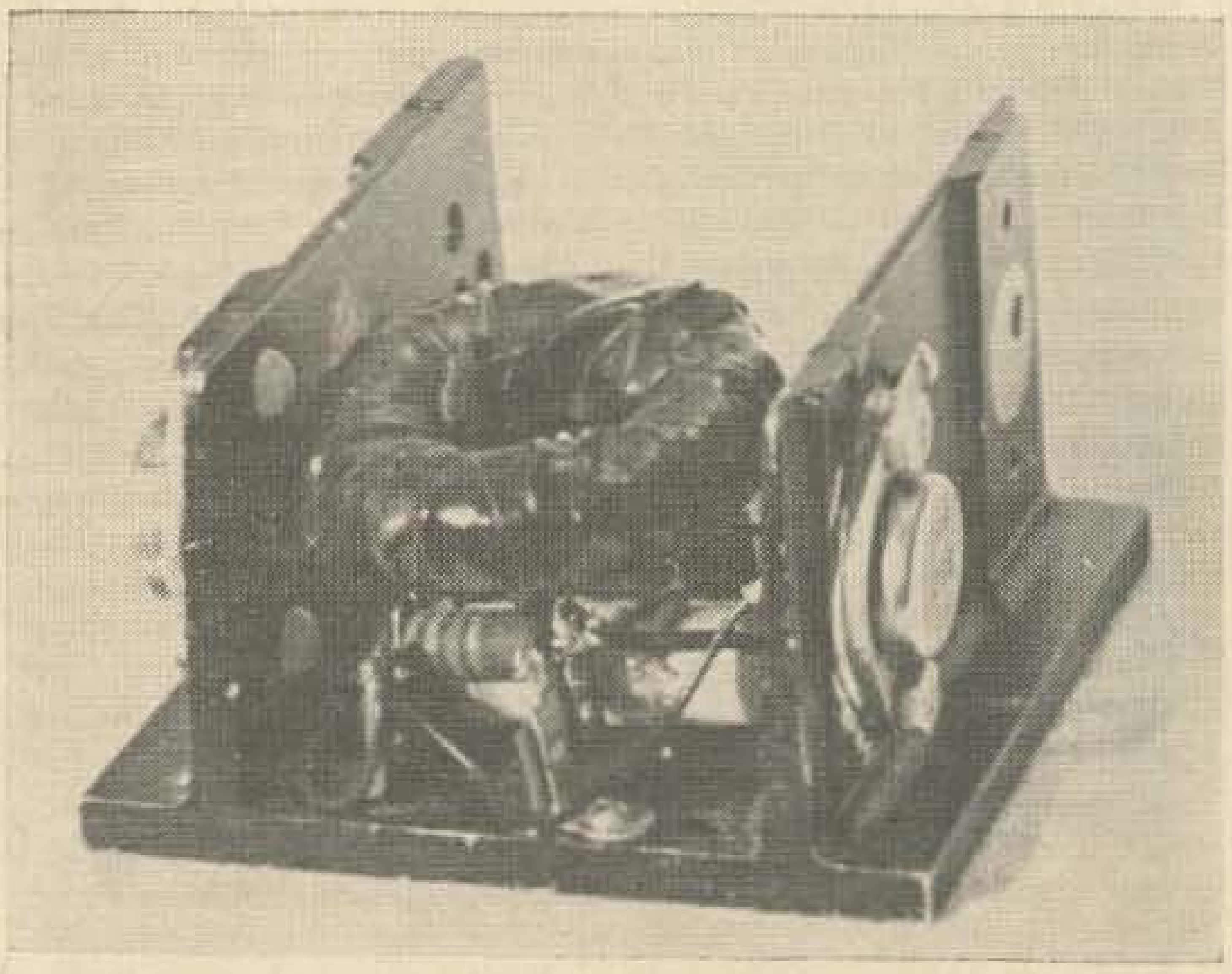


Fig. 1. Schematic diagram of the 12 to 24 volt converter. It's good for about 1 ampere output at 24 volts.


Here it is. The heat sink came from Meshna (#223) and cost 45¢.

WTW News

Gay Milius W4NJF at his station in Norfolk, Virginia. Gay sent in the first 100 cards for WTW and earned WTW Certificate Number 1. Besides his DXing activities, Gay serves as stateside QSL manager for several harried DX stations.

Worked the World

Certificates issued to 15 November 1966

SSB WTW-200	1. Bob Wagner W5KUC
SSB WTW-100	1. Gay Milius W4NJF
	2. Bob Wagner W5KUC
	3. A. B. Hopple W3DJZ
	4. Bob Gilson W4CCB
	5. Jim Lawson WA2SFP
	6. Joe Butler K6CAZ
	7. Warren Johnson WØNGF
CW WTW-100	1. Vic Ulrich WA2DIG

Bob Wagner W5KUC qualified for the first WTW-200 Certificate when he sent in over 200 cards from countries worked since May 1st. A superb job of sorting out the rare ones; I wonder if that four element beam at 170 feet might have something to do with it?

---

pacitor and R1 is for easier starting under no load.

Transformer design can be found in an article by K2BQK.[2] I used the same core he did, which was an Arnold Engineering 5387-D4. If you wish to design for different voltages, remember that an extra turn or two should be added to the feedback winding to compensiate for circuit losses and voltage drop in the emitter diode. Most of the precautions normally taken for preventing high voltage damage can be ignored since there is no high voltage present. Both windings were wound directly on the core using the spaces between one winding for the other. The toroid was then covered with one layer of electrical tape and mounted by its leads on two terminal strips.

As can be seen from the schematic (**Fig. 1**), the entire dc output current flows through the bases of the transistors. Since the base current rating of most power transistors is one third to one fifth that of the collector current, the most economical use of this circuit would be to multiply the voltage about four times. If you need 24 V in a 6 V car, you're in luck. If you want 24 V from 12 V, the circuit will be just as efficient but part of the capability of the power transistors is wasted since the collector current must be limited to twice the base current. Since I paid 29 cents for the pair, I don't feel too guilty. If substantial power is required (over 30 watts), it is necessary to use auto radio transistors such as the 2N174 or 2N443. It is not recommended that the output voltage be greater than 35 unless you're sure that the transistors can withstand the voltage. It might be a good idea to put spike suppression capacitors from the base to the emitter of each transistor in this case.

To those of you to whom 24 volts in the car is about as useful as one tube of epoxy, you can build one to amaze and mystify your friends.

. . .WA2IKL

[1]For a more extensive theoretical development of the saturated core oscillator, see *D. C. Transformers,* B. E. Harris, W6ANU; 73, Oct. 65, P. 102.
[2]*Design and Construction of Mobile Power Supplies,* QST, April 1960.

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The First WTW Award went to Gay Milius W4NJF. See next page for more on the WTW program.

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Sam Kelly W6JTT
12811 Owen Street
Garden Drive, Cal.

Storage Batteries

Whether you use new or surplus storage batteries, this article will provide you with much useful data.

Storage batteries have been with us a long time. The Babylonians used them, but Allesandro Volta rediscovered the galvanic battery in 1800, and Gaston Plante came up with the first lead acid storage battery in 1859.

Until the advent of the solid state age, amateur use of storage batteries was usually limited to trying to re-charge the family car battery, or a once a year cumbersome field day exercise. Inexpensive surplus storage batteries have made really portable operation not only within the means of the average ham, but a real pleasure.

Two types of storage batteries are generally encountered on the surplus market: Lead acid, similar to your car battery, and alkaline storage batteries. The most common alkaline batteries are the nickel-cadmium and the nickel-iron (Edison) cells.

When buying a surplus battery carefully inspect the case for cracks. Check the terminal posts for looseness or signs of internal damage. Remember, there may be a good reason for Uncle Sam to sell the battery! Buy the most recent battery possible (if they are dated). The negative plates of dry charged lead-acid batteries tend to oxidize rapidly on exposure to moist air, so look for the ones that still have the seals over the filler plugs.

To get the best performance and life out of storage batteries requires careful maintenance and charging techniques. Dirt, corrosion and mechanical damage all shorten the life of a battery.

Terminal corrosion is best removed with a stiff fiber brush. After the corrosion is removed, wash the battery with water containing a mild detergent, and rinse with plain water. After replacing the connectors, coat the connectors and terminals with a light coat of cup grease or petroleum jelly to prevent further corrosion.

Connectors should be the proper size to provide maximum contact area with the battery terminals. Remember, lead has about 12 times the resistivity of copper! Always loosen and spread the connector for easy fitting. Never drive connectors on with a hammer or mallet as this may cause internal battery damage if it doesn't crack the case.

It is necessary to use completely separate sets of hydrometers and syringes for lead-acid and alkaline batteries. The alkaline cells are readily damaged by impurities, especially acid. The Army even insists that completely separate sets of tools be used.

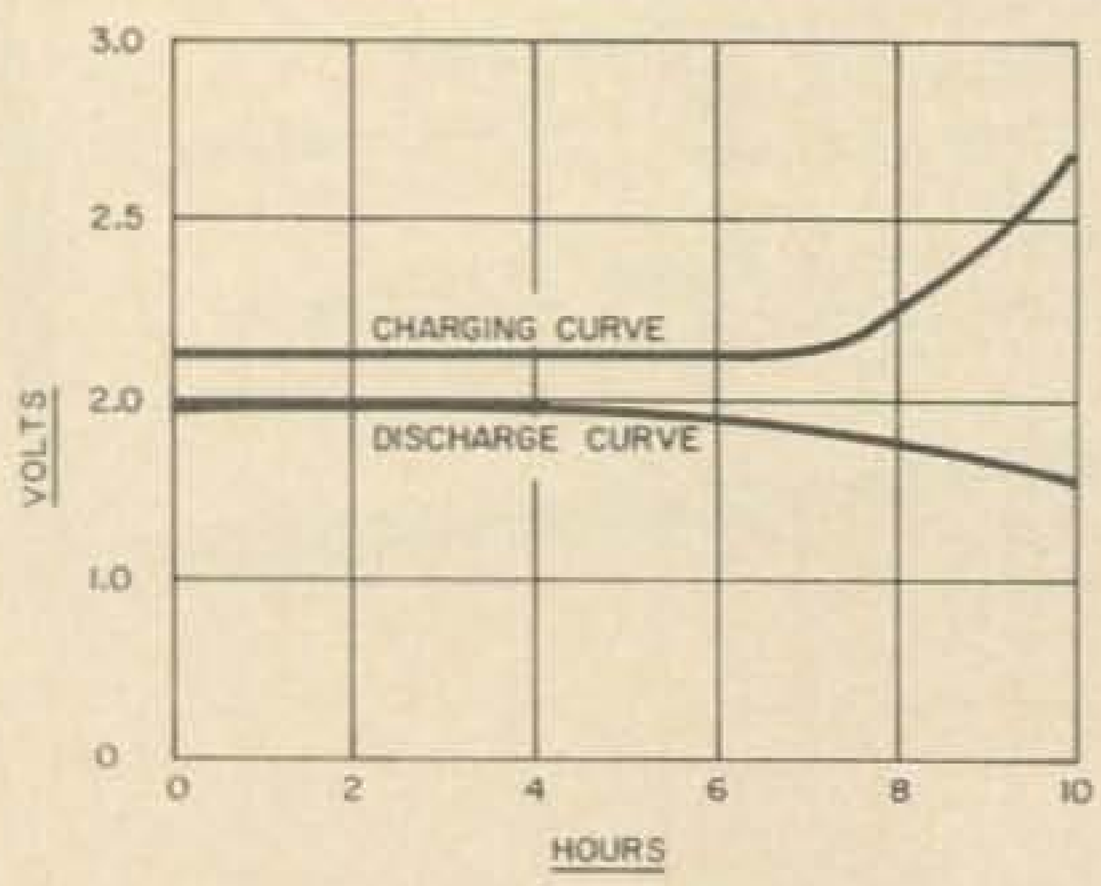


Fig. 1. Charge and discharge curves for lead-acid cells.

Sam is an electronics engineer for the Interstate Electronics Corporation. He has a BSEL from California State Polytechnic College and enjoys high frequency ham construction.

The electrolyte should be kept at the recommended level. If electrolyte is lost by spilling, replace it with electrolyte. If the loss is due to evaporation or electrolytic decomposition bring the level up with distilled water. Don't use tap water as it may contain mineral impurities harmful to the battery.

Lead acid batteries

These are by far the most common surplus batteries. The small 6 volt Sniper Scope units, and the cased 4 volt Marine Corps walkie-talkie units are most desirable. Most of these batteries come dry charged. Dry charged batteries are activated by addition of sulphuric acid electrolyte. This is usually available at local battery shops. The most common specific gravity is 1.280. The electrolyte should be at least 60 degrees F before filling. Fill slowly until the electrolyte fills about half the battery. Allow the battery to stand for 15 minutes. Tap it gently several times during this period to release the trapped gas. Continue to fill with electrolyte to the operating level. The battery should then be placed on a constant voltage charge (2.5 V/cell) until it is fully charged.

Battery life is largely determined by the charge-discharge cycle, charging at too high a rate will cause the battery to heat up rapidly and gas excessively. This can damage the separators and buckle the plates destroying the battery. A temperature corrected hydrometer is desirable for checking electrolyte specific gravity during operation and charging. An approximate state of charge can be found from the specific gravity. For most high discharge rate batteries, a specific gravity of 1.280 represents full charge, and 1.100 completely discharged.

For constant voltage charging, the voltage should not exceed 2.75 volts per cell. For constant current charging the current should be approximately 10% of the rated battery capacity.

Alkaline batteries

Nickel-cadmium and nickel-iron (Edison) are the two alkaline cells commonly found on the surplus market. They have the same positive plate material and use the same electrolyte (Potassium Hydroxide).

Unfortunately, all of the Edison cells I have found in surplus stores have been badly damaged. Thanks to design changes in certain anti-aircraft missile systems there is a good supply of new, small nickel-cadmium cells. These cells are of two types, the hermetically sealed type containing electrolyte, and the

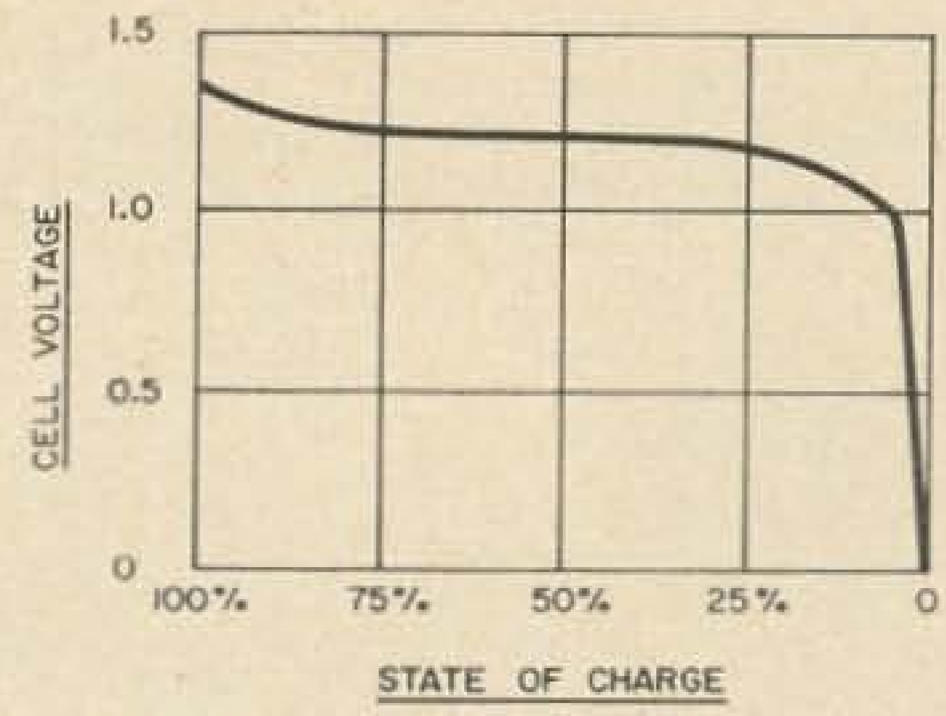


Fig. 2. Typical discharge curve for nickel-cadmium cell.

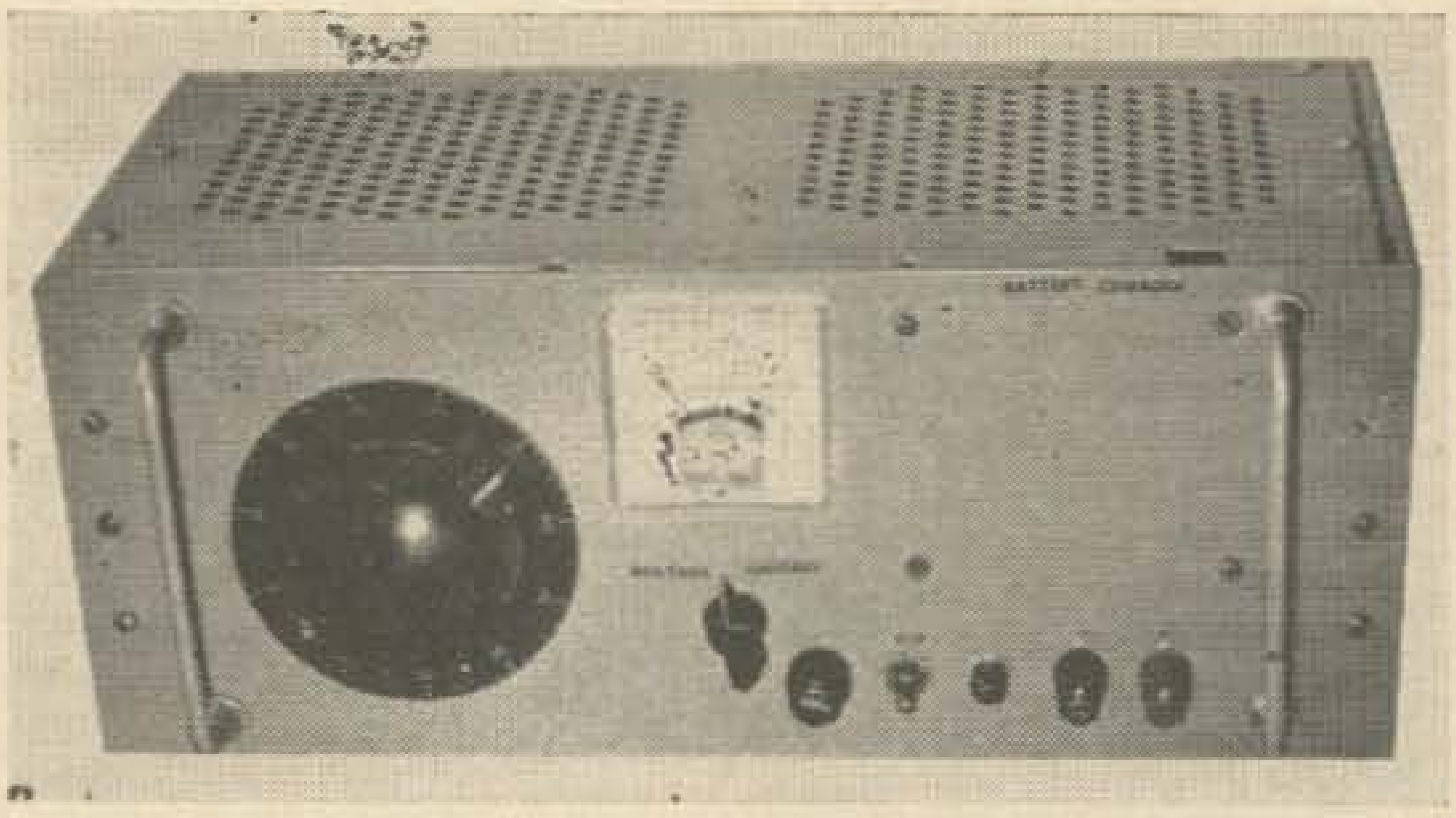
dry charged type. If you get the dry charged type you will have to obtain vent plugs to replace the shipping plugs or you will rupture the cases on charging. Vent plugs are packed in the carton with the cells, but they have a habit of getting lost in surplus stores.

The potassium hydroxide electrolyte can be obtained from three sources: 1, Surplus. The electrolyte is packed in cartons ready for use. Read the label carefully. It should have federal stock number FSN-6810-543-4041 printed on it. 2, Chemical supply houses. It can be ordered as a powder or in tablet form. Order potassium hydroxide, reagent grade and specify that it is for batteries. You will need distilled water to dilute it to the proper specific gravity. WARNING: Always add the potassium hydroxide to the water, never the water to the potassium hydroxide! Proceed slowly. The chemical reaction liberates heat which can cause the solution to splatter if you aren't careful. Both the chemical and the solution are highly caustic. They will do a fine job of dissolving skin. It is quite poisonous so store it carefully out of the kids reach. Mix according to the directions, or approximately 9 ounces of the powder to a quart of distilled water. The specific gravity of the solution should be 1.32. Check it with a hydrometer, *but* not the one you use for lead acid batteries! 3. Your local druggist can make up small quantities for you.

Fill the cells to the level mark, or just above the top of the plates using an electrolyte syringe or a large eye dropper. Tap and squeeze the cells to release the trapped air. Allow the cells to stand for at least 15 minutes before charging them.

A rule of thumb is to charge the cells for 15 hours at a rate equal to 10% of their rated service capacity (for a 10 amp cell the charging rate would be 1 amp for 15 hours). The final charging voltage will be 1.45-1.50 volts.

Since it is very difficult to determine the state of charge of these cells it is advisable to charge used cells in this manner before use.



Front view of the home-brew 10 A battery charger shown in Fig. 3.

