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de W2NSD/1

never say die

Vegas

A letter from the Sahara Hotel explained that I could come if I wanted to, but that under no circumstances was there to be any controversial discussion. This kind of substantiated my suspicion that this was not a convention at all, but a thinly disguised excuse for hams to come on out and enjoy girls and gambling. I'd rather buy a new rig.

Sunspots

Now that the present cycle is well on its way upward the experts are watching it carefully, trying to estimate just how high it may actually go. It has already surpassed the prediction made by George Jacobs W3ASK who thought it might peak out at 60-70 and now looks as if it will top off in the 140-150 range. What does all this mean for us? Well, the bands will be hot . . . ten will be wide open a lot now, twenty will frequently be staying open all night . . . conditions are definitely looking up.

Pot shots

Huntoon has been pegging off shots at me in QST lately. In the August issue he reported an IARU censuring movement against an unnamed amateur radio magazine, strongly implying that it was 73. I wrote directly to the party who instituted the censuring movement and have a letter from him stating that this was against another amateur magazine, and not 73. Tsk, tsk . . . yellow journalism.

Huntoon is still trying to sweep unpleasant facts under the QST carpet. He appears quite upset in the December Leaky Lines and calls some poor amateur who wrote in "anti-League." John, I don't think that any of us are really anti-League. There are a number of us, a growing number, who are disappointed in the way the League is running things, but is this a reason to lose your temper and call names?

John, a large number of us are seriously worried about the future of amateur radio and think that something concrete should be done to get more world support for our hobby. We want to know that the League realizes this situation and that it is doing something positive to influence the outcome. Yet we hear of little being done.

Now, about the 14,000 ARRL members lost last year. First of all I would like to say that I feel responsible for anything that I write and publish . . . I also assume responsibility for anything that I say. But I do not feel that I should be held responsible for something that someone else says I said. In this particular case I was not quoted at all correctly. However, lest anyone think I am trying to weasel out on something, let's just put aside all those pretty little figures that you've trotted out to confuse the unwary . . . and shame on you for doing that, John . . . was that really honest?

The question has been raised about how many members the ARRL lost in 1965. ARRL members, if they want to invest an interesting 75¢, can send for the 1965 Annual Reports. John realizes that very few amateurs do send for this document and thus writes freely. John cannot plead ignorance of the actual figures for they appear in his own personal report to the Directors. In paragraph 5 of his report we find that 18.4% of the ARRL members in the U.S. and possessions did not renew their membership in 1965. In paragraph 4 we find that there are 78,180 full members and 8,753 associate members as of the end of 1965, a total of 86,753 members (subscribers). 18.4% of that is 15,962 subscribers lost in 1965.

Now the bulk of those lost subscribers were replaced by new subscribers so that the *net* drop in overall membership of the League was only 1,214. This all comes from John's report, so let's see if he has anything but a very red face to show on the subject now.

DX thoughts

A letter from an SM complained about the lack of courtesy of the U.S. stations when they are after a rare DX station. I've heard this complaint for a lot of years now and I was rather surprised when I got on from KC4AF a few years back and found everyone to be just as cooperative as I could ask. I had virtually no problems with bad manners from

(Continued on page 112)

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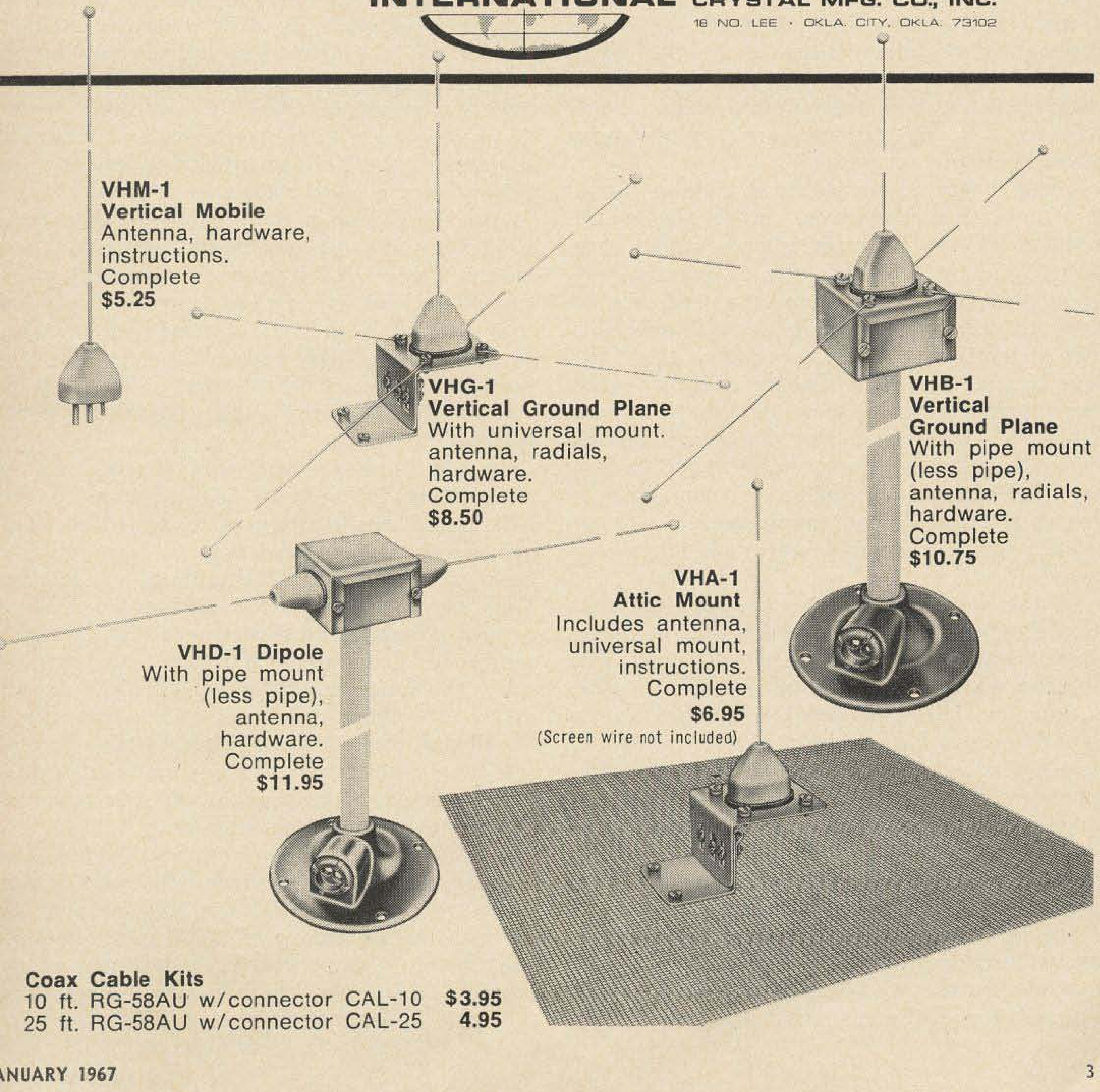

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Editor's Ramblings

Paul Franson WA1CCH

VHF frequency pressure

Businesses in this country badly need additional VHF frequencies for their two-way communication. Many of the channels allotted to them are hopelessly overcrowded. Two-way users in heavily populated areas often have long waits before their channels are free enough to pass even short messages. Yet other frequencies lie almost unused in the same areas because they are assigned by service rather than location. Agricultural channels are little used in metropolitan areas while more urban channels are jammed.

These inequities should be straightened out, of course. But that won't solve the whole problem. Two-way users simply must have more channels. The question of where these frequencies will come from is a vital one to hams. A few years ago, it seemed inevitable that at least part would come from the VHF ham bands. We could hardly complain with much justification in view of the small use these wide bands get. But things are looking up for hams now. We may not *have* to lose any VHF frequencies after all. Our possible saviour is an unlikely-seeming one.

Let's go back a few years to see what happened.

In the forties, when it was apparent that television was going to be feasible commercially, frequencies had to be allotted to it. The decision was made to assign channels in what is now our VHF TV band. Time has shown that this was a bad decision and that it would have been better to have allotted higher frequencies, but then no one was able to convince officials how popular TV would be, and how much interference the VHF TV channels (particularly the low band ones) would suffer during periods of favorable propagation.

So the channels were assigned and stations started broadcasting. It wasn't long before it was obvious that there simply weren't enough channels for all the cities that wanted TV, and all the interests that wanted to own TV stations, so additional frequencies were added in the present UHF TV band. Plenty of frequencies were made available so that there were 70 UHF channels and 12 VHF. Some UHF stations went on the air, but most suffered serious financial problems and many closed down. They had a number of strikes against them. First, most TV receivers couldn't receive UHF. UHF was an optional accessory, and many people wouldn't pay extra for it. Others who already had TV's wouldn't spend the money for a UHF converter and antenna, so watched the VHF channels by default even if there was a UHF station near them.

Also, UHF has a more limited range than VHF for the same power and equivalent antennas. Early UHF front ends were very noisy and unsatisfactory unless supplied with a strong signal. Thus UHF stations had a smaller audience than VHF and while the VHF stations prospered, UHF stations did poorly in most areas—especially if they had VHF competition.

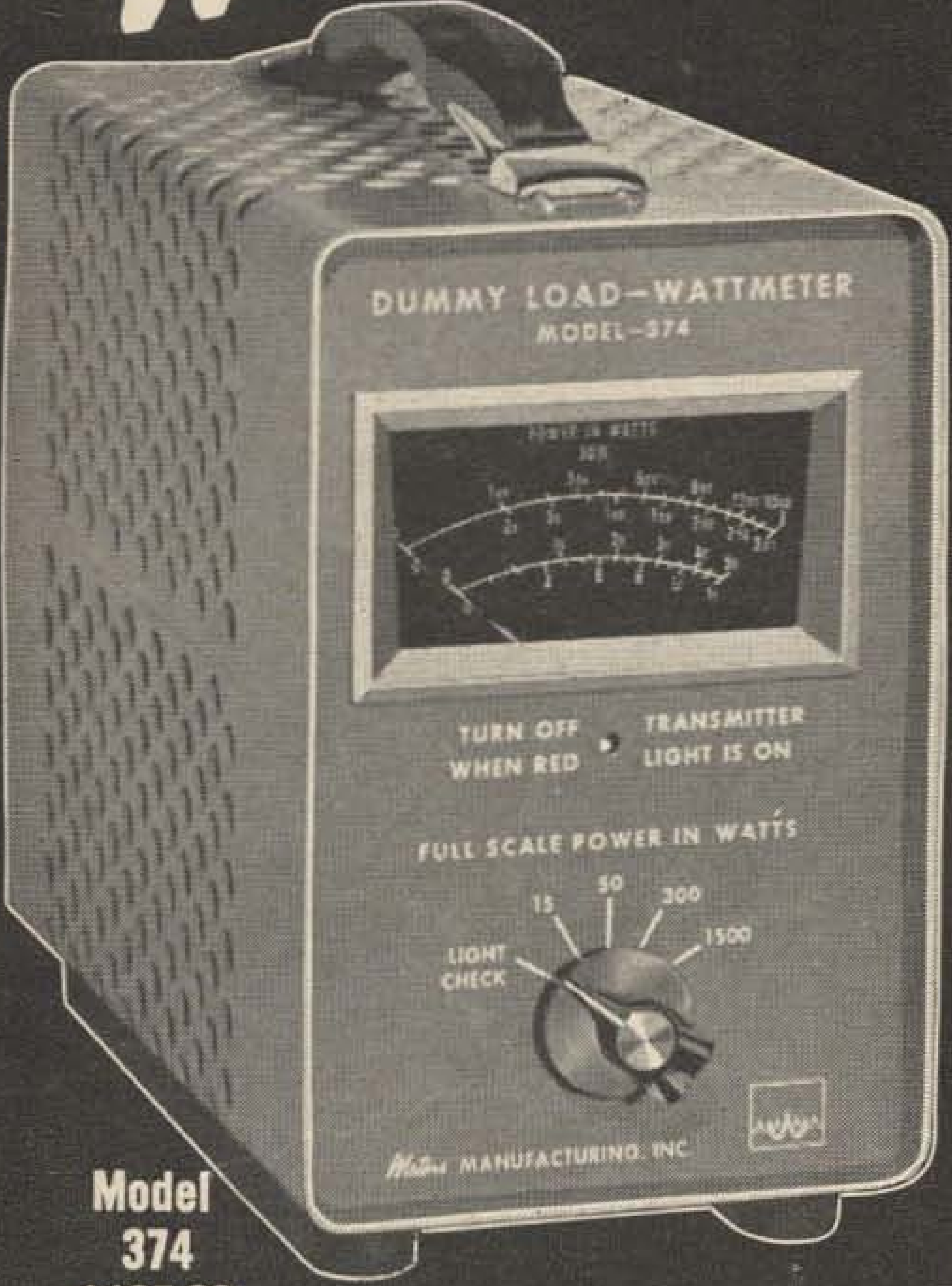
In a belated realization of the mistake in not putting TV on UHF in the first place, the FCC made some attempts to help the UHF broadcasters. One plan was to have all TV areas either VHF or UHF without any mixing. This was obviously an unsatisfactory scheme in well-populated regions where other stations might be receivable, and you can imagine what the reaction of the typical VHF broadcaster to this idea was. This plan was squelched. Part of the impetus for the squelching came from Congress since many Congressmen and other government officials have interests in broadcasting stations.

Finally the FCC and others decided that a better answer was to insure that all TV sets could receive UHF. This would reduce the competitive advantage of VHF somewhat, especially since improved broadcasting and receiving techniques (high power transmitters,

(Continued on page 108)

Waters ...for happier hamming in the New Year

So now we make 2!



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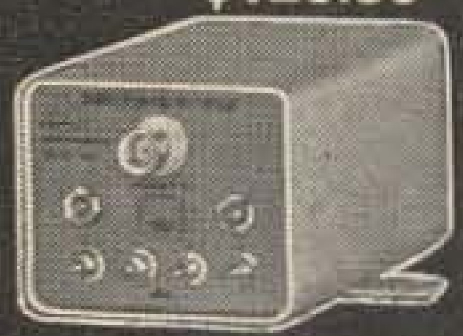

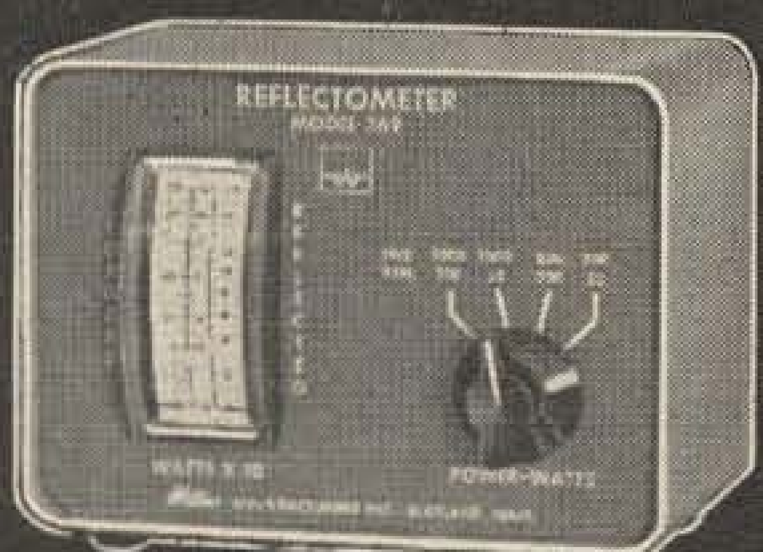

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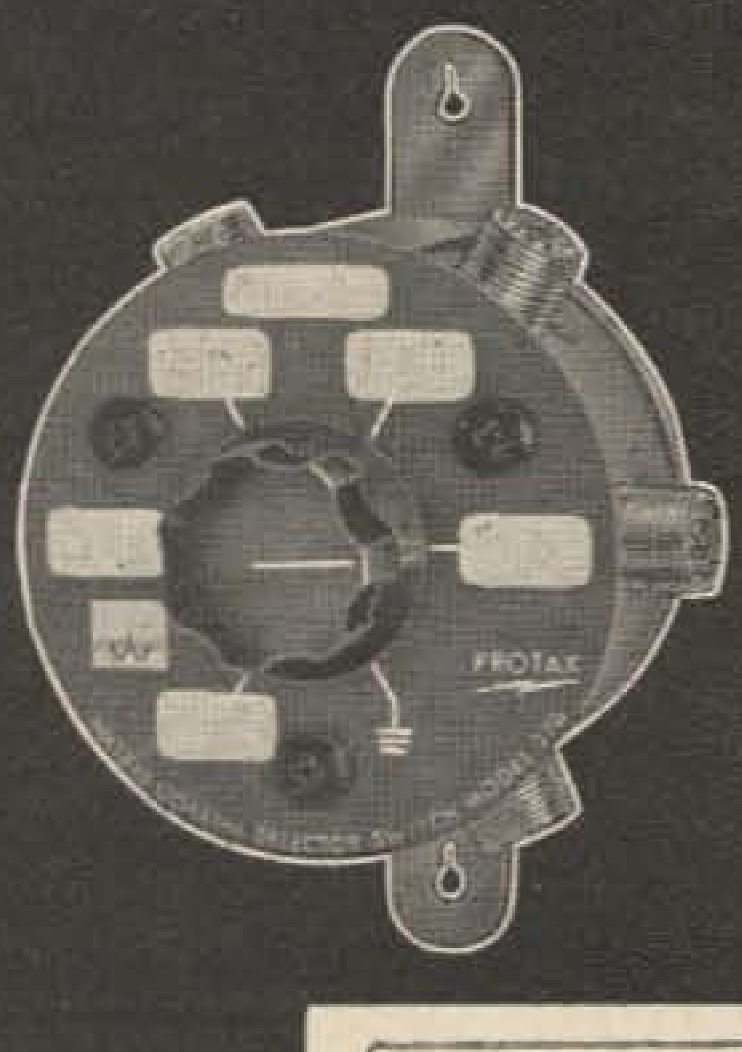

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Integrated Circuit Crystal Calibrator

This calibrator generates 10 and 100 kHz markers. It costs less than $13.

The crystal calibrator ranks with the SWR bridge and code practice oscillator in coverage in the various ham magazines. The names have ranged from the obvious "crystal calibrator" to the less obvious "transistor secondary frequency standard"[1] and "multical".[2] The type of circuitry involved has likewise ranged from simple tube circuits to more complex solid state digital circuits.

The IC crystal calibrator could be considered one of the more complex of the above listed calibrators, providing 100 kHz and 10 kHz outputs. Because of the use of integrated circuits instead of transistors, it is, however, one of the simplest and cheapest. The one described was built for under $13.

NOR gates and flip-flops

For those who don't have W1CFW's excellent article on the Micro-Ultimatic,[3] the operation of the two basic logic elements ar reviewed.

The truth table shows all possible combinations of inputs (A and B) and the resultin output (Q) for the NOR gate. The Fairchil μL914 contains two of these gates in on package.

A	B	Q
L	L	H
H	L	L
L	H	L
H	H	L

H = high
L = low

Notice that a high output occurs only if bot inputs are LOW.
Any other combination produces a LOW output.

The truth table for the flip-flop is as follows

S	C	Q
H	L	H
L	H	L
L	L	Reverse
H	H	No change

[1] Grigg, "A Transistor Secondary Frequency Standard", QST, July 1965.
[2] Davisson, "The Multical", 73 Magazine, October 1966.
[3] Pickering, "The Micro-Ultimatic", 73 Magazine, June 1966.

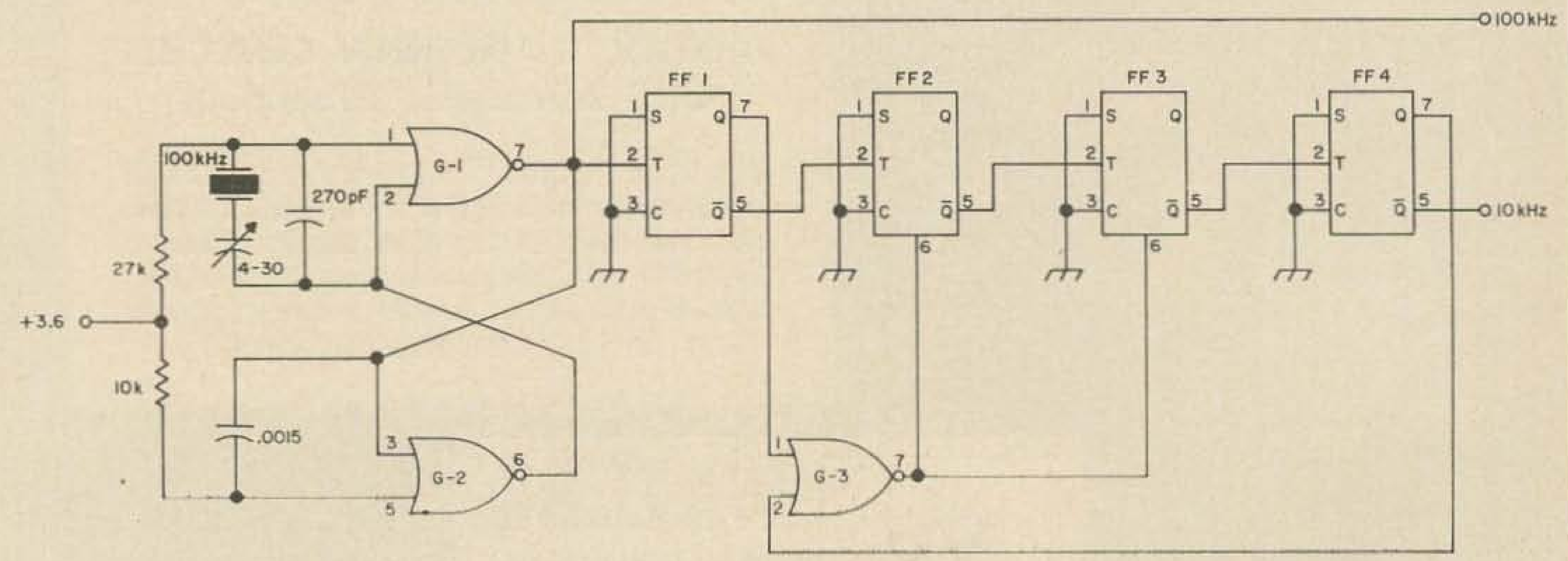


Fig. 1. Block diagram of K1DCK's crystal calibrator. Output is both 100 kHz and 10 kHz and total cost is under $13.

The states S and C are considered before the trigger has occurred, and Q is the condition of the flip-flop after the trigger occurs with a given S-C combination. The flip-flop has two states. It is SET when Q is LOW. It is cleared when Q is HIGH. Another input, called PRESET, can be used to make Q LOW regardless of its state and *without a trigger*.

Binary number system

For the following discussion, forget that 1 and 1 is 2 and we can clear up the last bit of theory needed to understand the operation of this calibrator. To simplify large digital computers, a number system was evolved that contains only two digits (0 and 1) rather than ten digits (0 thru 9).

To see how this system works, think of the odometer on your car and imagine each wheel on this odometer using only two numbers—0 and 1. As the car sat on the showroom floor, the mileage might have read 0000. When you drove it off, registered the first mile (and lost $1000 resale value), it would read 0001. Okay so far. But when you register the second mile and the right wheel on the odometer advances one more place, a zero appears again since that is the only other number! This second mile clears the first wheel back to zero and advances the second wheel to one. So now the odometer registers 0010. This represents the decimal number two in the binary system. The third mile would read 0011. The fourth mile turns the first wheel to zero, which turns the second wheel to zero, which advances the third wheel to one, and so on. With only four wheels on the odometer, we could register up to 1111 which would be fifteen miles. The sixteenth mile would register as 0000, so we would need a fifth wheel for this number (10000). A list of all the binary numbers from zero thru ten is shown below.

0	0000	6	0110
1	0001	7	0111
2	0010	8	1000
3	0011	9	1001
4	0100	10	1010
5	0101		

These binary numbers are called binary-coded decimal or simply BCD.

Pulse generator

The output of the pulse generator is a 100 kHz pulse. The high to low transition will be used to trigger the counter. The idea of using the μL914 as a crystal-controlled pulse generator is from a Fairchild application note. With

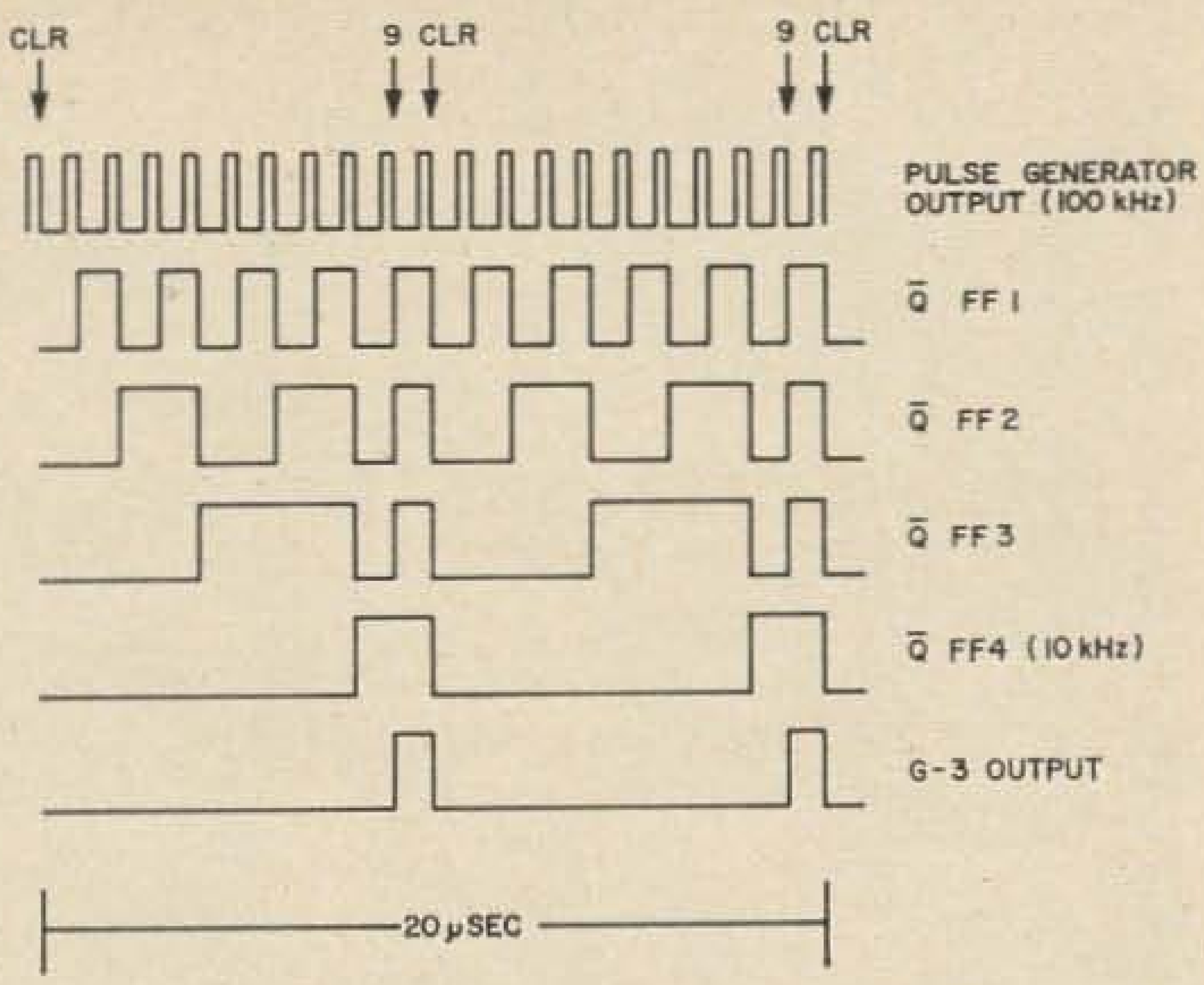


Fig. 2. Waveforms of various points in the BCD counter. Peak-to-peak voltages will vary from one to three volts.

the values shown in **Fig. 1**, the circuit works well with any of the surplus crystals in HC13/U holders advertised in "73". Another crystal in an HC6 case (also surplus) worked with different values of C1 and C3. Juggle them around; you can't hurt anything.