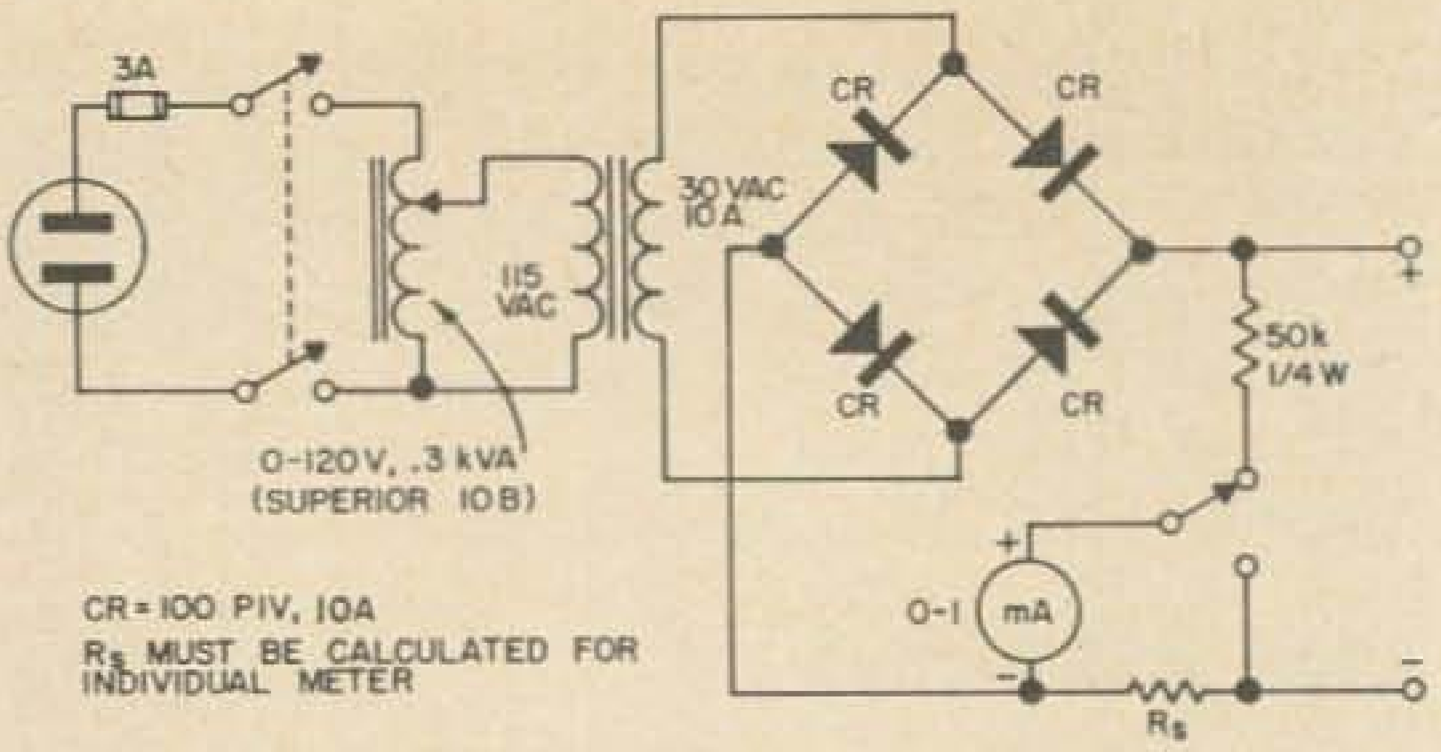


Fig. 3. Battery charger schematic.

After charging the cells let them stand two to four hours before adding distilled water (if necessary) to adjust the electrolyte level.

The cells are rated at 1.25 volts under nominal load. Open circuit voltage of fully charged cells runs about 1.33 volts. The voltage when loaded to the ten hour discharge rate ranges from 1.2-1.35 volts depending on state of charge. The state of charge cannot be determined by measuring the specific gravity of the electrolyte. One method is to measure the cell voltage under load. The standard ten hour discharge rate is normally used. Table 2 shows the approximate relation of cell charge to cell voltage. As you can see from figure 2, this is a very flat discharge curve. A more accurate way is to measure the current flowing into the cell when it is connected to a constant 1.50 volt source. If the current is less than 5% of the 10 hour rating you can assume that the cell is fully charged.

Paralleling of nickel-cadmium cells to increase the current capacity of the battery is not recommended. The internal resistance varies sufficiently so that it is difficult to prevent cells from over charging, failing to charge, and from reversing polarity.

Charging

Two methods of charging are commonly used for either lead-acid or alkaline batteries. They are the constant voltage and constant current methods.

The constant voltage method is the easiest to use providing the charger has adequate capacity. Initial charging rates for a fully discharged battery are high, running from 3-5 times the 10 hour rate for nickel-cadmium batteries, and 6 times the finishing rate for lead-acid batteries. The advantage of constant voltage method is that it is difficult to over charge the battery.

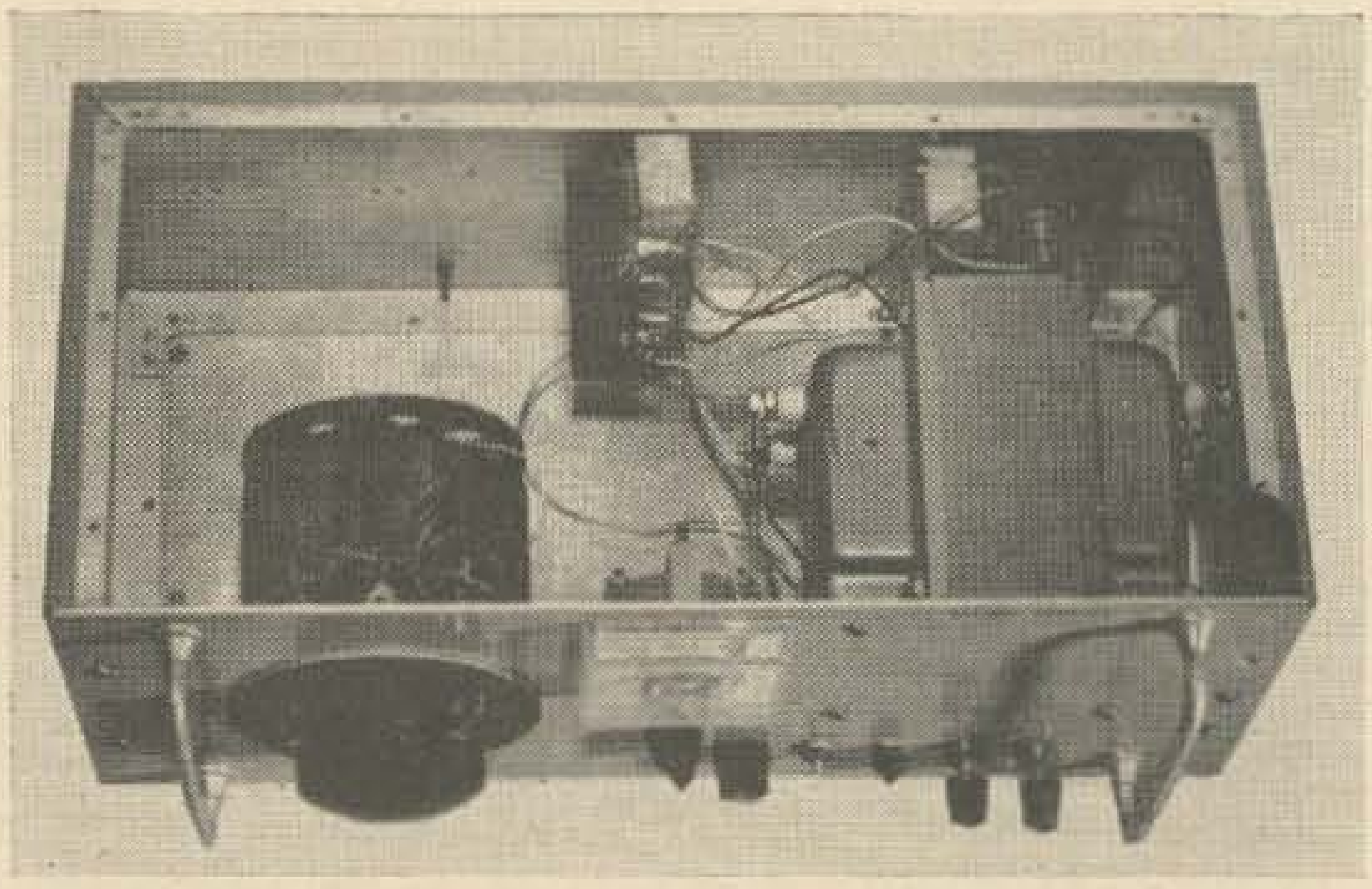
When using the constant voltage method on lead acid batteries you can take advantage of the "quick charge" technique used by service stations. A high percentage of the charge can be put back into the battery in a short period of time—if you are careful. The rule is to keep the charging rate (in amperes) less than the number of ampere-hours out of the battery. For example, if you have used the battery for two hours at a five amp rate you can charge it at a 10 amp rate.

When using the constant current method care must be taken to prevent over charging. For lead acid cells this can be done by checking specific gravity of the electrolyte. For nickel-cadmium cells charge at the rated current until the cell voltage reaches 1.45-1.50 volts.

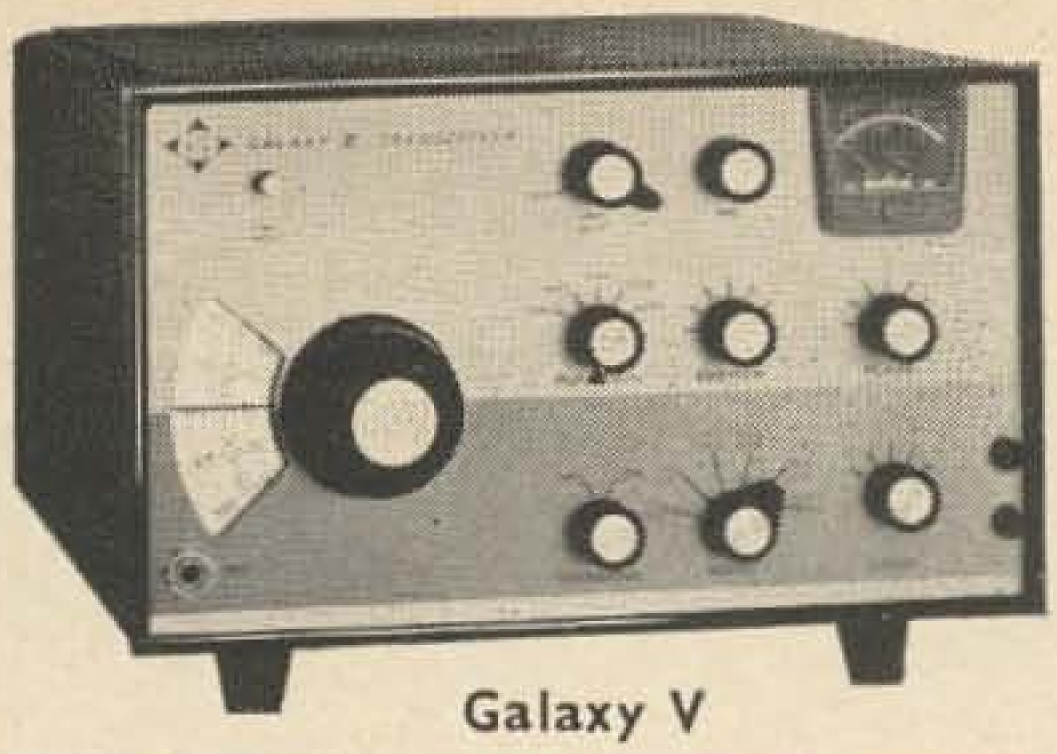
Fig. 3 is the schematic diagram of the battery charged. It is a simple bridge rectifier device built into a case made from a BC-375-E tuning unit. A Variac provides continuous voltage adjustment, while the transformer provides isolation and voltage step down. All components except the rectifiers are mounted to the front panel. The rectifiers, on insulated heat sinks, are mounted to the cabinet. The meter serves a dual purpose, reading either voltage or current.

A three wire power cable is used to provide added safety. This unit was built for less than half the cost of a 10 amp commercially built home type charger.

. . . W6JTT



Interior of the battery charger showing parts layout.



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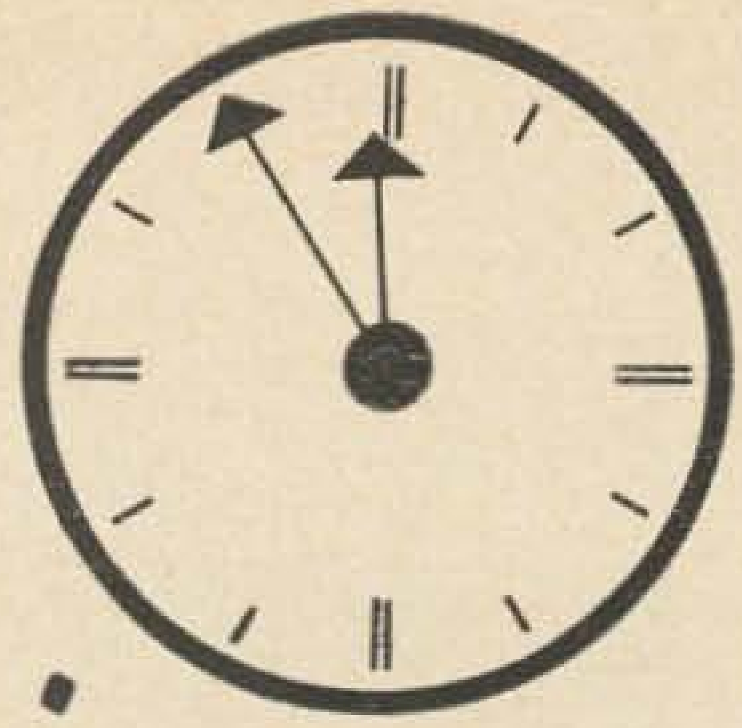

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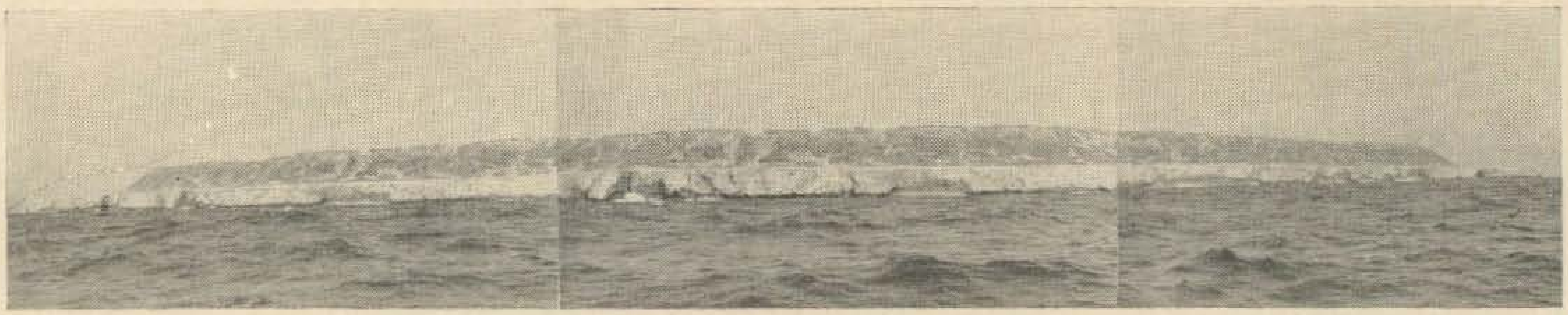
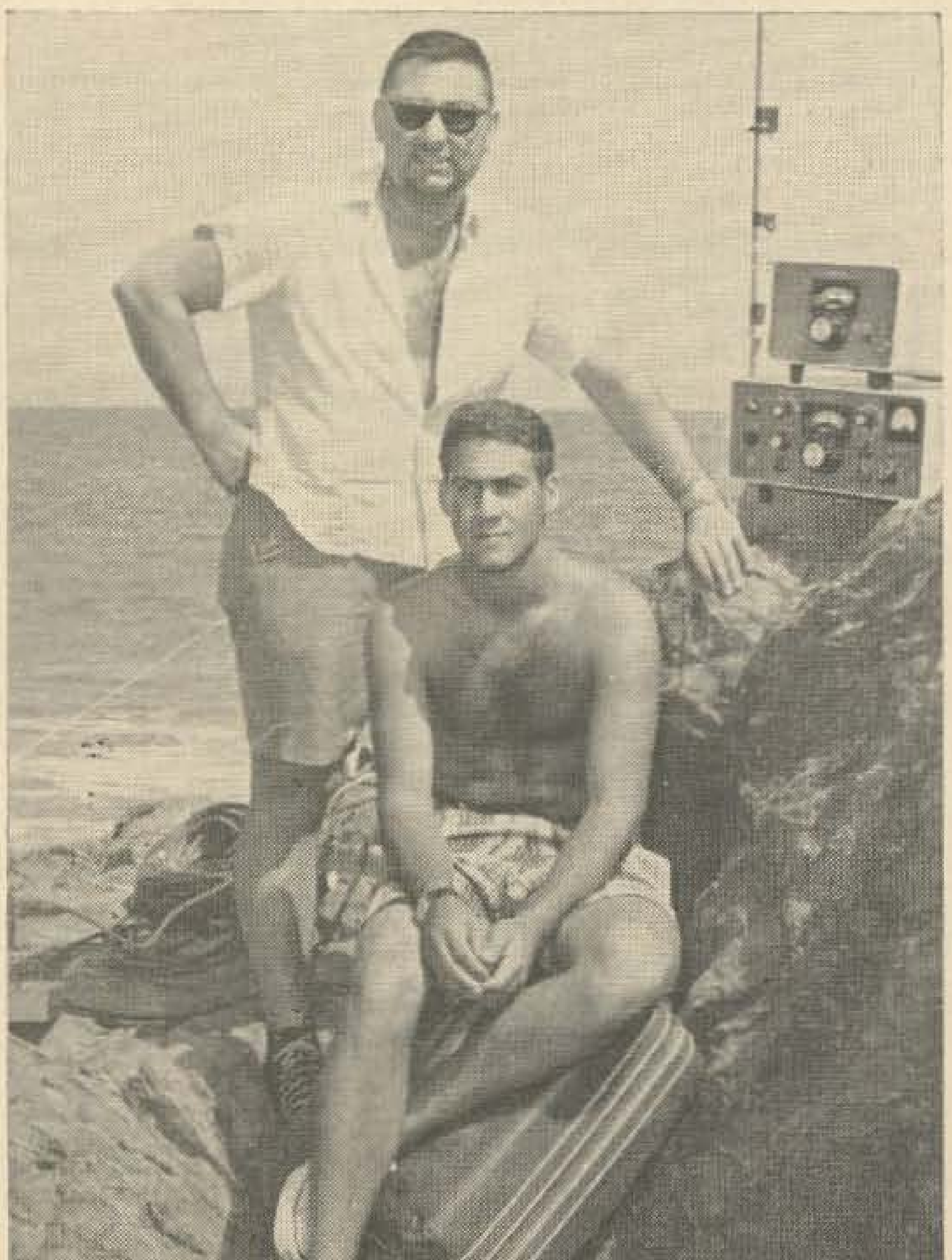


Wayne Green KC4AF

Navassa Revisited

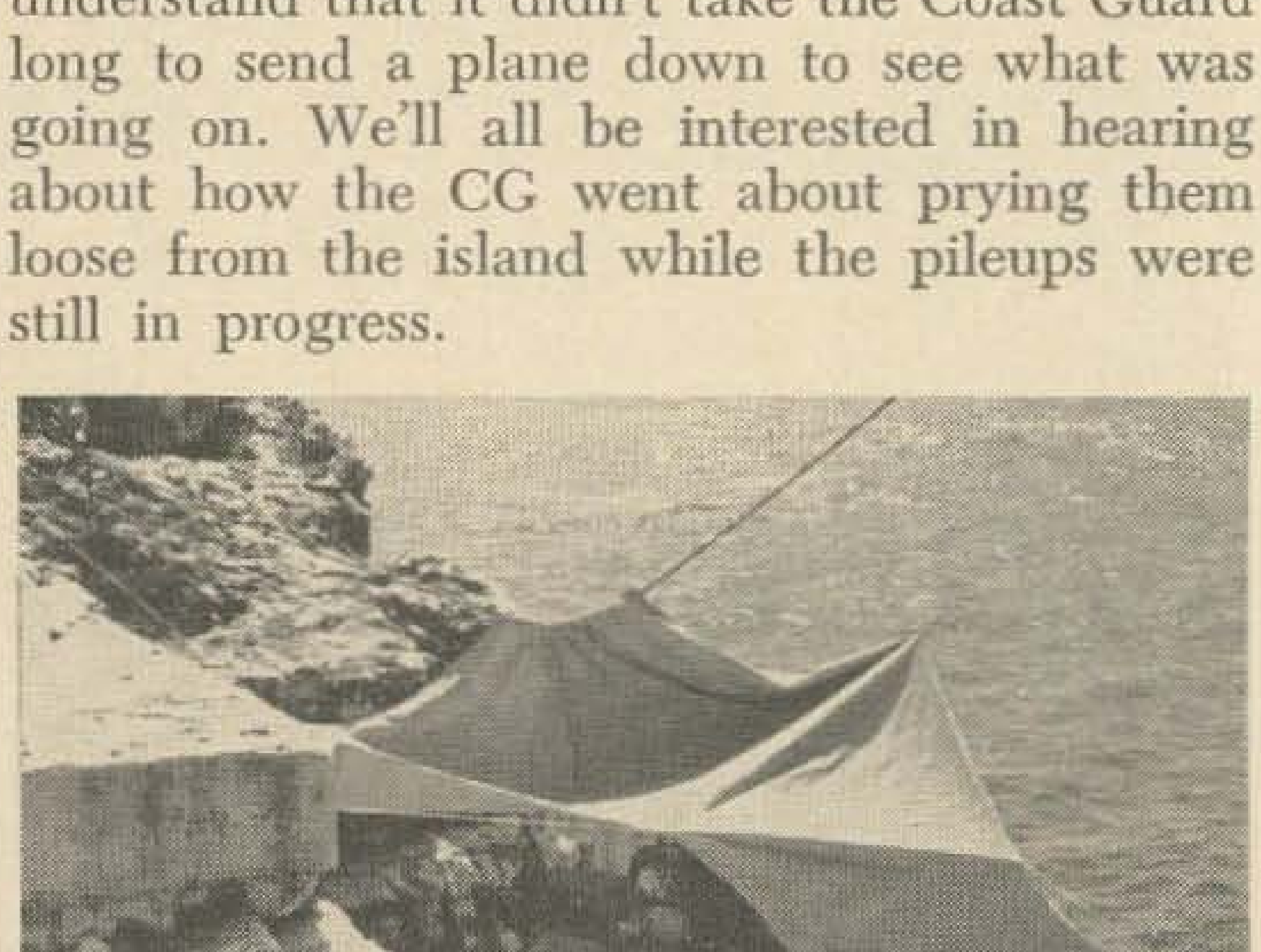
For about two years now I've been trying to get the U.S. Coast Guard to give permission for me to return to Navassa Island for a short DXpedition. They have steadfastly refused, giving no real reason for the refusal. Dick, WØMLY, has been after them about this, too, and he believes that the problem is a 75 meter phone ham among the top echelon of the Coast Guard who has decided that DXpeditioners can just drop dead. I find this hard to believe, but I do admit that we have been faced with what has seemed like a senseless decision to keep DXpeditions off Navassa.



Don W9WNV (standing) and Herb K1IMP

Navassa is a small island about one mile in diameter lying between Jamaica and Haiti in the Caribbean. It has no beach and can only be mounted by climbing a very difficult steel-rope ladder set in a slight indentation in the otherwise unbroken cliff that runs all around the island. Fortunately for us hams the Coast Guard has a winch set up. Back in 1958 when six of us mounted Navassa (with Coast Guard permission) we hauled our gear up with this winch. At that time I got the call KC4AF. The station was set up and operated for four days and made over 7000 contacts during that time.

No one has set up on Navassa since our little visit in 1958 and by now quite a few fellows "needed" Navassa. Don Miller W9WNV decided not to wait around for the Coast Guard to give its permission. He and Herb Kline K1IMP stopped off there for a short visit and signed K1IMP/KC4 instead of getting a regular KC4 call, which is only available with Coast Guard permission. We'll get the full story of their visit later, but I understand that it didn't take the Coast Guard long to send a plane down to see what was going on. We'll all be interested in hearing about how the CG went about prying them loose from the island while the pileups were still in progress.



Operating position on Navassa

Notice the defaced government property. For shame!

Don reported that he looked all over for my W2NSD call letters on the landing spot so he could blank them out with his. Heh, heh! I didn't put my call there, just on the photo I printed on the cover of CQ at the time. Don came armed with a big bucket of paint and I see by the photos that he and Herb did put their calls all over everything. Tsk, tsk, fellows . . . defacing government property.

. . . Wayne

This is a shot on the St. Peter and St. Paul Rocks (PYØXA), another recent Miler DXpedition

Swan 350

Happiness Is A Swan On Christmas

I have written a great deal about Swan in the past year, my ads having appeared in 73 Magazine, and other magazines as well. Suffice to say that I consider Swan to be the overwhelming choice in America today for small transceivers More Swans have been sold than all of the other brands put together and this is not an exaggeration. The fundamental reason why America has taken to Swan is the fact that you get the most for your money in this set—the maximum frequency coverage, the most power, and the greatest choice of options on accessories. Swan is an attractive piece and Swan sounds good when you listen to it on the air.

We carry the complete Swan line, and because we keep in close touch with the factory, we can introduce new models to the public before other distributors can. For example, we have sold more of the Model 250 6-meter sideband transceivers than any other dealer as of October 1966, and we will shortly have the new 6-meter kilowatt linear with 2000 watts of PEP. This will sell at $543. with tubes.

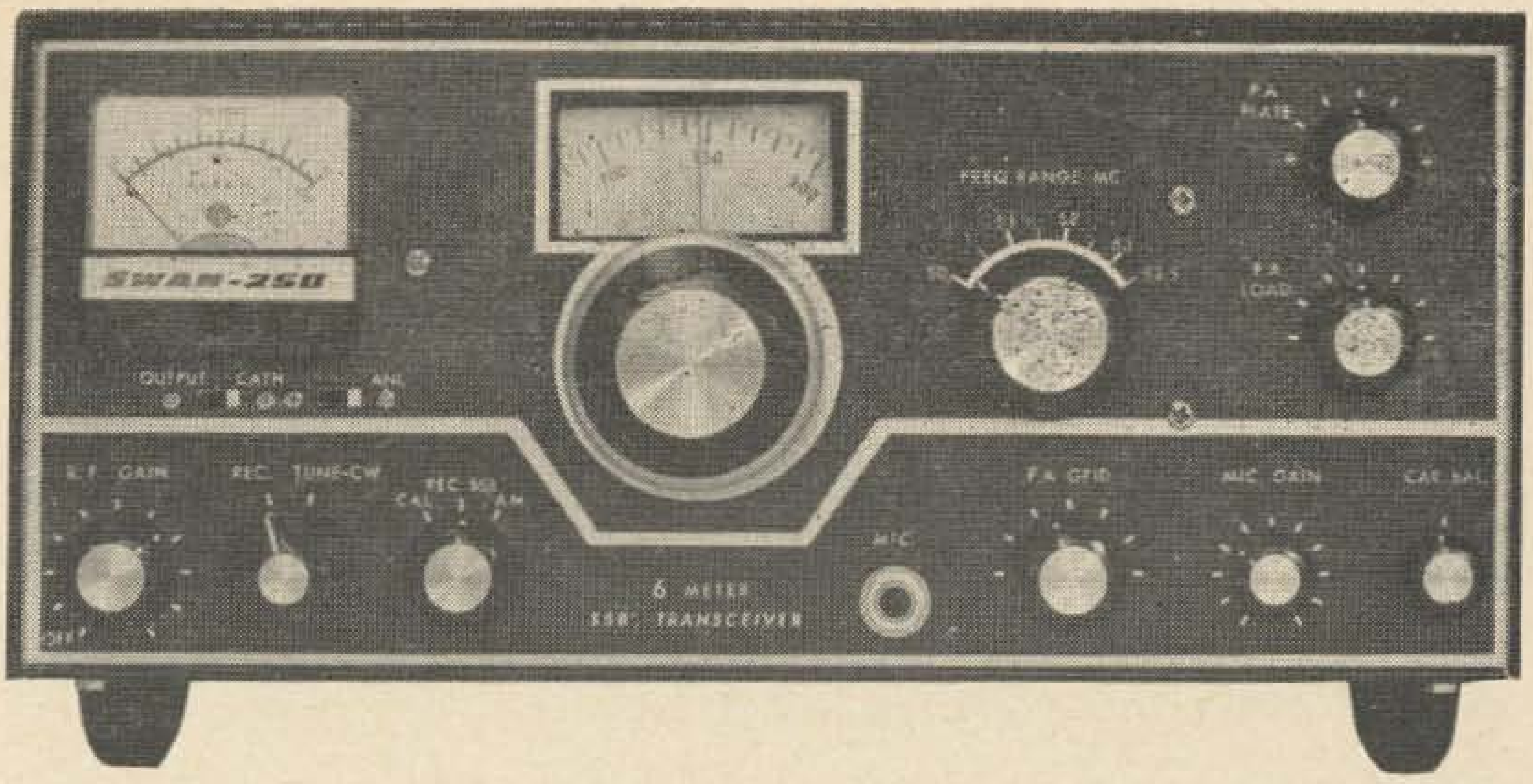
The largest seller continues to be the model 350. This is a 5-band complete-coverage transceiver providing AM, CW, and sideband operation. Its companion is the Model 400. Let me describe the difference between the two. The 350, with an appropriate power supply is a complete package requiring only a microphone and a suitable load. The Model 400 requires an external VFO in addition to a power supply, microphone and load. In other words, the 350 has a VFO; the 400 does not. The 350 was designed to be a basic set, providing the means for the owner to add the accessories of his choice. For example, with the 350 you can purchase a calibrator at $19.50. This will enable you to have 100kc markers throughout the set's spectrum and it is easy to install—takes only about an hour. If you are one of those rare fellows who wants to defy convention and operate on the opposite sideband from most of the gang, the other sideband kit is available for only $18. Ordinarily, of course, the 350 comes through with lower sideband on 80 and 40, and upper sideband on 20, 15, and 10. By contrast, the Model 400 includes the calibrator and the opposite sideband and a built-in speaker. You might think of the 400 as being a deluxe version of the 350. The price of the 350 and the 400 is the same—$420 each. Oh yes, I forgot a most important part—the transistorized VOX. The model 400 includes the VOX, but it is an accessory for the 350 and costs $35.

If you want to do it up brown and get the 400, there is a choice of three oscillators or VFO's. You can get the Model 410 which is essentially the same VFO as is normally found in the 350. This costs $95 but, unlike the 350, it provides for 8 ranges of 500 kc each with calibration better than 5kc on each band. The second is a crystal-controlled MARS oscillator which will enable either the 350 or the 400 to reach any frequency from 3 to 30 megacycles, and is available for only $45, less crystals. The third oscillator is the mobile model 406B selling at $75. This, in reality, is a control box and VFO combination. When used with the 400, it permits operating the transceiver in the trunk of the car and the controls themselves can be conveniently mounted underneath the dash. It is very small and compact. It includes an RF gain control, a jack for the microphone, etc. Another accessory is the remote control kit for trunk mounting of either transceiver. This is only $25.

One of the specific reasons why hams like Swan is the flexible design of the power supply. The standard supply, their model

Swan 400

Swan 250



117XC, sells for $95. It includes a small speaker, a phone jack, and a neon indicating light, and, of course, it matches the style and dimensions of the 350 and 400. It may be used with either the 350 or the 400 and, by the way, many of you hams have learned to your disappointment that you cannot easily make a supply to do this specific job. The reason why the Swan supply is unique is that it has the ability to deliver a hundred volts of bias at 100 milliamperes. Additionally, it provides 12 V DC at 250 mils for operating relays and, of course, the conventional 800V and 300V. But don't let me stop here. The Swan concept on power supply engineering makes it possible for you to use this same supply if you want to operate mobile. All you need do is to purchase their Model 14X for 12V grounded negative applications or their Model 14XP for grounded positive cars, and then plug this module into the back of the standard power supply. Some of you will only want to operate mobile, especially those who are on the road all of the time. Swan has the answer: Don't buy their console with the speaker and phone jack. Just buy the DC module and the basic AC supply. This is their model 14-117 and costs only $130, and, if you start out like this and later wish to convert, you can buy the matching console for only $20.

I think, when you evaluate the cost of other manufacturers' products, you will find it less expensive to put the Swan in the car to start with than other brands and certainly far less expensive to get a combination supply.

The 6-meter 250 has created a storm here in the East and more and more model 250's can be heard nightly around 50.110. The price on the model 250 is only $325 which makes it possible for the average ham to get on side band for less than the price of AM models of comparable power. Indeed, a one popular AM unit provides only 48 watts of input at a price of $367. Here is a chance to get 250 watts of sideband operation for only $325 plus the price of a Swan supply. The Swan 250, like the other Swan models, uses a transistorized VFO. The basic oscillator is multiplied by three, isolated and amplified, and then when added to a 10.7 megacycle filter produces output at the desired 6-meter frequency. By going down to 13 megacycles, Swan achieves a relatively high order of stability. They have a separate control for audio gain and RF gain. They have a noise limiter for impulse-type noise such as spark plugs or static, and they have available a special calibrator for 6-meters. This uses a 500kc crystal and can be added for only $19.50.

Swan's Mark I linear complete with tubes is $543. It is styled as per the accompanying photograph to match the appearance of their transceivers. The unit will operate cool with a pair of 3-400Z's and produce a maximum rating of 2000 watts PEP input. In other words, you can run a thousand watts of DC input. This is a modern air-cooled unit with solid state rectifiers engineered as a mate to the models 350 and 400.

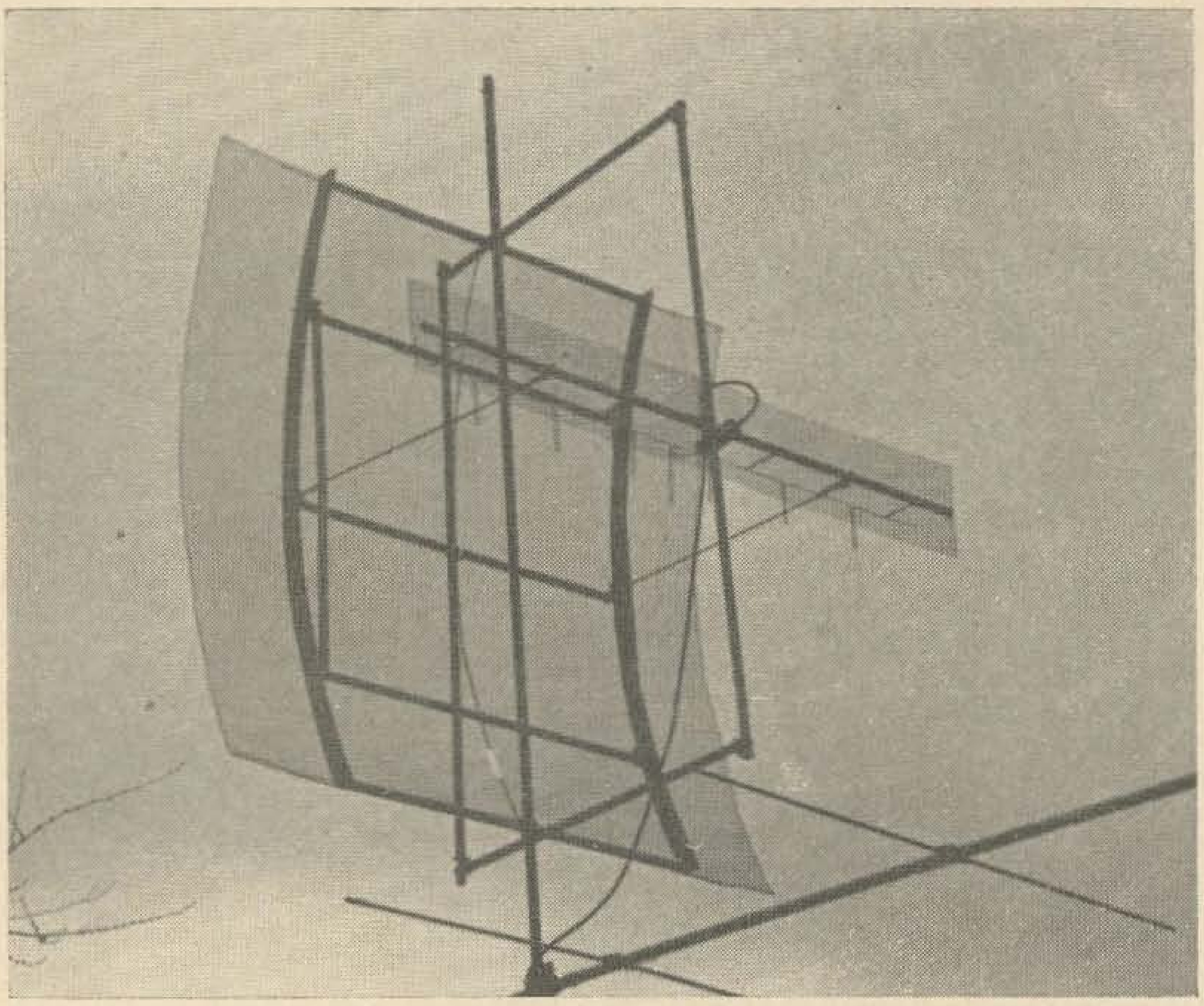
We have the other Swan products in stock including their antennas, and we hope to have their model 500 transceiver when it is first brought out. Swan products are guaranteed both by the manufacturer and ourselves and we are proud to state that without exception all Swan service has been accomplished in our own well-equipped shop. Swan transceivers have a velvety smoothness about them; they are easy to tune; they are engineered to provide the maximum safety for their finals, and if you use them into a proper load, you will have one of the best pieces of communications gear available.

Swan Mark I Linear

HERBERT W. GORDON CO.

Woodchuck Hill, Harvard, Mass., 01451

Telephone 617-456-3548



Cylindrical parabola.

Jim Kennedy K6MIO
2816 E. Norwich
Fresno, Calif.

Illumination and Parabolic Antenna Design

Most moonbouncers are using or intending to use parabolic reflectors as antennas in their attempts to further the boundries of amateur radio. Here's some discussion of their problems from a well-qualified author.

On frequencies above about 300 MHz, high antenna gain becomes increasingly more difficult to achieve with multi-element arrays. This is due to a number of factors which are the result of a common cause—the shortness of the wave length.

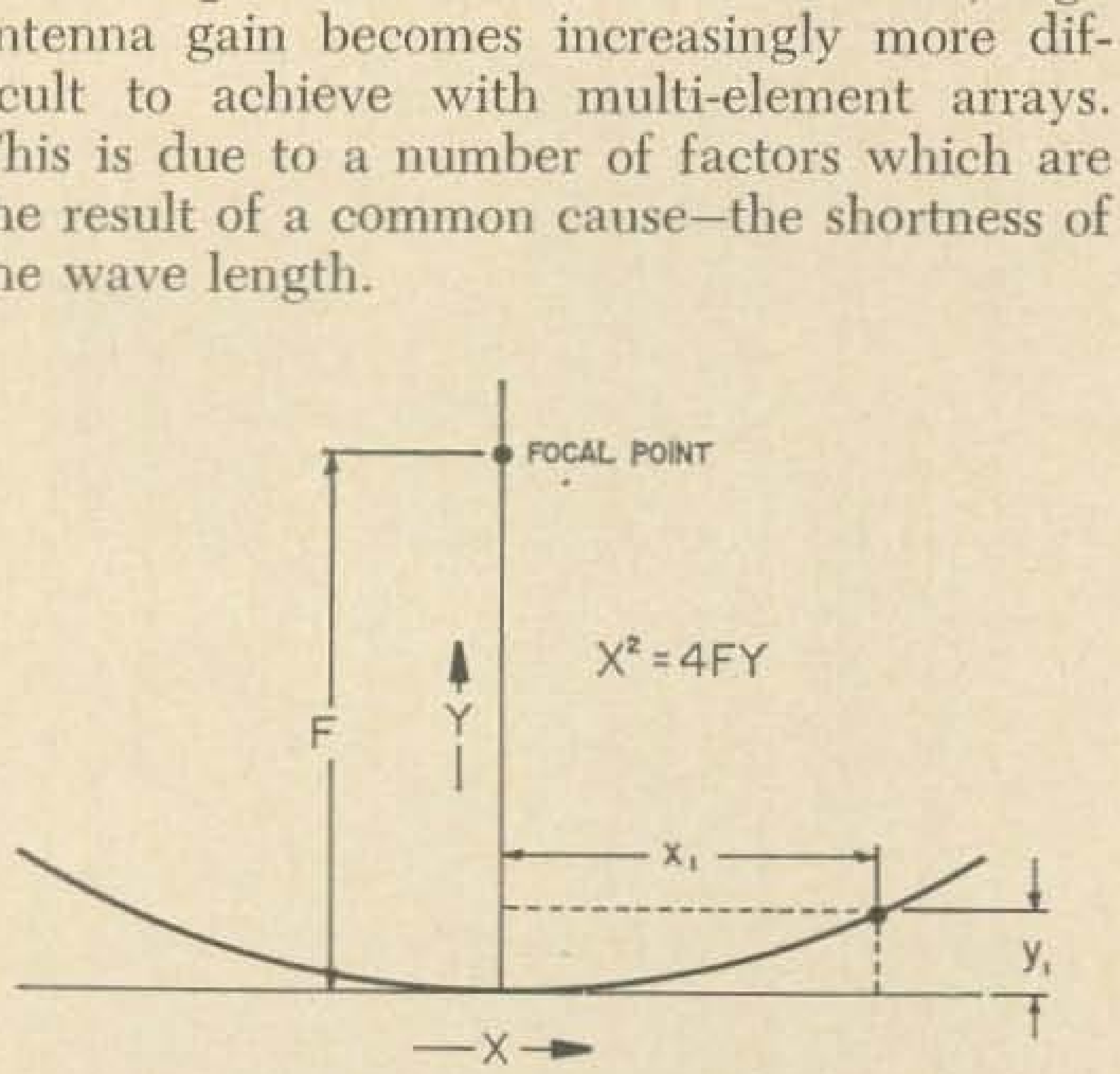


Fig. 1. Basic parabolic diagram.

In the UHF spectrum, the practical level of antenna gain attainable with a colinear broadside array reaches a limit around 20 dB. Above this value the number of elements and the associated feedline phase problems multiply at a fearsome rate. Higher gains are certainly possible, but difficult to achieve. The same is the case for the various other types of arrays in common use by amateurs today.

It is because of these same problems that the use of parabolic antennas has become so extensive in the UHF and microwave region by the commercial services. The parabolic reflector's ability to focus the energy that strikes its surface to a small point reduces the number of elements required to a very few.

As activity on UHF has increased there has, naturally, been an increase in interest in the various types of parabolic reflectors. This situation has been further inhanced by the occasional appearance of parabolic reflectors on the surplus market.

Parabolic reflectors

Basically, there are two types of parabolic antennas: the cylindrical and the paraboloid of revolution.

The cylindrical parabola is simply a sheet of reflecting material bent into a parabolic shape in one plane only, and is the easiest to construct. It concentrates all the reflected energy on a thin focal line. The feed antenna must be an array of radiating elements fed *in phase* and placed on this focal line. There should be a half wavelength array for each half wavelength of reflector length in the non-parabolic plane.

The paraboloid of revolution is the more familiar type of reflector. Here the surface has a symmetrical parabolic shape in all planes. As this type concentrates all the reflected energy to a single point, it is the easiest to feed. It requires only one feed antenna at the focal point, rather than several on a line.

In either case the distance to the line or point of focus is called the focal length and is derived from the general parabolic equation:

$$X^2 = 4FY$$

so that

$$F = X^2/4Y$$

where F is the focal length and X and Y are the base line and deviation from the base line respectively.

Illumination

One of the most important considerations in designing a dish or putting a surplus dish into service is that of illumination.

In order to make proper use of the reflector, it is very important that the feed antenna place all of the available rf energy on the reflecting surface. This process has been likened to light optics and, hence, it is, quite appropriately, described as "illuminating" the dish with rf.

The ideal situation would be a feed antenna which produced a beam pattern such that the rf was distributed evenly over the entire dish surface but stopped, completely, just at the edge of the dish, so that no energy "spilled over."

If the beam is too narrow, all the energy will strike the dish, but the portion illuminated will be less than the full dish and hence, the gain is reduced. The result is the same as using a smaller dish in the first place.

Should the beam pattern be too wide, the entire dish will be illuminated, however, part of the energy will miss the dish. This spilled over energy is lost and, hence, the gain is reduced. Spill over also causes side lobes, as the antenna will radiate energy in some other direction besides the main beam out the front of the dish. **Fig. 2** illustrates these three situations and shows antenna patterns that might be expected.