For those of you on a tight budget, stop here. You have just constructed the cheapest and most reliable 100 kHz calibrator anywhere! However, for those of you who aren't afraid of the XYL, we'll add on the counter/divider.

BCD counter

Sometimes called a divider, this circuit has the ability to count to nine and reset to zero on the tenth count. It is called a divider, because for every ten pulses at its input, it produces one pulse at the output—division by ten. Naturally, for every 100,000 pulses at the input, the output will be 10,000 pulses: the 10 kHz marker. Any inaccuracy in the 100 kHz pulse is divided by ten also, but the percentage of error remains the same.

Looking back at the odometer example, each wheel had two states—ZERO and ONE. A flip-flop also has two states—SET and CLEAR. So flip-flops can easily be substituted for wheels, making a counter which counts in exactly the same way the odometer did. But

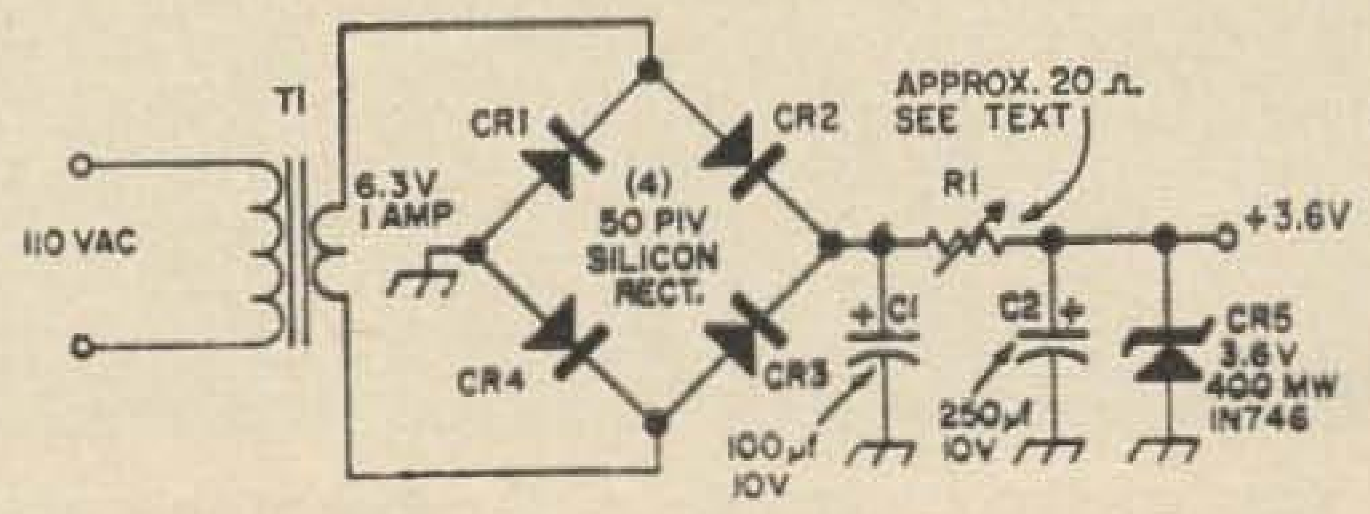
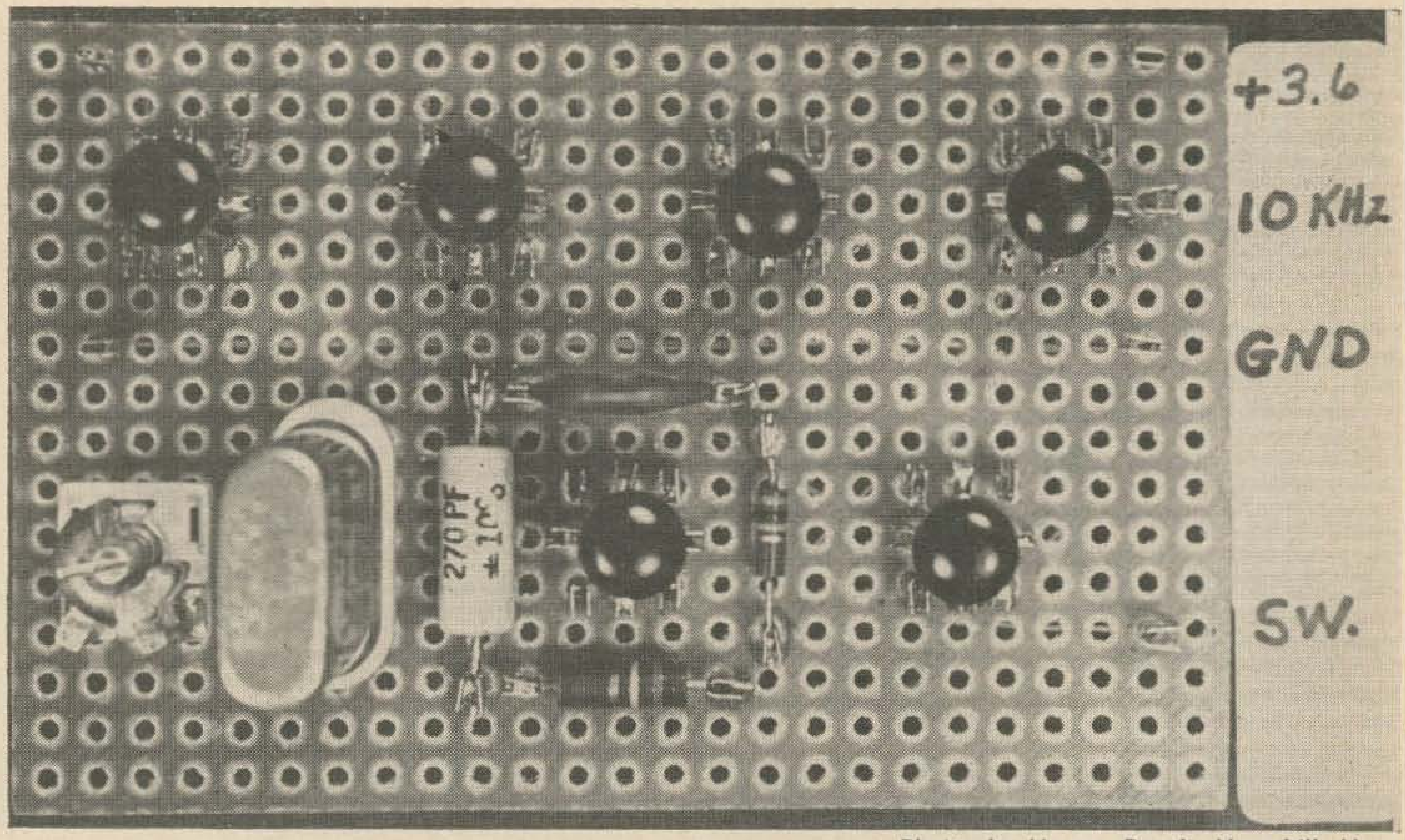


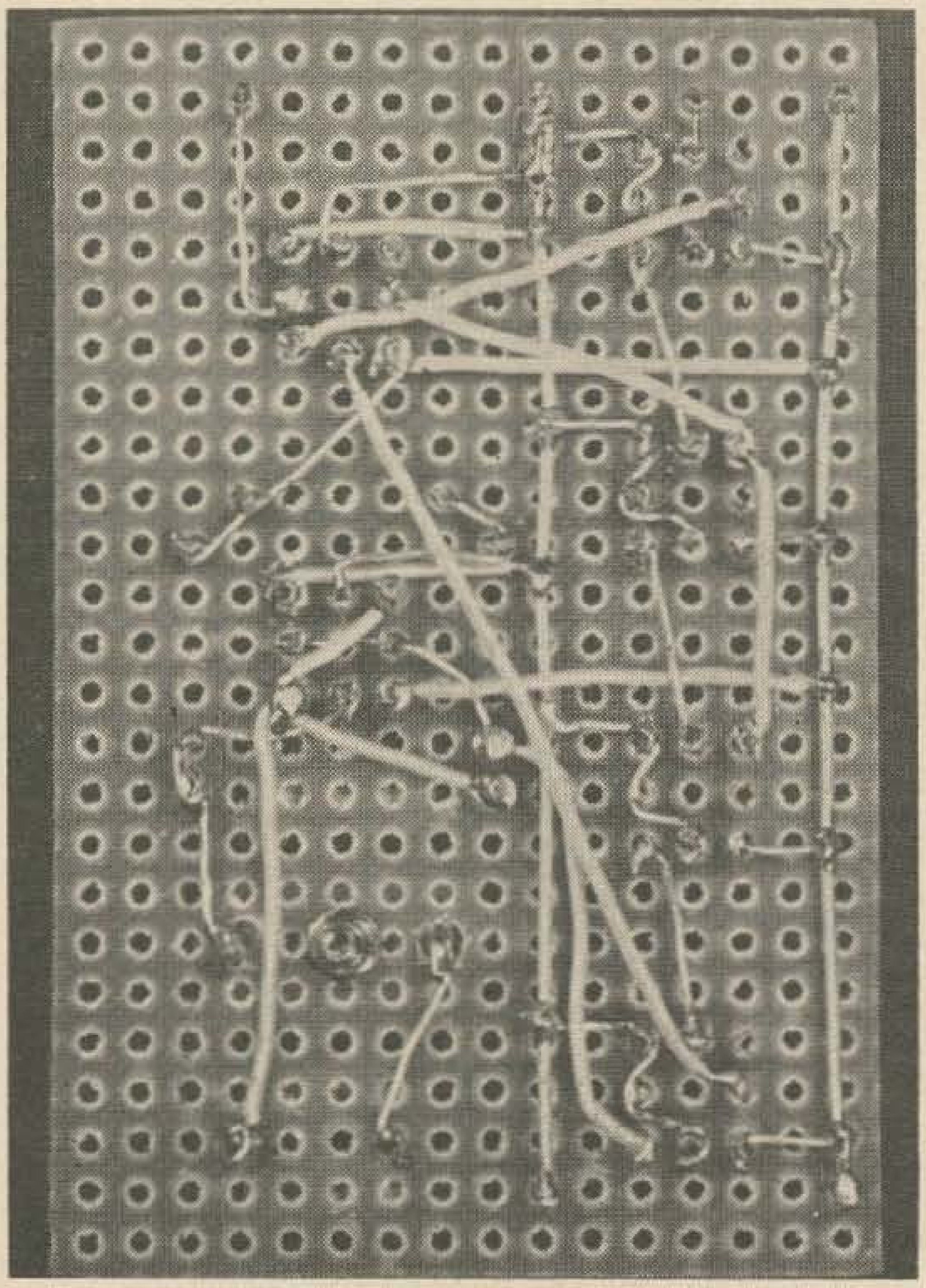
Fig. 3. W1CFW's power supply. Also see Fig. 8 on page 14 in the December 73.



Photos by Harvey Benoit, Haverhill, Mass.

Top, left to right—FF1, FF2, FF3, FF4. Bottom, G1/G2, G3/G4.

this counter counts to fifteen! The counter is fooled into thinking it has reached fifteen when, actually, it has only reached nine. The action of G-3 does this.



View of the underside of the board, showing wiring. The right bus is +3.6 V. The bus near the center is ground.

In the binary system, nine is 1001 and fifteen is 1111. The states of the flip-flop when it reaches nine are as follows:

FF	Q
FF1	H
FF2	L
FF3	L
FF4	H

To make the counter think it has reached fifteen, G-3 will go H and preset FF2 and FF3, changing Q to H. This is done by applying Q output of FF1 and FF4, both of which are LOW at this time, to the input of G-3. FF1 and FF4 are SET only when the counter has reached nine.

Power supply

The calibrator draws 80 mA at 3 volts and 95 mA at 3.6 volts. A power supply similar to W1CFW's may be used and is reprinted in **Fig. 3.** Adjust R1 for 20 mA zener current,[4] under load. The separate power supply is recommended since tube-type receivers will not have suitable voltages available. The power supply won't be very big; if you have a tube-type receiver, you're probably not that finicky about miniaturization anyway.

[4] Ashe, "Zener Diodes", 73 Magazine, October 1966.

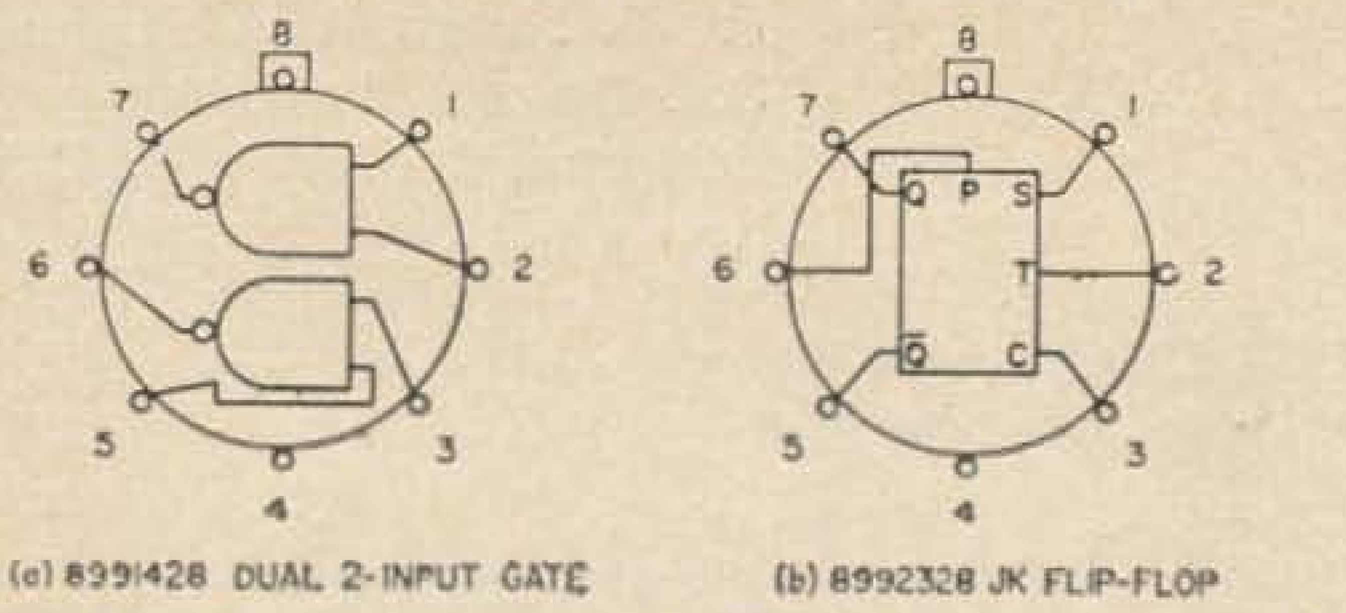


Fig. 4. Bottom view of Fairchild gate and flip-flop IC's. The right side of the gates should be curved.

Construction

The details used in this project are clear enough in the photographs. Flea clips are mounted on a piece of Vectorboard about 2¼ x 3½ inches. No attempt at miniaturization was made, so you may want to try. The crystal socket and trimmer were mounted, then all the wiring underneath was done. The large bus across the middle is the ground bus; and the one at the top is the +3.6 voltage. Wire pin 4 of every can to ground and pin 8 to the +3.6 voltage. Pin connections are shown in **Fig. 1.** Wiring is point-to-point; and teflon-covered wire was used for crossovers. The IC's were then mounted using normal precautions with semiconductors. On some of the earlier epoxy units, pin 8 was identified by a red line; it is identified by a flat spot on present units. The Fairchild UX8991428X is used for G-1/G-2 and G-3/G-4. Fairchild UX8992328X's are used for FF-1 thru FF-4.

Operation

The output of the calibrator may be connected thru a small capacitor, or "gimmick", to the antenna terminal of your receiver. As many receivers have provisions for a plug-in calibrator, the capacitor may already be in. My NCX-3 uses a 6-inch piece of coax. One end of the center conductor is connected to the output of the calibrator and the shield on the other end is connected to the antenna terminal. The small capacitance between the inner and outer conductors makes the small coupling capacitor.

There are two ways to turn the calibrator off when not in use. One is to put a switch in the primary of the power supply transformer. Don't switch the +3.6 voltage. Operating the power supply without a load may damage the zener. Another way is to make use of G-4. **Fig. 5** shows how this may be done. With pin 5 always LOW and pin 3 open, the output of G-4 is HIGH. This HIGH has no effect on the operation of the 100 kHz oscillator. If this point goes LOW, then pin 6 will be clamped LOW and the oscillator stops. This

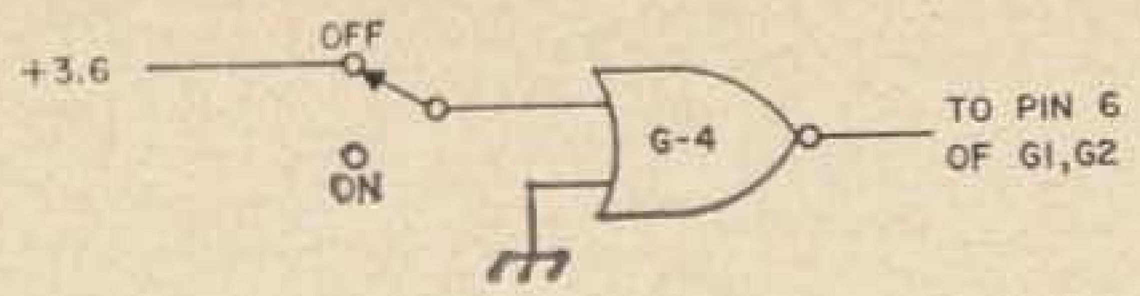


Fig. 5. Gated on/off switch.

point will be LOW if pin 3 is HIGH, which would be the case if the switch were in the OFF position.

Harmonics were quite useable up to 30 MHz. It's possible they may be heard on six meters, but no receiver for this frequency was available. In the event the harmonics are not useable on six, this should present no problem, since the calibrator could be hooked into the antenna terminal of the HF receiver. The harmonics would certainly be heard on the frequency used for the converter *if*. Of course, this scheme would work for any of the VHF bands.

This calibrator points out several of the advantages of integrated circuits. It is small in size and cost, but big in performance. Since it "flew" right off the drawing board, and is easily duplicated, the ease of circuit design is apparent.

. . . K1DCK

Where to Buy Fairchild Semiconductors

Fairchild Semiconductors are very popular with many ham experimenters and engineers, as can be seen from the many articles in 73 that specify them. But none of the large, well-known national mail order distributors that go after the consumer trade seem to carry Fairchild. Nevertheless, Fairchild has an extensive network of excellent and very large industrial distributors. Hams who don't work in the industry may not be familiar with them, but these dealers carry very large stocks and are usually very pleasant to deal with even though their sales to individual hams are a very, very small part of their business. You can get a list of Fairchild distributors from Richard Molay WA6KGS at Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, California 94041.

One Fairchild distributor that has indicated that they're happy to handle mail orders from individuals is Cramer Electronics, 320 Needham Street, Newton, Mass. 02164, and 60 Connolly Parkway, Hamden, Conn. A call or letter to them will give you current prices on any Fairchild semiconductor.

Frank Jones W6AJF/AF6AJF
850 Donner Avenue
Sonoma, California 95476

Some Notes on VHF Transistor Converters

Frank discusses some problems with the popular TIXM05 transistors, adds some notes on newer transistors, and describes an improved 220 MHz converter in this article.

The transistor converters, described in the June 1966 issue of 73, using the low cost TIXM05 transistors have brought a great many inquiries about the source for these little gems. Personally, I'd like to know myself as after the first purchase from a Texas Instrument (TI) distributor of a few TIXM05's, my next request was back ordered for six months and still no delivery. Finally I received several dozen TIM10 transistors which were supposed to be an improved type in the same price range. The breakage problem with the plastic cased transistors seems to be solved, and the characteristics were much more uniform. The "forward gain" characteristics were much better also but all this added up to some changes in circuit values, and even in type of circuits, particularly at 432 MHz. The "X" in the TI transistors apparently stands for experimental type which may not be produced in large numbers. The writer will shun those types in future magazine articles, having been "burned" once is enough.

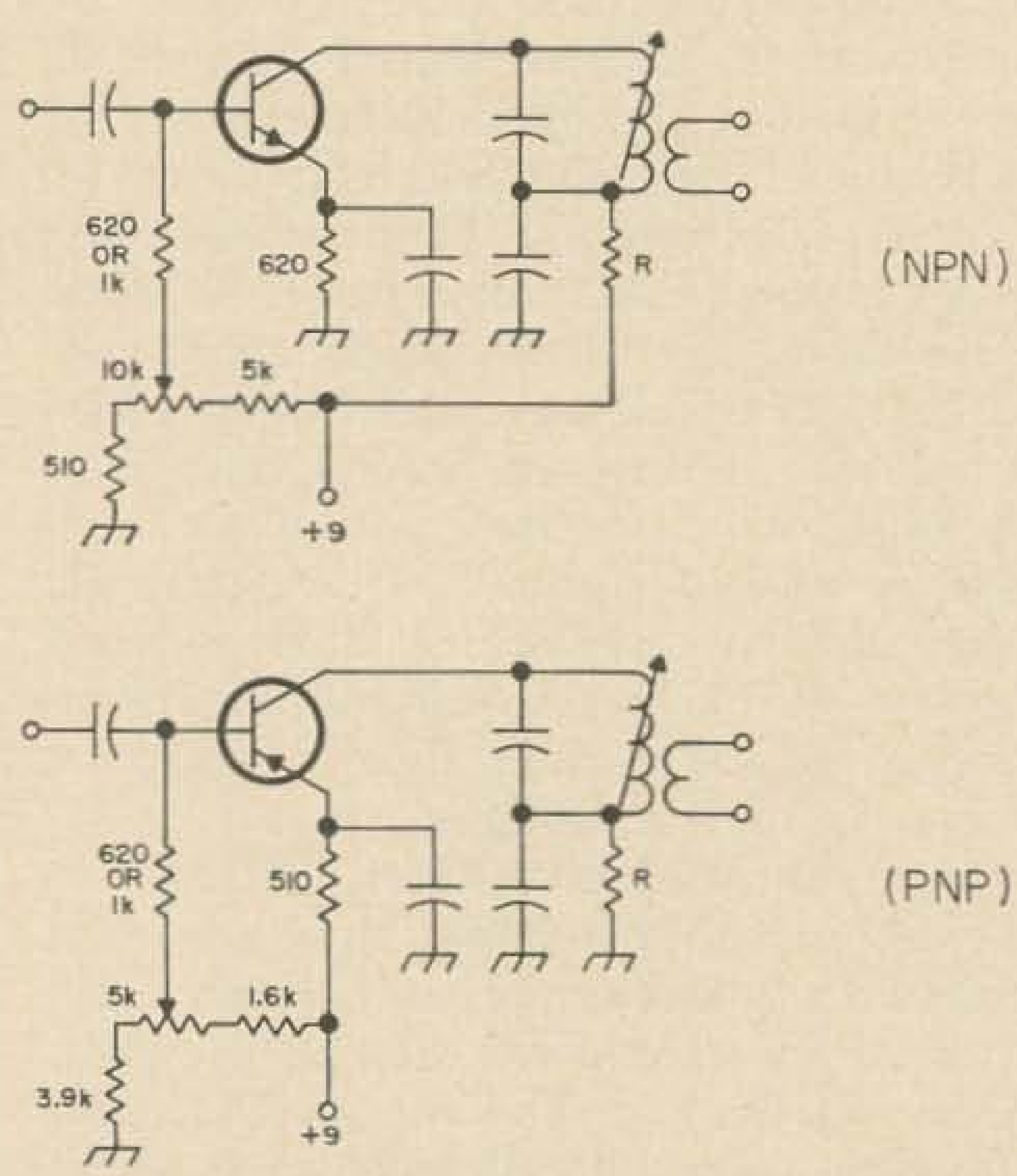
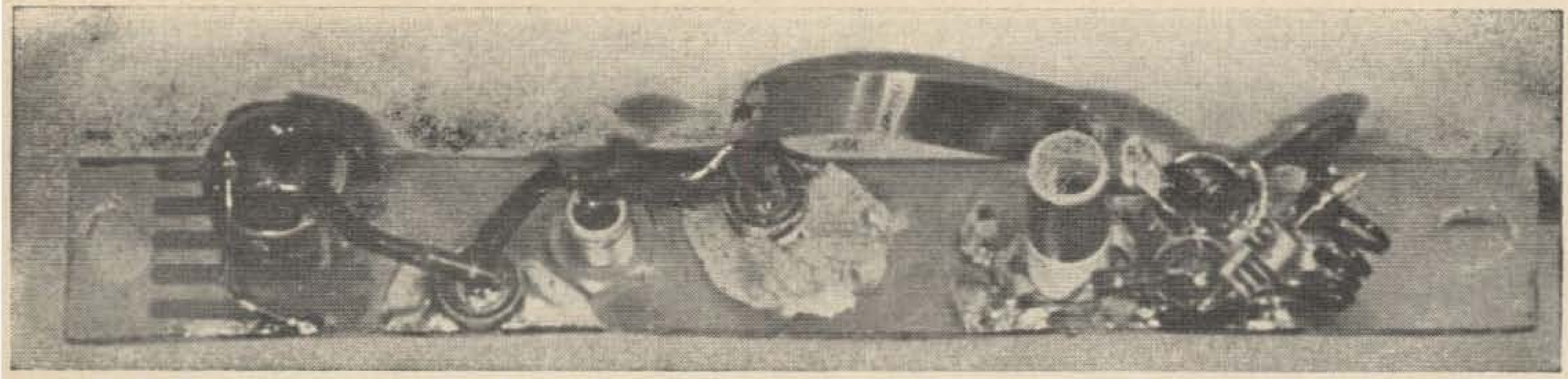


Fig. 1. Forward gain control for one or two rf stages. R should be 510 for an 8-volt supply, 620 for 9 V, and 1000 for 10 V.