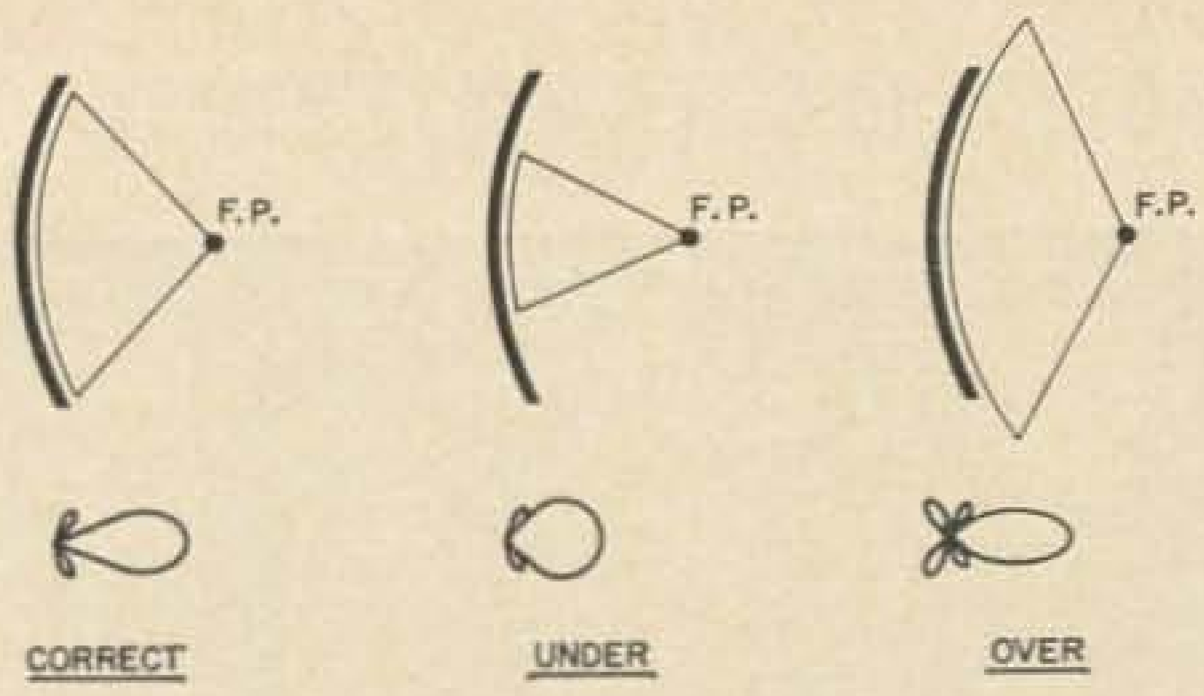


Fig. 2. Various degrees of illumination and typical associated overall antenna patterns.

It is well to recall that the ideal situation described—a perfectly uniform beam which suddenly and completely stops just at the edge of the dish—is a physical impossibility. In reality, the intensity of the beam pattern of the feed antenna will taper gradually, rather than remain uniform or stop suddenly. This itself generates some other problems which will be taken up later, but, for the moment, the ideal situation is of help to demonstrate the basic problem of illumination.

It can be seen then, that the angle between the focal point and the edge of the dish assumes a degree of considerable importance. If the angle is either too great or too small for the pattern of the feed antenna, the maximum available gain is not achieved.

Suppose, for example, you wished to build a dish 10 feet in diameter. Let us further suppose that you have a feed antenna which will produce an "ideally" shaped pattern 110° wide. It will then be necessary to select the dish curvature so that the focal length will be such that the 110° angle will just touch the edges of the dish. The required focal length in this particular case is 5 feet. Just how this value of focal length might be obtained will be discussed in some detail later.

As it was mentioned earlier, the beam pattern of a *real* feed antenna does not have

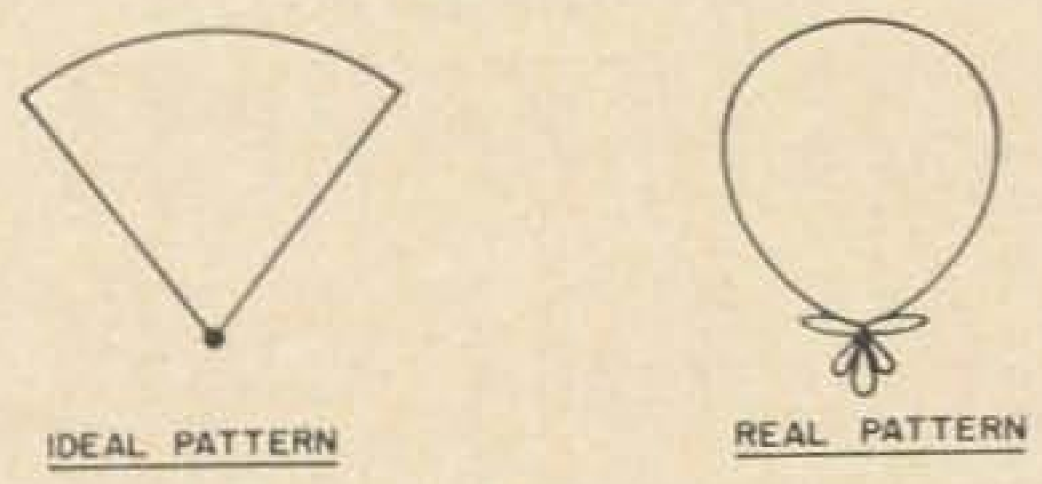


Fig. 3. Typical ideal and real dish feed patterns.

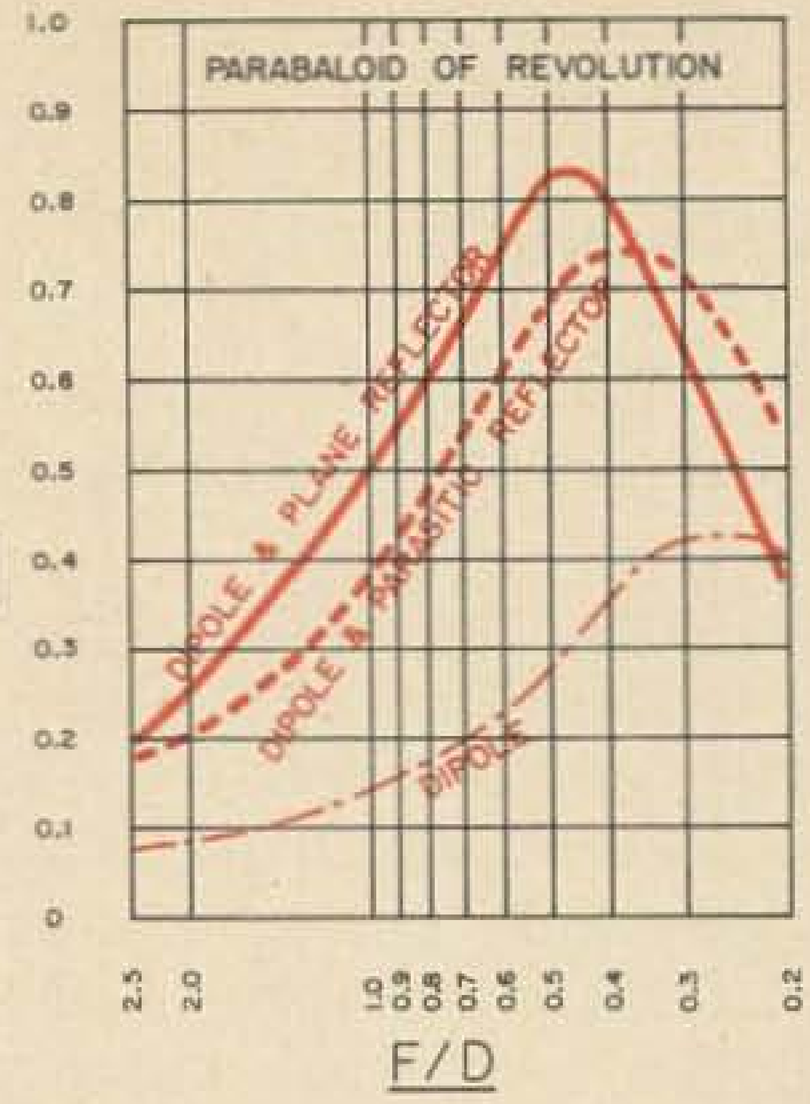


Fig. 4. Effective aperture versus focus-diameter ratio for the paraboloid of revolution.

"ideal" shaping. The intensity is not uniform and its boundaries are not sharply defined. The intensity tapers off gradually and boundary limits can be assigned only arbitrarily. (A real and the ideal feed antenna pattern are compared in **Fig. 3.**) This situation complicates the selection of the focal length or feed pattern considerably.

The feed antenna's tapering field means that energy reflected at the edge of the dish strikes the feed antenna at an angle where its response is lower than maximum and hence, this energy will be weaker than if the same amount of energy had been reflected by the central portion of the dish. Consequently the tapered feed field causes the gain of the dish to be less than the ideal value. This effect is the same as under illumination, except that it occurs gradually.

The fact that the tapering field has no sharply defined boundaries means that there is likely to be some energy radiated at wide enough angles so that it will miss the dish and hence, become spill over energy.

The final value of the desired illumination angle is a compromise under illumination and spill over. The whole approach is, in turn, a compromise between maximum gain and minimum sidelobes.

In approaching parabolic design from the amateur's standpoint it would seem that the latter compromise should be to design the antenna for maximum possible gain with no consideration for sidelobes, except that they be low enough not to affect the gain of the antenna (−10 dB or more). This lays the ground work for the first compromise.

While it is not the purpose of this article to delve very deeply into the mathematical aspects of this problem, and, we have, in fact, already side-stepped some of the physics involved, for the sake of simplicity (mainly the

question of diffraction and its relation to sidelobes), for those who enjoy such discussions, an attempt will be made to provide some insight as to just how the gain parameters, to be given shortly, are derived.

The nomenclature in this area of physics seems to be somewhat less than universal and often ambiguous, as many of the same terms are used by different authorities, but often to describe different things. The liberty will therefore be taken to add to this confusion by inventing two more names—taper factor and spill over factor.

Deriving the taper factor is a bit complicated and it will not be attempted here. This factor is the one which expresses the efficiency of the reflector in view of the tapering of the field toward the edges of the dish.

The spill over factor is merely the ratio of *power* incident on the dish to the total power radiated by the feed antenna.

The product of these two factors is the overall efficiency or *effective aperture* (to use another of those ambiguous terms), A_E, of the dish and, as such, is the factor by which the actual gain of the dish is related to the ideal gain of the dish. It will be seen that this factor will vary up to maximum value of about 0.82, in theory, at least.

It is probably apparent from this discussion that the exact *shape* of the feed antenna curve will have considerable effect on the results obtained with a given dish. As the shape of the curve varies with different feed antennas, the parameters will not be the same for different types of feeds. It is also true that the parameters for a paraboloid of revolution and a cylindrical parabola are somewhat different.

In **Figs. 4** and **5** the effective apertures for the two types of parabolics are plotted for various types of feed antennas as functions of the ratio focal length to dish diameter, after the derivations by Fradin.[1]

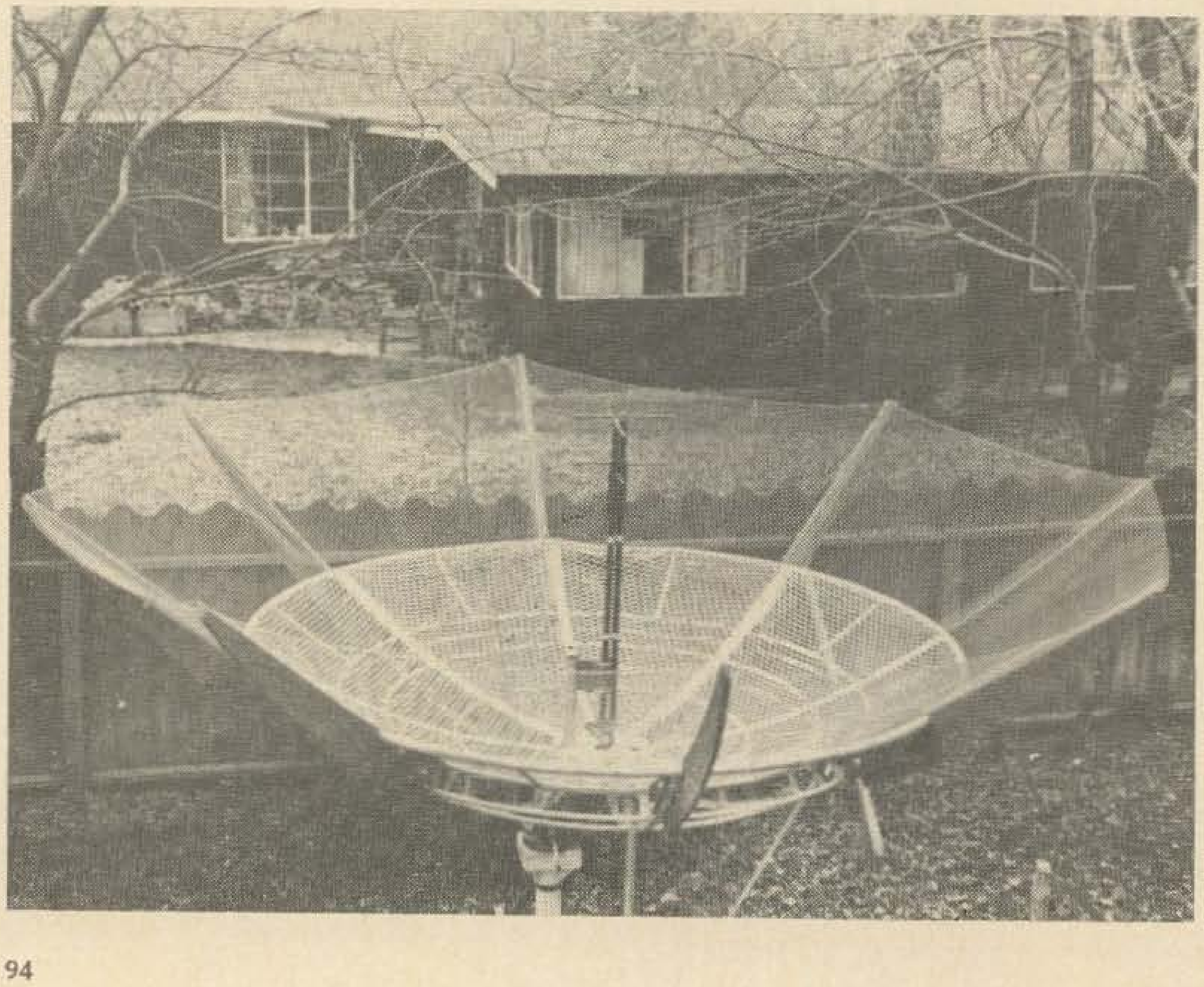
As the derivation of the various plots is somewhat involved, only three types of feed antennas are considered here. These are, however, the most common types; the dipole, the dipole and parasitic reflector, and the dipole and screen or plane reflector. A rule of thumb approach for other feeds will be given shortly.

The discussion of illumination has, up to this point, been in terms of proper feed angle, however, as it greatly simplifies the actual design of the dish, **Figs. 4** and **5** are given in terms of the proper ratio of focus to diameter which gives the proper angle for the desired feed type.

It will be noticed that the maximum effective aperture attainable in a paraboloid of revolution with the given feed types is in the neighborhood of 0.78 using a dipole and parasitic reflector. This occurs when the F/D is about 0.44. This is very nearly the maximum value attainable with any practical feed. A very carefully designed waveguide horn feed do only slightly better.

It will be noted that for simple feed types, the cylindrical parabola actually can perform slightly better than the paraboloid of revolution, as it turns in a value of 0.82 with a dipole and screen reflector when F/D is around 0.5.

1. A. Z. Fradin, *Microwave Antennas*, Chap. 3, 7.



Paraboloid of revolution —the common dish.

Another interesting feature of this reflector type is that the simple dipole can produce an effective aperture as high as 0.7, if the reflector is "wrapped" around it with a F/D of 0.08 or so, whereas, the simple dipole can produce no more than 0.37 with a paraboloid of revolution for any F/D. The reason for this lies in the fact that the paraboloid of revolution has its illumination tapered in all planes and hence, is in a sense less efficient than the cylindrical parabola which need only be tapered in one plane only. It serves the purpose of a simple passive reflector in the non-parabolic plane. It should rather be noted, however, that this apparent profit in efficiency is bought at the expense of complexity in the feed antenna as a large antenna of this type which requires a number of dipoles in phase along the focal line rather than one dipole at the focus point as in the case of the paraboloid of revolution.

The sidelobes for the maximum gain conditions for both types of reflectors are on the order of −16 dB which should be most acceptable for practically any amateur application.

If some other type of feed is used which produces patterns different from the examples given (for instance, a wave guide horn), the optimum effective aperture will be realized when the feed antenna field intensity is about −5 dB at the *angle* corresponding to the edge of the dish. If the field intensity of the antenna feeding a paraboloid of revolution is not the same in both planes, the angle should be such that the average of the two intensities is about −5 dB. This is only approximate, but it will work well for most conventional feed systems.

It should perhaps be clarified, in this respect that there is a difference in the nomenclature between the presentation here and those found in some other sources. It has been indicated here that the field intensity of the feed should be about −5 dB for maximum A_E and gain. This is to say that if an ordinary polar field pattern plot is made on the feed antenna by rotating it and noting intensity readings at a fixed point some distance from the antenna, the maximum A_E will ordinarily occur when the dish subtends an angle equal to the −5 dB beamwidth of that plot. However, this −5 dB is *not* the field intensity actually incident *on the dish surface itself*. The power from the feed must travel further to reach the edge of the dish than it does to reach the center and hence, the actual feed intensity on the dish surface, due to the inverse square law, as well as the original feed pattern, is around −8 to −10 dB. In as much as the −5 dB beamwidth of the feed antenna is any easier quantity to measure in the field, this approach has been suggested here for designing feed systems other than the types stated.

Designing the antenna

To use the effective aperture graphs to design a new antenna, one must decide what type and of what diameter the dish is to be and then, what kind of feed is to be used. Then multiply the diameter by the F/D which corresponds to the maximum effective aperture for that feed type and you have the focal length desired.

At this point you plug the focal length, F, into the previously mentioned formula for a parabola

$$X^2 = 4\ FY$$

and solve for the various Y points and you have the measurements of the dish.

For example: it was desired to build a cylindrical parabola 8 feet square. The diameter in the parabolic plane was, then 8 feet (the diameter in the other plane is superflous to the effective aperture). It was desired to use a dipole and plane reflector array as a feeder, hence, from **Fig. 5** the optimum F/D is about 0.5. As

$$0.5 \times 8 \text{ feet} = 4 \text{ feet}$$

the focus is established as 4 feet.

The general parabolic formula then becomes:

$$X^2 = 16\ Y \text{ or } X^2/16 = Y$$

and, supplying values of X for every foot out to the 4 foot mark we make table or graph, as in **Fig. 6**, showing the curve of the dish (in actual practice 6 inch intervals were used). All that now remains is to construct a dish with this curve.

Such an antenna was actually constructed and was described in detail in an earlier article.[2] This antenna did, in fact, perform very nearly as predicted, having side lobes that measured almost exactly −16 dB and an effective aperture in the neighborhood of 0.70 or about 85% of the predicted value.

On the other hand, if one wishes to put an already constructed dish, such as a surplus unit, into service, it is necessary to measure the dish to find its diameter and corresponding X and Y values. The X and Y values at any point may be plugged into the parabolic formula to provide the focal length:

$$F = X^2/4Y$$

Now that both the diameter and focal length

2. Jim Kennedy, "The Big Sail," *73 Magazine*, (August, 1965), 50.

are known the F/D of the dish is known. We may now refer to the appropriate graph and select whichever feed system provides the greatest effective aperture and, of course, the graph tells what that value is.

For example: a surplus paraboloid of revolution obtained which was 8 feet in diameter. At the edge of the dish ($X = 4$) the Y value was 16 inches or 1.33 feet, as

$$F = X^2/4Y = 16/4 \times 1.33 = 3.33 \text{ feet}$$

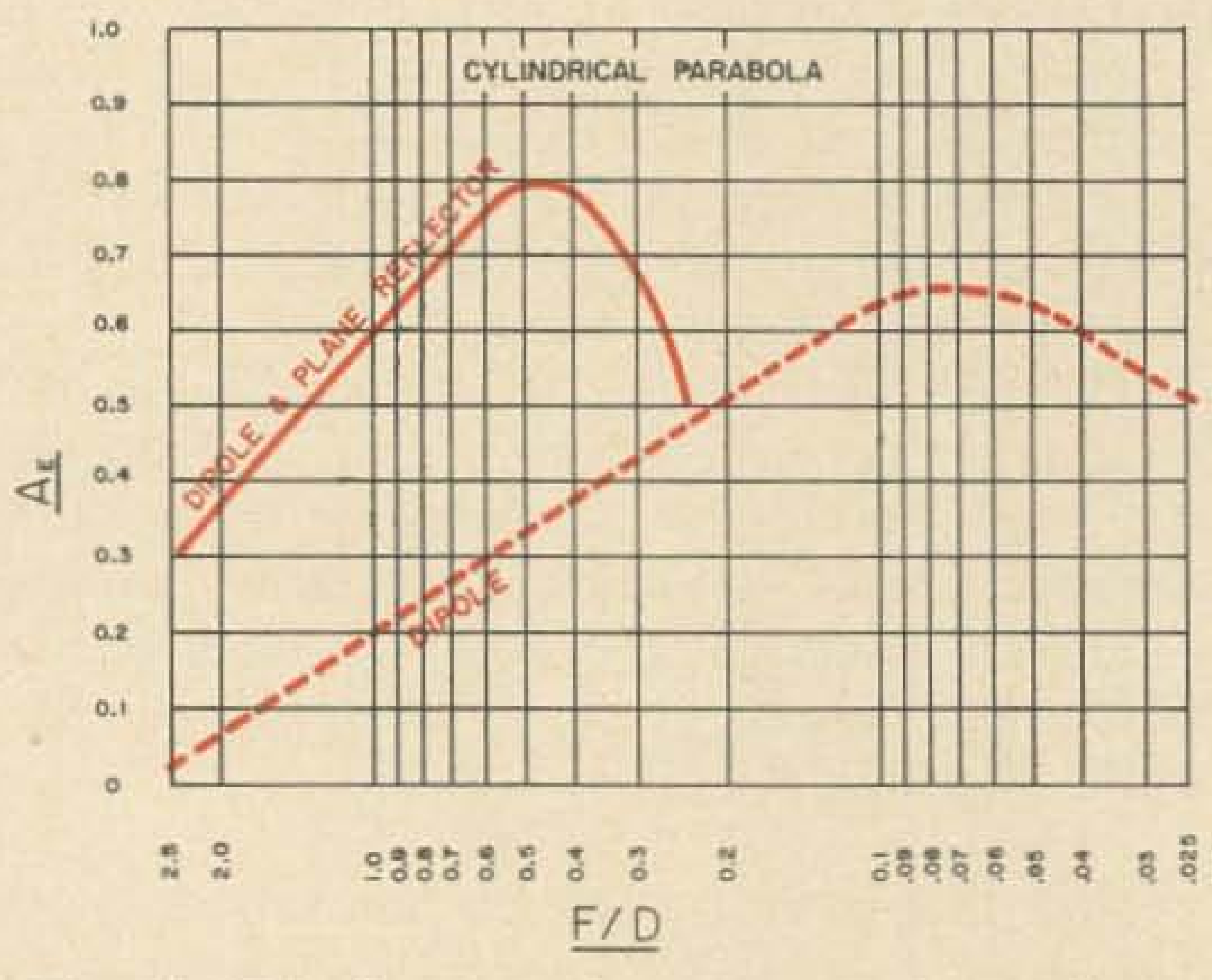


Fig. 5. Effective aperture versus focus-diameter ratio for the cylindrical parabola.

The focal length was 3′ 4″, and $F/D = 3.33/8 = 0.415$. Referring to **Fig. 4** we find that the dipole and plane reflector will produce the maximum effective aperture for the F/D and this aperture should be around 0.77.

An example of a further applications: it was desired to enlarge the above antenna to 13 feet; if this could be shown to be worthwhile. The X and Y values for the new portion were plotted and it was found that the new F/D was 0.25, that is, the feed would lie on the same plane as the mouth of the dish. At this F/D, the graph shows that the best feed is now the dipole and parasitic reflector and that the effective aperture is about 0.62.

As the new dish was bigger but also less efficient, it remained to be seen whether there was any advantage in enlarging the dish. The gain of a dish is proportional to the product of the area and the effective aperture and, as the area is proportional to the square of the diameters, the ratio of the gains was:

$$\frac{(13)^2 \times 0.62}{(8)^2 \times 0.77} = 2.1 = +3.2 \text{ dB.}$$

Therefore, enlarging the dish would more than double the gain and hence, in this case, the modification was well worthwhile.

x	0'	1'	2'	3'	4'
y	0"	¾"	3"	6¾"	12"

Fig. 6. Table showing x and y values computed for various points along a parabola with a 4 foot focus. See Fig. 1.

Gain

As just mentioned the gain of a dish is proportional to the area of the reflector times the effective aperture. In precise terms the gain over an isotropic radiator is given by the formula,

$$G_I = A_E\ (12.6)\ A/\lambda^2$$

where A_E is the effective aperture, A is the area of the dish, λ is the wave length in the same units as A, and G_I is a power ratio, not dB.

The gain in decibels is given by

$$G_{dB} = 10 \log_{10} G_I$$

The gain of the dish over a dipole is 2.2 dB less than that over an isotropic radiator.

The maximum values of A_E and, hence, gain derived here are somewhat higher than values generally found in many of the handbooks and other sources in common use. It was found that while many readily admitted that the effective aperture was variable and was usually between 0.5 and 0.7 of those checked few mentioned why and not mentioned how. Many of the gain formulas and graphs in these sources are based on an A_E of 0.55. This value is commonly used in radar systems. It is achieved by slightly under illuminating the dish in order to reduce the sidelobes somewhat. This is done at some expense in gain. Furthermore, there are a number of factors which will, in practice, reduce the actual gain or A_E from the theoretical value derived from the graphs.

The manufacturing tolerance of the dish has a definite effect on antenna gain. If the RMS tolerance remains under 0.1 wavelengths, the gain should be within 1 db of the maximum value.

It is well, too, to caution that the A_E values shown are presented with the assumption that there are no ohmic losses in the feed system and that the reflector is a perfectly reflecting surface. *Neither of these factors will affect the value of the optimum F/D*, but it will act to lower the actual A_E value by reducing the overall gain.

Ohmic losses in the feed system can be held to a quite small value by the usual methods of using low loss materials such as copper with silver plating or a lacquer coating in the radiating elements.

The reflectivity of the dish surface is a function of its surface conductivity and its RF porosity. A high conductivity metal like silver or copper will produce a superior reflector to a metal like steel or aluminum, however, solid silver dishes are rather rare and steel and aluminum are quite reasonable substitutes. The surface should be protected from corrosion by a coat of paint or lacquer or be of galvanized or dipped material.

Porosity becomes a factor when the reflecting surface is a meshed material such as hardware cloth. If the openings in the mesh are 0.25 wavelengths or less the porosity is practically nil and practically all of the power will be reflected; whereas, if the openings are of the order of 0.5 wavelengths or more, the porosity is nearly 1 and almost all of the power will pass through the screen rather than be reflected by it.

All these factors operate to lower the gain and A_E though, with careful design, they can be held to a minimum and actual A_E's in the range of 70 to 80% of theoretical values in Figs. 4 and 5 should be attainable.

. . . K6MIO

Gus Browning W4BPD
Cordova, S.C.

Gus: Part 18

In the last episode I was on my way to the Chagoes and the ill-fated /VQ8 operation. I use the term "ill-fated" loosely here since as explained in my last episode I think I was about as legal as was possible at that time. I did not know I was being stabbed in the back by a brother ham (the word "brother" is used loosely, too!). I hear over the air that Harvey Brain is thinking about leaving VQ9. Well, let's wait and see about that before we ah–ah –ahh—. Anyway I was on the way to VQ8C and I had a FB trip there with my fish-catching antenna.

The Chagoes, you know, consist of some 200 islands. We passed many very small ones, each covered with coconut palms loaded with coconuts. Looking at the captain's charts I could see that the ocean was very shallow in many places so the captain had to do some real navigating. We landed at Diego Garcia, an island some 20 miles long and a mile across. I was surprised to see how much work they had done to make the loading of copra efficient. A long concrete dock projected out into the bay a few hundred feet. The ship we arrived on was anchored out in the deep channel. Copra was boated to it from the long pier. We went ashore and I presented my letter of introduction from the island's owner. From then on I was treated as a guest–tea and crumpets any time and plenty of help to assist in erecting my antennas. A shack was prepared for my use at the end of a very nice little walkway with coconut trees on both sides. The shack was about half full of coconuts, and coming in at night presented quite a challenge to keep from slipping all over the floor.

I met Leny's (ex-VQ8CB; now 5Z4GT) old friend Pi-Po, the operator of the WX station. Pi-Po was a wonderful companion and everything I asked him to do was done with a smile. He had been there for 20 years or so. He took me over to Leny's old house, and Leny's operating table was still there. I actually saw where the key had been screwed down. His house was empty and looked as if it had been ever since Leny and his XYL, Lillette, had left some years earlier. Pi-Po told me Leny had taught him his code and what knowledge he had of radio. Leny did a good job, too, because Pi-Po was a very good operator and not too bad a technician. Pi-Po made my stay on VQ8C very pleasant.

We met the owner of the island for a long chat the first night there. His hobby was underwater photography. He showed us his home-made waterproof camera holder, with all adjustments protruding through waterproof holes so he could make all necessary adjustments while underwater. Then he showed us lots of underwater movies and a batch of color slides he had made of the waters around the Chagoes. His camera work would have delighted even Hollywood. We talked and drank tea most of the time. Some of the fellows were drinking something a bit stronger. There were no Cokes there, so I suffered in silence! They had a kerosene-burning ice box so there was ice. The water was rather salty, since the wells are not far from the ocean, though they also had rain water from the roof tops which was better. All the islands in the Indian Ocean use rain water. On Aldabra it's directed to a sort of little swimming pool, and occasionally they find a dead rat in the pool! Makes drinking this water a little rough on you! Well, you gotta have water, you know! I understand the manager of the Chagoes has left now and I guess is back in Mauritius. I bet Pi-Po is still there, though, since he just looked like a fellow who would never leave.

When I fired up at /VQ8C all the gang were there QRX for me. On almost every QSO I was told, "Gus, you are a new one." It seemed as if all the QSO's that Leny had had when he was there, year after year, had been wiped from everyone's log. There was every chance in the world for the VQ8 authorities to stop me while I was there because there is a twice-per-day schedule with the WX station at Mauritius. A message to me would have been delivered minutes after it was sent because I saw Pi-Po ten times each day and our shacks were not over 200 feet apart. I don't think anyone in VQ8 wanted to get me any messages! Before I left VQ9 I was told by them to be on that boat and not miss my chance of going to VQ8C. Everyone knew the only reason I would go to VQ8C was to operate a ham station from the island. One of these days someone will yet hit every one of those Indian Ocean islands and wring them out dry. That is the day I will laugh my head off. Just as I have done in the AC spots with over 65,000 QSO's from them; lots more than I have ever had from my 40 years of hamming from W4BPD. But still many have asked me to return there for them! No one can work them all, even when they work everyone on the air from some spot. Two years later on it will be rare again. Look at Aldabra: two trips I was there with something over 12,000 QSO's and still many need this one.

Now let me see where I was with my story. Oh yes, I was on Chagoes and we were having supper with the island manager, who had two real nice looking "maids" for his own personal use. The supper was a real feast: fish cooked about five different ways, coconut meat prepared a number of ways, turtle meat, and items brought ashore from the ship. We got a radio message the next day from Solomon Island that a rainstorm that night had dumped over 15 inches of rain there in 10 hours. Now that's a rain for you! I asked why most of the coconut trees on the Chagoes were so straight, and they explained that the Chagoes were out of the cyclone belt and their prevailing winds were variable, so the trees had no chance to get that permanent lean like on all the other islands I had seen.

I visited their copra works and saw more doggoned coconuts than I thought there were in the world. They have very large concrete rooms with no roof overhead, just a sliding roof that runs on old railroad tracks. They slide the roof back and forth every few hours keeping the temperature just right to cure the coconut meat into copra. They told me that copra production on the Chagoes was the world's highest for the amount of land and number of workers used in its production. They say their copra is the world's best since it's under a sort of "quality control."

The island manager was telling me about something that happened on the island a few months before we arrived. One of the copra workers came running to the manager's house one day saying he had some "visitors" up on the north end of the island. The manager with a few of his workers went up to investigate. A large black ship, with no flag or markings, was anchored a considerable distance out in the sea. He estimated it to be about 350 ft. long. There were about a dozen "visitors" walking all around the northern part of the island with machine guns! They said they were studying bird life!! The manager asked them if they had any documents that indicated they were invited to come ashore. They acted surprised that anything like this was necessary, and told him they would be leaving sometime that afternoon. The big black ship was gone the next day. I have my own idea as to who it was and what they were doing. You know the Chagoes are in a very FB spot for emergency aircraft landings, and take-off's. Maybe some day someone will put an airfield there. Then it would be real easy to get to VQ8C instead of a 10-day sail from VQ9 land.

One day I was invited to go out sharking. The boat was about 55 to 60 feet long and 12 feet wide, its hold being about 15 feet deep. Only three other people went along. We went in among a number of small islands until we found the sharks. Let me tell you there were sharks there; I mean by the hundreds or maybe even thousands. Two lines of ¼ inch steel stranded wire with only one hook, about five inches long and baited with a 1-pound piece of fish, were tossed overboard. The moment it hit the water, bango, a 12-foot shark grabbed the hook and the fun started. The two fellows with their poles brought him up, lifted him into the boat—a real he-man job, this—and threw him down into the hold of the ship. The other fellow in the hold had a two-edged ax, and he chopped right into the brains of the shark. Blood flew all over him and the inside of the hold, the shark quit flapping and the lines with that big hook were again cast over the side of the boat—this time without any bait on the hook. Bango! Another shark grabbed that bare hook. Up he came and over in the hold he went. The fellow with that double bladed ax swung into the fish's brain and blood flew. This kept up for four or five hours, until the boat was full of sharks. They caught 253 sharks in that time, weighing about 5 tons. These fish are brought ashore, cleaned, dried and salted down and then shipped on to Africa where they are sold to the natives. The natives, I was told, usually eat this dried meat uncooked. I guess it's sort of like dried herring that I have seen people eat even over here.

There is always something going on on these islands. If it's not one thing it's something else. There is that stuff they get from coconut trees. It's a sort of white, milky fluid, and when it sits a few days they say it has the kick of a mule. I have yet to go anyplace where strong drinks cannot be found. They always find something to drink, you can be sure of that. I wish this were true of Coca Cola, hi, hi.

. . . Gus

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Convert Your AM Transmitter To FM

Get in on all the activity on VHF wideband FM.

Have you listened to two meters in the past few months? If you have, you've probably heard two meter repeater stations on the air. Here in Houston we have three such stations. One is on the Air Force MARS frequency and two are in the ham band. They work very well and are very popular. Repeaters are usually designed for FM service, and these are no exceptions.

I had been on two meter AM for a long time but I didn't have any FM gear. I wanted to get on FM so that I could use the repeaters but I still wanted to be able to transmit AM. I tried a Varicap (variable capacitance diode, or varactor) across the crystal, but it didn't give enough deviation to provide the sweep I needed at two meters—12 to 15 kHz. My AM transmitter uses 8 MHz crystals and multiplies 18 times to reach the two meter band. It uses a Colpitts oscillator. After a bit of work, I built the adapter shown in **Fig. 1.** It converts the transmitter so that the oscillator is followed by a phase modulator driven by phase-corrected audio. This phase modulation is equivalent to frequency modulation after it's passed through a number of class C stages in the transmitter, and, in fact, this is the FM system used in most commercial FM gear.

The adapter can be plugged into any transmitter with a VFO jack, or into any transmitter by converting it as shown in **Fig. 4.** To disable the AM portion of your rig, all you have to do is to use a shorted microphone plug. If your transmitter has push-to-talk you can run a wire from the PTT terminals to the

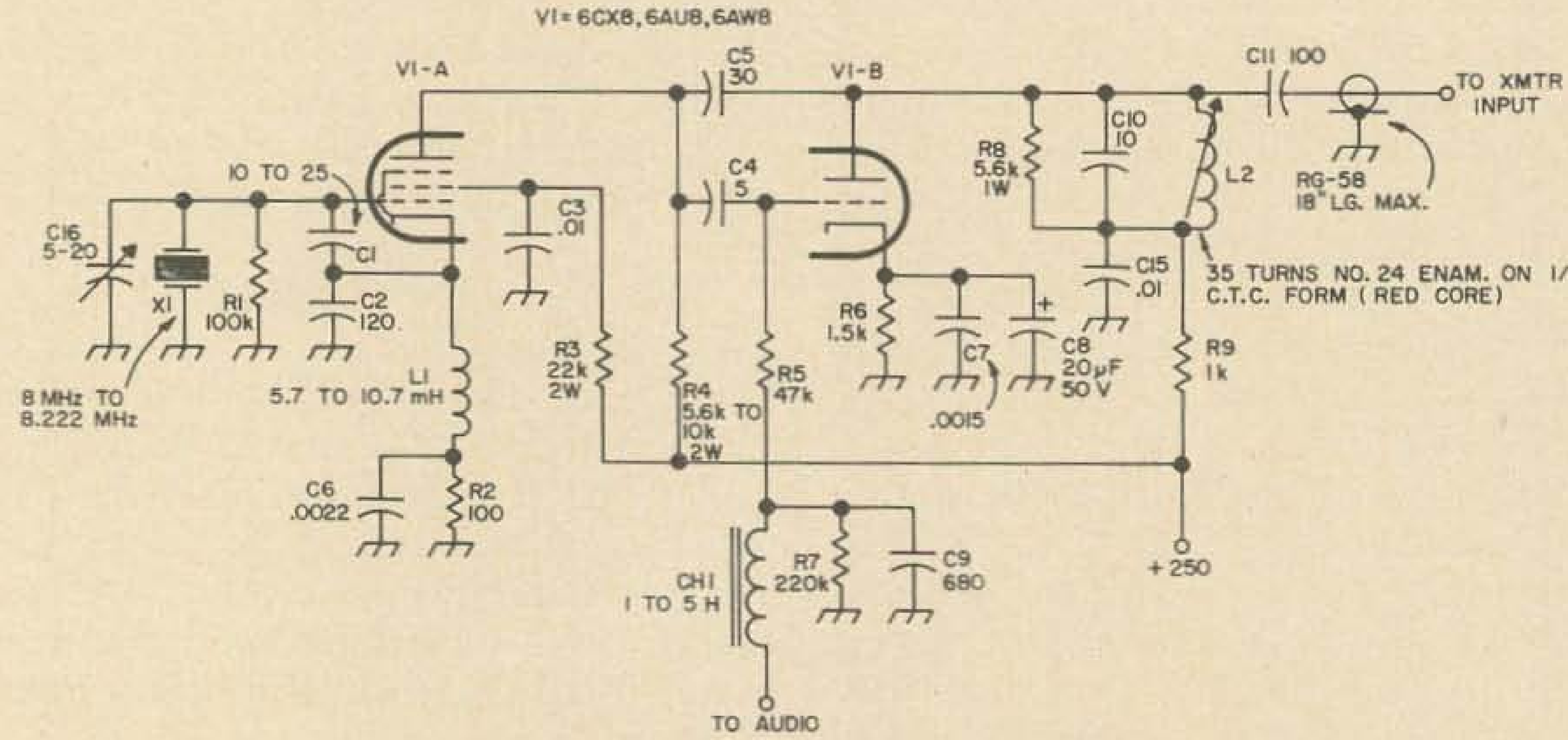

Fig. 1. FM phase modulator for two meters.

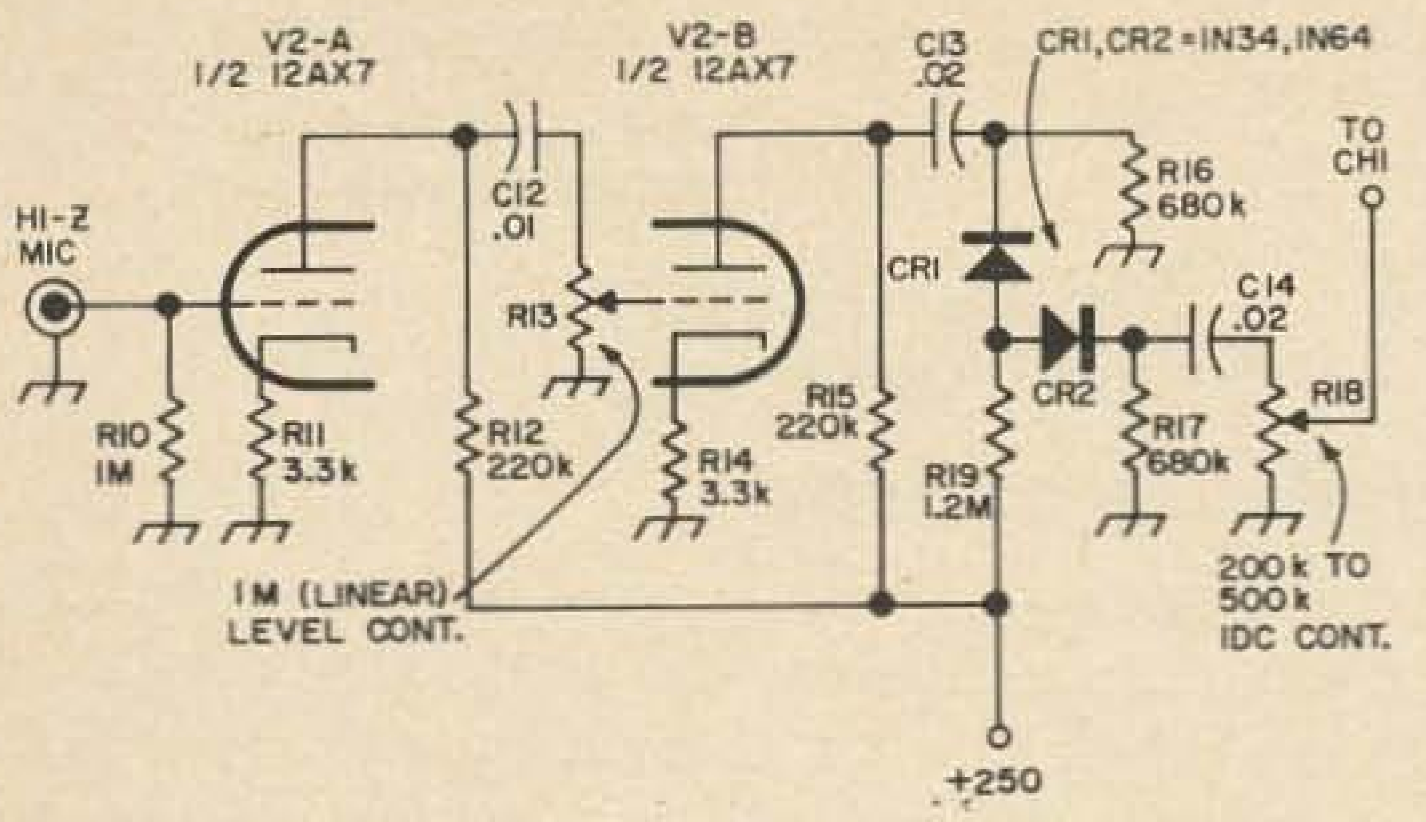

Fig. 2. Tube-type audio for FM adapter.