The TIM10 transistors that I've tested so far in the 50, 144, 220 and 432 MHz. converters do not have quite as good a noise figure as a few selected TIXM05's, particularly at 432 MHz. However, at approximately a half dollar cost, they are excellent values, being quite superior to the three dollar types such as the 2N2398's. The forward gain characteristics and higher collector current requirements seem to have been met by the circuit values shown in **Fig. 1.** The 5000 ohm "pot" permits adjustment of gain for difference antennas, power supply voltages over a limited range, and cross-modulation problems in some receiving locations. The collector series resistors for dc voltage drop should be around 500 ohms for the TIM10 rf stages with a dc supply of 8 to 9 volts. For 10 volt supply a 1000 ohm collector resistor will give greater gain control and 1500 to 2000 ohms could be used for even better results with a 12 or 13 volt supply. The emitter resistor in all cases should be around 500 to 600 ohms. The base bias resistors, two fixed and one variable, should be fairly satisfactory for 8 to 12 volt supplies. The TIM10 transistors will work satisfactorily on any of the VHF bands without neutralization if the base input impedance is kept to 50 ohms or less and a variable gain control is available to keep them below the oscillating points. Too high a collector load impedance will also cause oscillation problems. At 50 and 144 MHz, sometimes a 3900 or 5100 ohm ¼ watt resistor can be wired across the collector tuned circuit to keep the load impedance within reason. A great deal depends upon shielding between stages and the effectivenes of rf bypass capacitors. Sometimes parallel capacitors of 500 or 1000 pF can be conected from emitter to nearby copper plated ground points with short



432 MHz preamplifier using the new Motorola EL229 in a grounded emitter unneutralized circuit. Note that the EL229 is an NPN transistor, while the TIM10 is PNP.

leads to cure a stubborn rf oscillation.

Most of the new transistors such as the Motorola EL 229 and the Texas Instrument TIM10 types are much more stable at 432 MHz when used in grounded emitter circuits as compared to the older grounded base designs. The grounded base circuits are inherently regenerative and require heavily loaded circuits and critical base bias adjustments. This regenerative effect was necessary with older types of transistors to get good results at 432 MHz. The new types apparently have smaller capacitances and usually will not oscillate at 432 MHz when used in grounded emitter circuits with no neutralization. Grounded emitter circuits can be neutralized at lower frequencies where higher input and output impedances will mean more gain and possibly lower noise figures. Grounded base circuits are real "blankety-blank" things to neutralize, as theory would indicate.

The new experimental Motorola EL229 plastic cased transistor will probably cost more than the TIM10 but is a real gem on 432 MHz. The noise figure checked within 1 to 2 dB of that obtained with a parametric amplifier which had a 1600+ MHz pump oscillator. The apparent noise figures were compared by using a weak signal generator connected to each rf amplifier thru high quality 50 ohm 10 dB pads. A similar 6 dB pad was connected in the output of each of the two rf amplifiers into a reasonably stable 432 MHz converter with its rf stage. A comparison of microvolts input in the two cases gives a pretty good idea of the actual noise figure of the rf stage under test. The transistor pre-amplifier shown in the photograph on a long narrow copper plated strip and in **Fig. 2** uses an EL 229 in a grounded emitter unneutralized circuit. Its performance indicated that transistor development is catching up with diode parametric amplifiers. The latter are highly regenerative and costly as compared to the simple transistor rf amplifier shown in the photograph and in Fig. 2. The EL 229 is a NPN transistor so can not be compared easily with a PNP TIM10, etc. Separate rf amplifiers designed for the TIM10 seemed to show from 1 to 2 dB poorer noise figure than the EL 229. The EL 229, with about 1200 MHz f_T, was better than the very expensive 2N3783 PNP transistor, which in turn was better than the TIM10 units tested here so far.

Let me emphasize the fact that I think the EL 229 is an experimental transistor and may not be available yet at Motorola transistor outlets. I've heard a rumor that it will be about a dollar in price. The experimental rf pre-amplifier in the photograph was built on a scrap piece of copper plated plastic board ⅝" wide and 6" long to fit into a small space available near the regular 432 mc converter. The transistor has three wire leads in line, with emitter in the center to give some added isolation between the base and collector circuits. The EL 229 transistor was soldered directly into the circuit using a cooling clamp between the transistor case and the point of soldering to the wire lead. The base input impedance is approximately 50 ohms at 432 for best noise figure, so was connected to the coax input jack thru a 300 pF coupling capacitor to isolate the base bias circuit from the grounded antenna. A small four turn coil of #20 wire about 5/16" long and ⅛" diameter tends to tune the input capacity of the transistor to 432 MHz. It also tends to short out if band

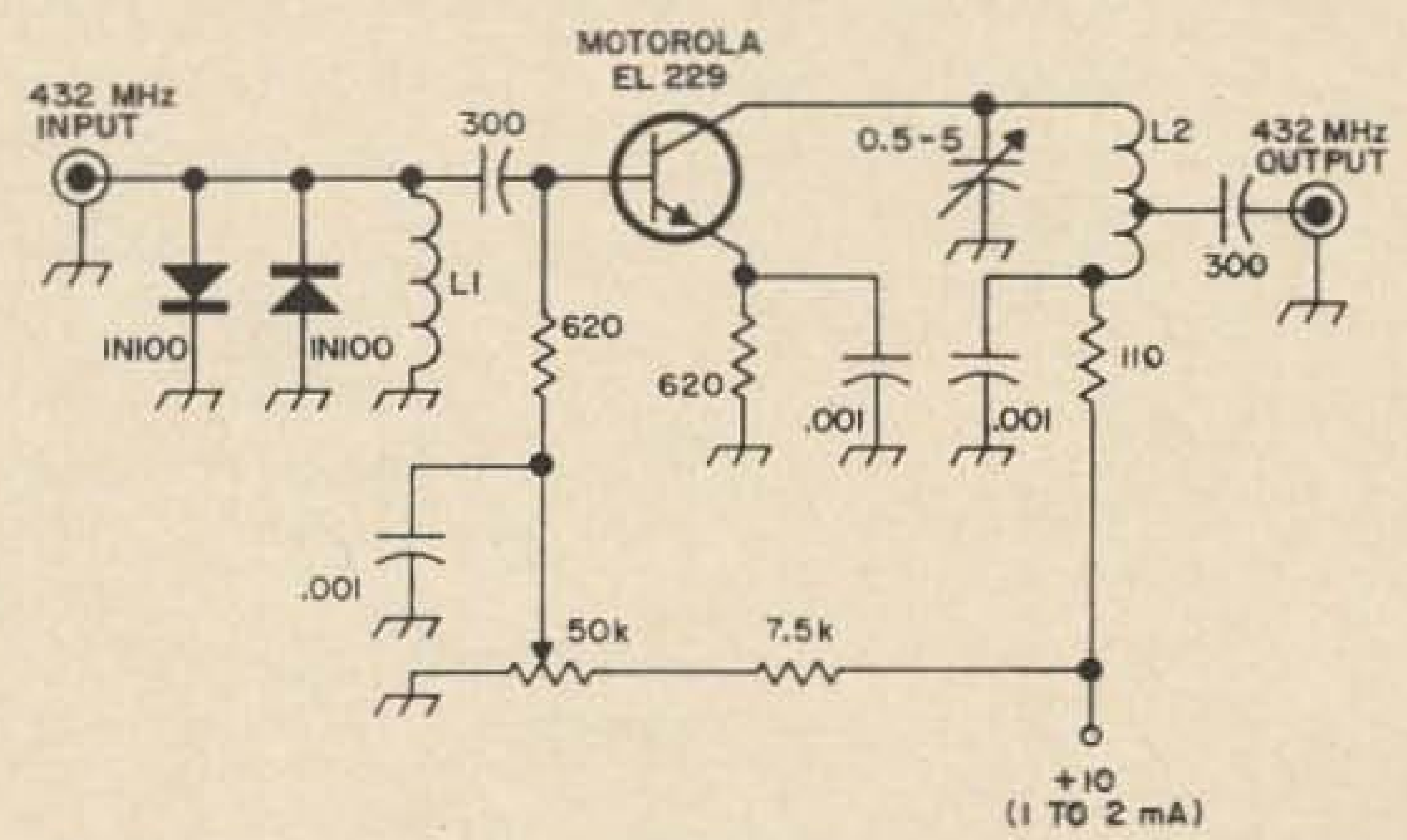
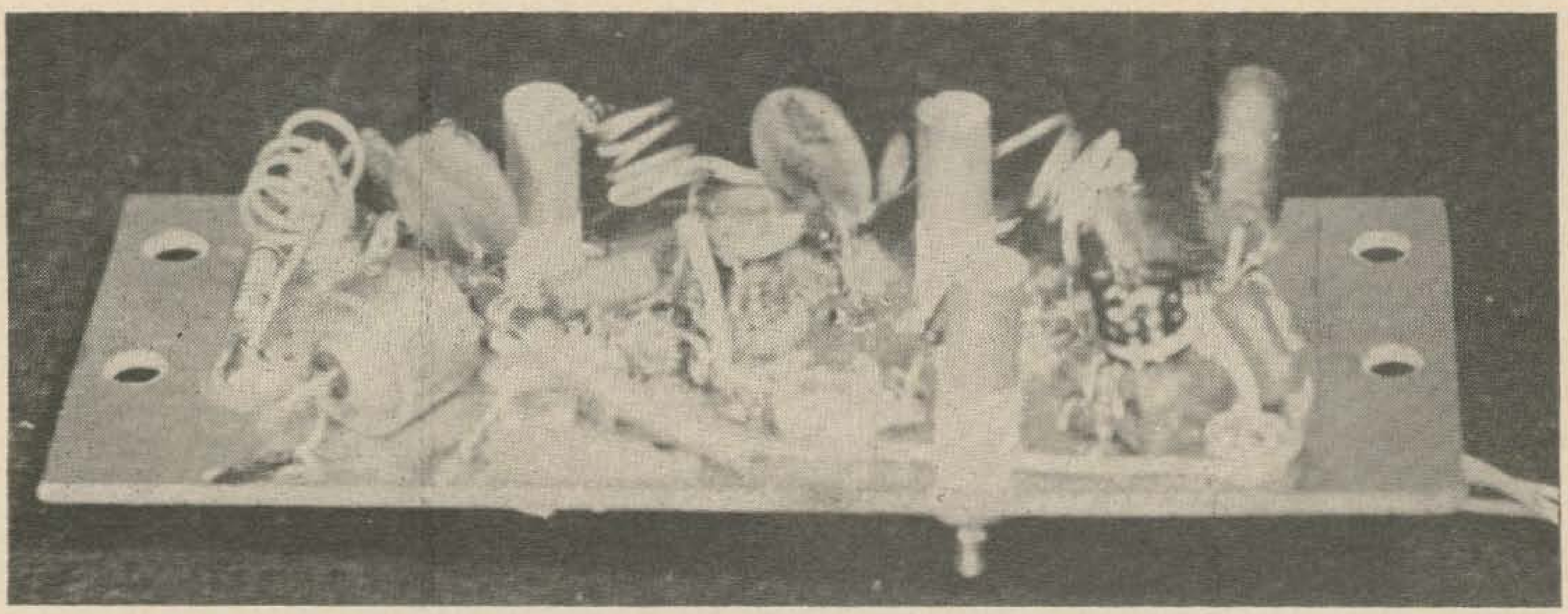


Fig. 2. Low noise 432 MHz preamplifier. L1 is 4 turns #20, 5/16" long x ⅛" diameter. L2 is 2" of a 3/16" wide copper strap bent into a U. Tap up about ½".



W6AJF's 220 MHz converter using TIM10's. It's built on a 2" x 5" piece of copper-clad board. See the article on a 220 converter in the June issue for more information.

feedthru signals. The collector circuit consists of a 2 inch long by 3/16" wide piece of copper strip soldered to the tuning capacitor and transistor at one end and to a 1000 pF feedthru bypass capacitor at the other end. These little A-B solder-in feedthru capacitors are very good up thru 432 MHz but are hard to find since they are a manufacturer's item. The slightly larger 500 pF button feedthru capacitors which are used in surplus gear are not bad at 432 MHz. A small 300 pF disc capacitor was connected in parallel to the 1000 pF feedthru capacitor to add a little rf "cooling" to the emitter. The small 5000 ohm pot was adjusted for best signal-to-noise reception which occurred at a collector current of between 1 and 2 milliamperes. The output coax jack used capacitance coupling on a tap about ½ inch from the by-pass capacitor in the collector circuit. Link coupling is another possibility.

Connection of this pre-amplifier as well as a couple of other rf grounded emitter 432 MHz units to a diode noise generator, with or without a 6 dB pad, resulted in a curious noise figure effect. The collector circuit always had to be tuned to a lower frequency (more tuning capacity) for best noise figure measurement in the output of a 14 MHz *if* receiver. Two types of diode noise generators were used with

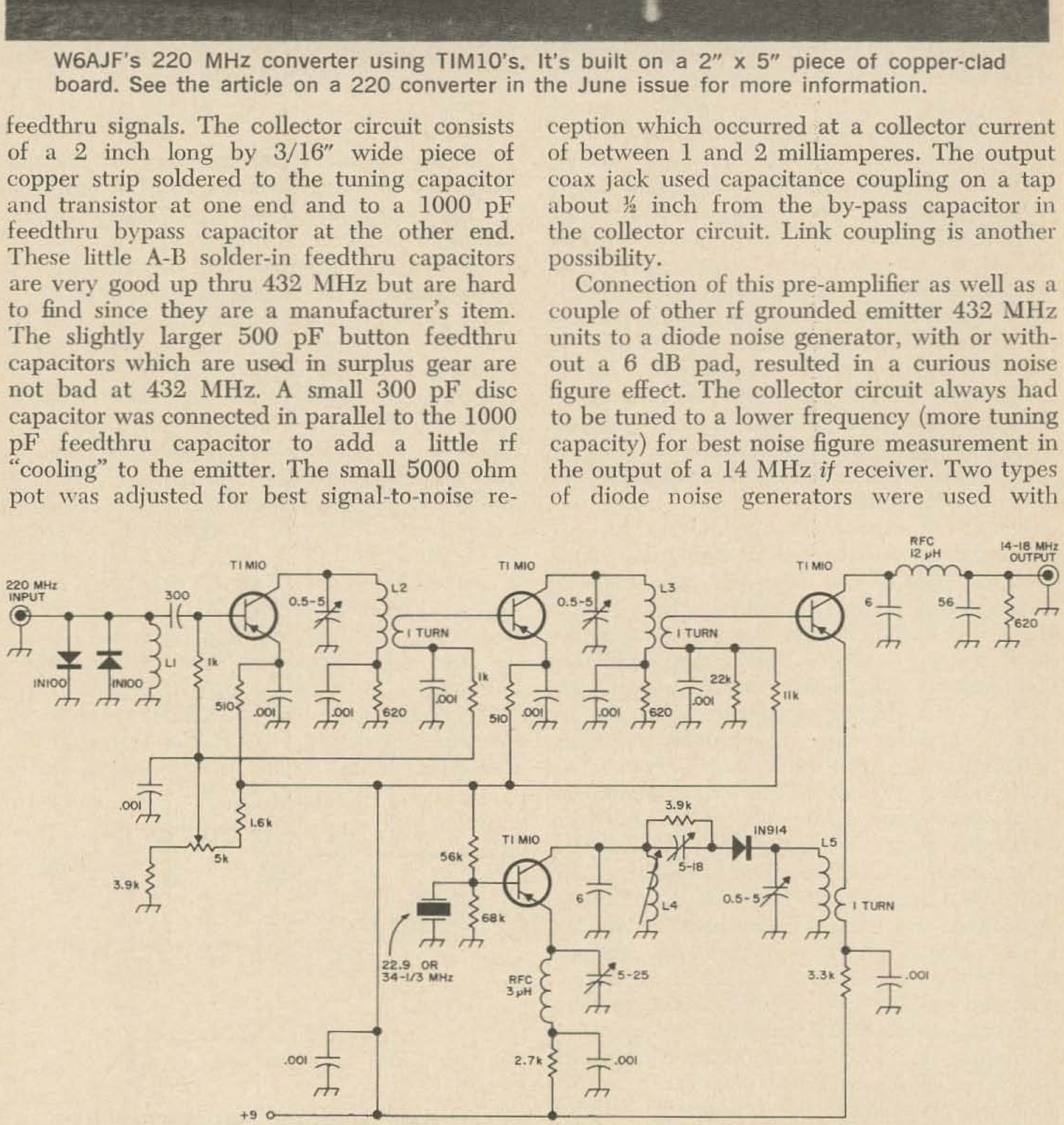


Fig. 3. 220 MHz converter built on a 2" x 5" copper plated board. L1, L2, L3 and L5 are each 4 turns #18 wire 1/4" in diameter. L1 is 1/2" long and the other three are 3/8" long. L4 is 11 turns #24 enamelled on a 1/4" form with a brass slug. The winding is 1/4" long.

similar results. This effect was not noticed in grounded base 432 MHz amplifiers, nor in equivalent grounded grid tube amplifiers. Possibly a 432 MHz neutralized transistor amplifier would not have this problem. The final result was to always use a very weak signal from an antenna or from a signal generator (thru a pad) to align the 432 MHz circuits. This method permits extremely weak signal reception which is the desired result.

The 220 MHz converter shown in **Fig. 3** and in the other photograph was built on a 5 by 2 inch piece of copper plated board. It uses the new TIM10 transistors in grounded emitter circuits without neutralization. The small 1000 pF feedthru capacitors connected to each rf stage emitter were shunted by rather large 820 pF di bypass capacitors. These were connected from emitters to ground across the transistor sockets and act as small shields between tuned circuits as well as aiding in bypassing the emitters to ground. The two rf stages and mixer circuits were run along one side of the board, and the crystal oscillator and diode frequency multiplier on the other side, so the final multiplier coil is near the mixer socket. A low Q broad-band pi network covering 14 to 19 MHz connects the mixer collector to a coax line output to an *if* receiver which in turn is used to tune the 14 to 19 mc. band. Several of these 5 inch long converter boards were mounted in a 13 x 5 x 3 inch chassis to complete the shielding. All forward gain controls were mounted on a small panel at one end of this chassis. Also included was a small 10 volt zener regulated supply made from a 6.3 volt ac transformer and a diode voltage doubler (full wave) with three 1000 μF 15 volt filter capacitors. The power supply and if coax outputs are switched from different converters by means of a small wafer switch.

The apparent noise figure ranged from 3 to 4 dB in the 220 MHz band subject to errors in the noise generator calibration. This simple converter is somewhat similar to the one described in the June 1966 issue of 73 magazine. Like many letters I've received over the past few decades, "it's just like the one you described in the magazine except it's smaller, uses different parts, and different transistors (or tubes)"—except in this case it works, hi.

Just received word from a TI distributor here in California, that there will be six weeks delay on delivery of more TIM10 transistors. By the time this article is printed, there should be lots of these transistors available and let's hope some of the real hot Motorola EL 229 units on the market also.

. . . W6AJF

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A KW With The New Amperex 6KG6

The purpose of this article will be to see what can be done with the new 6KG6. The actual amplifier design is the result of trial and error. It is not supposed to be an example of the latest and most sophisticated technique.

Under the "New Products" heading in one of the recent magazines we spied a brief write up on the Amperex 6KG6. The 34 watts plate dissipation and obvious high voltage capabilities took our eye. So we wrote the Amperex company for spec, then got four 6KG6's for experimental purposes. We are more than pleased with them.

It is assumed that the ham who starts out to home brew a kilowatt is not embarking on his first construction project. So whoever decides to build up some 6KG6's will do it his way with what he can salvage from his junk box. This is what we did.

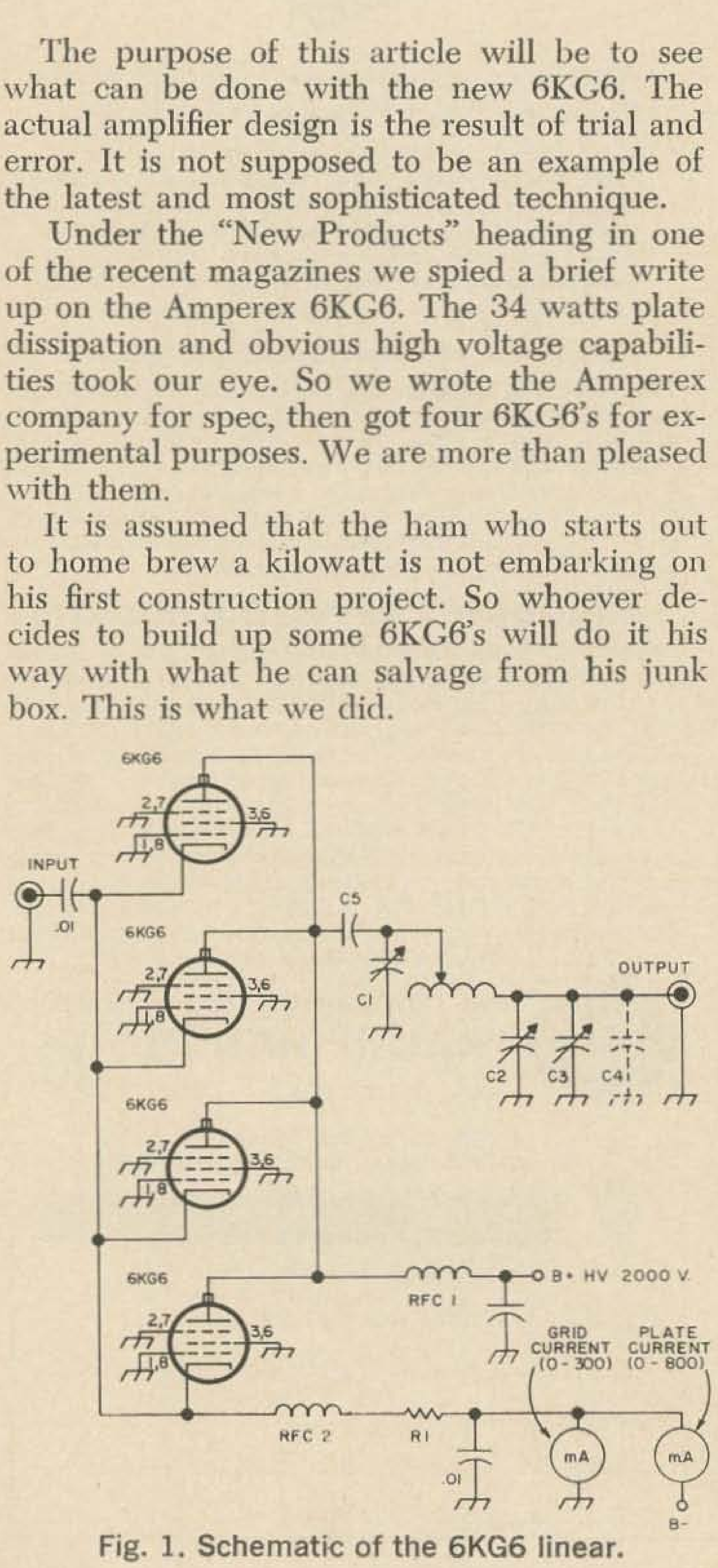

Fig. 1. Schematic of the 6KG6 linear.

We decided to go the grounded grid route by tying all of the grids (control, screen, and suppressor) together and grounding same. As a first try we decided to use an MB 150 National all band tuner in the plate circuit. Don't do it, chum! We wound up on 75 meters tuned about where 40 ought to be and 40 was clear out of the tuning range. It seems that when you tie three grids together and ground them, using four tubes in parallel, you have a plate to ground capacitance on the order of 100 pF. This puts a high frequency limitation on any amplifier and calls for some unusual tank circuit design.

We wound up with the amplifier as shown as per the schematic in **Fig. 1.** The tank is designed to use minimum C_1 on the higher frequencies due to the plate to ground capacitance being in parallel. This means a turn-by-turn experiment. In our case we simply used a battery clip to find the proper tap and then marked the coil. The tank coil should be 20 turns of 3/16 inch copper tubing or heavy ground bus copper wire about 2½ inches in diameter. Or—you design your own. The taps could be located by trial and error and then wired into a rotary switch if you like front panel control for all bands. We didn't have a switch. And—what's that double-spaced midget capacitor on top of the tank capacitor? You guessed it—we ran out of copper before we got 20 turns and couldn't quite get on 75 meters and had to outboard a little extra. Some ex-

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Bob is the department chairman and an associate professor of electronics at the Oregon Technical Institute. He has a BS in EE and an MA from Washington State University. Many of Bob's 30 articles have appeared in 73.

Back view of the 6KG6 linear good for about a kW input on 80 through 15.

planation is probably in order about the assorted junk we used. C_1, the tank capacitor, was liberated from an old command transmitter. The spacing is such that you can't unload the amplifier or it will arc over. We always make initial loading adjustments on reduced voltage anyhoo. C_2 and C_3 are 300 pF variables we had on hand. This is still insufficient loading capacitance for the lower frequencies so we outboarded a fixed C_4 through a co-ax "T" from the output connector. On 75 meters this amounted to a .001 µF mica and on 40 meters a .0005 µF mica. Strangely enough we found that parasitic suppressor chokes are not necessary with the 6KG6's in this amplifier. Previous experience with 6JB6's led me to put them in. Later we took them out and the amplifier is perfectly stable. RFC_1 has to be a good rf choke capable of at least a half amp or maybe an amp. The one used has been on hand a long time and I believe it was made by Johnson. Any good choke that will operate all bands should be ok. This is not a new problem for those who have ever built a shunt fed plate circuit. RFC_2 can be a garden variety but must also carry total plate current. We used an Ohmite choke which measured about 8 microhenries. More would be better. R_1 is a 100 ohm 10 watt wire-wound resistor which is ok for SSB but probably would be better if it were 20 watts. Also if the high voltage is to be left on all of the time 150 or 200 ohms might be better. Our HV is tied to a relay energized by the exciter. We like to have a grid meter but it is not entirely necessary. With the HV turned off you can easily pin a 300 mA meter. Plate meter is in series with the whole stage and the power supply on the B- side.

In its final form the linear performs very well on all bands 80 thru 15. In each case the tank is tapped for as low a value of C_1 as possible. On 15 meters only two turns of the coil are used and the L/C ratio leaves something to be desired; in fact the roving clip lead gets hot. So the output is somewhat reduced. With a Swan 350 as driver the amplifier can be driven to well over 1 kW dc input on all bands. With a 180 or 200 watt PEP rig on 75, 40, or 20 you could get close to 1 kW. We operated at all voltages between 1000 and 2000 volts. At 2000 it is very easy to drive the millameter to 600 mA on speech peaks with the Swan. (We did this into a dummy load, not on the air) There is no flattening. The resting current at 2000 volts is close to 100 mA which makes the plates a cherry red. The plate supply turns off while we are receiving. Total rated dissipation is 132 watts; so we are crowding it in true ham style. Maybe a little greater R_1 would be a good idea. Just how high you can run the HV we don't know but 2000 volts seems like enough.

No doubt the 6KG6 will operate at comparable power as a grounded cathode amplifier and require much less drive. This almost always leads to neutralizing problems and with a pi network this always gets a bit sticky. We have plenty of drive for the grounded grid and it's so much simpler and so much more stable. Anyhoo it looks like the 6KG6 has a promising future.