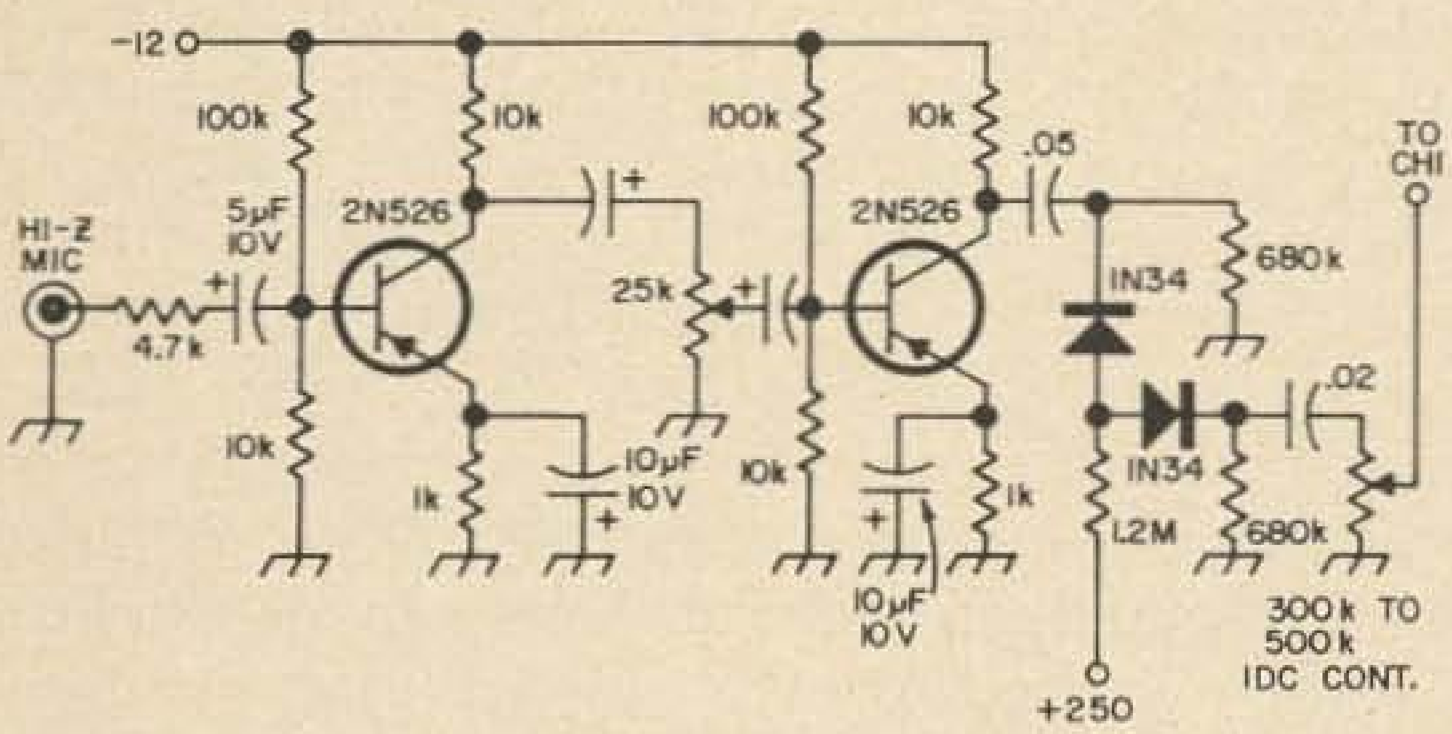

Fig. 3. Transistor audio for FM adapter.

new microphone input on the FM adapter.

The FM adapter can be built on a small chassis or in your transmitter. The wiring is straightforward. Normal rf wiring practices should be followed. None of the values are critical so 10% components are fine.

Fig. 2 shows a tube-type audio system for the modulator and **Fig. 3** an all-transistor audio amplifier. Both include clipping.

Tune up is very simple. Simply connect the adapter, plug in a crystal and turn it on. Then tune L2 for maximum negative output, around 15 volts.

To use your rig in the AM mode after you have modified it for FM, all you have to do is disable the FM audio by shorting out the audio input. Then attach the mike to the regular AM input and you're ready to go.

. . . WA5CJG

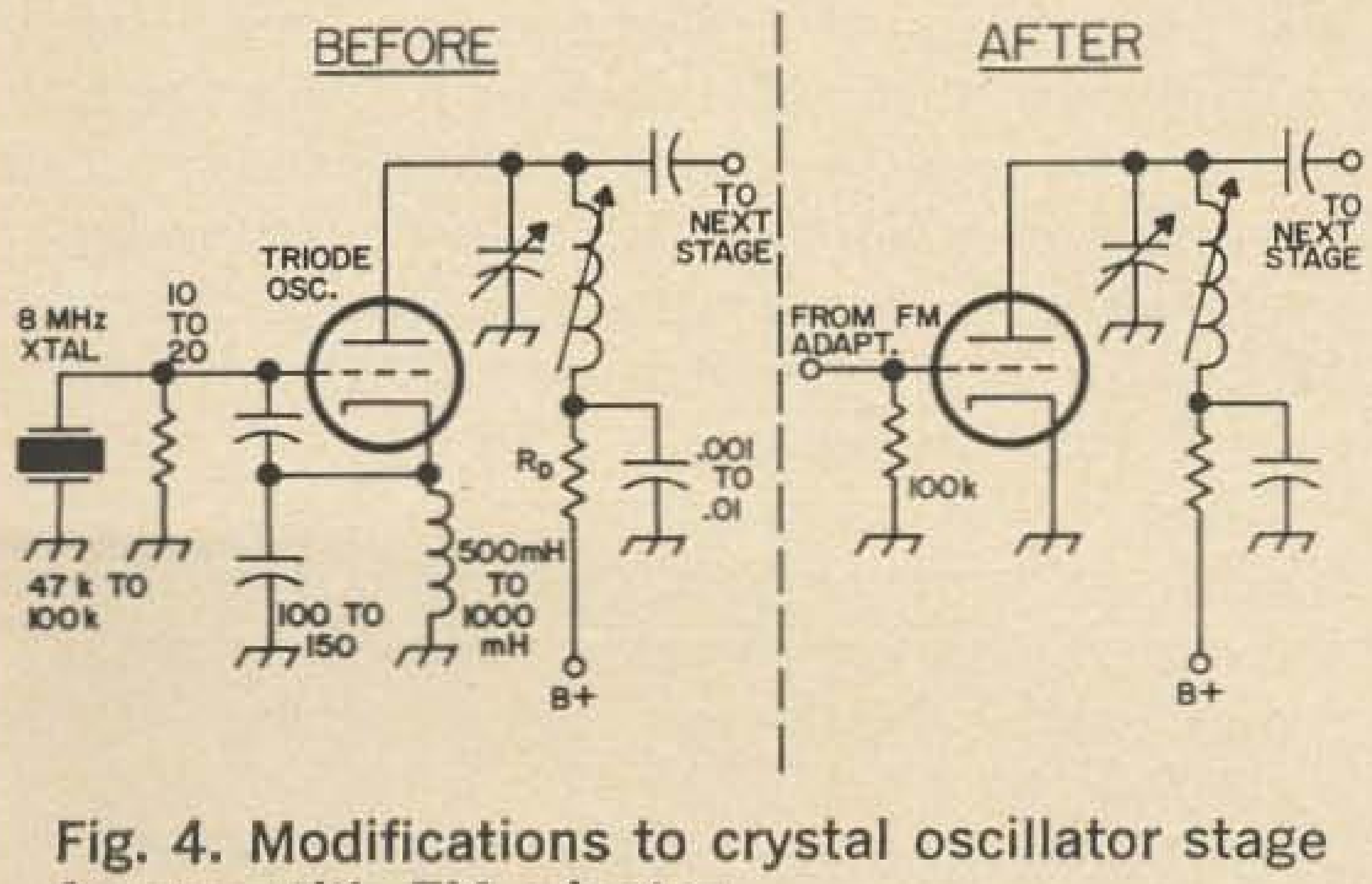

Fig. 4. Modifications to crystal oscillator stage for use with FM adapter.

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Good Hand Sending

Some reflections and suggestions

When the writer started with landline Morse in 1917 and amateur radio three years later, the use of semi-automatic keys—bugs—was not widespread, and some real "copper plate" hand sending was being produced in both codes, Morse and Continental. While Morse has nearly died out on landline, CW radio transmission is still very much alive, but really first class hand sending seems scarce. This article is written in the hope that it will interest and help some amateurs in better performance with the hand key.

As with any manual art, if keying mistakes are unwittingly repeated long enough they will become habits and be hard to stop. The novice should, if possible, practice sending in the hearing of someone able—and willing—to offer constructive criticism. Failing that, do not practice sending until you can receive well enough to evaluate your own sending. This is a hard thing to do, and experienced hams can assist the novice greatly, both in club work and on the air.

The key should be securely fastened to the table in line with the forearm, in a similar position in relation to the body as the writing pad, or somewhat to the right of it. As an alternative the key can be fastened to one end of a board fitted with rubber feet, about six inches wide and long enough to accommodate the elbow.

There is a direct relation between key sending and handwriting. Many of the oldtime key experts also produced "copper plate" writing, and the "glass arm" affliction that no doubt spurred the development of the bug is similar to writer's cramp.

A free and easy style of holding and manipulating the key is akin to the exercises that were used in such training as the MacLean system of handwriting. The best method for good character formation without tiring is mainly forearm and wrist action rather than wrist and fingers, with the grip on the key being loose enough to prevent tenseness. The elbow will roll or "ball" on the table top without leaving it, and the forearm will move up and down considerably further than the key lever. There are two reasons for this "overthrow": one, the key-top movement is unnaturally short for the human arm, and continued sending without the overthrow would soon produce tenseness and strain. The other reason has to do with key design. A string of dots should measure about 50% of closed circuit current on a meter, that is the dots be the same length in milliseconds as the spaces between them. In a bug one of the dot contacts is flexibly mounted, so that with proper adjustment there is "follow" each time the contacts close, which provides the proper dot length. On the standard hand key with its rigid contacts, if the arm does not continue downward or pause after the contacts close, the dots will be too short or "light." A pause is not practicable for rhythmic hand sending, so the overthrow is the only solution.

With key travel and spring tension suited to the individual, and with correct grip and arm action, it should be possible to send continuous dots at a natural speed for several seconds without tiring, and with no discernible change in pace or "percent make." This is a good practice exercise.

Until proficiency is attained, don't be afraid to make the spaces between words extra long —this will help the receiver to separate the words in case there is any hesitation *inside* the words.

Improper spacing inside *letters* is a more serious error, and is most common on letters where dots and dashes are intermixed. In these more difficult letters one aid for the beginner is to make the dashes extra long. In the letter *A* for instance, if there is any pause between the dot and the dash it can be received as ET, but if the novice sender thinks and sends a dot and *immediately closes the key*, it can only be received as A even if the final key opening is delayed. Build up other letters from this beginning; *R* is formed by immediately making a dot after the dash in *A* is terminated; *C* is produced if the key is closed and *R* formed immediately it is opened. To make *U* or *V*, send the two or three dots and close the key; *D* or *B* are two or three dots sent from a closed key, and so on.

Your keying may not *seem* to be as imperishable as your writing, but when you are on the air who knows how many people are listening—and who knows, maybe somebody is *recording* it!

Good sending—and good C.W. QSO's!

. . . VE7CT

Automotive Trim Brightens Construction Projects

Chrome finished plastic trim strip, available in automotive supply stores, fills many construction needs. Economical and easy to work, this material really dresses up the rough edges on a project. This brilliant trim is made of moderately flexible plastic, 7/16-inch wide and formed in a closed "U" shape to fit over panel edges up to ⅛-inch thick. The inside of the channel is coated with pressure sensitive adhesive to hold the strip in place after installation.

Applications of the trim strip include framing of panel openings. In this use, work is really speeded up since only a rough-cut, reasonably square hole is required. The strip completely covers the rough edges. Installation is a snap since the product may be easily cut to exact size using a sharp knife, razor blade or diagonal pliers.

The photograph shows a typical use for the strip. How many times have you installed rack mounted equipment and found that standard panels failed to quite fill the available rack space? The trim strip provides a simple, low cost and highly decorative answer. Slip a 19-inch length of the trim over the edge of the offending panel and cut the back side of the strip as required to provide clearance for the rack mounting rails. Install the panel and position the strip to fill that unsightly gap.

The product shown in the photograph is "Silvatrim" manufactured by Glass Laboratories, Inc. of Brooklyn, New York. Two 33-inch lengths of the trim, mounted on a display card, sell for around a dollar.

. . . Roy Pafenburg W4WKM

Now You See It; Now You Don't

The addition of a mobile rig is not always the happy event that an addition to the family should be. The XYL may not be tolerant of a husband who seems to prefer to talk to strangers rather than to the wife while driving on the vacation. Even if a ham, who enjoys talking on the rig . . . the wife's enthusiasm dwindles the second she snags her nylons or draws blood on the sharp corner of the rig under the dash.

Every ham wishes his car had come equipped with a cutout in the dash designed for his rig. The dash and glove-compartment installations of the past were limited to low power, often home-brew rigs for one VHF band. With the coming of SSB transceivers, mobile operation has become a reliable means of communication with high power in small packages.

My mobile rigs, until recently, were conventionally mounted under the dash with the

It's easy to get at when the glove compartment door is open, but invisible when the door is closed.

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expected side-effects on the XYL. The "out of sight, out of mind" solution to the XYL problem came as a result of a middle-age weakness which caused me to close a deal on a luxury automobile without thinking about where to put the ham rig. The type of car purchased is characterized by the manufacturers as a sporty personal automobile. . . . to avoid offending the "true" sports car owners. This Detroit specimen is easily recognized by the console or divider strip which separates the front seat passengers; and incidentally occupies all of the space normally available for the rig.

My wife was naturally pleased with the deluxe features of the car as she remarked, "Looks like there is no room for your ham rig in this one." The grin faded from my face as I realized she might be right. Soon I had the gear salvaged from my trade-in piled along side the new car, and commenced to

Mike and SWR bridge are installed neatly by the driver in the console.

measure the rig and examine the car for any bit of space.

Fortunately, some months before I had been seduced by the glowing reports of the receiving ability of the SBE series of transistorized transceivers. With the arrival of the SB-34, I had picked up a bargain in the SB-33, which is the same size, but lacks some styling and features of the 34. These rigs measure only 11¼" wide, 10" deep, and 5" high, yet offer high performance in the 80, 40, 20, and 15 meter bands in SSB mode. The installation shown in the photographs may suggest solutions to other hams who have the same or competitive rigs approaching or bettering this small package size.

The glove compartment when opened revealed a dinky and shallow space that was not at all suitable for my rig . . . but wait, the opening itself looked large enough. A few minutes with the tape measure confirmed that the opening in the glove-compartment was larger than the width and height of the SBE. Close examination revealed that the compartment was a basket-like affair held by screws to the frame of the door opening in the dash. A minute with the screwdriver left a glorious expanse of space extending to the firewall with only a few flexible cables that might be in the way . . . heater controls etc. Sliding the rig in from behind proved a cinch and confirmed a perfect fit with no problems in closing the door of the glove-compartment.

Since the SBE has a self-contained AC supply tailored for 117 volt operation, I deemed it desirable to design the mounting for easy removal to permit portable operation. In my car body style (Buick Riviera 1963-65), the lower metal structure of the dash housing forms a natural shelf. It only required a small wooden platform shaped to tilt the rig slightly and raise it about two inches to provide a solid mounting. The platform is retained in place by wedging it under the rig, forcing the transceiver to press against the top of the dash from underneath. A similar platform in another installation might require ventilation holes, although none were used with the SBE.

Now with the rig mounted, and the power cables running through grommets in the firewall, I found I could close the dash compartment door and the rig disappeared. It suddenly became very desirable to complete the installation while retaining this concealment philosophy. The mike cord was the first fly-in-the-ointment as plugging in the PL-068 kept the door from closing . . . also the mike was almost out of reach from the driving position. A right angle plug by Switchcraft is made in the PL-068 type, and is a must for SBE or Collins rigs of recent vintage. This right-angle plug wired to a short piece of shielded twin lead allowed me to make an extension to a new jack located in the center of the console. This allows the mike to be easily in reach of the driver and a hang-up clip can be mounted conveniently on the driver's side.

To complete the installation, a MARS SWR-bridge was attached with L-brackets to the side of the console using the same screws which hold the chrome trim. In addition to making antenna adjustments easy and repeating the modulation indications where the driver can see them, the SWR-bridge also makes a convenient terminal block from the heavy RG-8 antenna lead to the smaller RG-58 cable running under the dash to the rig. The antenna and power supply are mounted conventionally so need not be discussed. The installation pictured has been in daily use for almost one year without any trouble. The XYL is happy, and the OM has the additional satisfaction of knowing that even with his ham plates on the car . . . potential thieves see no rig when peering in the window.

. . . WA6DLI

(Continued from page 4)

on for many minutes calling and never stand by to see if the DX station is coming back or not. This may sound idiotic, but I've heard it happen far too many times to ignore it.

Even so, I tried out the transceive system, but with firm control of the situation and rules that were inflexible and fair. I found that this worked wonders even when my signals were very weak. I countered the tendency to give long calls by working fast break-in and stating that I wanted to get one call and one call only, then we would see if I had gotten the call. Long winded ops soon found that they were hearing only the end of my transmissions and they pruned their calls.

Fifty stations breaking in all at once seldom resulted in any one standing out. So I broke the pileup into call areas and then, if this didn't reduce the piles enough to let one or two stand out, into prefixes, one through zero. Prefixes are tricky. If I asked for W2's, I got K2's, WA2's, WB2's and everything all together. So I learned to start with WB2's . . . no W2 could possibly break in when I ask for WB2. Then WA2's, then K2's, and then, finally W2's. This rarely failed to work out. Once everyone knew that I was inflexibly working my way through the call areas the system was self policing and any out of turn breakers were dealt with by angry waiters.

This system made it so I was able to work quite a few mobiles and low powered stations that had seldom been able to contact DX before. I worked each prefix right down to the S-1 signals before going to the next prefix. One chap complained that he had had to wait fifteen minutes to contact me. That's really pretty good. A complete round seldom took more than twenty minutes, during which time I would work about 75 stations. About every five minutes I'd give QSL information.

The prefix system works quite well for Europe too and I was able to polish off long strings of DL's, DJ's, SM's, and G's this way. When the U.S. is coming through predominantly I find that if I stand by for "any other two's" after mining the WB2, WA2, K2 and W2, that in will come the VE2's, the VP2's, the YN2's, and such . . . even ZL2's and VK2's queue up this way, and the lack of QRM on the channel allows them to get their reports in turn, though they may be just barely audible.

Giving rare DX contacts is just like a contest. You have to exchange call signs and signal reports and get on with it. Speaking of contests, I had a speaking engagement at the Manchester (NH) radio club at their annual banquet right in the middle of the World Wide DX Contest so I decided not to enter it seriously. I did go in it working one station from each country I heard and I was up to 85 countries during the first day of the contest, including a full night's sleep. I'm sure I could have broken a hundred if I'd kept at it.

Area for experiment

Those of us interested in DXing have been wondering for a long time now about the advantages of the quad vs the yagi antenna. An examination of the antennas used by outstanding DXers has not been conclusive since both types of antennas are generally well represented in the DX fraternity. It is interesting that almost all of the DX antennas are either yagis or quads.

QST had an article by W4RBZ comparing the two at his QTH in their October issue. We don't get all the good articles, only most of them. He went on at length on his comparison and the result was that he found the four element yagi and the four element quad to be about the same much of the time, but the quad to be advantageous by 2-3 dB where a lower angle of radiation would help.

This angle of radiation business needs more investigation. A few fellows are running their beams up and down the tower to get the best angle. In my experience different types of beams give us different angles of radiation. I tried the Twin-Three (twin-triplex) back when it was first introduced in 1948 and found it a real winner. This is an 8JK type antenna made up of two threewire dipoles spaced one sixth wave apart, fed out of phase. The result is a bi-directional beam with an exceptionally low angle of radiation. It was my experience that I almost invariably got the report that mine was the first signal through from the States and then, as the other signals began to come up I would get calls from further on, again reporting only my signal coming through.

When the sunspots dropped down, the degree of ionization went below that which would permit my low angle signals to propagate and the antenna became virtually useless.

The sunspots are climbing rapidly now and should be at a peak in the next couple years. I'll be very interested in reports on low angle radiation antennas and any experimental work on varying the angle of radiation of arrays. The three element yagi I'm using now gets out just fine, but the propagation is quite normal and my signal comes in and goes out along with all the others.

Any takers? . . . Wayne

(Continued from page 6)

Even if they do try to charge taxes on some of the income, it will take a lot of figuring to decide how and on what. Most non-profit groups can rearrange their books in perfectly legitimate ways to show profits or losses on individual activities they engage in.

Of course, as I mentioned above, freedom from income taxes is only part of the bounty non-profit groups garner. They also pay very low postage on their bulk mailings. Organizations judged tax-free by the IRS are eligible for special mail rates from the Post Office. These low rates can amount to huge savings on the mail involved.

Most magazines in this country are mailed second class. For this mail, postage is paid by weight. For taxpaying magazines, the Post Office figures what percent of each issue is advertising and what percent is not. This non-advertising part is usually called editorial matter. The magazines are charged 2.8¢ per pound for editorial matter and between 4.2 and 14¢ per pound for advertising depending on the zone to which the magazines are mailed. The average for 73 is 9¢ per pound, and since each 73 weighs half a pound, average postage on it is 4.5¢. That's hardly an unreasonable fee in spite of the poor service we receive. Apparently the PO isn't losing money on regular magazine delivery, though.

Against the 9¢ per pound (a fair approximation) paid by tax-paying magazines, tax-exempt magazines pay 1.8¢ per pound. Period. No extra charges for advertising, no zonal breakdown—and one-fifth the cost. This and other postal subsidies to non-profit organizations cost regular businesses and other postal patrons about $300,000,00 per year.

It's interesting to compare our bill for mailing 73 with what it would be if we received the government subsidy given non-profit organizations. We pay about $15,000 a year to mail 73. If we received the low rate for non-profit groups, the cost would be only $3000. We're not so big that the $12,000 difference is unimportant to us—or you, since, of course, that amount could be spent on more and better articles, higher pay for authors, a larger staff so that we could answer more questions from readers, and so forth. Yet we know that we're paying a very reasonable amount for delivery of 73.

The other type of bulk mail used by magazines is third class. It's used for promotions, renewal notices and so forth. Tax-paying businesses such as 73 are charged about 2.8¢ per item mailed this way. Tax-exempt magazines pay only 1.3¢ apiece. Again taking 73 as an example, we mail about 300,000 pieces of third class mail each year, so the difference between the two rates is substantial. Here again, the Post Office loses money carrying mail for tax-free organizations. The total figure is $300 million a year.

To most people who know about this situation, it seems unfair. Are the articles and ads carried by the non-profit magazines so different from those in tax-paying periodicals? Why should one group have to pay five times as much to carry an ad to a reader as another? The Post Office and Congress have discussed the situation at length, but have done nothing about it so far. There are very influential people on the boards of most of these non-profit organizations and they naturally do what they can to prevent losing the subsidies for their groups.

The Postmaster General appointed a committee of distinguished citizens to study the problem of postal rates and, among other things, they recommended that the Post Office

> Seek legislation to discontinue all preferential rates which now acount for nearly $300 million of tax-supported public service costs. If subsidies are justified, they should be paid directly from Treasury funds rather than indirectly via postal rates.
>
> Report of the Advisory Panel on Postal Rates
>
> May, 1965, Govt. Printing Office

As the Post Office and Congress study mail rates, the matter will come up again. Perhaps Congress will eliminate these special subsidies which cost you and me $300 million a year. If not, take comfort in one thought: we'll undoubtedly be helping some non-profit, non-lobbying organization do good—as well as paying a government subsidy to the Chamber of Commerce so that it can compete with McGraw-Hill.