. . . W7CSD

Drilling Glass

There are several schemes which are used for drilling holes in glass, but most of them are difficult to manage in the home workshop. A simple solution to this problem requires only a dab of wood putty, a teaspoon of kerosene and an old triangular file. First of all, the file is ground down to a point on the end; then it is placed in the drill motor chuck. Place the dab of putty on the glass where the hole is to be drilled. Fill the crater with kerosene and start drilling with the triangular file bit; drill slowly and keep the bowl in the putty filled with kerosene. To keep the kerosene from splattering, it may be necessary to run the drill motor at a reduced speed. At any rate, this method of drilling glass is much faster and more convenient than any method I have tried yet. . . . Jim Fisk W1DTY

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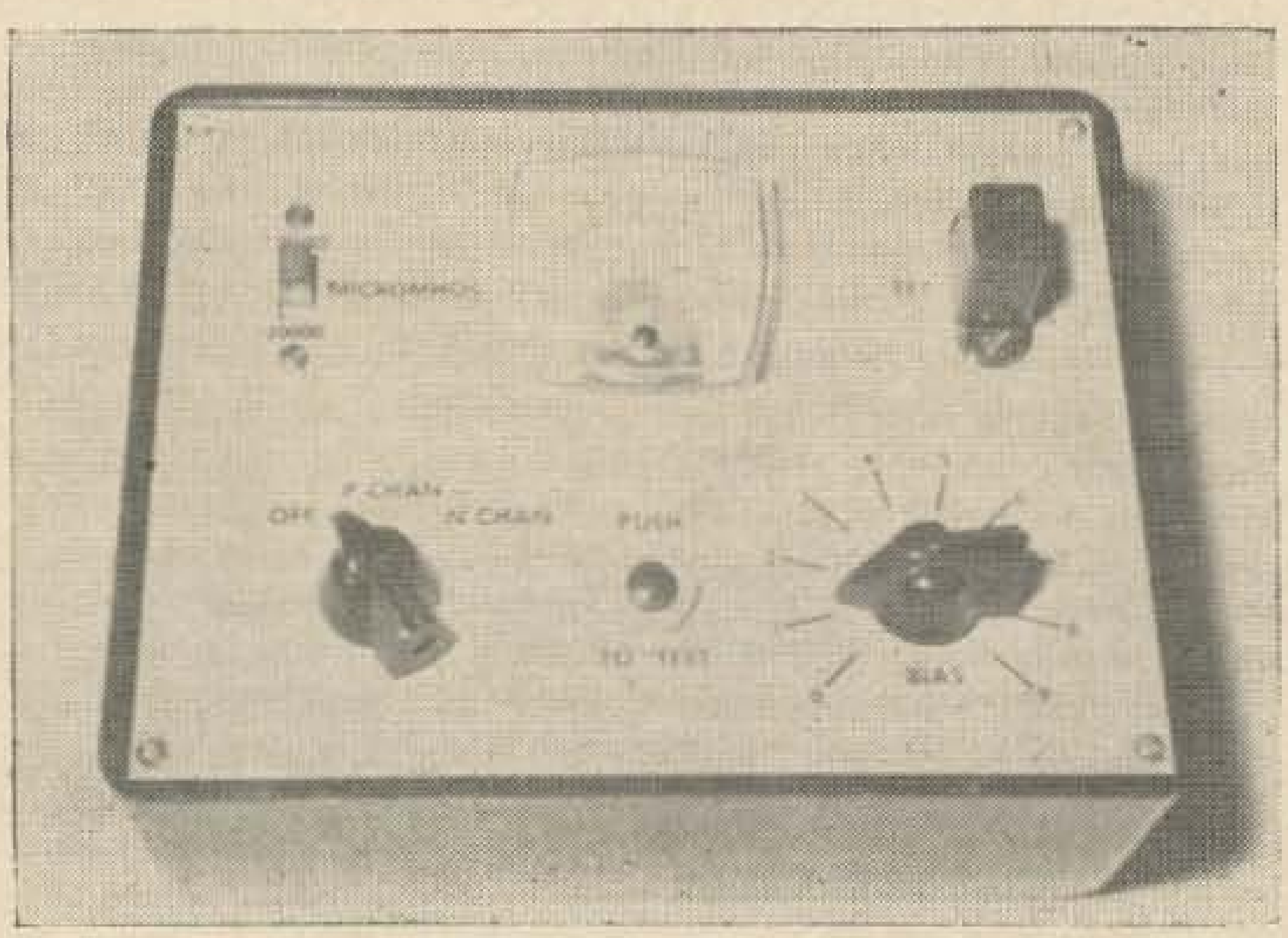
Field Effect Transistor Transconductance Tester

FET's are becoming more and more popular with hams. Here's a simple tester for them.

With the recent advances made in the manufacture of field effect transistors (FET's), the resultant price reductions and their extended usage by industry, greater and greater quantities of FET's have been dumped on the surplus market. Many of these surplus FET's are perfectly good, but some are defective; this isn't usually the fault of the dealer, he just doesn't have an easy way to check them.

Unfortunately, you can't check out an FET with an ohmmeter like you can a conventional junction transistor; some other method must be used. The most obvious approach is to use a transconductance tester similar to that used in testing vacuum tubes. However, since the FET requires no filament power and a relatively low value of B+, the entire test unit may be made quite compact and portable.

You will remember from your school days that the transconductance of a vacuum tube was the ratio of the change in plate current to the change in grid voltage with the plate voltage held constant. For the field effect transistor, the definition is almost the same; just change the name of the respective electrodes and you have it: FET transconductance is the ratio of the change in drain current to the change in gate voltage with the drain voltage held constant. In practice all you have to do is apply the proper bias voltages to the FET, apply a small measured amount of gate drive voltage and measure the amount of resultant ac drain current. Then the transconductance in mhos[1] may be calculated from the following formula:



The FET transconductance tester. The push-to-test switch is a Grayhill model 35-1; the transistor test socket a Pomona TS-187.

$$g_m = \frac{I_d}{E_g}$$

Where: g_m = Transconductance in mhos
I_d = Change in drain current
E_g = Change in gate voltage

When the drain and gate measurements are given respectively in microamperes and volts, the transductance is given in millionths of a mho or micromhos, the conventional term.

The FET transconductance tester described here combines the essential necessities with some operating conveniences that make it more versatile for all around FET tests. Basically, a small amount of 1000 Hz voltage is applied to the gate of the FET; the resultant 1000 Hz drain current is rectified by the full wave diode bridge and measured on the meter. The bridge circuit is capacitively coupled to the drain of the FET so the dc supply component will not affect the meter reading. Likewise, a large choke is included in dc supply lead to prevent the 1000 Hz signal from being bypassed to ground through the power supply.

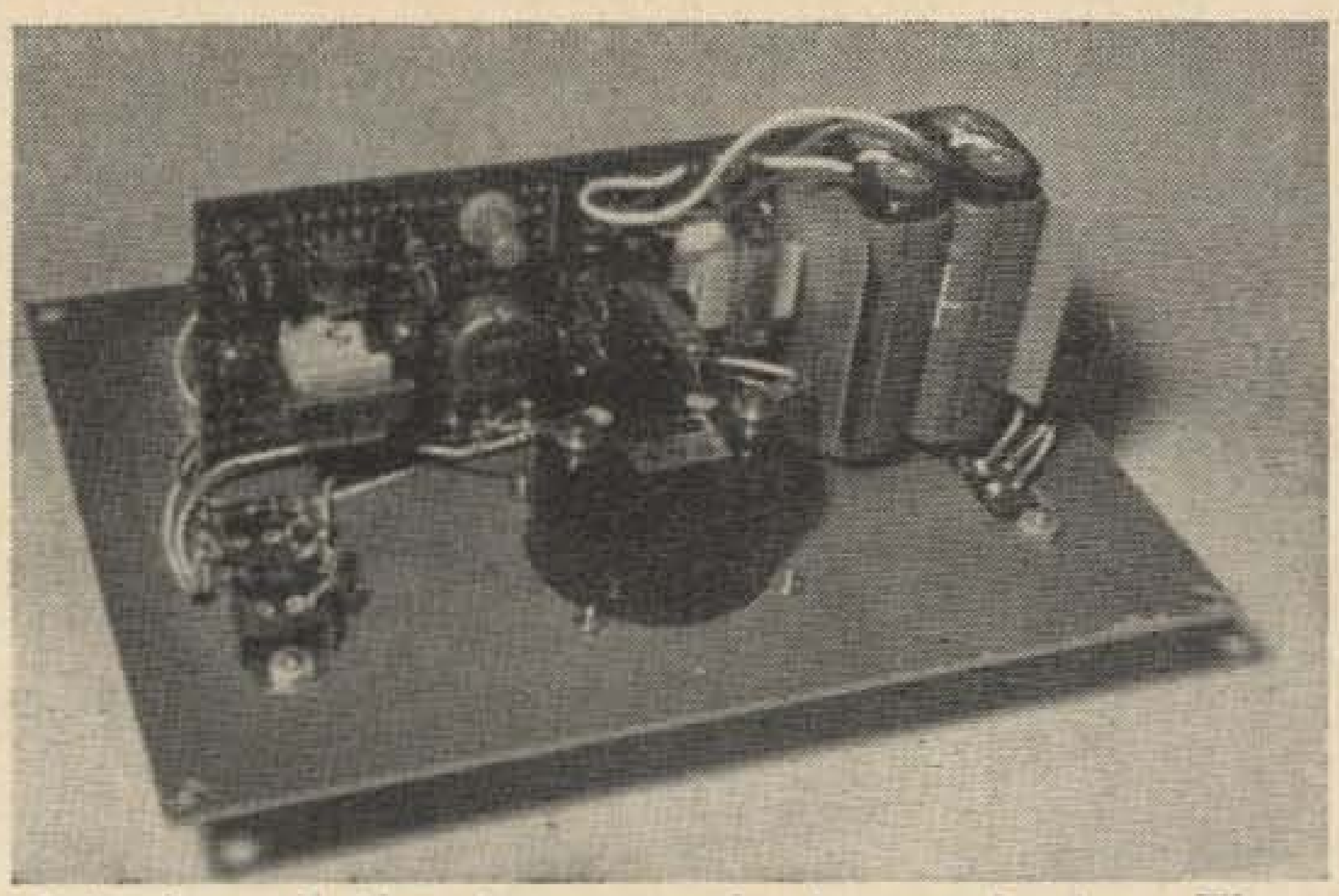
A potentiometer is connected in the gate bias circuit so that the gate bias may be varied from zero to nine volts. This is very helpful in determining the effect of various bias levels and in measuring the gate-cutoff or

[1] The new term for mho is siemens. Unlike hertz, siemens is not widely used yet.

pinchoff voltage of the device. Since the polarity of the dc supply voltage may be conveniently switched from the front panel, this unit will accommodate either P- or N-channel FET's. In addition, two ranges of transconductance, 2000 and 20,000 μmhos, are provided by placing appropriate shunts across the meter.

The entire transconductance tester is built on a $4\frac{15}{16}$ by $6\frac{7}{16}$ inch aluminum panel laid out as shown in Fig. 2. After the unit is completed, this panel is mounted in a standard bakelite instrument box. All of the active circuitry, including the 1 kHz audio oscillator, is laid out on a piece of perforated Vero board $1\frac{3}{8}$ inches wide by $4\frac{3}{8}$ inches long. This board is mounted to the front panel with an aluminum angle bracket. No screws are used to hold this bracket to the panel; the battery polarity switch, push to test button and bias poteniometer do the job. There is no crowding of the board. The layout is not at all critical and any convenient arrangement is suitable. The two batteries are mounted on one side of the unit in an aluminum bracket which is epoxied to the Vero board.

The toughest part of the whole construction lies in the meter shunts. The meter used in the author's tester, a 50 microampere unit from Radio Shack, required two shunts, one for 100 microamperes and one for one milliampere full scale. These currents correspond respectively to 2000 and 20,000 micromhos full scale. The required values were calculated from the standard formula and then made up from standard carbon composition resistors. In each case a carbon resistor with a resistance value *less* than the desired shunt resistance was chosen. Then a small amount of the resistor was filed away with a rat-tail file until the resistance was raised to the desired value. Initial resistance checks were made with an ohmmeter; final tests were made by comparing the shunted meter to an accurate VOM. Except for the nonlinearities which seem to be inherent in low cost meters, the results have been encouraging.



Interior of the transconductance tester. The 1000 Hz oscillator is mounted in the upper left hand corner of the Varo board. The batteries are installed in a metal clip on the far right.

After the shunt resistors are completed, they should be completely covered by a coat of epoxy cement. Since the protective composition cover is destroyed during the filing, the epoxy coating will prevent the ingress of moisture. Moisture will change the value of

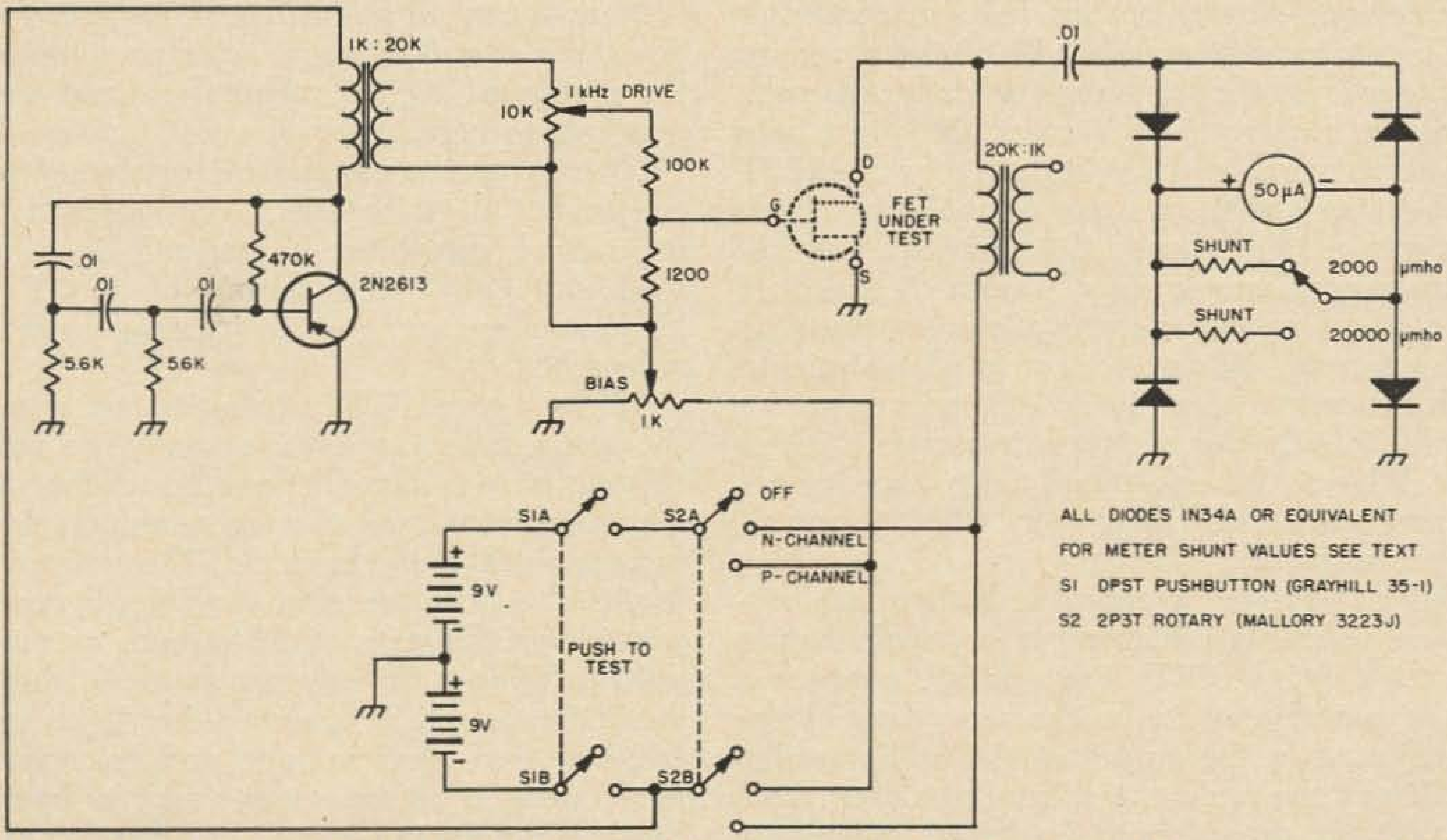


Fig. 1. Schematic of the FET transconductance tester. Although a 2N2613 was used in the 1000 Hz oscillator in the original model of this tester, almost any high gain transistor may be used in this circuit.

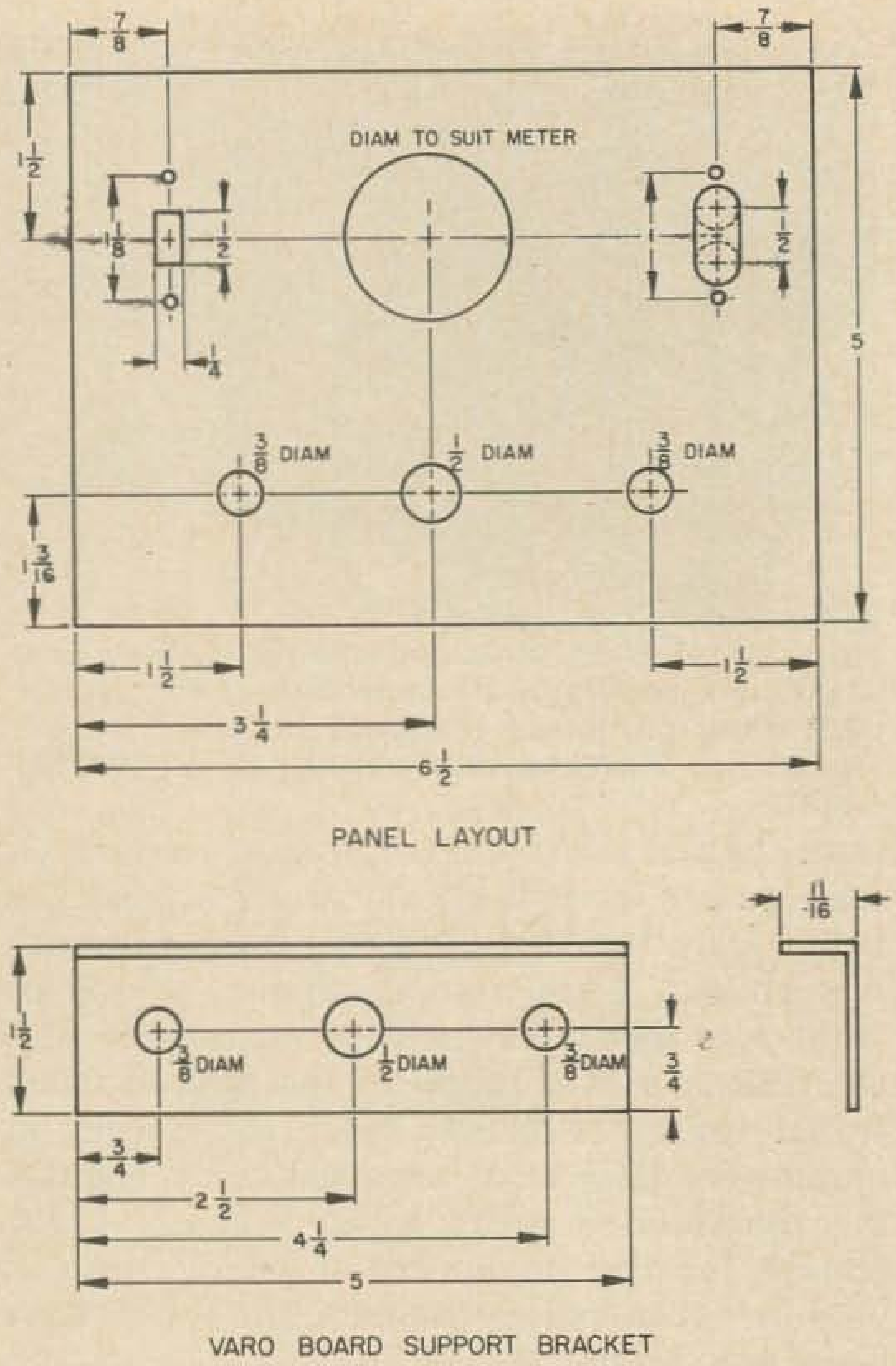


Fig. 2. Panel layout and Varo board mounting bracket.

the shunt resistance and affect the accuracy of the meter.

Although it is not strictly necessary to duplicate the parts used in the author's transconductance tester, it does help in acquiring the necessary components. All of the parts are available from the large mail order houses such as Allied, Lafayette or Newark. This is a help because several of the parts, notably the 2PST pushbutton switch, are not normally available through neighborhood distributors. The 50 microampere meter was chosen because of its modern appearance, availability (locally) and low cost. However, any small instrument with a sensitivity of 50 or 100 microamperes would be suitable. A 100 microampere meter would have the additional advantage of requiring only one shunt (for 20,000 micromhos full scale).

After the tester is completed, there are several adjustments which must be made before plugging in an FET. First of all, connect a set of ear phones across the secondary of the transformer in the output of the audio oscillator. When the push to test button is depressed, a 1000 Hz note should be heard. Switching from P-channel to N-channel should have no effect on the tone. Next, measure the amount of 1000 Hz signal available on the high end of the drive potentiometer with a VTVM; 8 volts RMS is about right. Now, place the VTVM test probe on the wiper of the driver pot and adjust for 1 volt RMS. This will put 100 millivolts of 1000 Hz drive on the gate of the FET being tested.

Now connect the dc probe of the VTVM to the gate connection on the test socket and adjust the bias potentiometer for 5 volts. Loosen the knob and set it opposite the 5 on the bias scale. If you don't have a VTVM for these initial setups, don't worry about it; a good VOM will work just about as well.

The discerning readers among you have probably figured out that 100 millivolts of drive (0.1 volt) and 100 microamperes of drain current *do not* add up to 2000 micromhos. You're right, they don't—1000 micromhos is more like it. That is, if *all* of the 1000 Hz drain current were flowing through the bridge. However, in this circuit, the 1000 Hz drain current divides just about equally between the audio choke in the drain power supply lead and the capacitively coupled meter circuit. So, twice as much drive must be applied to obtain accurate readings. This would be circumvented by using a larger value of coupling capacitance. However, when the push to test button is depressed, there is a large surge of current through the capacitor as it charges through the diode bridge. In the original model of this tester, the large voltage spike from the charging of a 0.47 coupling capacitor (since replaced by the 0.01 μF) destroyed a couple of $13 FET's.

Now you're all set to test those new FET's. Set the P- or N-channel selector switch, put the meter on 20,000 micromhos, and set the bias pot to zero. Push the test button—if the FET is a good one, the meter should swing up scale. If it doesn't, try adjusting the amount of gate bias. If you still don't get a reading, change the setting of the P- and N-channel switch; the device may have been mismarked.

When a good FET is being tested, note that the transconductance varies with the amount of gate bias voltage. Normally, as the bias is increased from zero, the transconductance will increase and then decrease. The point where it starts to decrease after reaching a peak approximates the gate cutoff-voltage or pinchoff voltage. This is directly analogous to the grid-cutoff voltage in a vacuum tube. With knowledge of the cutoff voltage and transconductance curve, it becomes quite easy to optimally bias the device in a circuit. Remember though that these are the characteristics of the FET with a 9 volt drain supply; other supply voltages will change the operating characteristics slightly. However, this does not negate the usefulness of the transconductance tester; on my bench it has proven to be extremely useful in determining bias levels and in sorting out defective FET's.

Afterthoughts

How would you like to measure the transconductance of conventional junction transistors? In some transistor circuit design transconductance is a very useful characteristic. This can be very easily done by the addition of one SPDT switch connected in the gate (base) supply lead as shown in **Fig. 3.** In the FET position the gate voltage is oppositely polarized from the drain supply voltage. In the junction transistor mode the base supply voltage has the same polarity as the collector supply. Now the transconductance tester will measure the transconductance of PNP devices when in the P-channel position, and NPN devices when in the N-channel configuration.

When running transconductance tests on junction transistors, handle the bias control very carefully. Most transistors will be destroyed if the base to emitter voltage is more than 4 or 5 volts; some with considerably less. Since the emitter of the transistor is grounded in this test circuit, always start the test with the bias pot on zero.

The additional capability afforded by this one switch has the additional advantage of discriminating between FET's and junction transistors. It's quite easy to tell whether that newly acquired FET is really an FET or a mismarked (or misadvertised) junction transistor!

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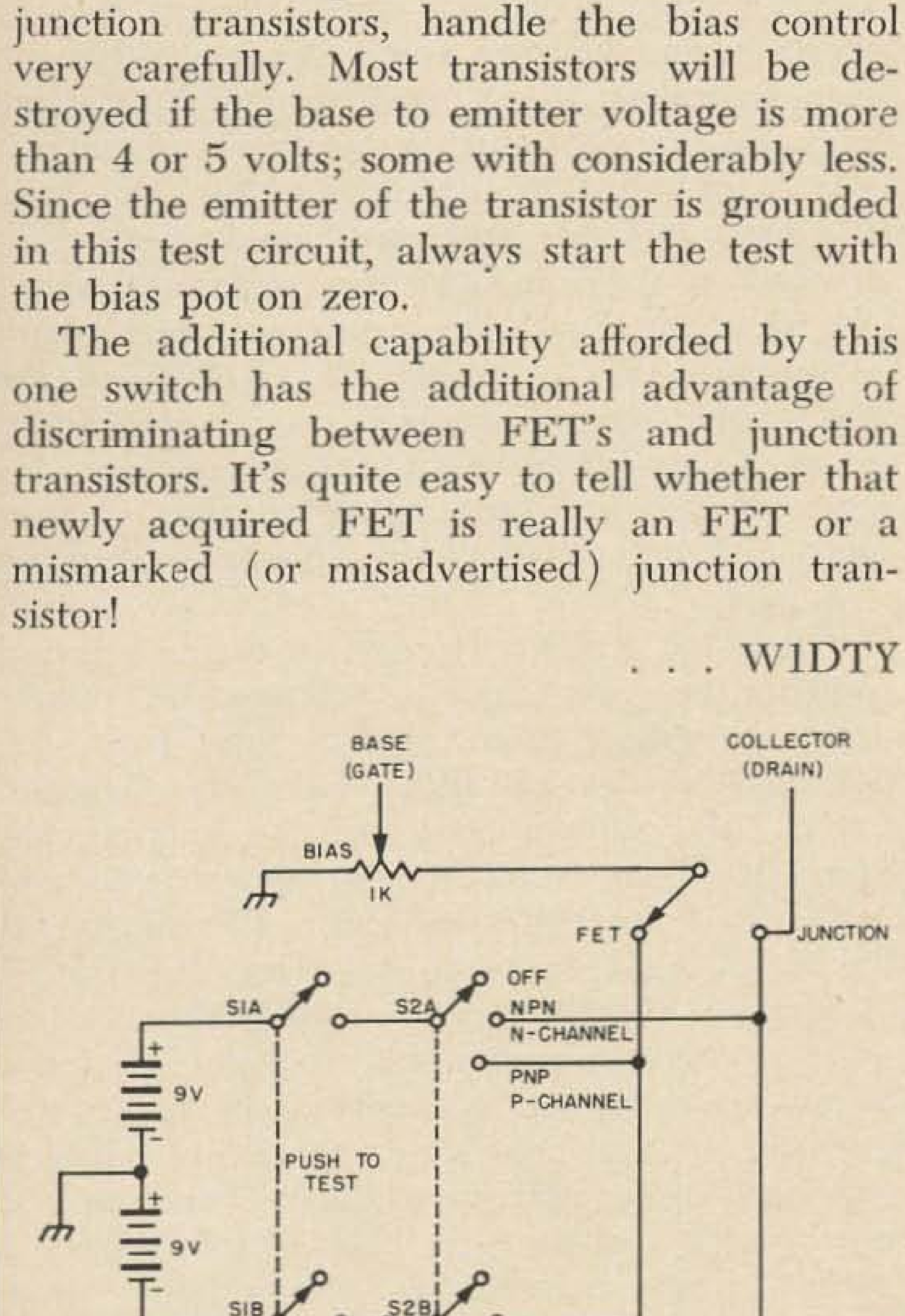

Fig. 3. The addition of a SPDT switch allows the use of this tester with junction transistors. This switch may be mounted on the front panel below the push-to-test switch.

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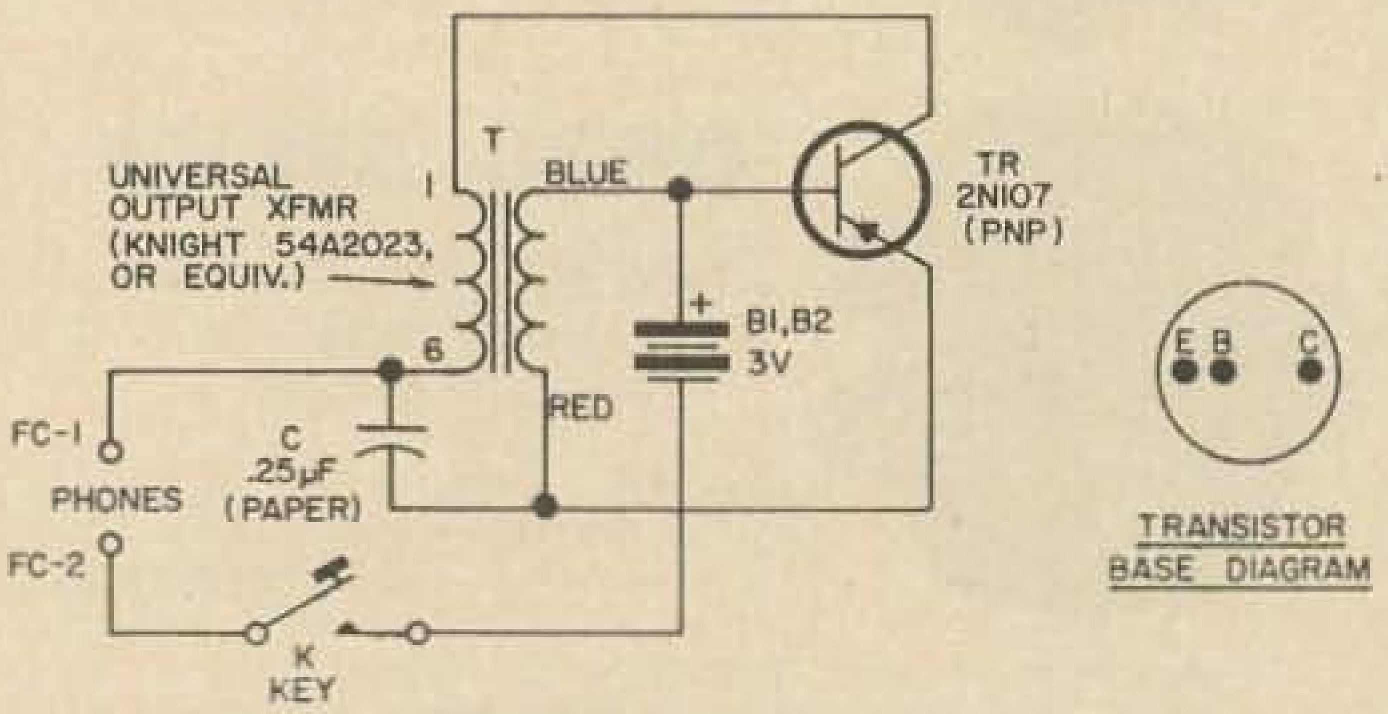
Climbing the Novice Ladder

Part II: Joe Starts A Home-Brew Project

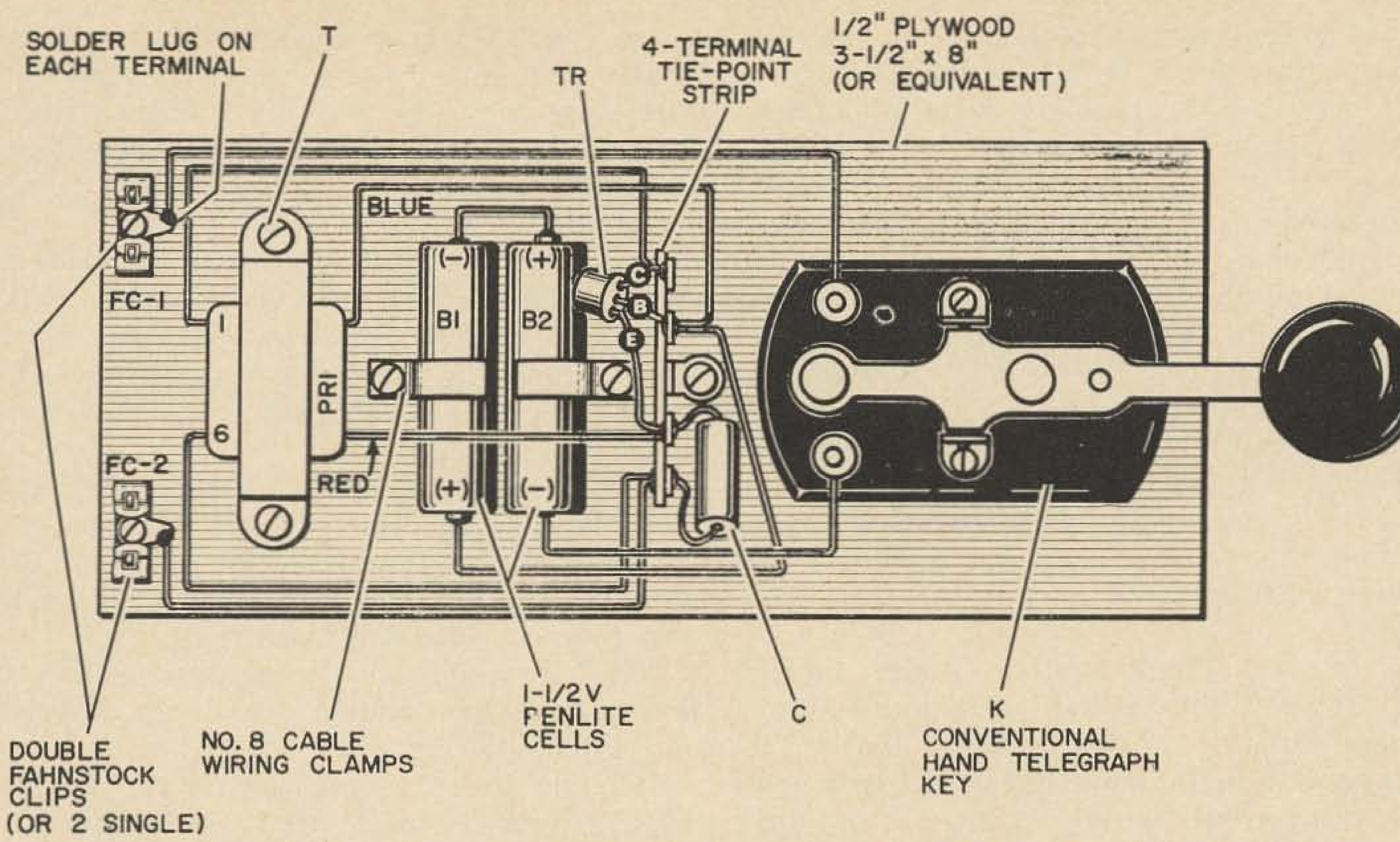
On the Saturday morning following his initial visit with Larry to the ham shack of ol' timer Dwight Mansfield, or 'FN' as he preferred to be labelled, Joe hopped on his Honda and again headed out to the basement shop. Today was the day he was to build a code practice oscillator under FN's guidance, as his initiation into amateur radio 'home-brew' construction. After greeting Joe heartily, FN immediately launched into a bit of preliminary explanation. "I've got everything here in this little tray Joe, all cadged from my junk box, so we're ready to go. While a little piece of gear like this could be mounted in a neat little metal cabinet and marked with decal lettering, it's hardly worth it. A CPO, which is what the hams call a code practice oscillator, is not considered a permanent piece of station equipment. You'll probably use it for only a few months at most and then discard it for its original purpose, saving the parts however to start your own junk box for future projects.



Here's the schematic of the code practice oscillator (CPO) shown in pictorial form above.

So let's mount it 'bread-board' style on a little wooden base. That way you'll find it easy to work on and you can turn out a neat little job in a very short time. I picked up a little piece of scrap board the other evening and gave it a coat of paint to take away the 'raw' look. It's nice and dry now and you can go right to work on it. Your first chore will be to mount the few parts and I've made a rough layout sketch for you to follow. You'll find all the tools you'll need right here on my tool board so go to it; I'll be right outside mowing the lawn if you run into anything that puzzles you; call me when you're through mounting the parts."

Thanking FN, Joe turned to the bench and picking the parts from the salvaged TV dinner tray, identified them one by one from the sketch FN had left him. "Gee," he thought, "that TV tray is a neat idea for keeping the parts right in front of you where you can easily find 'em. We use those TV dinners at home; I'll get Mom to save me the trays." Taking up the transformer which appeared to offer a good starting point, Joe reached for a screw-driver nested with others in an orderly rack on the tool board, positioned and marked the transformer placement on the baseboard in the position shown on the sketch. With a handy prick punch the screw holes were started and with a couple of #6x½" round head wood screws from one of the tray compartments, the transformer was soon mounted. The pen light batteries which would power the CPO, seemed like the next logical items to mount. FN's sketch called for a couple of



Pictorial diagram of the simple code practice oscillator that Judy and Joe built under FN's supervision. It's shown half size.

cable wiring clamps for this and sure enough, there were two in the tray. Another pair of wood screws and presto . . . the batteries were in place.

Joe had just selected the tie-point terminal strip to mount next and was positioning it on the baseboard when the door opened and he was a bit taken aback when not FN, but an attractive young lady of about his own age walked in! She put him at ease at once in the easy familiarity of today's teen-agers; "Hi . . . you must be Joe Blake . . . I'm Judy Mansfield, FN's granddaughter," adding as she wrinkled her pert little nose, "I call him Gramps though. He told me I'd find you here and thought maybe I could give you a hand."

"Well hi" Joe replied, "are you a ham too?"

"No" she said, "not yet. Gramps has been giving me the old needle for some time now to learn the code and join the fun but I couldn't get too much interested in learning by myself . . . it looked like a dreary job. Gramps says you're about to start studying for your ham ticket; maybe we could work together."

"Wow," Joe thought, "she's really *neat;* this sounds like a *break!*" Aloud he said, "Sure Judy . . . it'd be a lot more fun learning that way; you wanna help me finish this little oscillator?"

"Why not Joe . . . Gramps has used words like that lots of times . . . maybe now I can find out what they mean!"

Having established a common bond through a mutual interest (perhaps not entirely electronic!), Joe proceeded to explain what little he had so far accomplished. "Look Judy; here's what we have to do" he continued. "Mount these other pieces on the board like I did with the other two. Why don't you do the tie-point and the key . . . I'll show you how I did the others." Judy proved pretty adept with the prick punch and screw driver and did her part in short order, prompting Joe to say, "Gee Judy . . . you handle tools like an old hand . . . ever use any before?"

"Lots of times Joe; I've helped Dad with his cabinet-making, putting on little hinges and things like that. Once I spent quite a bit of time right here helping Gramps put a hi-fi kit together . . . it's kinda fun." With that Joe was sure he'd found a kindred spirit; now ham radio really *was* for him!

All that was now left of the mechanical assembly was mounting the little clips which would serve as binding posts for the phones. These were labelled "Fahnestock clips" on FN's sketch and Joe had them and their accompanying solder lugs mounted in place in short order. "Well, I guess we're ready to wire the thing Judy; I'd better let your Gramps know" and so saying Joe went to the door and called, "All parts mounted FN . . . what next?"

From around the corner of the house FN replied, "All set eh? I'll be with you in a minute." As he came through the door he said, "Well I see you kids got together. I thought you might find it a little more pleasant to work together as long as you both have an interest in ham radio. You'll find Judy pretty handy with a screw driver and a pair of pliers Joe . . . look out she don't outstrip you in home-brewing."

Laughingly Joe replied, "Yeah; she sure takes hold of a tool like a born mechanic."

Connecting the parts looked to be not too difficult; Joe had done more than a little soldering in his school physics class and in experimental electrical projects at home. Judy had somewhat less experience although FN had shown her the basic principles of soldering and she had made a few connections for him from time to time; both she and Joe were therefore adequately equipped for this little project.

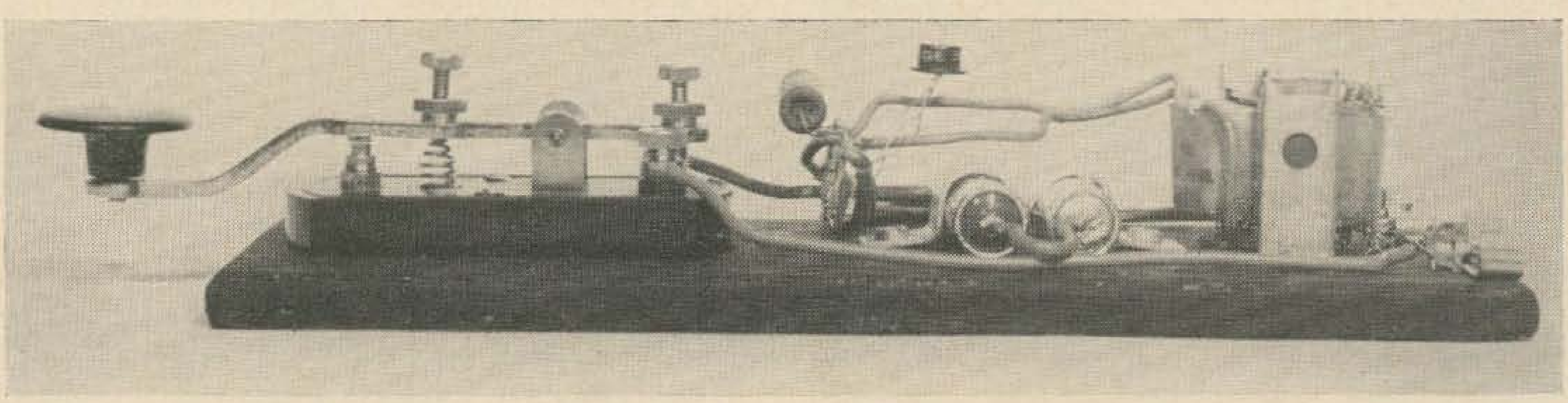
FN handed them another rough sketch which showed the wiring in pictorial form. He then explained, "When you've had a bit of experience in building electronic gear you won't need these wiring 'pictures' to work from. You'll use a 'schematic diagram' which uses symbols to represent the various parts and simple single lines to show the connections. When you're through with this job I'll draw you a schematic circuit on the back of this sketch and you can compare them; all good ham constructors use schematics just like the professionals do. I'm going to give you just one tip before you start wiring. We're using one of the little transistors for the oscillating element here . . . you know about transistors from your pocket radios. We could use a vacuum tube but it would take a more intricate power supply, would cost more, complicate the building and gain . . . nothing! We could even use a common, ordinary buzzer like you probably have at your back door. Either of these would make up into a useable code practice set. We've ignored the tube for reasons I've explained . . . buzzers generally have an unpleasant raspy sound and often change pitch while you're sending; this throws you and upsets your practice. The transistor oscillator is stable, reliable, produces a nice tone and is easy to build but it *is* susceptible to excess heat. When you solder it's three wires to the tie-point strip, be sure and hold each wire close to where you are going to solder, with the long nose pliers and do the soldering as rapidly as possible but be sure it's a solid connection . . . I'll check it when you're through. Besides holding the wire in place for you, the pliers will serve as what we call a 'heat sink' which will draw the heat to the pliers rather than having it run up the wire to the transistor body. That's it kids, I'll go finish mowing the lawn."

The young people turned back to the bench and while Joe picked up and examined the transistor, Judy suggested, "Joe, why don't we do the transistor *first;* we'll get it out of the way then . . . the rest looks pretty easy."

"OK" Joe replied as he plugged in the soldering iron; "you wanna put on the first wire and I'll do the next?"

"Oh, no Joe . . . *you* put on the first *two* while I watch you . . . that way I'll catch on and then I'll do the last one."

With that, Joe picked up the long nose pliers and carefully made a little hook in one of the tiny wires protruding from the transistor body. He hooked this into terminal lug #1 on the tie-point strip and squeezed the hook closed with the pliers. The quick heating iron was ready now so, with a short length of solder wire and holding the connecting wire close to the terminal with the pliers, Joe completed the termination. Previous experience in soldering had taught him to *always* apply the heated tip of the iron directly to the *terminal;* never to the solder. When the terminal itself had absorbed sufficient heat to melt the solder, he carefully placed the end of the solder wire against the terminal at the point where the little wire hooked into it, keeping his iron in place against the back of the terminal until a small amount of solder had liquefied and run down over the face of the terminal, burying the wire hook in the molten solder. He then carefully removed the iron so that the cooling solder was not disturbed. He then repeated the operation using the second wire from the



Side view of the code practice oscillator built by Judy and Joe.

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PARTIAL SB-110 SPECIFICATIONS—RECEIVER SECTION: Sensitivity: 0.1 uv for 10 db signal-plus-noise to noise ratio. **Selectivity:** 2.1 kHz @ 6 db down, 5 kHz max. @ 60 db down. **Image rejection:** 50 db or better. **IF rejection:** 50 db or better. **Audio output power:** 1 watt. **AGC characteristics:** Audio output level varies less than 12 db for 50 db change of input signal level (0.5 uv to 150 uv). **TRANSMITTER SECTION: DC power input:** SSB, 180 watts PEP; CW, 150 watts. **RF power output:** SSB, 100 watts PEP, CW, 90 watts (50 ohm non-reactive load). **Output impedance:** 50 ohm nominal with not more than 2:1 SWR. **Carrier suppression:** 55 db down from rated output. **Unwanted sideband suppression:** 55 db down from rated output @ 1000 Hz & higher. **Distortion products:** 30 db down from rated PEP output. **Hum & noise:** 40 db or better below rated carrier. **Keying characteristics:** VOX operated from keyed tone using grid-block keying. **GENERAL: Frequency coverage:** 49.5 to 54.0 MHz in 500 kHz segments (50.0 to 52.0 MHz with crystals supplied). **Frequency selection:** Built-in LMO or crystal control. **Frequency stability:** Less than 100 Hz drift per hour after 20 minutes warmup under normal ambient conditions. Less than 100 Hz drift for ±10% supply voltage variations. **Dial Accuracy:** Electrical, within 400 Hz on all band segments, after calibration at nearest 100 kHz point. Visual, within 200 Hz. **Dial backlash:** No more than 50 Hz. **Calibration:** Every 100 kHz. **Power requirements:** High voltage, +700 v. DC @ 250 ma with 1% max. ripple. Low voltage, +250 v. DC @ 100 ma with .05% max. ripple. Bias voltage, —115 v. DC @ 10 ma with .5% max. ripple. Filament voltage, 12.6 v. AC/DC @ 4.355 amps. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

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Prices & specifications subject to change without notice. AM-178 transistor and after cradling the iron in its rest, handed the pliers to Judy. As she had absorbedly followed the process both times that Joe had accomplished it, she then proceeded to repeat his performance in commendable style; both were satisfied that they had the transistor licked. As Joe unplugged the iron to keep from cooking the tip, the door opened and FN appeared with a couple of bottles of Coke and a bowl of potato chips. "Time out for a Coke break, kids; you ready for it?" Both replied in chorus, "You said it!"

FN then produced a thermos of hot coffee from the confines of his shack, poured himself a cup and while giving it a minute to cool a bit, examined the transistor wiring. "Good," was his pronouncement, "you've got nice shiny joints proving that they are soldered with *metal*, not 'resin' joints held together with the flux from the solder wire. A resin joint won't conduct electricity and your project won't work. A cold solder joint, produced when you don't heat the connection sufficiently to make the solder flow freely, is bound to be a troublemaker too. You can recognize a cold joint as the solder won't be smooth and shiny but will appear dull and grainy. You do have a bit of resin residue on the surface of the solder though. While it does no harm, it makes the joint appear unfinished. You can easily remove this by scraping lightly with the point of a knife blade, followed by wiping it with a cloth dipped in alcohol or shellac thinner. There's some thinner in that upper cabinet . . . rags in the metal waste can under the bench . . . want to clean it up Judy?"

FN rinsed his cup at the laundry tub faucet, the empty Coke bottles were dropped back in the carrier and Judy proceeded to clean the resin residue from the tie-strip terminals, finding it surprisngly easy and quick and resulting in a more workmanlike appearance to the soldered terminals. By then, FN had gone out to clip the hedge after leaving them several scrap lengths of hook-up wire with which to complete the wiring. Removing the insulation from the wire ends, commonly referred to as skinning and preparing the wire for connection by tinning or coating with a thin film of solder, was duck soup for Joe after having accomplished such operations both at school and at home. He soon had Judy cutting the wire lengths he needed, skinning the ends and passing them to him to tin and solder in place. Working together like this the job went fast and in half an hour Joe unplugged the iron and said, "Well, Judy, I think we've got it made . . . it should work now; wanta call your Gramps?"

FN gave the completed project a careful inspection; almost at once he said, "A nice looking job kids but it'll never work!"

With some trepidation Joe asked, "What's wrong FN?" while Judy shot her Gramps a questioning look.

"Look here Joe, you've left out one all-important wire . . . from the key to the battery!"

A quick look and with a somewhat crestfallen look, Joe acknowledged the point . . . "Don't know how I missed it FN, but I sure enough did; cut me a 4" hunk of wire, will you Judy?" and he plugged the iron back in.

Entering his shack, FN tossed back over his shoulder, "It's the little things Joe that cause big troubles; can't be too careful in checking even the most minor projects."

As Joe completed correcting the omission, FN came from the shack carrying a pair of headphone receivers. Another quick check-over convinced him that the wiring was now complete and connections solidly made. He inserted the tips of the headphone cord into the Fahnestock clips and manipulated the hand key several times. His expression told the story although both kids could faintly hear the pleasing musical tone the oscillator made, even though the phones were tightly fitted over FN's ears. A relieved sigh from Judy and a broad grin from Joe met FN's pronouncement; "Well done, me hearties . . . you've got yourselves a workable code practice oscillator; now all you have to do is to learn to *use* it and use it p-l-e-n-t-y! Let's talk about that next."

Swinging a somewhat battered old cot out from a gloomy corner FN said, "My thinkin' couch . . . you can sit here . . . I'll get my chair from the shack." With all comfortably seated, FN stoked his pipe, lit it and, when drawing to his satisfaction, offered some sage advice; "Joe, Judy lives down the road a piece toward town . . . about three miles closer than I do; that puts you two about 4 miles apart. Now if you're going to get in a reasonable amount of code practice together, you're going to have to arrange pretty frequent sessions between you. No need to come way out here two or three times a week; glad to have you visit anytime but for code practice you'll do better in a more familiar environment. Joe, you've got a motor bike . . . 4 miles is just a hop, skip and jump for you. Why don't you stop at Judy's place today on your way home, meet her Ma and Pa and work out something among you that will get you kids together for an hour or so two or three times a week? The fall term of school won't start for about five more weeks so you should be able to get in some pretty good licks meanwhile."

"Now here's another little pitch," FN continued, "you've got one CPO between you and no headphones . . ."

Joe broke in here with, "I've got a pair of phones, FN, I've done a bit of short wave listening from time to time though I never got really excited about it like I am with ham radio. My phones are marked "2000 ohms" . . . will they do?"

"Splendid" replied FN, "I have this extra pair of phones which I'll loan to Judy. Now maybe you wonder why *two* pair of phones with only *one* oscillator and one key. I'll tell you; I've got a little CPO and several keys left over from my adult education classes at the High School a few years ago; I'll also loan Judy the CPO and a key. That way you'll each have practice equipment at home so you can practice sending to yourselves at odd moments between your get-togethers; you'll gain confidence in handling the key and familiarize yourselves with character formation that way. When you get together, have *both* pair of phones with you; that's why the *double* Fahnestock clips on the CPO you just built; you can clip *two* pair of phones into them then. The CPO I'll loan Judy is fixed the same way so equipment-wise, you're all set now. From here on out it's your baby for the next few weeks. Come out here on Saturday mornings when you can and bring one CPO and I'll check your progress; no need to bring the phones . . . we'll use mine from the shack for the test sessions. Joe, you take this little CPO you just built with you and git fer home now; take this little book too; it will give you a bit of dope on proper grip of the key, character formation and the like; swap the book back and forth between you. I've got to run down to your place this afternoon, Judy, to see your Pa and I'll bring my CPO, a pair of phones and a key for you. S-o-o-o, that's for now kids and let's see what you can do with the code in the next few weeks."

Chorusing their profuse thanks, Judy mounted her bike and took off, Joe leisurely trailing behind on his Honda.

Next month: FN checks Judy and Joe on their progress and starts them on their technical studies. . . . W7OE

Parts List

2	FC-1, 2	Double Fahnestock clips (or 4 singles)
1	T	Universal output transformer (Knight 54A20323)
2	B-1, B-2	1.5 volt penlite cells
1	Tr	2N107, HEP250, GE2, SK3003 or almost any other low power PNP transistor
1	C	.25 μF paper capacitor
1	K	Conventional hand telegraph key
1	TS	4-terminal tie-point strip
2	CL-1, 2	#8 cable wiring clamps
1	BB	½" plywood base-board, 3½ x 8"

The QRZ Machine

Bill Johnson W6MUR
9372 Hillview Road
Anaheim, California 92804
Illustrations by Wayne
Pierce K3SUK

Bill is a consulting engineer with a BSEE from the University of California, graduate work in EE and undergraduate work in law. He's been a ham since 1935, and enjoys DXing.

Insula Nuevo* was the beginning of a long string of triumphs for Jules Silvergold III, W2BUKS. There were St. Ginsburg's Rock, Low Tide Shoal, Ebony Sandbar, and several more that he alone could claim. Jules even received the Elby Jaye Award at a special Texas ceremony for removing so many hazards to navigation as his new countries vanished by the push of a button on his departure. Jules was the unquestioned DX champion, but he found this a strangely lonely experience, for once the other HRAs** realized there could be no top for them, they rediscovered the fun of the game. Jules traveled alone in a polite but aloof fraternity.

But Jules had other troubles too. Grandfather's estate proved not inexhaustible; mothballed Liberty ships got scarce, and the cost of rock, barges, and even TNT had soared over the years. The IRS had denied him a deduction for the helicopter, too. Jules' father had long since put his well-heeled foot down and for the first time in his life, Jules was face to face with economic reality. A crisis was approaching.

On his flight back from Amuck Islet Jules stopped in at the Fresno DX conference to hear about the latest exploits of each of the 27 professional travelers and their foundations. Jules had been at Fresno once before, back in 1966 when Foundation Fever first started on its epidemic way. He had regarded it then as a sort of prostitution of the amateur service, but after reviewing the annual balance sheets for many years, Jules now thought differently. In his present predicament there just might be something to this, after all.