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And what does the above discussion have to do with amateur radio? Not too much. But it does concern amateur radio publishing and many of you are interested in this business. 73, Inc., which publishes 73, and Cowan Publishing Co., which publishes CQ, are tax-paying organizations. The American Radio Relay League, which publishes QST, is classified a non-profit organization and is therefore eligible for the special treatment mentioned above. The ARRL is not doing anything illegal as the laws and court decisions now stand and would obviously be incompetent businessmen if they didn't take advantage of their favored treatment. Though the ARRL's annual report is quite detailed, it is almost impossible to make a satisfactory estimate from the report of what

SOME ARTICLES TO COME IN 73

PAØVDZ—432 MHz TV Converter
W7OE—Novice Series
K3OJK—Phase-Locked Microwave Oscillator
K6JFP—Solid-State RTTY Indicator
WB6CHQ—Solid-State Product Detector
K6YKH—SSB Proof of Performance
W6BLZ—All-Band SSB Receiver
W1DCG—CW Audio Filter
K8DOC—40 Meter Vertical
W3ZP—Aero Mobile
Elkhorne—Edison: The Fabulous Drone
WA6NIL—Charging Dry Batteries
W1DCG—Buried Antennas
K6GKX—The TS-34 Scope
W6JTT—APA-38 Panadaptor
VE1TG—Beginner's 10 Meter Beam
W3WPV—160 Meter Flattop
VE1TG—The Really Rugged Rotator
VE1ADH—Assault on FP8
W6DDB—Novice Data
WB2PTU—813 Linear
WA2APT—Miniquad
W1DCG—Minibridge
K1CLL—150 Watts on Two
W1JJL—UHF Dippers
WB2GYS—Video Camera Tubes
W6BLZ—The Ancient Marriner
W6MUR—The QRZ Machine
K6ZGQ—A Little About Noise
W7CSD—6KG6 Linear
K8ERV—Equalizing AFSK Tones
VK9TG—Hamming, VK9-Style
W2DXH—Voltage Calibrator
W5SJN—FET Six Meter Converter
W6AYZ—RTTY Encoder and Decoder
W6GXN—FET S-Meter
W6OSA—Improved UHF Multipliers
K6ZCE—ID Generator
W7CSD—Vacation Antennas
KØOLG—Silicon Diode Tester
VE1TG—Broad-Band 80-Meter Vertical
Cameron—7 Element 20-Meter Beam

fraction of the ARRL's annual expenses is devoted to "non-profit" activities (for which they are considering charging non-members) and what part is devoted to publishing. It is obvious that the lion's share goes to publishing, and an unbiased observer (obviously not me) might think that their publishing activities look surprisingly like the activities of Cowan Publishing, Editors and Engineers, Howard Sams Co., Radio Publishing—and 73.

Other reference: "Publishing's tax freeloaders," by Jimm Galligan in Printer's Ink, August 12, 1966.

Fundamental abbreviations

A number of people who have objected to the term *hertz* seem to feel that *cycles per second* is more "basic" or "natural" than hertz. That's probably right, but there's more to the story than that. In the first place, did you ever notice that there's something basically different between cycles per second and most of the measurements we use such as volt or foot or quart? Well, there is. Cycles per second (or hertz) is not a measurement at all; it's a count of occurrences in a certain time period. Mathematically, the name cycles is superfluous. We'd be more correct in saying 1000 per second than 1000 cycles—but are better off to just say 1000 cycles per second or 1000 hertz. Musicians often say vibrations per second instead of cycles per second; the terms mean the same thing.

But also don't forget that all electrical units can be stated in terms of four basic quantities: length (meter), mass (kilogram), time (second), and an electrical unit. Almost any electrical unit can be used, but for our purposes, the coulomb seems most convenient. The coulomb is a quantity of electricity, 6.28×10^{18} electrons. If we write our common units in terms of the basic units, we find that an ampere is a coulomb per second (coulomb/second) and the other units are:

$$\text{watt} = \frac{\text{kilogram-meter-meter}}{\text{second-second-second}}$$

$$\text{or} \frac{\text{kilogram-meter}^2}{\text{second}^3}$$

$$\text{volt} = \frac{\text{kilogram-meter}^2}{\text{coulomb-second}^2}$$

$$\text{ohm} = \frac{\text{kilogram-meter}^2}{\text{coulomb}^2\text{-second}}$$

$$\text{farad} = \frac{\text{coulomb-second}^2}{\text{kilogram-meter}^2}$$

$$\text{henry} = \frac{\text{kilogram-meter}^2}{\text{coulomb}^2}$$

$$\text{hertz} = \frac{1}{\text{second}}$$

All of the above is rather technical and perhaps even pedantic in a ham magazine. Nevertheless, I suspect that those who say they prefer cycles per second to hertz because it's more basic aren't anxious to adopt any of the more basic equivalents to other common units.

. . . Paul

Letters

New Propagation Charts

Dear 73:

The new enlarged propagation chart is a tremendous improvement over the tiny old one. The article by John Nelson of the future of the ten-meter band in the October issue is excellent, too. However, my 73 keeps arriving so late that part of the chart is unusable. I hope that you'll try to get the magazines out earlier.

M. L. Peterson W2FMX
Waterville, N.Y.

Dear 73:

I do not like the propagation charts. The old one I could Xerox, delete the East and West Coast sections and have a convenient reference at hand, one on the operating table and one in my desk at work. The new one does not give any more info than the old one, but takes two pages instead of half a page. And it's in red, which doesn't Xerox. Also, it is now necessary to look from the chart to the legend. One vote for the old chart.

Harlan Bercovici KØBHT
St. Louis, Missouri

Rotten 73

Dear 73:

Back in '62 when I first started buying 73 on the newsstand I used to count the days till the new issue would arrive, then rush home clutching the precious copy in my hand in anticipation of the swell construction and technical articles that were between the covers. Now that you've wrested a subscription from me, what's happened? I don't see quite as many construction articles on down-to-earth stuff.

Just comparing the last issue, the article, "A Pox on Your Junk Box," belongs in the junk box—way down on the bottom.

And nothing against Gus, but 15 issues already? And the end is still not in sight! I have enough experiences of my own, let alone reading about someone else's.

And the coaxial accessory handbook—fine for one issue but let's not drag it out. Swell information, but any ham who doesn't already know a third of it shouldn't be classed a ham in my opinion. A good book on the subject would supply the other two-thirds, which, by the way, I would purchase if I had a need of it at the present time.

So I'm taking a wait-and-see attitude for another year and renewing 73. Let's stop cluttering up and return to the swell magazine you used to put out.

Francis Brna K3KKG
Washington, Pa.

Dear 73:

Anyone would be out of his mind if he didn't renew his subscription to 73.

Syd Tymeson W3FL
Takoma Park, Md.

Micro-Ultimatic Keyer

Dear Paul

The Micro-Ultimatic Keyer article was one of the most timely articles in quite a while. Finding no fault with its operation, I have to nit-pick, and bring up the fact that the symbol shown for the 914 gate is in error, as is the terminology used for it.

The gate is, in fact, a NOR gate as mentioned in a footnote, but is not a NAND gate without qualification. It is a *negative* NAND gate. The difference is significant as the truth table for the NAND is exactly opposite from the one shown in the article!

The symbol for a NOR gate has a concave back, rather than a flat back. The circle is still on the output side. The symbol for the negative NAND is sometimes used interchangeably in the industry since it has the same truth table. This symbol has a flat back like the NAND gate, but has a circle on each of the inputs and none on the output. Incidentally, the circles represent inverters. These are the MIL-SPEC symbols, and are used by a majority of the manufacturers, including Fairchild.

E. Jorgensen K1DCK
Electronic Associates Inc.
Dedham, Mass.

AM on Twenty?

Dear 73:

After reading WA5FRL's letter in the October issue, page 93, "AM on Twenty? Bah," I think something should be said in defense of AM. WA5FRL says "those who choose to work AM as a matter of personal preference can do so on other bands." Well, apparently he hasn't been listening to those other bands. The SSB interference is just as bad on 40 and 80 as it is on 20. The gentlemen's agreement worked out fine until the newer SSB operators broke it! The FCC says both AM and SSB can operate from 14.20 MHz to 14.35 MHz. WA5FRL apparently wants all AM on 20 meters outlawed to satisfy his own selfish needs and wants. The amateur bands are for everyone—not just for one person or one small group of people. I will continue to operate on 20 meters AM from 14.2 to 14.25 MHz as per the genlemen's agreement.

Ronald Zurawski WA8FVD
Menominee, Michigan

Two Meter Repeater

Dear 73:

I read with considerable interest the article on a "Two Meter Repeater" in the September 1966 issue of 73 Magazine. I noted, however, several technical points that bear consideration when utilizing this system in the amateur bands. I am not familiar with the regulations or technical restrictions imposed by the Air Force MARS program, so I will restrict my comments to application of this system within the limits of the amateur bands where it falls within FCC jurisdiction.

First and foremost, the method of keying the transmitter is not a fail-safe system. In the event of failure of the keying tube V314, the discriminator V309, the noise amplifier V310, or the noise rectifier V311, the keying relay will drop out, permanently keying the transmitter on.

Second, no mention is made of a timer in the transmitter keying circuit to limit the on-the-air time. In the event of a keying relay circuit failure or a continuous carrier of any form on the input frequency, the repeater would be on the air continuously, thus rendering the frequency useless.

Third, no mention is made of controlling the repeater from some other point so that it can be deactivated in case of a failure as mentioned previously, or in case of misuse. In such event, someone would have to make a trip up the tower to turn the thing off! This comment is made on the assumption that the repeater is unattended.

In addition to these comments, I might mention that the majority of FM operation around the nation is vertically polarized, and this is recommended if operation on 146.940 MHz or 52.525 MHz, etc., is contemplated. Also, you might obtain an improvement in audio quality by taking the audio from the receiver directly from the output of the discriminator, at the discriminator test jack, thru a cathode follower.

When used in the amateur bands, some form of logging the repeater transmitter must be provided, be it a tape recorder, pen and ink strip chart time recorder, or what have you. Also, automatic identification is convenient so as to alleviate the necessity of stations operating thru the repeater from identifying the repeater as well as their own stations.

The transmit frequency suck-out crystal is an interesting feature, that we will keep in mind for our repeater.

I might make a few suggestions to alleviate some of the problems pointed out.

First, I recommend a keying circuit similar to that used in General Electric's Progress Line Mobile Telephone System "busy-circuit" which uses a single 12AT7. It samples both noise output from the discriminator and limiter grid voltage. In order for it to key, two conditions must reduce, or "quiet," and the limiter grid voltage must increase, both conditions occurring only with the presence of a carrier at the input of the receiver. In the event of failure of any tube in the receiver, the relay will not key, thus providing a fail-safe keying system.

Second, a three- or ten-minute timer is recommended in the transmitter keying line to prevent the transmitter from locking on the air continuously in the event a continuous carrier is received.

The timer and cathode follower options are available on G.E. remote control panels, which can be obtained from sources similar to the receiving and transmitting gear.

Third, some method of controlling the repeater must be rovided in case of misuse or malfunction. Used 450 MHz 'M equipment is easily available and has been used quite ffectively for remote control purposes.

These comments are offered in the hopes that you might void some of the problems we have encountered in the onstruction and operation of a repeater system in the reater Baltimore area. During the past five years we have leveloped a system including six to six, six to two, two to ix, and two to two repeaters, all using 450 MHz for re-note control of several sites, as well as for point-to-point inks. We use Secode tone coding equipment for primary nd secondary control. Future plans call for interconnec-ion with the greater Washington, D.C. area, and the York nd Carlisle, Pa. areas, so as to obtain continuous coverage ver the entire area.

Gary Hendrickson W3DTN
Secretary-Treasurer
Maryland FM Association, Inc.

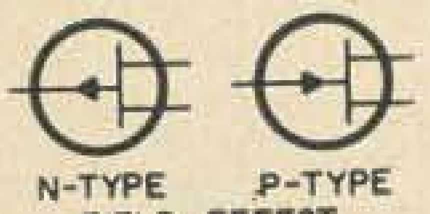
)ear 73:

A word of thanks for your good magazine and a few omments on your September issue. The two meter re-eater article was quite good overall, but the GE Progress ine 4ER25D receiver mentioned is definitely not cheap on he West Coast if it can be bought at all. It runs $50 to 125 when available. It is very easy to narrow band at cost of only a few dollars, so is still popular for com-nercial use. Other GE and Motorola models, available at ower cost, will perform better. Also, in Fig. 3, the 100-kΩ olume pot should be 250 kΩ and the squelch pot 15 kΩ. 'he repeater as shown will work but a much better job ould be done with the time and money invested.

James Lev K6DGX
Huntington Park, Cal.

Correction

'he symbols for the N-channel and P-channel field effect ransistors in the chart on page 75 in the September 73 are hown reversed. Here are the correct symbols:



N-TYPE P-TYPE
FIELD-EFFECT

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Act of October 23, 1962: Section 4369, Title 39, United States Code)

Publisher: File two copies of this form with your postmaster.

DATE OF FILING: 13, Sept. 1966
2. TITLE OF PUBLICATION: 73
FREQUENCY OF ISSUE: Twelve times per year
LOCATION OF KNOWN OFFICE OF PUBLICATION (Street, city, county, state, zip code): 73 Pine Street, Peterborough, Hillsborough, New Hampshire 03458
LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS (Not printers): Peterborough, New Hampshire

6. NAMES AND ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR
PUBLISHER (Name and address): Wayne Green, Peterborough, New Hampshire
EDITOR (Name and address): Paul Franson, Peterborough, New Hampshire
MANAGING EDITOR (Name and address):

7. OWNER (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.)

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73 Inc.	Peterborough, N.H. 03458
Stockholder: Wayne Green	Peterborough, N.H. 03458

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9. Paragraphs 7 and 8 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages or other securities of the publishing corporation have been included in paragraphs 7 and 8 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.

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C. TOTAL PAID CIRCULATION	45,116	48,859
D. FREE DISTRIBUTION (including samples) BY MAIL, CARRIER OR OTHER MEANS	336	348
E. TOTAL DISTRIBUTION (Sum of C and D)	45,552	49,207
F. OFFICE USE, LEFT-OVER, UNACCOUNTED, SPOILED AFTER PRINTING	1,321	1,293
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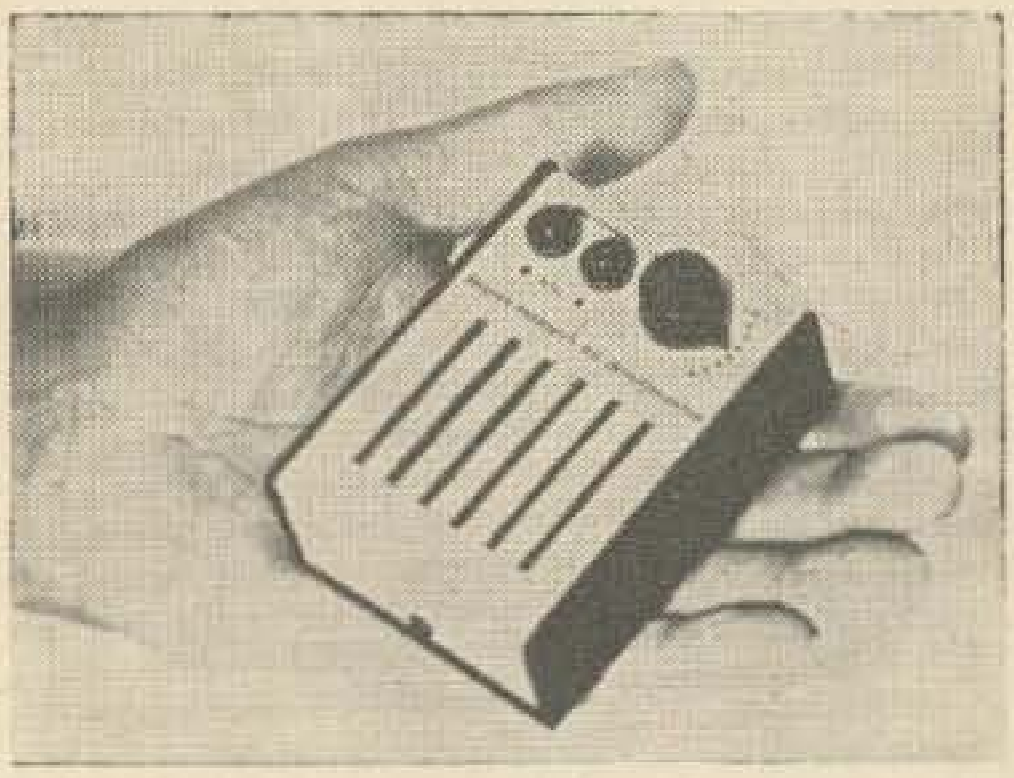
I certify that the statements made by me above are correct and complete. (Signature of editor, publisher, business manager, or owner)

POD Form 3526 Jan. 1965

NEW PRODUCTS

Ami-Tron Toroid Cores

In addition to their famous toroid core kits, Ami-Tron is now carrying a complete line of toroidal cores in stock that fill almost any need. These cores are available in several sizes from 0.370" O.D. to 2.00" O.D. with prices that range from 45¢ to $3.00. There are three types of ferrite available which cover the frequency range of 500 kHz to 30 MHz, 10 to 90 MHz and 30 to 200 MHz. Although Ami-Tron does not supply winding data for each of these cores, it is assumed that the user can proceed empirically in the toroid design; their data sheet on these cores provides some helpful hints along these lines. For more information, write to Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California 91607.



James Research Oscillator/Monitor

This new unit from James Research is a sensitive broadband rf detector which produces an audible tone signal when activated by an rf field. The detector is quite sensitive, and will respond to as little as 10 milliwatts of power from 100 kHz to 1000 MHz. It is useful for tuning up transmitters, checking oscillators and stray rf fields or as a CW monitor. In this case it will emit a clear sidetone whenever the transmitter is keyed. For use as a code practice oscillator, a key may be connected directly to the device; in some cases the leads going to the key may be used to detect rf from the transmitter. Other features of this unit are built in tone control and speaker, small size, low battery drain and 90 day guarantee. $12.95 from James Research Company, 11 Schermerhorn Street, Brooklyn Heights, New York 11201.

Lafayette HA-700 Amateur Communication Receiver

Lafayette's new HA-700 communications ɜceiver features 6 tube superhetrodyne cir- uitry with two mechanical filters in the *if* ɔr superior signal selectivity. The sensitive rf tage incorporates a front panel controlled ntenna trimmer and sensitivity of 1μV for dB signal to noise ratio. Frequency stability ; maintained by continuous filament voltage n the critical oscillator and mixer stages.)ther important features of this new receiver re built-in BFO, variable BFO tone for im- roved CW reception, slide rule dial, flywheel perated tuning dials for smooth, fast tuning, nd silicon diode automatic noise limiter and ˌVC circuitry for efficient noise suppression. 'requency coverage: 150-400 kHz, 550-1600 Hz, 1.6-4.0 MHz, 4.8-14.5 MHz, and 10.5- 0 MHz. Selectivity: 10 kHz at 55 dB down. 89.95 from Lafayette Radio Electronic Cor- oration, 111 Jericho Turnpike, Syosset, L.I., ɪ.Y. 11791.

Aquadyne Radioteletype Terminal Unit

Aquadyne, Inc has just introduced a new ransistor terminal unit for the reception of adioteletype signals. Designed specifically for he radio amateur, this new converter is oused in an attractive small case and features peration from either the high impedance eadphone output or low impedance speaker utput of the receiver. A three section audio lter provides good discrimination against oise and interfering signals.

Eight transistors and six diodes are used in he circuit which includes two meters for ac- urate tuning of the received signal. A solid tate regulated power supply assures stable perations from the AC power line. Provision ; made for receiving three different radio- eletype signal shifts: 850 hertz, 425 hertz nd 175 hertz; this permits reception of many ommercial stations as well as amateurs. ince this converter operates the print magnet lirectly, there is no necessity for a polar relay. 'or more information, write to Aquadyne, nc., Box 175, East Falmouth, Mass. 02536.

Aquadyne RTTY Converter Kit

The new Aquadyne KTY-1 receiving converter kit utilizes five silicon transistors and four diodes in a circuit that provides the signal for driving the selector magnet of a teleprinter. The audio filter section uses 88 mH toroids and mylar capacitors for separating the mark and space signals. This converter is designed for the 850 hertz shift normally used in amateur RTTY operation, but sufficient bandpass is allowed for those signals encountered in the ham bands that don't have precisely 850 hertz shifts.

Although the audio filter circuit is pretuned, the other parts of the converter are assembled by the purchaser on a printed circuit board. When operated from the audio output of a communications receiver, this unit provides a simple converter for those interested in receiving RTTY signals with only a modest outlay of time or money. $24.95 from Aquadyne, Inc., Box 175, East Falmouth, Mass. 02536.

Motorola Semiconductors

Motorola has just announced several new semiconductors which should be of interest to amateurs. First of all, they have three new field effect transistors in plastic cases which will retail for 50¢ in large quantities. These FETs are designed for general purpose audio and switching applications. The low price of the MPF103, 104 and 105 should popularize the use of field effect transistors in input stages to audio amplifiers, low frequency crystal oscillators, VFO's and other applications where the high impedance of the FET offers considerable advantage.

The other new device from Motorola is the 2N3950, a transistor that provides a guaranteed 50 watts at 50 MHz with a minimum power gain of 8 dB. Although 2N3950 is characterized for Class C operation, it can also be operated Class A or B to meet high power ssb requirements through 76 MHz. The data sheet on this new transistor includes data measurements that describe large-signal Class C behavior of the device. These measurements are made at full operating power and are more accurate than small signal parameters when designing high power stages. In fact, these characteristics now make it possible to design large signal rf output stages without resorting to the older cut and try methods.