* See QST, February, 1965, p. 96
** Honor Roll Addicts

So Jules listened carefully while the 27 speakers paraded to the Fresno rostrum, showed their slides of the native girls and the erections of stubs and towers, and played recordings of the pile-ups. One of the highlights of the meeting was the recording of the time five DXpeditions were all on at the same time and the piles drifted together on 14025. The speakers had to borrow each other's recordings to find out who worked whom.

Clearly, thought Jules, some improvements were called for. With 97,600 active DX men by actual Honor Roll count, there were well over 1000 for every kHz that remained of the 20-meter band after the Canberra Conference in 1968. (The broadcasters had seen the balance sheets too, and had won some major concessions.) And the Fresno speakers had a lot to complain about. Tactics were indeed getting a bit rough, and more efficiency was clearly called for. One speaker even discarded his carefully prepared talk to editorialize and harangue the convention on this very subject.

And then Jules spotted an old Harvard friend, one of the electronics types who had designed the big 14050 computer used for the first Venus trip. Ferrite Manibit was his name, a scholarly looking bright-eyed chap who, though now graying slightly at the temples and balding on top, was still as bright as ever and was well planted now in W6. Jules invited him up to his 18th floor suite after the dinner meeting for a few drinks and a little private talk.

Jules checked the suite for bugs and swore Ferrite to secrecy on what he was about to say. He told Ferrite about his dollar problems and how even the helicopter was now mortgaged to the hilt. Jules then outlined his plan.

"The real problem is that you simply can't work 97,600 guys in less than 40 days, no matter how hard you try," said Jules. "What every one of these 27 chaps has said is that they need more efficiency. Now I've been thinking. How much memory can you put in the size of a portable typewriter now?"

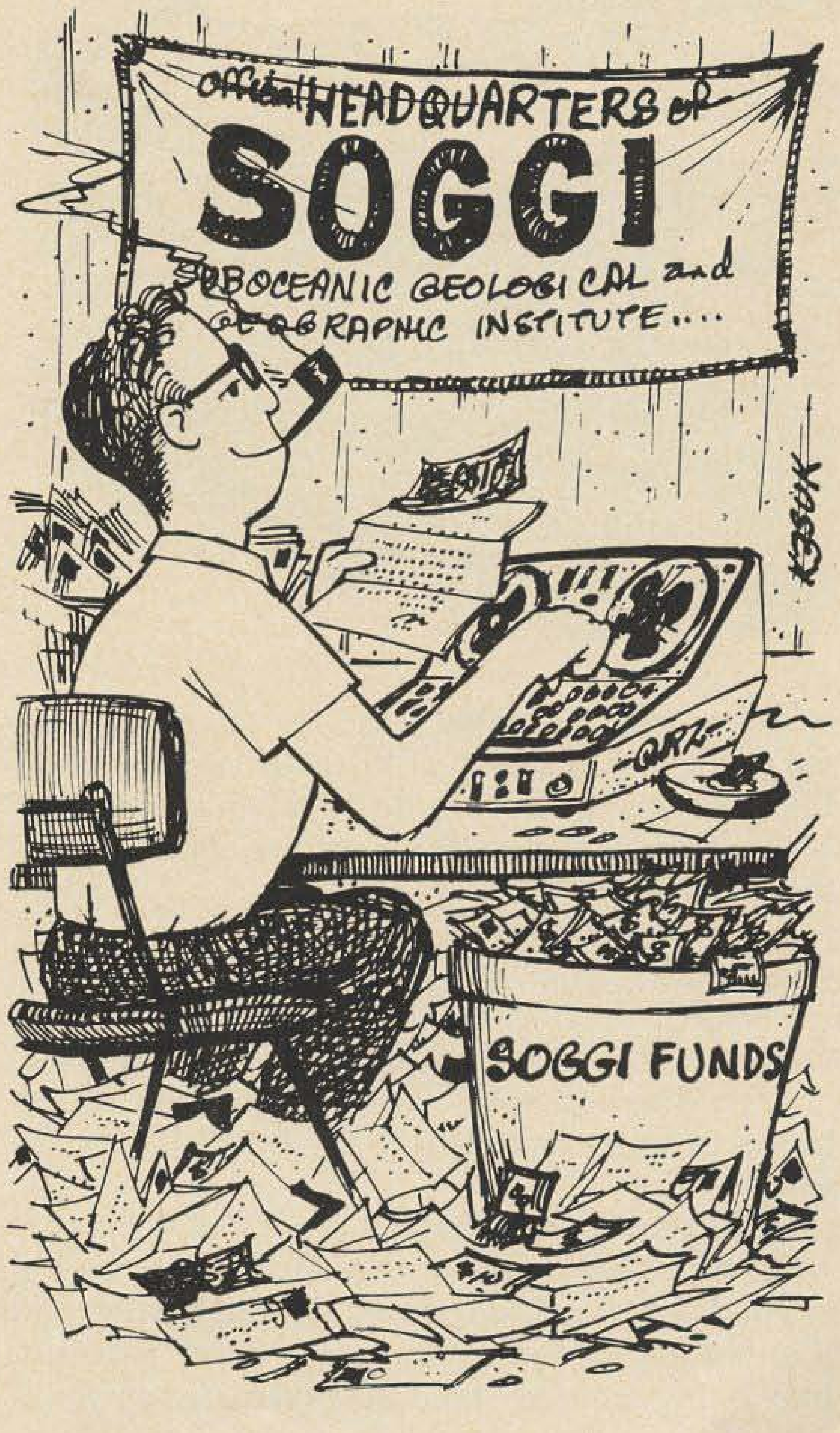
"Oh, about 4 megabits, I guess," Ferrite replied. "We worked up one computer for the Pluto shot that had about that in it. Of course, we have to go fully integrated to be able to do any processing in that space. Why?"

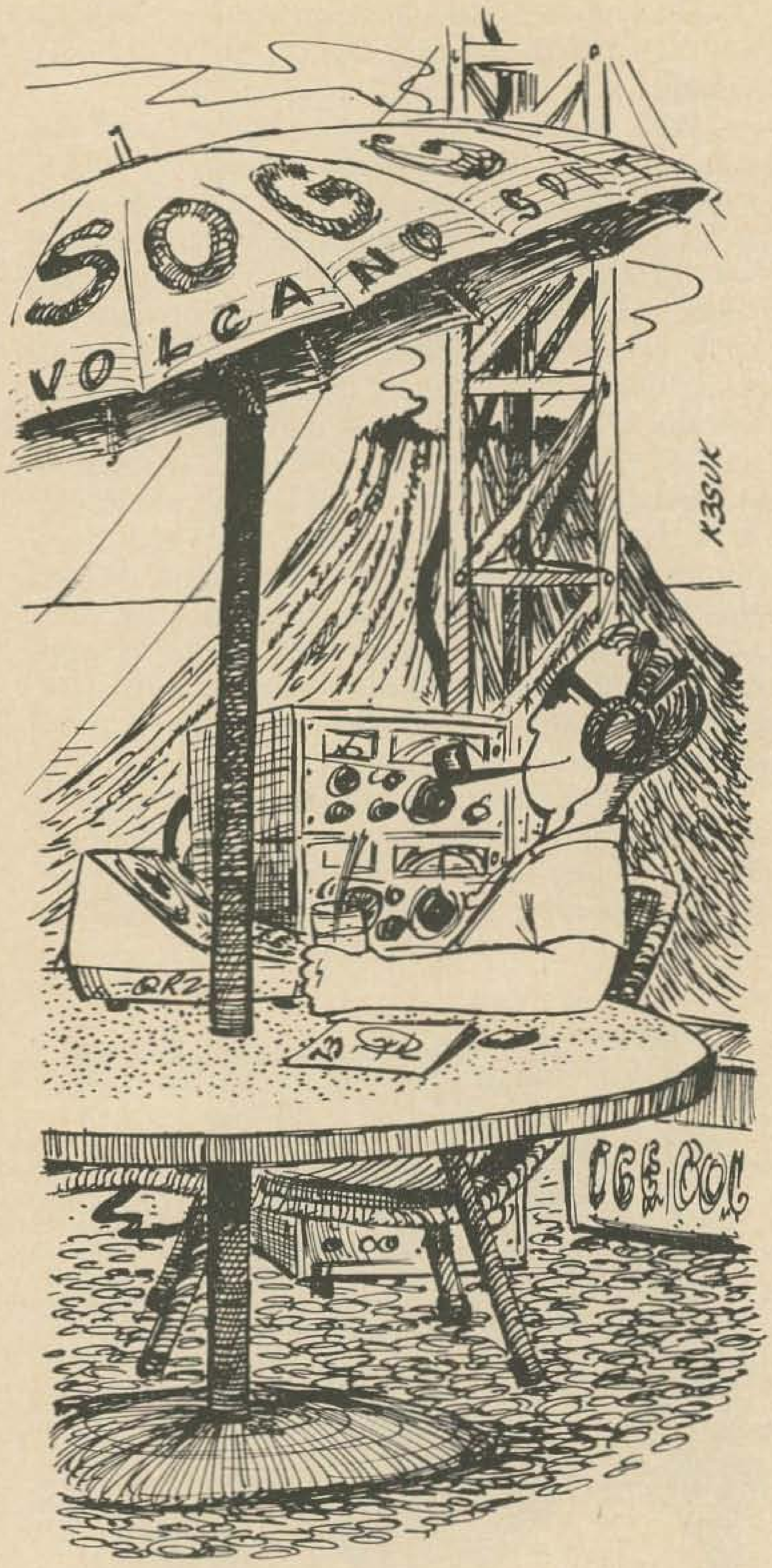
"Well, what I have in mind is a sort of data processor. I can still afford to fill in one or two more shoals but then I'm through. I thought this time I'd like to work the rest of the boys instead of just W2BUKS. It would improve my popularity, I think, and after looking at these Foundation balance sheets I think it could solve my other problems too. What's the going rate on QSO's, anyhow?"

"Oh, some of them have gone for as little as $10, what with inflation and all. It depends on whether it's a new one," said Ferrite.

"Well that's a good round figure, and we can convert it to Sterling or Rubles or whatever for the boys abroad. Now what I want is for you to put together a little data processor for me with a keyboard on it, so I can type in the call and all the pertinent data on each contributor before I leave. And I want some recognition circuits in there to unscramble the CW out of the pile and check the call against the master file. If he's paid, it sends a standard report—let's say 579 for the minimum or if he goes to $25 he gets 599—and then automatically logs the contact on tape. While this is going on, I want it to send QRZ and key the other rig. Then for QSL's all I have to do is play the tape back home and they're printed, stamped and addressed. Think you can do it?"

"Jules, I think you've got something there!" Ferrite's mental abacus was flicking through $15 average, times 97,600, times 2 for the second contact, less trip expense, payoff to





customs and licensing officials, etc. "I don't see any real technical problem here at all, and I'll tell you what I'll do. I'll design it and build it for you for 50% of the trip net. How's that?" he said.

Jules was shocked. "50%!! Are you out of your mind? 25%!"

"Well I don't ordinarily work on a contingent fee at all, but I'll go 35%, and that's it."

"You have a deal," said Jules. "You get it to me in Long Island by June 1 and I'll do the rest."

"Just be sure you work me too," said Ferrite.

So the QRZ machine was built, and worked beyond Jules' wildest expectations. Ferrite had thought up a few more convenient features, like being able to take several calls at once. He figured to make at least 1000 QSOs per hour.

Meanwhile, Jules dusted off his Harvard class notes and went to work. Full page ads, brochures and application blanks, mass mailings to the HRAs, and all the rest—it was a publicity campaign never seen before. The applications and $10 bills came pouring in, for contacts to be made with Volcano Spit. Jules called his foundation the SubOceanic Geological and Geographic Institute (SOGGI) and won the coveted IRS tax exemption on the basis of his stated purpose of research on how to stimulate suboceanic eruptions to create temporary islands.

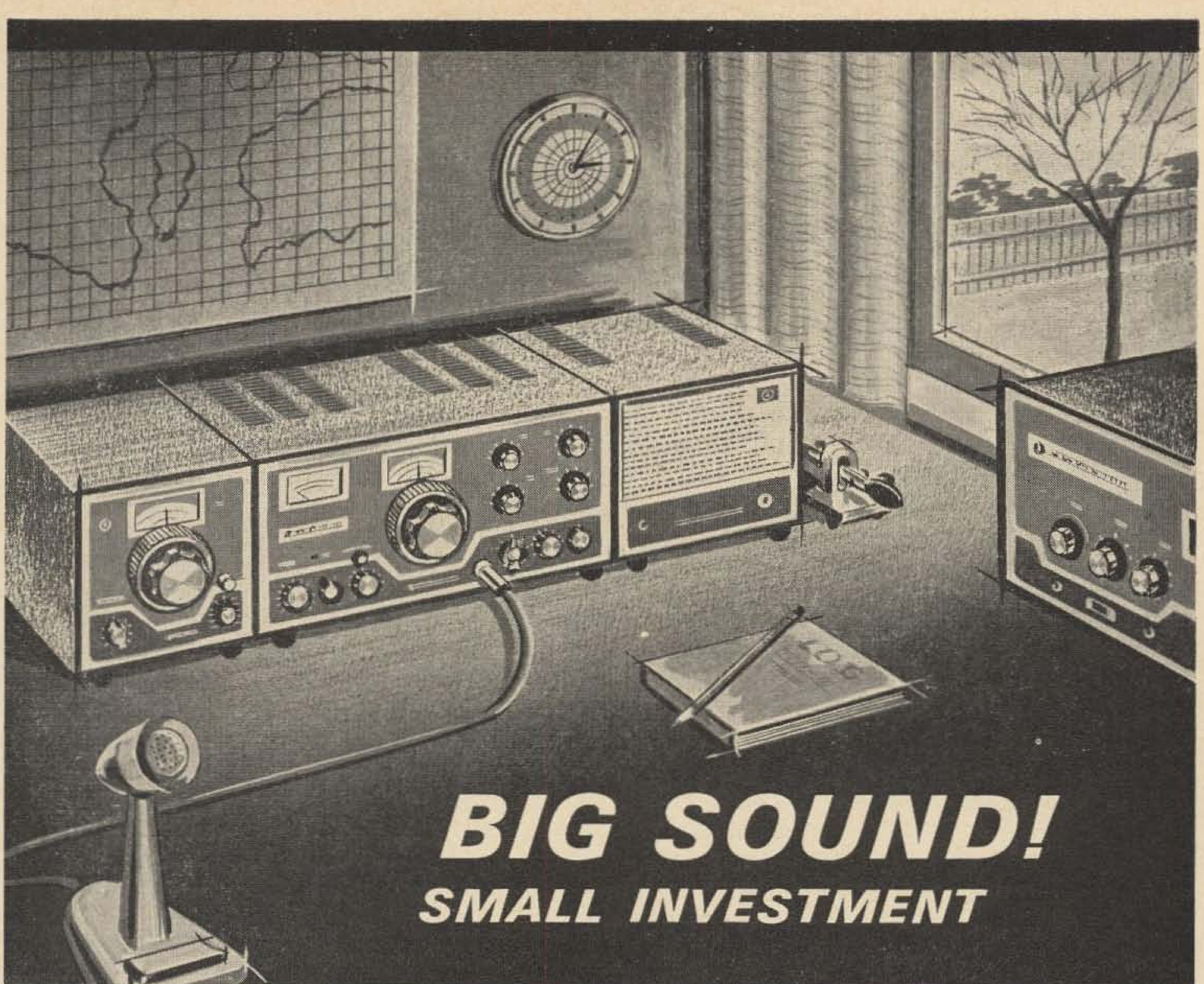
The expedition itself was routine, at least for Jules. His solid-state equipment easily fitted into the helicopter, and of course his contractors and shipping people were old hands now in manufacturing islands. Jules kept everybody posted through regular QST broadcasts taped from his home station in Long Island. His time of arrival was pin-pointed to the second, and everyone synchronized their watches and got off work in plenty of time. The word was out on procedure—the W6's would come first (Ferrite had insisted on this), then the W2's, and then, in deference to Texas, would come the W5's. Propagation was all worked out so there would be no problem with the signals.

The QRZ machine performed admirably. Once or twice Jules had to type in the call when the check stop light came on, but except for that the predicted 1000 QSOs per hour were easily achieved. While Jules relaxed, the QRZ machine did the work, two bands at once with two rigs per band. When some of the free loaders showed up, the machine would reject their calls as unacceptable and come back QRZ. Those it recognized were automatically logged, and the standard reply made. All in all, the Volcano Spit operation was by far the most efficient and successful of any DXpedition ever. Four days after arriving, 91,382 HRAs had their new country, and Jules' Honor Roll lead was reduced by one. Jules packed up and returned to Long Island.

But once again ancient and outmoded laws took over. Profit-motivated competition, pretty well discredited over the years, emerged. The 27 regular foundations convened an emergency meeting of the DXpedition Foundation Association and took corrective action.

So Jules never had to make that second trip and decrease his Honor Roll lead one more. Ferrite Manibit retired in Palm Springs luxury. QRZ Machines, Inc., was doing an island-office business.

. . . W6MUR



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A Simple Converter for 70 cm TV

This three-transistor converter furnishes a quick way to receive ham television signals on 440 MHz.

Here is a simple converter for the 430-450 MHz ham TV band. The two rf stages are conventional quarter-wave trough-line circuits. They possess very high Q so the amplifiers are rather narrow—at least for TV. The mixer-oscillator also uses trough-line circuits.

The AF139 transistor (U. S. equivalent is Amperex 2N3399) has a collector capacitance of only 1 pF and a comparatively high collector resistance so it loads the high Q circuits very little. The converter has fairly high resistance to overloading and spurious signals in spite of the high sensitivity of the converter. Each rf stage has a gain of about 10 to 12 dB.

The tap point on the input trough line is set for a 52-ohm antenna. If you want to use a 75-ohm antenna, the tap should be moved a few millimeters up from the grounded side.

Emitter current of the AF139 should be set at about 1.5 mA for lowest noise.

It is advisable to use button mica or other UHF capacitors for coupling and decoupling. Disc ceramics can be used if they are modified slightly. Heat one side of the capacitor to crack off the ceramic and unsolder one lead. Then place the bare, tinned side of the capacitor against a tinned part of the chassis while heating the chassis from the other side. This makes a very good UHF capacitor, though you may break a few capacitors doing it.

The third transistor in the converter is a self-oscillating mixer. It is stable enough for wideband TV.

A voltage variation of 2 volts causes a frequency drift of only 100-125 kHz (a TV signal is about 4.5 MHz wide). Even a rise in ambient temperature from room temperature to 150° F makes the oscillator drift no more than 80 kHz.

The 0.8 pF capacitor between the emitter and collector maintains oscillation. The inductor L5 compensates the capacitive part of the input impedance, and moreover, functions as a low impedance path for the *if* signal and the emitter current. The collector current of the oscillator-mixer is 4.5 mA.

The *if* signal obtained after the mixing process is filtered out by L6 and the 6 pF capacitor and fed by a link to the input of a TV receiver tuned to channel 2 (54-60 MHz in the U.S.). L6 is damped with a 2.7 kΩ resistor to get sufficient bandwidth.

L6 and L7 are housed in metal shields on top of the chassis. The coaxial connectors were spaced off the chassis a little to prevent their interfering with the quarter wave lines.

You can silver-plate the chassis and lines for the utmost in reception.

Good luck with the construction and reception.

. . . PAØBVO

This article originally appeared in the February 1966 issue of CQ-PA published in the Netherlands. It was translated by Jos. Stierhout PAØVDZ.

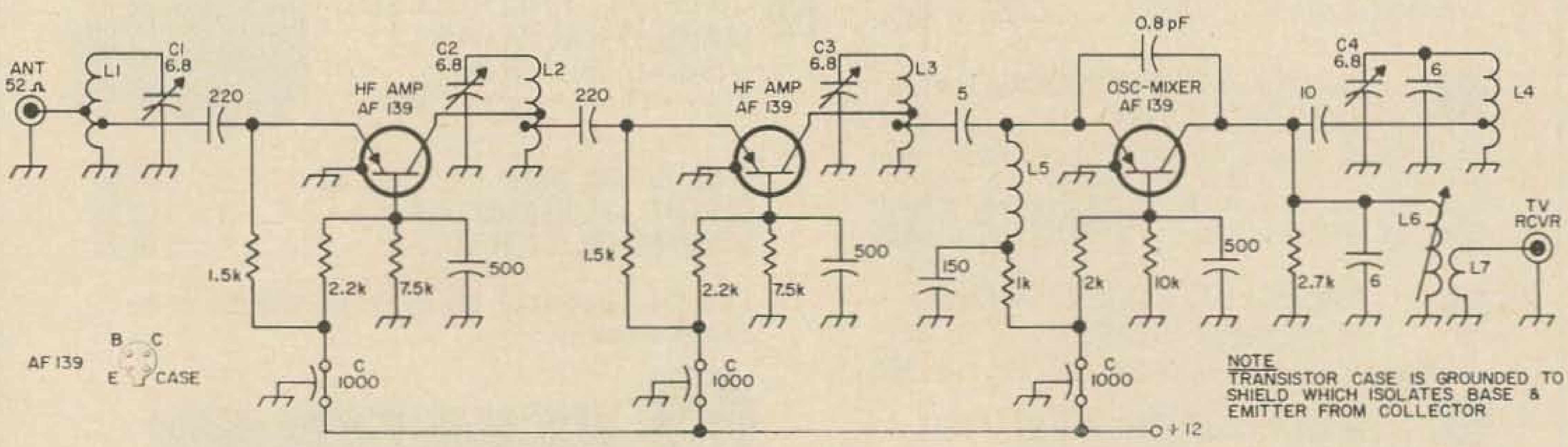

Fig. 1. Schematic of the simple 440 MHz converter for ham TV. L1-L4 are quarter-wave trough lines, 5 mm (1/4") in diameter and 68 mm (2-11/16") long. L5 is 3 turns number 18 7 mm (5/16") in diameter. L6 is 7 turns number 18 on a 5/16" form and L7 is 3 turns on it.

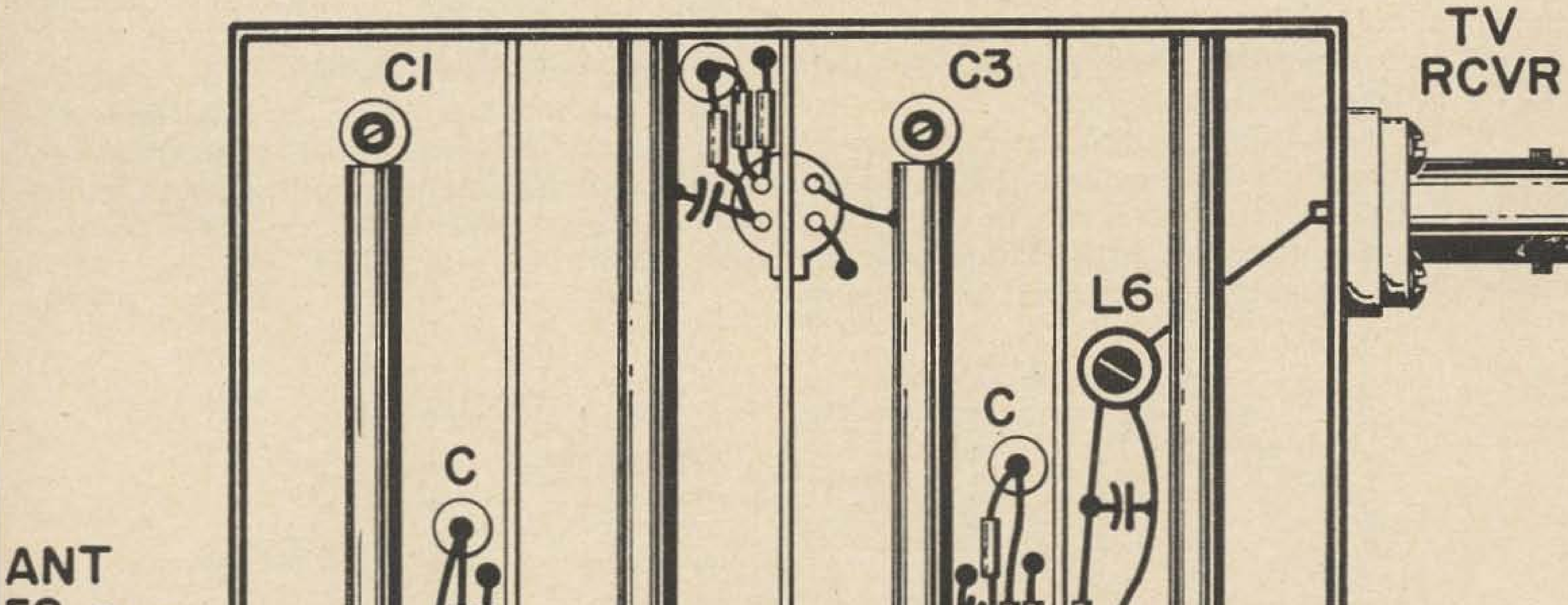

Fig. 2. Full size layout of the ham TV converter. This view is from the underside. The walls of the converter are 30 mm (1¼ inches) high.

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Arlington, Texas 76010

Silect Six Meter Converter

This simple and inexpensive six meter converter uses low-cost Texas Instruments plastic-cased Silect transistors. The rf stage is an FET, too.

Have you heard about the new Texas Instruments economy line transistors? TI calls them "Silect" transistors and they give excellent performance at low prices.

I recently attended a transistor seminar sponsored by TI in Dallas. Among the topics and devices discussed were a number of the Silect-line transistors, including the TIS34 N-channel VHF epitaxial planar silicon field effect transistor. This transistor, which is a low-cost version of the excellent 2N3823, has been written up before in two 73 articles: "RF Applications of N-Channel FET's" by WA5KLY in the May 73 and "A Low-Cost FET Two Meter Converter" by K6HMO in the October 73. The TIS34 is ideal for VHF mixer and amplifier service. It has a low noise figure and high, high frequency figure of merit. Cross modulation is minimized by its square law transfer characteristics. This transistor is used as the rf amplifier in converter.

The TI409 transistor, which wasn't discussed at the seminar, is an excellent NPN planar silicon transistor for general use. It costs 75¢, not a bad price for a 500 MHz, 200 mW transistor. Both transistors are encased in inexpensive plastic packages. Note that the leads of the TI409 are a bit different from most transistors.

Total power consumption is 2.5 mA at 12 volts.

This converter is similar in many ways to previously-described converters except for the FET rf amplifier. I couldn't find any FET rf circuits when I was starting to build this converter, so I decided to come as close as possible to tube circuits. The gate (grid) resistor was varied from 470 kΩ to 3.9 MΩ; 1 MΩ seemed best. The source (cathode) and drain (plate) resistors were likewise varied and the best values are shown. You're welcome to try your hand at improving it.

The etched circuit board shown in Figs. 2 and 3 may be used for constructing the converter. The coil forms I used were Cambion SPC-1, 3/16" diameter and 3/4" high.

It only took two evenings to lay out the circuit and etch the board, and assemble the converter. When I tried it out, I was pleasantly surprised at its excellent performance. It outperforms my other transistor converter and can't seem to be overloaded.

. . . W5JSN

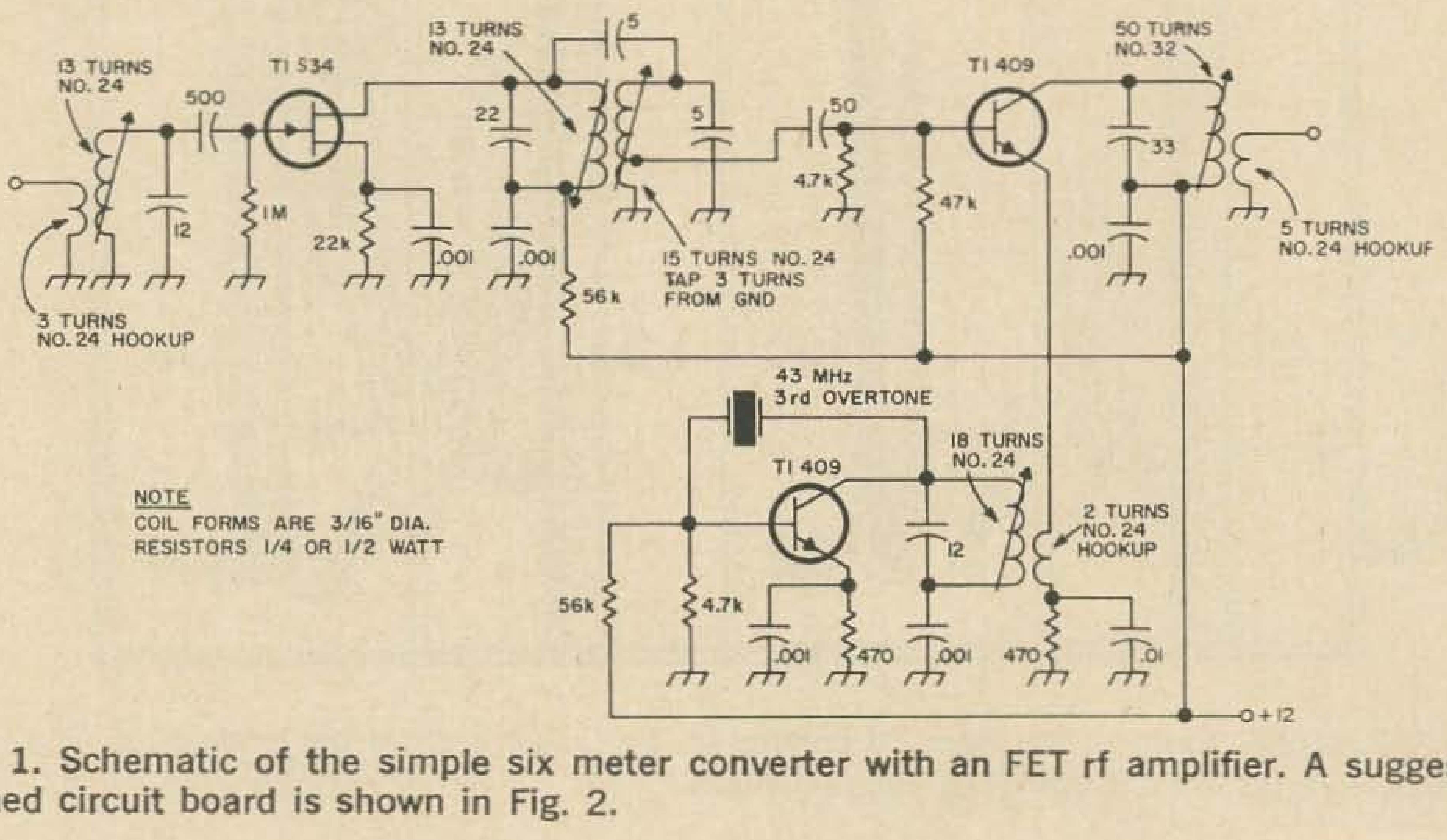

Fig. 1. Schematic of the simple six meter converter with an FET rf amplifier. A suggested etched circuit board is shown in Fig. 2.

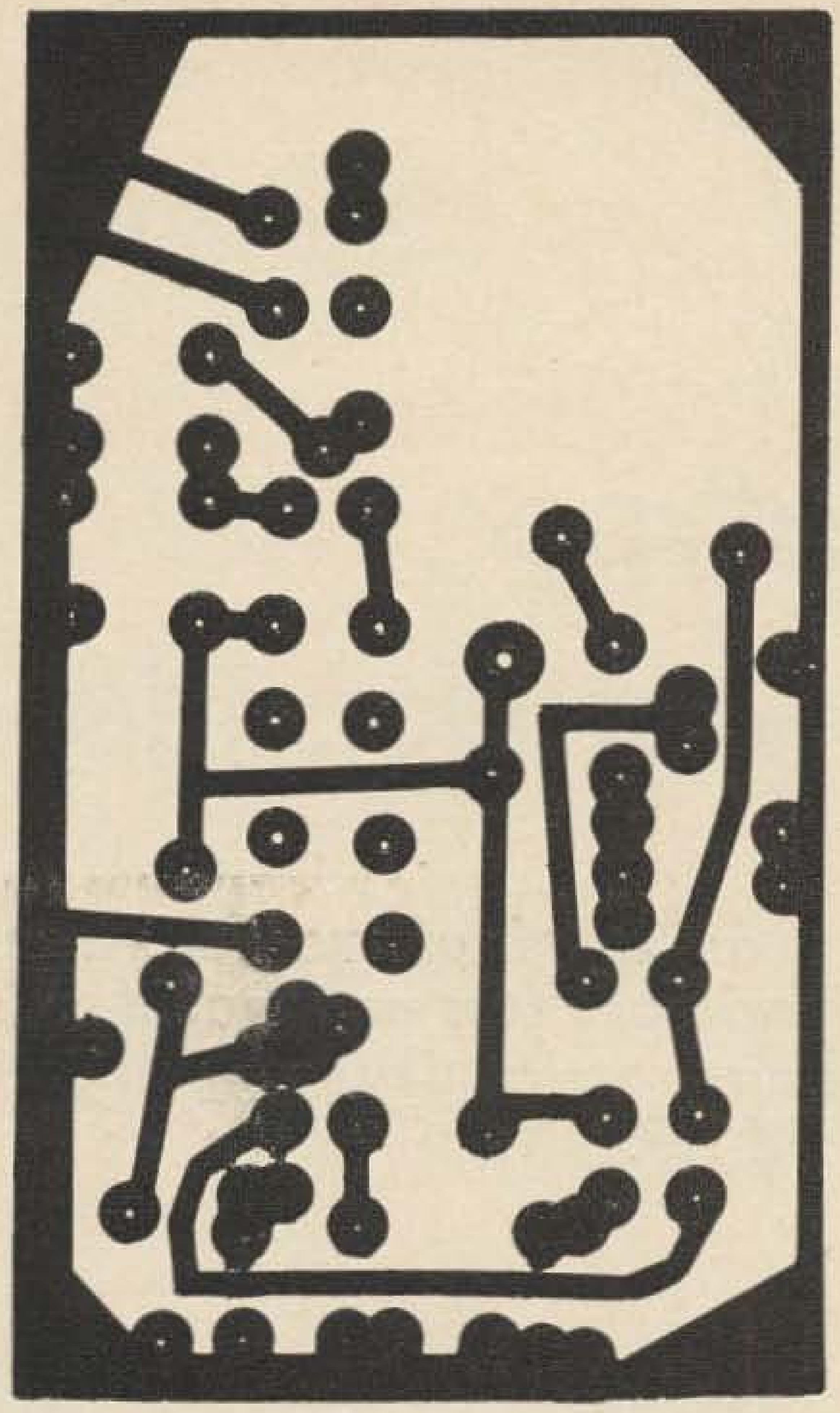

Fig. 2. Copper foil side of the etched circuit board for the six meter converter. The board is available for $1 from the Harris Co., 56 E. Main Street, Torrington, Conn.

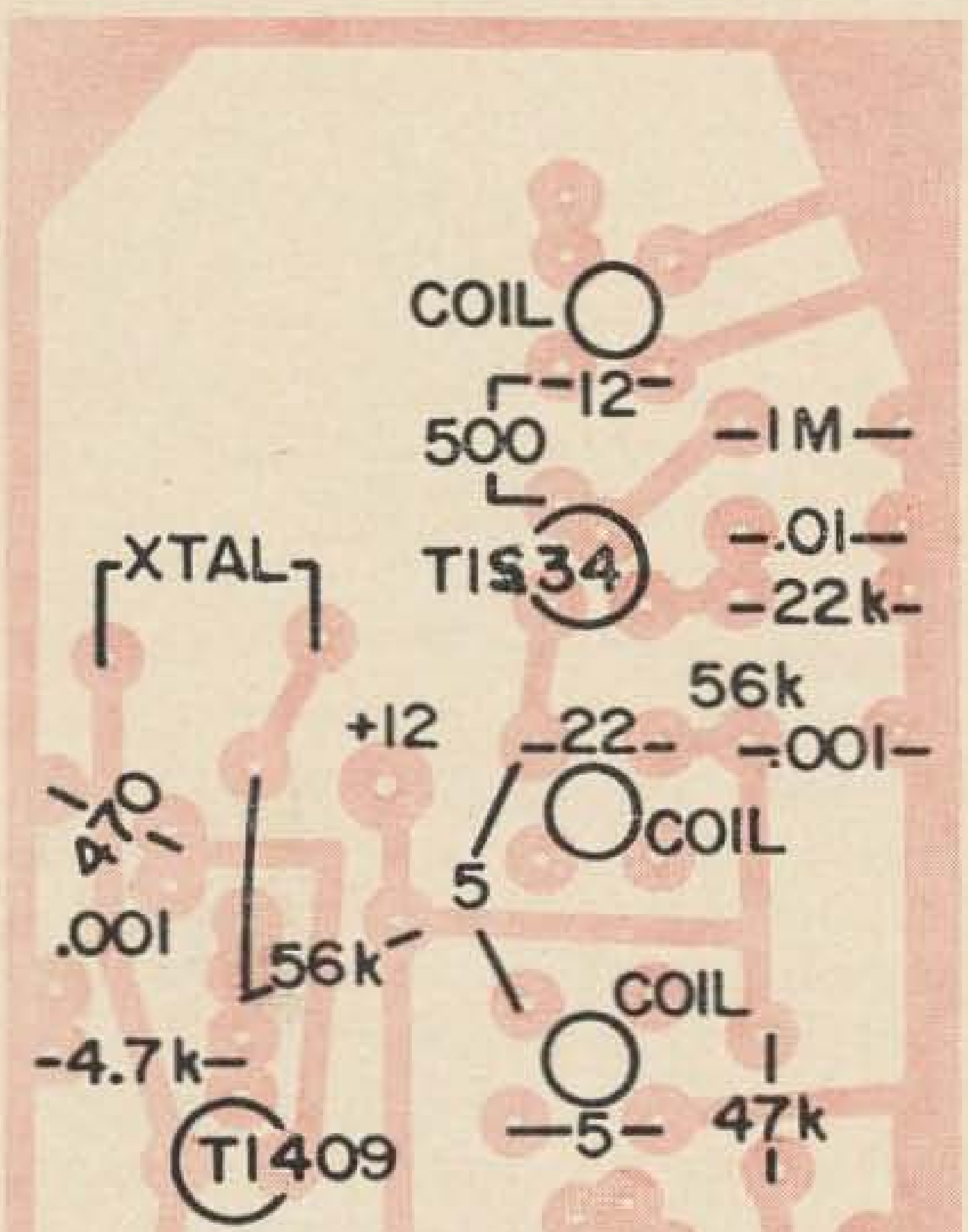

Fig. 3. Component side of the etched circuit board. The coil forms are standard etched circuit types.

Autostart Teletype Encoder and Decoder

Like to get in on the RTTY fun? Here are a pair of excellent transistor projects that will get you on quickly without fuss and trouble. Circuit board layouts are included and the boards are available if you prefer to buy them. Good for AFSK VHF or RFSK HF.

The VHF amateur who is interested in establishing dependable communications between his friends in his own area should be interested in a method of improving that dependability. It is called autostart Teletype and is used in amateur activities that center around one particular channel which is used by many people as a calling frequency. Although employed to a limited extent on the low bands, autostart Teletype proves to be most useful between club or net members using the VHF bands for local communications.

Autostart means "automatic starting" and this is exactly what the name is meant to imply. As an example, suppose you have a receiver monitoring your favorite channel. While you are out one of your friends calls you on the radio to give you a message. When you don't answer he turns on his teletype tone. Your Teletype machine starts up, prints his message and shuts itself off again, all automatically. When you come home the message is there, waiting to be read. The possibilities of this system are virtually limitless.

Teletype decoder

The Teletype decoder (converter) to be presented here was designed for VHF activity using AFSK* (audio-frequency shift keying). It was revised a few times to make it simpler, cheaper and more compatible with existing equipment. The result is a solid-state unit which will run for years in continuous use without maintenance. It is simple to build and will cost very little in the way of parts. The printed circuit board for the unit is larger than necessary so as to provide plenty of space for odd-sized parts. It may be copied directly or you may wish to design your own.

The decoder works in the following manner: The input audio is limited, amplified and then split to separate channel filters. Q2 is the 2125-hertz (mark) filter and Q3 is the 2975-hertz (space) filter. The audio is then rectified and filtered to dc which is fed to a divider network consisting of two 56-kΩ resistors. With respect to ground, the junction of these two resistors swings positive and negative on mark and space tones.

Transistors Q4, Q5 and Q6 form the dc coupled amplifier which drives the printer magnet and turns the current on and off. The diode D7 helps shut off Q6 completely and also acts as a fuse to protect the transistor junction against execessive currents.

Transistors Q7, Q8 and Q9 also act as DC switches. The zener diode D8 prevents triggering on random noise and voice. The resistor-capacitor network between Q8 and Q9 forms the on/off time constants for the autostart section. There is a delay of about one second from the time the mark tone is applied to the input until the relay pulls in and about three seconds delay for the relay to drop out when the tone is released. These time constants prevent the machine from coming on during noise and

*It may also be used for HF frequency shift RTTY by leaving out or ignoring the connections to the autostart circuitry (Q7, Q8, Q9 and the autostart relay).

voice reception and also prevent the machine from shutting off during high space content transmissions.

The relay employed at the output of the autostart section is a small, sensitive, 24-30 volt sealed type which only requires a few milliamperes of current to pull in. If you can't find this type, a higher current relay can be used provided that Q9 is chosen so as to handle the power. The contacts of any relay you use must be capable of handling 110 volts ac at about 2 amps. This means that it will be necessary to drive a large 24 volt relay from the small one if it is used.

Many different types of transistors will work in this unit and I would urge you to try the ones you have before you go out and buy. Except for Q6 and Q9 the parameters are not critical. The type shown in the diagram are the type I used. General purpose, silicon audio types with medium betas will serve just fine. For Q6 a power transistor in a TO-3 case was used. It will require no heat sink. Select one with a low leakage current. For Q9 be sure it will handle the relay current you plan on using. The one specified in the schematic is good for about 50 milliamperes.

Once the components are mounted the decoder can be tested in the following manner. Check all diodes to be sure they are in correctly. Remove Q4 and the zener diode D8 from the circuit and apply power. Place an audio tone of either mark or space on the input and check for audio with a scope or high impedance crystal earphone at test point 1. At point 2 the level should be higher. At point 3 the mark tone should be stronger than the space tone and at point 4 the space tone should be stronger than the mark tone.

Connect a VTVM to test point 5 and switch back and forth between mark and space tone. On mark the voltage should go about 5 volts negative and on space it should go about 5 volts positive (Q4 and D8 must be disconnected for these readings). The swing can be greater, but less than plus or minus 5 volts indicates possible malfunction. If the mark and space voltage at point 5 differ by more than .3 volts it would be advantageous to adjust R1 and R2 so the gain thru both channels is equal. This point is a discriminator type output which, like an FM receiver, will tend to cancel noise and random audio interference.

If all checks out, insert Q4 in the circuit and adjust R12 until the magnet current is 60 milliamperes* with the mark tone on. The value

*This will allow either series or parallel configuration on the magnets by simply adding a resistor in series with the magnet for 20 milliampere operation.

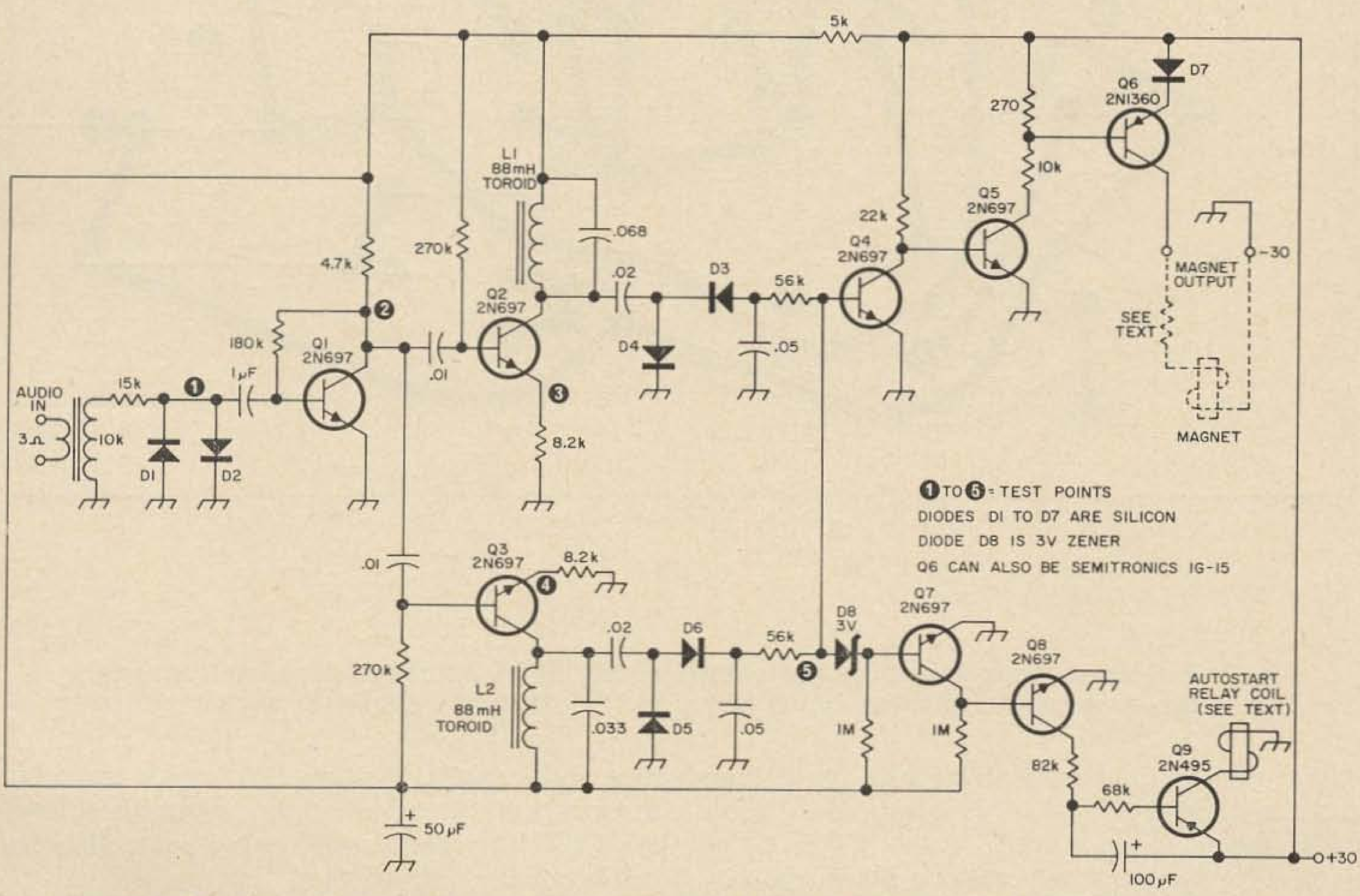

Fig. 1. Schematic of W6AYZ's decoder (converter) for VHF AFSK autostart RTTY. It can also be used for HF RTTY, but the autostart circuitry might prove unreliable for this use, so it's best to ignore it.

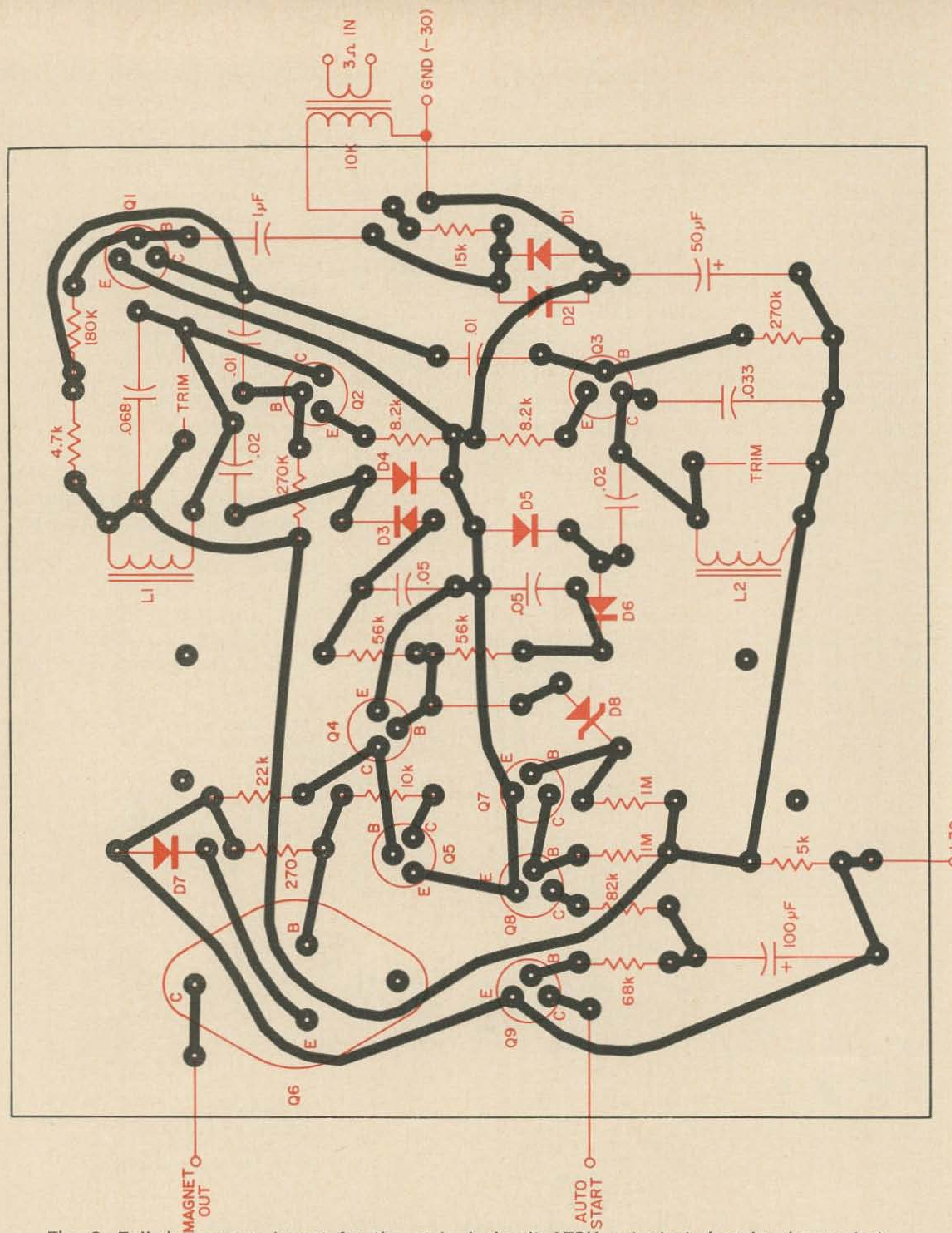

Fig. 2. Full-size copper layout for the etched circuit AFSK autostart decoder (converter). This is the copper side with the components on the other side shown through the board.

shown is a nominal value. Switch to space tone and the magnet should no longer hold in, even when manually depressed.

Finally insert the zener diode D8 in the circuit and apply the mark tone to the input. After approximately one second delay the autostart relay should pull in. Release the mark tone and measure the time it takes for the relay to drop out. This should be about three seconds. These times can be longer but will cause trouble if they are shorter.

This completes the checkout of the Teletype decoder and it should be ready to place in service. The range of the machine will be slightly narrower than on local loop but if the decoder is adjusted properly the loss should not exceed 10 points.

Teletype encoder

The Teletype encoder is really an audio oscillator with a transistor switch and is used for the transmission of Teletype signals by modulating the carrier. Two tones are used, the mark tone (2125 hertz) and the space tone (2975 hertz).

The encoder can be built on the printed circuit card or any other way you may choose. Only frequency determining components are critical in this circuit and many types of transistors will work equally well here. The audio output is enough to drive any transmitter including carbon mike types. An external potentiometer should be used to control the level of the generator.

The only difficulty you may encounter is getting Q4 to switch from space to mark. First try a few different types of transistors and if that fails juggle the values of R10 and R12 around. The beta of the transistor is most likely the gremlin in the problem. If it is too low

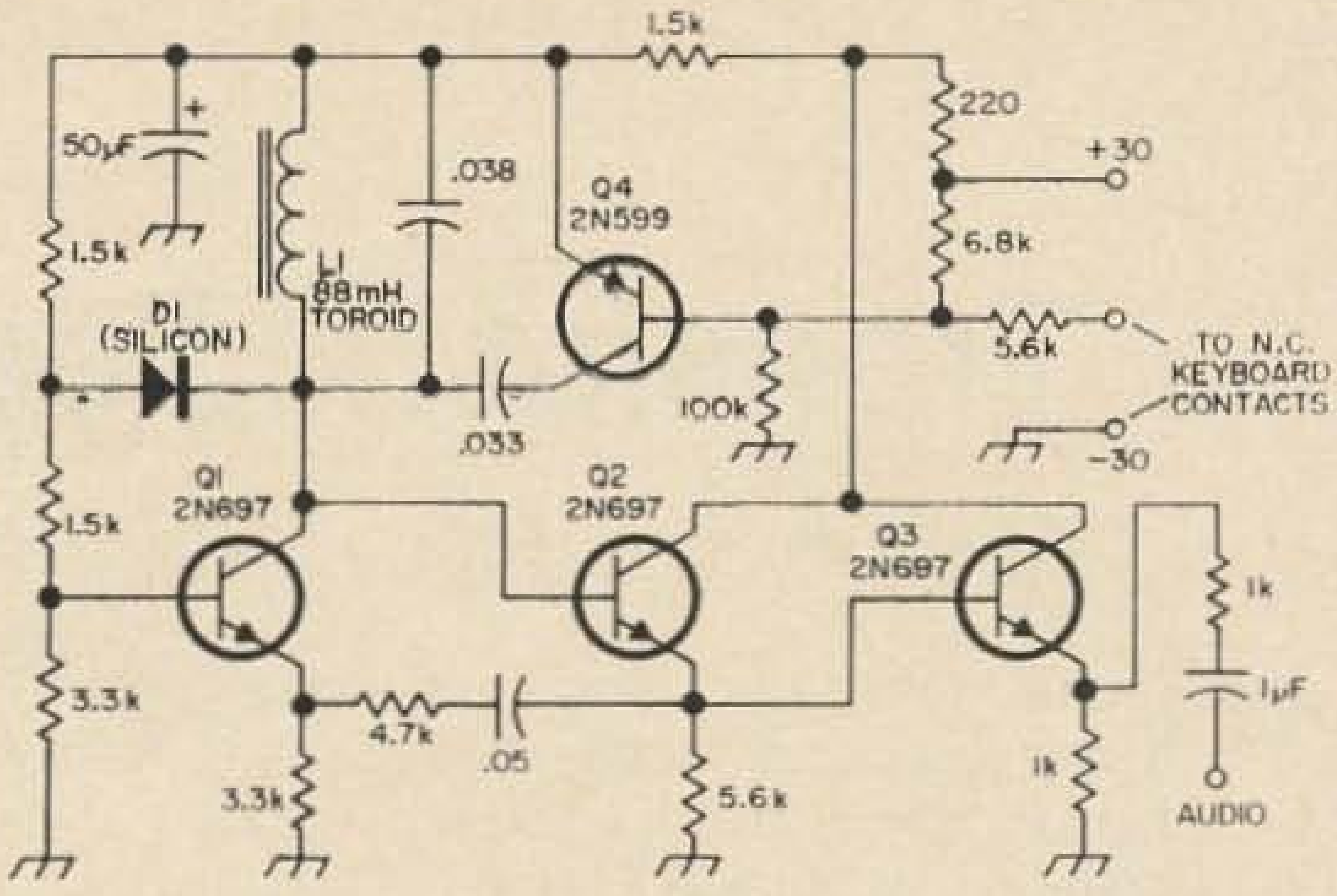

Fig. 3. Schematic of the AFSK RTTY encoder (generator). This circuit generates 2125 and 2975-Hz tones used to modulate AM transmitters for VHF RTTY.

the mark tone will not come on and if it is too high the space tone may not come on.