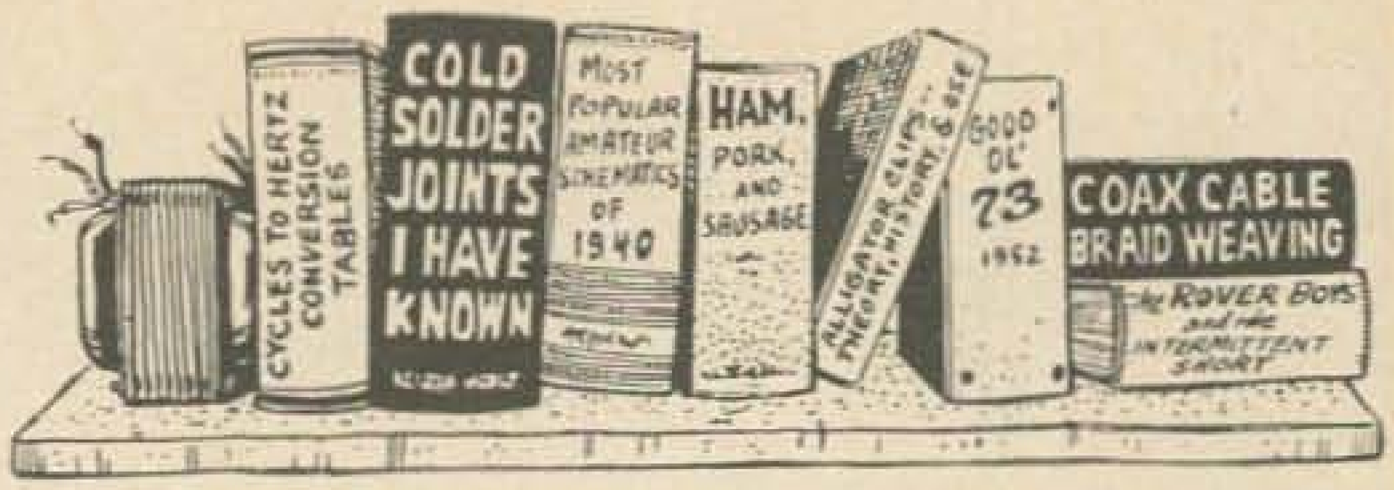
Both the 2N3950 high power rf transistor and MPF-series field effect transistors are available at Motorola distributors. For more information write to Technical Information Center, Motorola Semiconductor Products Inc., Box 955, Phoenix, Arizona 85001.

Eicocraft Solid-State Electronic Kits

Eico has just come out with a line of professional solid-state kits at popular prices. With these kits it is economically feasible for the newcomer to the electronics field and the beginner in electronics to work with professional components at modest cost. These new kits are designed, manufactured and backed up by 20 years of kit experience in ham gear, test equipment, stereo and hi-fi; only the complexity has been reduced to make kitbuilding easier, faster and less expensive. Each Eicocraft Trukit consists of solid-state circuitry, pre-drilled copper printed circuit boards, finest quality compounds and comprehensive step-by-step instructions. Among the kits presently available are the code practice oscillator, power supply, audio power amplifier, and intercom; prices vary from $2.50 to $9.95 per kit. For more information write to EICO Electronic Instrument Company, 131-01 39th Avenue, Flushing, New York 11352.

WA6FKYN RTTY Filters

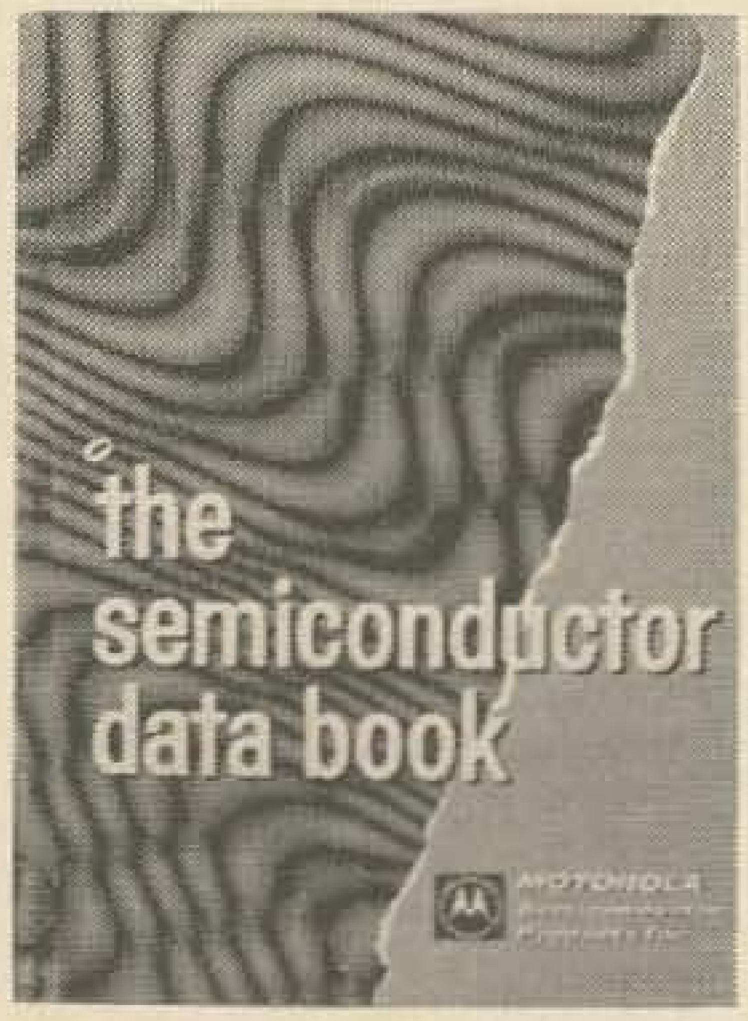
James R. Humphrey WA6FKN has just come out with some compact RTTY filters that look ideal. Each of these filters consists of an uncased 88 mH toroid coil tuned to the exact audio frequency with a high grade mylar capacitor. The use of a mylar capacitor insures frequency stability and long life. These components are mounted on a small 1¾" by 2" printed circuit board. Provisions are made on the board for the addition of a low impedance winding and/or a loading resistor. In addition, the toroid center tap is brought out to a separate pin. Each of these filters carries a money back guarantee and is available for $4.25 each; specify exact frequency with order. WA6FKN also has uncased center tapped 88 mil coils available, 5 coils for $2.50. Write to James R. Humphrey WA6FKN, P.O. Box 34, Dixon, California 95620.



NEW BOOKS

Amperex Electron Tube Catalog

Amperex Electronic Corporation has just announced the latest edition of their Condensed Electron Tube Catalog. This new catalog contains a description and basic specifications of the full line of Amperex tubes and serves as a quick reference guide for new equipment designers and replacement tube buyers. This catalog covers power tubes, subminiature tubes, entertainment and audio tubes, premium quality tubes, UHF special purpose tubes and many other special purpose vacuum tubes. A special insert in the catalog covers the basic specifications on Amperex microwave tubes and components; included on this insert are magnetrons, klystrons, disc-seal triodes and traveling wave tubes. Free copies are available by writing on your company letterhead to Amperex Electronic Corporation, Advertising Department, Hicksville, Long Isalnd, New York 11802.



Complete Semiconductor Specs

Motorola has just published a hardbound, 1500-page reference handbook that lists all EIA registered semiconductors. It tabulates 10,500 1N-, 2N-, and 3N-devices made by all manufacturers with their major specifications, and gives equivalents for many of the ones not made by Motorola. In addition, the book includes complete data sheets on over 2800 Motorola semiconductors and a number of application notes and other general information. All semiconductor users should have this valuable book. It costs only $3.95 from any Motorola distributor or by mail from TIC, Motorola Semiconductor Products, Box 955, Phoenix Arizona 85001.

1967 Heathkit Catalog

Heathkit's new 1967 catalog, just off the ɔress, illustrates more than 250 different elec-ronic kits. This 108 page kit-builder's treasure ıas a kit for every interest and every budget. [here are complete lines of amateur gear, test ınd lab instruments, stereo/hi-fi components, ɔlus many home and hobby items including narine electronics, electronic organs, color elevision and AM and FM radios. This catalog epresents Heath's biggest offering yet, featur-ng many new kits including a deluxe SSB re-eiver and matching transmitter, SB-series ımateur station console and a signal monitor. [o obtain your free copy, send a post card to he Heath Company, Benton Harbor, Michi-gan 49022

Dictionary of Electronics

Harley Carter has compiled a most complete lictionary of electronic terms in the latest edition the *Dictionary of Electronics* by the Hart Publishing Company. This dictionary is iberally illustrated and covers the latest levelopments in electronics. In addition to the lefinitions of electronic terms, a list of ab-ɔreviations, symbols, graphical symbols, color codes and conversion tables in included in the ɔack of the book. A very worthwhile buy for he amateur, engineer and technical writer; $2.65 at your book store or write to Hart Publishing Company, 74 5th Avenue, New York, New York 10011.

New TUCO Catalog

The new catalog from Transistors Unlimited will certainly excite your soul if you're a build-ng ham. It lists hundreds of diodes, transis-ors and other semiconductors, electrolytics, antalytics and other capacitors, pots, resistors, sockets, test equipment, kits and plenty more. The prices are good, too. Send 25¢ today for catalog 1967S from TUCO, 462 Jericho Turn-pike, Mineola, N.Y. 11501.

Electronic Cable Handbook

The Engineering Staff of the Belden Manufacturing Company has in the *Electronic Cable Handbook*, put together a very complete treatise on the subject of electronics wire and cable. This handbook covers the installation, test, manufacture and use of all types of cable encountered in electronics. There are chapters on coaxial cables for rf, audio and microphone cables, phono pickup and speaker cables, television lead-in, commercial sound and television cabling, intercom and telephone, instrumentation and data processing and automation. All in all, it is a very complete collection of useful facts and figures for users of electronic cable. In addition, this book contains a glossary of electronic terms, a list of military and non-military specifications for wire and cable and many tables of wire and cable operating information. $3.95 at your local distributor or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana.

Multistage Transistor Circuits

Multistage Transistor Circuits by R. D. Thornton et al is just one of a series of eight books produced by the Semiconductor Electronics Education Committee (SEEC). Although this series of books is written specifically for the college undergraduate student, they are very useful to advanced amateurs and electronic technicians familiar with college algebra and the electronics required for transistor circuit design. *Multistage Transistor Circuits* delves into the parameters of multistage circuit design in great depth and presents the effects of external parameters on final circuit operation. Among the subjects covered in this worthwhile book are gain and bandwidth calculations, stability and frequency response of feedback amplifiers, tuned amplifiers, direct coupled amplifiers and broadband amplifiers. Of particular interest is the discussion of the interaction problems between coupled transistor stages and methods of minimizing this undesirable feature. This interaction is of major importance when predicting the high frequency behavior of a particular amplifier circuit. Although this book is much too complex for the casual reader, it presents many subjects to the serious circuit designer that aren't available in other texts. Although *Multistage Transistor Circuits* is very useful by itself, it is much more useful when backed up by the other books in the SEEC series which include *Introduction to Semiconductor Physics, Physical Electronics and Circuit Models of*

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Stevens Precision Choppers $2@, ...3/$5
Helipots Multi Ten-Turn@, ...$5
Helipot Dials $4@, ...3/$10

X-Formers All 115V-60Cy Primary—
2500V @ 10Ma & Fil $2@, ...3/$5
1100VCT @ 300Ma, 6V @ 8A, 5V @ 3A & 125V Bias. abt 1200VDC $5 @, ...4/$15
2.5V @ 2A $1@, ...3 for $2
6.3V @ 1A $1.50@, ...4 for $5
Micro-Switch Rated 40AmpAC & DC 50c@, ...4 for $1
BandPass Filters 60 or 90 or 150Cys $2@, ...3 for $5
"Bruning" 6" Parallel Rule @, ...$1
2V3G Tube HiV Repl 2X2A ....5/$1

PL259A & SO239 CO-AX M&F Pairs ....3/$2
Phone Patch Xfmrs Asstd ....3/$1
FT243 Xtals & Holders ....2/$1
Insltd Binding Posts ....20/$1
Sun-Cells Selenium Asstd ....6/$1
TO36/100W Untested Transistors ....3/$1

Tube Clamps Asstd ....8/$1
.01 Mica 600WV Condsr ....6/$1
.001 to .006 Mica/1200WV Cdsr ....4/$1

"TAB" TUBES TESTED, INSPECTED, BOXED — GUARANTEED! NO REJECTS! GOV'T & MFGRS SURPLUS! NEW & USED

OA2	.65	4KP1	$50	4-1000A	$70
OA3	.80	5ABP7	20	4E27A	20
OB2	.55	5ADP1	15	250TL	14
OC3	.45	5ADP7	14	307A	1.50
OD3	.45	5AFP1	50	203A	2
2J39	18	5AQP7	20	VR92	5/$1
3BP1	2	5BCP7	50	388A	2
3BP5	3	5BP1	7	350A	1
3CP1S1	2	5BP2	9	350B	2
3DP1	2	5BP4	7	371B	1

We Swap Tubes! What Do/U Have?

3EP1	3	5BP7	7	6146	2
3FP7	1	5BGP2	45	416B	12
3GP4A	4	5BHP2	45	450TH	30
3GP7	2	T51P2	45	450TL	25
3HP14	2	T54P2	45	460	5
3JP1	3	T533P2	45	703A	2
3JP14	3	T543P2	45	707B	3
3RP1A	6	5CP1A	7	715C	7
3WP1	25	5CP4	9	725A	10

Send 25c for Catalog

2C39	4	5CP7	5	807	1.35
2C40	5	5CP11A	8	811	2.75
2C43	7	5FP1A	10	812	4
2C51	.65	5FP4A	9	813	11
2E22	2	5FP7	4	815	2.25
2E24	2	5FP14A	9	826	Q
2E26	2	5HP4	10		
2E30	2	5JP1A	5	829B	9
2E35	2	5JP2	5	832A	7
2K26	18	5JP4	7	833A	Q

All Tubes Stocked at Low Prices!

2K28	18	5JP7A	18	837	1.35
2V3G	6/$1	5JP11A	18	866A	2
2D21	3/$1	5JP14	18	884	1.35
3A4	2/$1	5LP1A	10	954	4/$1
3A5	2/$1	5LP2	12	955	2/$1
2K43	Q	5LP7A	12	958A	2/$1
2K50	45	5QP4	20	991	4/$1
3C24	3	5RP1	18	1614	2
3D23	2	5RP2	20	1620	3
3E29	6	5RP11A	25	1625	2/$1

We Buy! We Sell! We Trade!—

3Q5	2/$1	5SP2A	27	1629	.60
4D32	12	5SP7	21	2050	.90
4-65A	7	5UP1	9	5517	3/$1
4-125A	18	5UP7	12	5544	20
4-250A	24	5XP21	24	5608	4
4X150A	9	5YP1	22	5618	4
4X250B	18	5YP11	21	5651	.80
4X500A	70	7BP1	15	5654	2/$1
3X2500A3	100	7BP4A	14	5656	4
4-1000A	70	7EP4	9	5663	1

Top $$$ Paid for XMTTR Tubes!

5R4GY	1	7ADP7	1	5670	3/$1
5R4WGB	4	9LP7	2	5686	1
5T4	2/$1	10KP7	20	5687	2/$1
5U4	.70	10UP21	45	5691	2
5V4	1	B1036P7	15	5692	2
5Y3	2/$1	B1045	15	5693	2
5Z3	2/$1	K108DP15	18	5725	2/$1
2A4G	1	1808P1	Q	5732	Q
885	2/$1	2501A3	20	5736	81
6C4	4/$1	2511A5	20	5750	2/$1

Wanted Test Sets (TS) & Equip.

6A8	1	12GP7	5	5751	2/$1
6AB4	.75	1848	75	5762	72
6AC7	3/$1	1850A	75	5814	2/$1
6AG5	2/$1	Don't "C" Write		5894	12
6AG7	3/$1	25A6	1	5963	2/$1
6AK5	3/$1	25A7	1	5964	2/$1
6AL5	3/$1	25C5	2/$1	5965	2/$1
6AQ5	2/$1	25L6	4/$1	5948	54
6AR6	2/$1	25T	7	5820	75
6AS7	2	25Z5	2/$1	33	10/$1

Send 25c for Catalog!

6AT6	2/$1	25Z6	2/$1	991/NE165/1	
6AU6	2/$1	26A7	1	10/VT25	4/1
6B4	3	FG27	9	VR92	7/$1
6BA6	2/$1	28D7	2/$1	NE2	12/$1
6BE6	2/$1	FG33	18	12AU7	2/$1
6BG6	1	35A5	2/$1	12AX7	2/$1
6BH6	2/$1	35L6	2/$1	6AN5	1
6BJ6	2/$1	35T	5	6SN7	3/$1
6BK7	1	3525	2/$1	6V6	2/$1

6BL7 TOP $$$ PAID FOR 304TL TUBES

6BL7	Q	43	4/$1	9001	3/$2
6BN4	2/$1	45	3/$1	9002	2/$1
6BN6	2/$1	50L6	2/$1	9003	2
6BN7	Q	75	2/$1	Write for Sub-	
6BQ6	1	83	1	Miniatures	
6BQ7	2/$1	83V	2/$1	Large Stock	
6BX7	2/$1	4PR60A	30	5933	2/$5
6BY5	1	4X150G	18	4J52	20
6BZ6	1	4X250B	18	5762	72
7C24	72	4-400A	25	8233	7

WANTED TUBES ALL TYPES
WE BUY, SELL & TRADE AS WELL!

"TAB" TERMS: Money Back Guarantee! Our 23rd Year. $5 Min. Order F.O.B., N. Y. C. Add Shipping Charges.

111 HM LIBERTY ST., N.Y.C. 10006, N.Y.
SEND 25c PHONE 732-6245 FOR CATALOG

"TAB" * SILICON ONE AMP DIODES
Factory Tested & Guaranteed

Piv/Rms	Piv/Rms	Piv/Rms	Piv/Rms
50/35 .05	100/70 .07	200/140 .10	300/210 .12
400/280 .14	600/420 .21	800/560 .30	900/630 .40
1000/700 .50	1100/770 .70	1700/1200 1.20	2400/1680 2.00

**All Tests AC & DC & Fwd & Load!*

1700 Piv/1200 Rms @ 750 Ma ....10 for $10
2400 Piv/1680 Rms @ 750 Ma ....6 for $11

SILICON POWER DIODES STUDS & P.F.**

D. C. Amps	50Piv 35Rms	100Piv 70Rms	200Piv 140Rms	300Piv 210Rms
3	.10	.15	.22	.33
12	.25	.50	.75	.90
18	.20	.30	.75	1.00
45	.80	1.20	1.40	1.90
160	1.60	2.90	3.50	4.60
240	3.75	4.75	7.75	10.45
D. C. Amps	**400Piv 280Rms**	**600Piv 420Rms**	**700Piv 490Rms**	**900Piv 630Rms**
3	.40	.50	.60	.85
12	1.20	1.50	1.75	2.50
18	1.50	Query	Query	Query
45	2.25	2.70	3.15	4.00
160	5.75	7.50	Query	Query
240	14.40	19.80	23.40	Query

5U4 Silicon Tube ....$2 @, 6 for $ 9
5R4 Silicon Tube ....$5 @, 2 for $ 9
866A Silicon Tube ....$14 @, 2 for $25

*** TRANSISTORS * SCR'S * ZENERS!!!**
FULL LEADS FACTORY TESTED & GTD!

PNP100 Watt/15 Amp HiPwr TO36 CASE!
2N441, 442, 277, 278, DS501 Up To 50/VCBO $1.25@, 5 for $5
2N278, 443, 174, Up to 80V $3@, 2 for $5; 5 for $10
PNP 30 Watt/3A, 2N115, 156, 235, 242 254,255, 256, 257, 301, 392, 40c @ ....3 for $1
PNP 2N670/300MW 35c @, ...5 for $1
PNP 2N671/1 Watt 50c @, ...3 for $1
PNP 25W/TO 2N538, 539, 540 ....2 for $1
2N1038 6/$1, 2N1039 ....4 for $1
PNP/TO5 Signal 350MW 25c @, ...5 for $1
NPN/TO5 Signal IF, RF, OSC 25c@, 5 for $5
PWR Finned Heat Sink 180 SQ" $1.50@, ...4 for $5
PWR Finned Sink Equiv. 500 SQ" $5 @, ...3 for $10
SILICON PNP/TO5 & TO18 PCKG 2N327A, 332 to 8, 474 to 9, 541 to 3, 935 to 7 & 1276 to 9, 35c@, ...7 for $2
MICA MTG KIT TO36, TO3, TO10 30c@, 4/$1
ANODIZED TO PWR 30c@, ...4/$1
ZENERS 1 Watt 6 to 200V, ...$1 Each
ZENERS 10 Watt 6 to 150V, ...$1.25 Each
STABISTOR up to 1 Watt ....10 for $1
GLASS DIODES Equiv 1N34A ....20 for $1

18 Amp PWR Pressfit Diodes to 100 Piv ....5 for $1
MICRO-MUSWITCH 35 Amp AC/DC ....3 for $1
2N408 RCA SHORT LEADS ....5 for $1

TRANSISTORS — TOO MANY! U-TEST!
Untested 3A Diamond/TO3 ....10 for $1
Untested 15A Round/TO36 ....3 for $1
Untested 1 Amp TOPHAT Diodes 25 for $1
TO5 PCKG IF, RF & OSC LOW VCBO ....20 for $1

D. C. Power Supply 115V/60 to 800 Cys. Output 330: Tap 165V up to 150 Ma, Cased $5@, ...2 for $9

SCR-SILICON-CONTROL RECTIFIERS!

PRV	7A	25A	PRV	7A	25A
100	Q	Q	500	2.50	3.75
200	Q	Q	600	3.25	4.25
300	1.80	2.25	700	4.00	5.00
400	2.00	2.90	800	4.75	5.65

UNTESTED "SCR" Up to 25 Amps, 6/$2
Glass Diodes 1N34, 48, 60, 64 ....20 for $1

2 RCA 2N408 & 2/1N2326 Ckt Bds
1N2326 Can Unsolder ....4/$1

DISCAP .002 Mfd @ 6KV ....6 for $1
DISCAP @ 1KV ....10 for $1
DISCAP Asstmnt up to 6KV ....20 for $1
6 or 12VAC Minifan & Blade $1
Pushon Lugs/Pins Pwr Tr'sistrs ....15 for $1
WANTED TRANSISTORS, ZENERS, DIODES!

May your signals be strong, your QSO's solid and a world of DX at your fingertips is the Christmas wish from all of us at Waters to all of you. And a Happy New Year, of course!

Bob Waters

W1PRI

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MANUFACTURING INC.
WAYLAND, MASSACHUSETTS

Makers of fine Amateur Radio gear designed to improve the image of the amateur operator

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*AUTO MATCH® ANTENNAS *REFLECTOMETER *CLIPREAMP™ *COMPREAMP™ *DUMMY LOAD/WATTMETER *CODAX™ AUTOMATIC KEYER *PROTAX™ COAXIAL SWITCHES *COAXIAL FILTERS *UNIVERSAL HYBRID COUPLER AND PHONE PATCH *"LITTLE DIPPER®" GRID DIP METER *WIDE RANGE ATTENUATOR *NUVERTER®