There are many things you can do with your new system and you will spend many happy months discovering new uses. Nets, field days or just plain fun will convince you that VHF Teletype is most useful and here to stay.

. . . W6AYZ

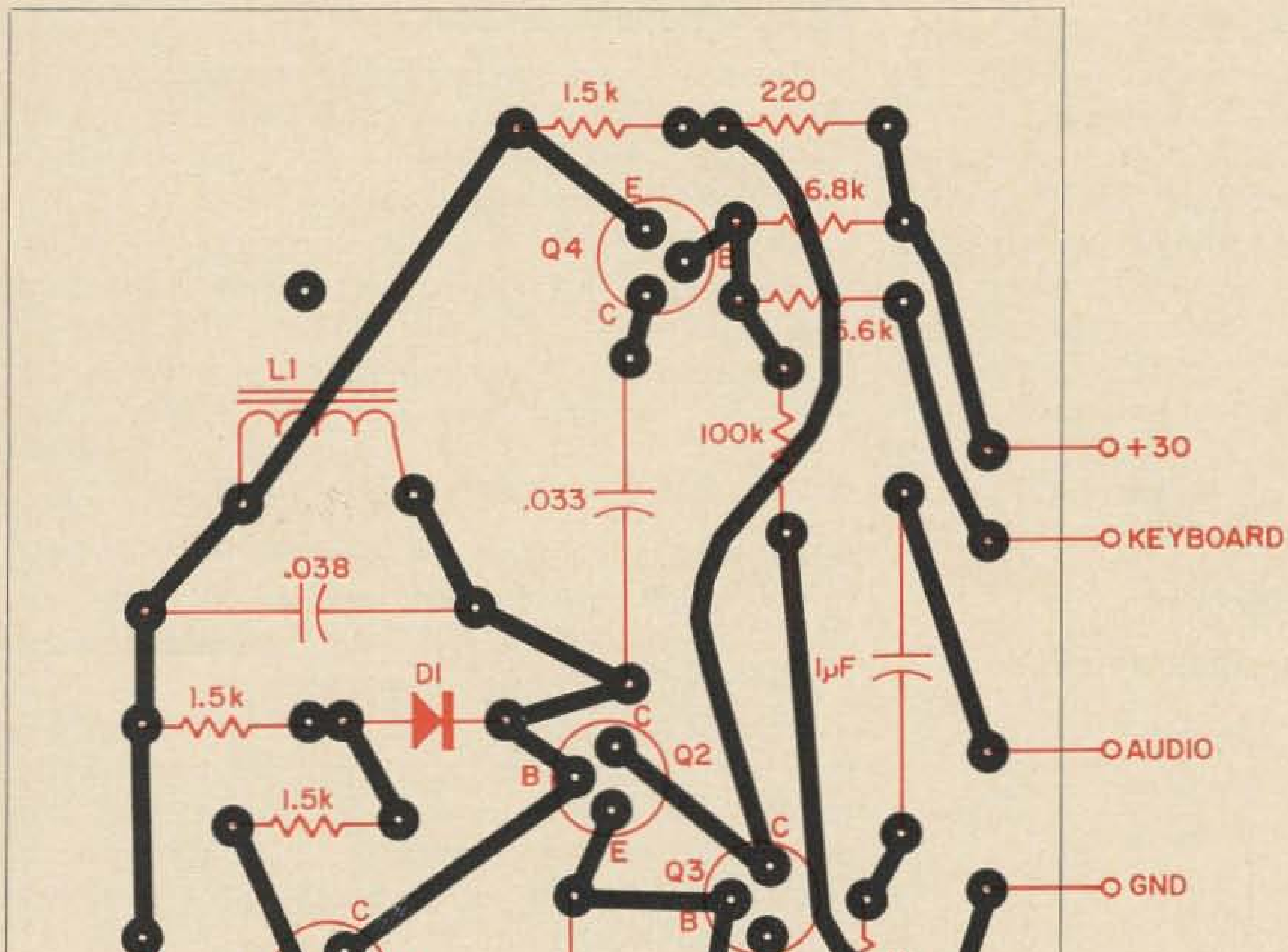

Fig. 4. Full-size Copper layout for the AFSK RTTY encoder (generator). The components are shown in a phantom view from the copper side.

Darrell Thorpe
3110 N. 83 Street
Scottsdale, Arizona

Transistor Tester for VOM's

Check current gain, shorts and opens with this simple adapter.

Like most of you, I have always desired and half-way needed a reasonably good transistor checker. The problem has been that the ones available in the \$7.00 to \$10.00 price bracket are practically useless, and the actual need never seemed to warrant the investment for a decent checker. The checker described here provides a reasonably good solution to this dilemma.

If you have any kind of a junk box, this transistor checker adapter for your VOM or VTVM will cost considerably less than the ready-made cheapies, and it will give more test data. Getting down to details, you can check current gain, determine which junction is open or shorted, and check for leakage.

The circuit

The adapter tester utilizes a standard common-emitter circuit as shown in **Fig. 1.** Hence, devices are being checked under typical working conditions. Here is how it works. With R4 set at zero resistance, the base voltage will be equal to the voltage V_B which is 6 volts (less a tiny drop across R3). Then, depending upon if the transistor is germanium or silicon, there will be from 0.3 to 0.7-volt drop across the base-emitter junction. Thus, with a good transistor in the circuit the remainder of the voltage will be dropped across R5 giving a meter reading of about 5.5 volts.

Checking transistor defects

With S2 in the test position and R4 set at zero, faults are checked as follows:

1. A collector-emitter short will give a meter reading equal to the full battery voltage (9 volts).
2. A collector-base short will also yield a full supply voltage reading.
3. A base-emitter short will produce a 2-volt reading on the meter. There is no transistor action, hence, R_3 and R5 function as a voltage divider.
4. An open collector will also give a 2-volt reading.
5. An open base or open emitter—no reading.

All of these meter readings are fairly widely spaced for easy recognition of a particular transistor defect.

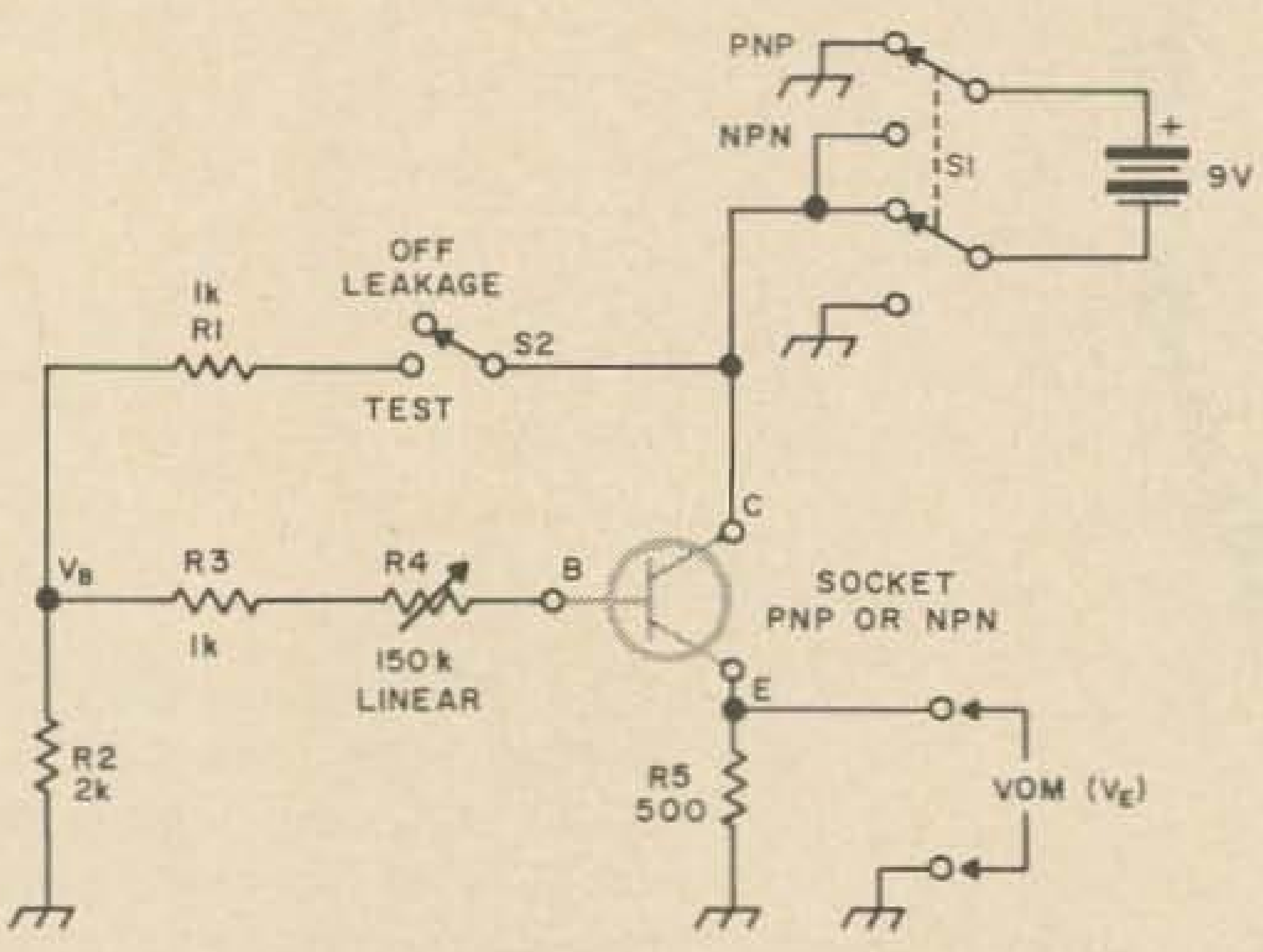

Fig. 1. Transistor tester adapter for use with a VOM.

Accurate beta measurements

By now, you are probably wondering why R4, and 150 kΩ linear potentiometer, is in the tester. Well, this is used to make rather accurate beta measurements.

By performing a circuit analysis, it can be shown that the voltage V_E across R5 is a function of V_B, R3, R4, R5 and the gain of the transistor. We won't bore you with the math details, just take our word for it. Actually, the equation boils down to $\beta = \frac{R4}{2R5}$ if $V_E = 2$, and, since we have made $R5 = 500$ ohms, transistor current gain is equal to R4 in kilohms. Get the idea, all that is necessary to get accurate gain measurements is to calibrate R4 in steps of say 5 kΩ. Then, to measure current gain, simply adjust R4 so that the meter reads 2 volts, and read gain from the calibrated pot. For example, a 50 kΩ reading on the pot (meter set at 2 volts) is equivalent to a current gain of 50.

To check leakage, open S2. A low leakage device will give a very low or zero meter reading. Also, a pair of headphones connected in place of the VOM will give a fairly good indication of transistor noise.

Depending upon the type of meter you own, this adapter checker could be built in a small case outfitted with appropriate plugs spaced to match the jacks on the meter.

. . . Thorpe

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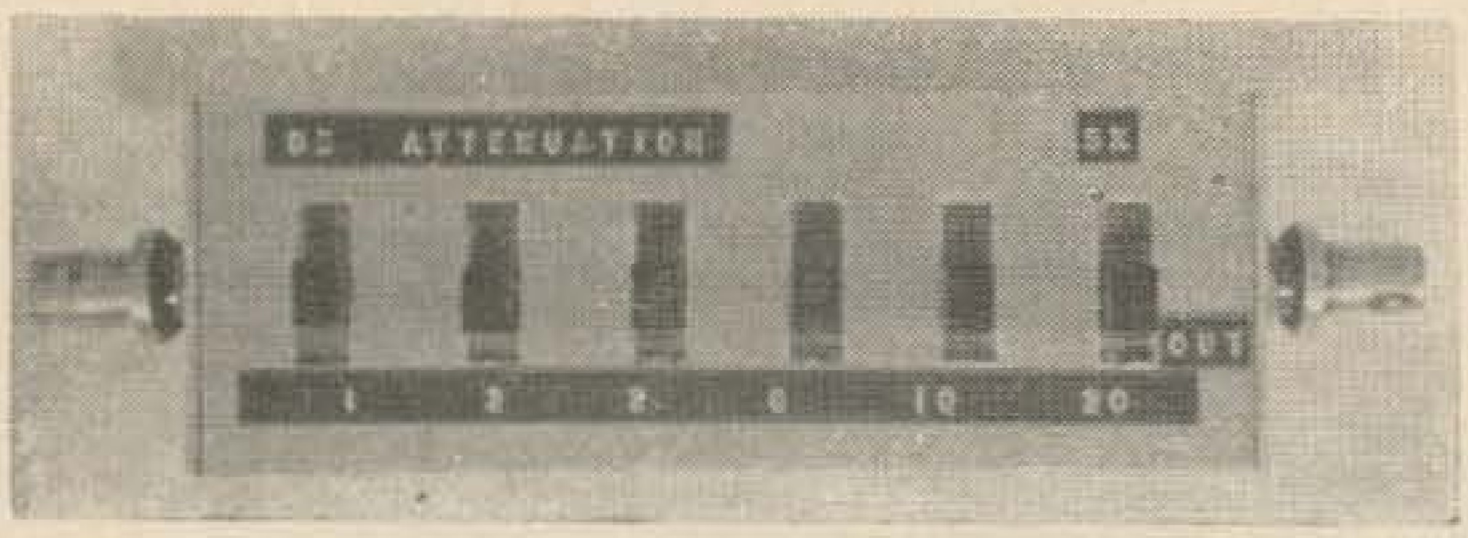

Amateur low-power attenuator made from inexpensive slide switches, 5% resistors and fiber glass, copper-clad board.

George Daughters WB6AIG
Will Alexander WA6RDZ
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Mountain View, Calif.

Low Power Attenuators for the Amateur Bands

Simplified construction, excellent performance and low cost make these attenuators attractive to the ham. They're good to over 450 MHz.

In the evaluation of rf amplifiers, filters and many other devices, a variable attenuator is indispensable. This article describes attenuators built and tested by the authors. These attenuators are flat from dc to over 50 MHz and usable to over 450 MHz. They use low cost parts, are very simple to build, and are more accurate than ordinarily required in amateur applications.

The basic attenuator section is the symmetrical pi shown in **Fig. 1**. Resistance values are given by the relations:

$$R_1 = R_s (\sqrt{K} + 1)/(\sqrt{K} - 1)$$
$$R_2 = R_s (K - 1)/(2\sqrt{K})$$

where R_s is the characteristic impedance of the pad (equal to the source and load impedance) and K is the attenuation factor, P_{in}/P_{out}.

Resistor values for the most commonly used impedance (50 ohms) are shown in **Table 1.**

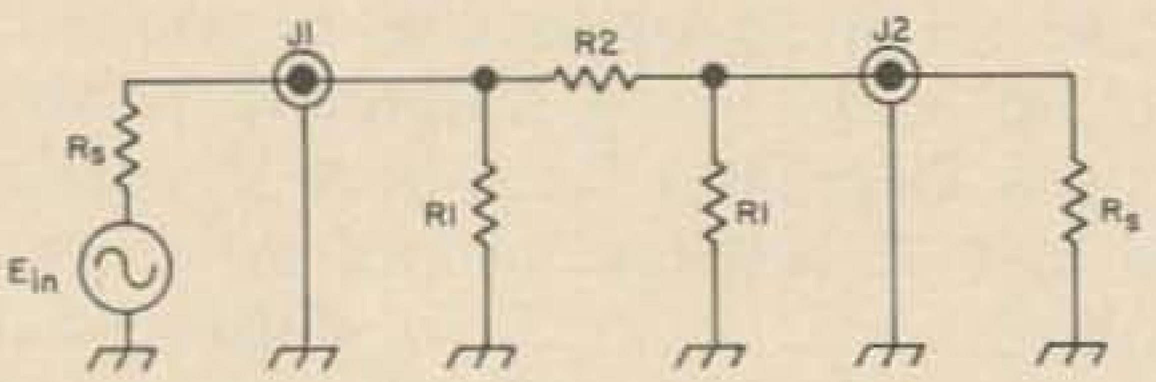


Fig. 1. Basic pi-network attenuator section.

Nominal attenuation in dB	R_1 in ohms	R_2 in ohms	Calculated attenuation in dB	Measured attenuation in dB
1	910	6.2	1.1	1.1- 1.2
2	430	12	2.1	2.1- 2.3
3	300	18	3.0	3.2
6	150	39	6.2	6.3- 6.6
10	91	68	10.2	9.6-10.1
20	62	240	19.6	19.5-19.7

Annenuation measured at 50 MHz and lower.

Table I. Resistor values for 50-Ω attenuators.

Notice that the use of standard value 5% half watt composition resistors allows accuracy within 1 dB of the calculated value of attenuation and within 1 dB of the desired nominal value.

The attenuators are built in small channel boxes made of copper-clad etched circuit board material. Aluminum channel boxes commercially available would probably work equally well. Small, inexpensive DPDT slide switches (H. H. Smith No. 518 or equivalent) are soldered directly to the copper board and the resistors are soldered to the switch terminals (which have been cut short) with the shortest leads possible.

Two wiring variations have been tried, one

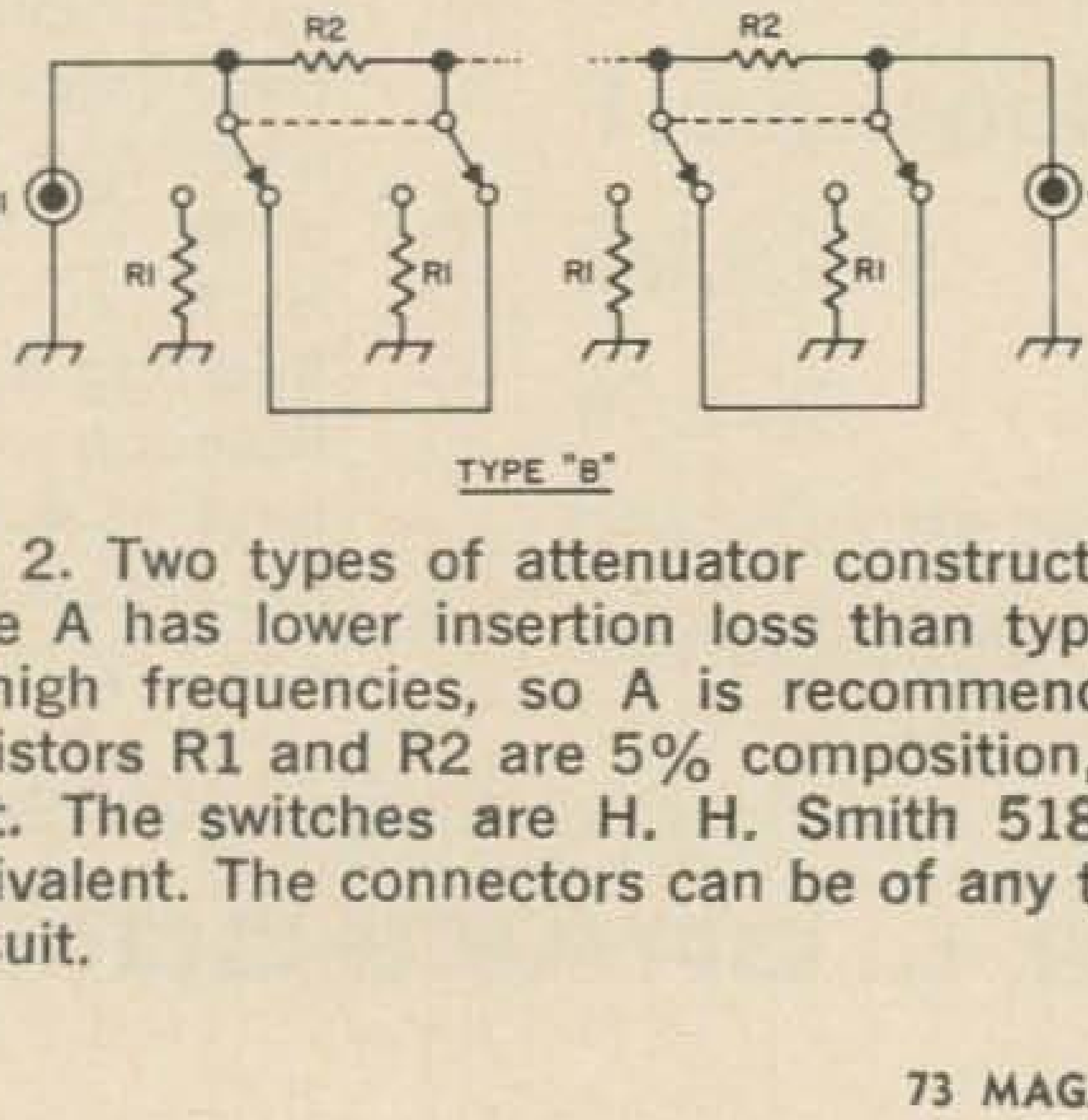
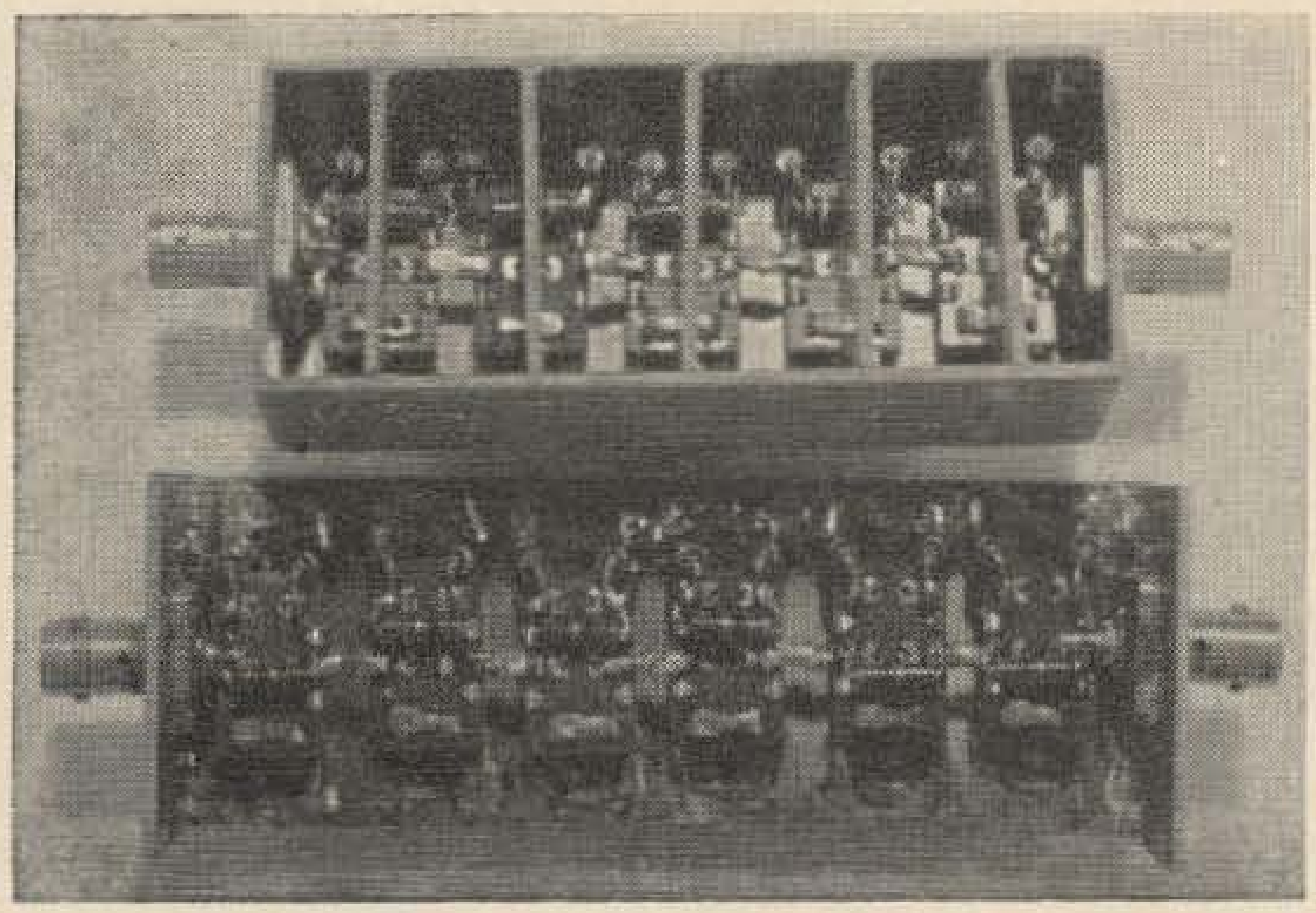


Fig. 2. Two types of attenuator construction. Type A has lower insertion loss than type B at high frequencies, so A is recommended. Resistors R1 and R2 are 5% composition, ½ watt. The switches are H. H. Smith 518 or equivalent. The connectors can be of any type to suit.



Details of attenuator construction. The top style, with complete shielding, is recommended.

with the series resistors (R_2) mounted between the switch wiper contacts (type B), and one with all resistors connected to the attenuator in terminals (type A). See **Fig. 2** and the photo of the interior of the attenuator. It was found that the latter arrangement, type A, provided less insertion loss than the former at high frequencies, so this type of construction is recommended. Also note that dividing shields are desirable between input and output elements of a single section. These shields prevent capacitive feedthrough at the high frequencies, and are desirable on the high attenuation sections (anything over 10 dB) even at low frequencies. On the low attenuation sections, very little difference is evident below VHF. See **Fig. 3** for the attenuation of the attenuators up to over 450 MHz. Building attenuators with greater than 20 dB attenuation per section by this method is not recommended for high frequency use.

. . . WB6AIG, WA6RDZ

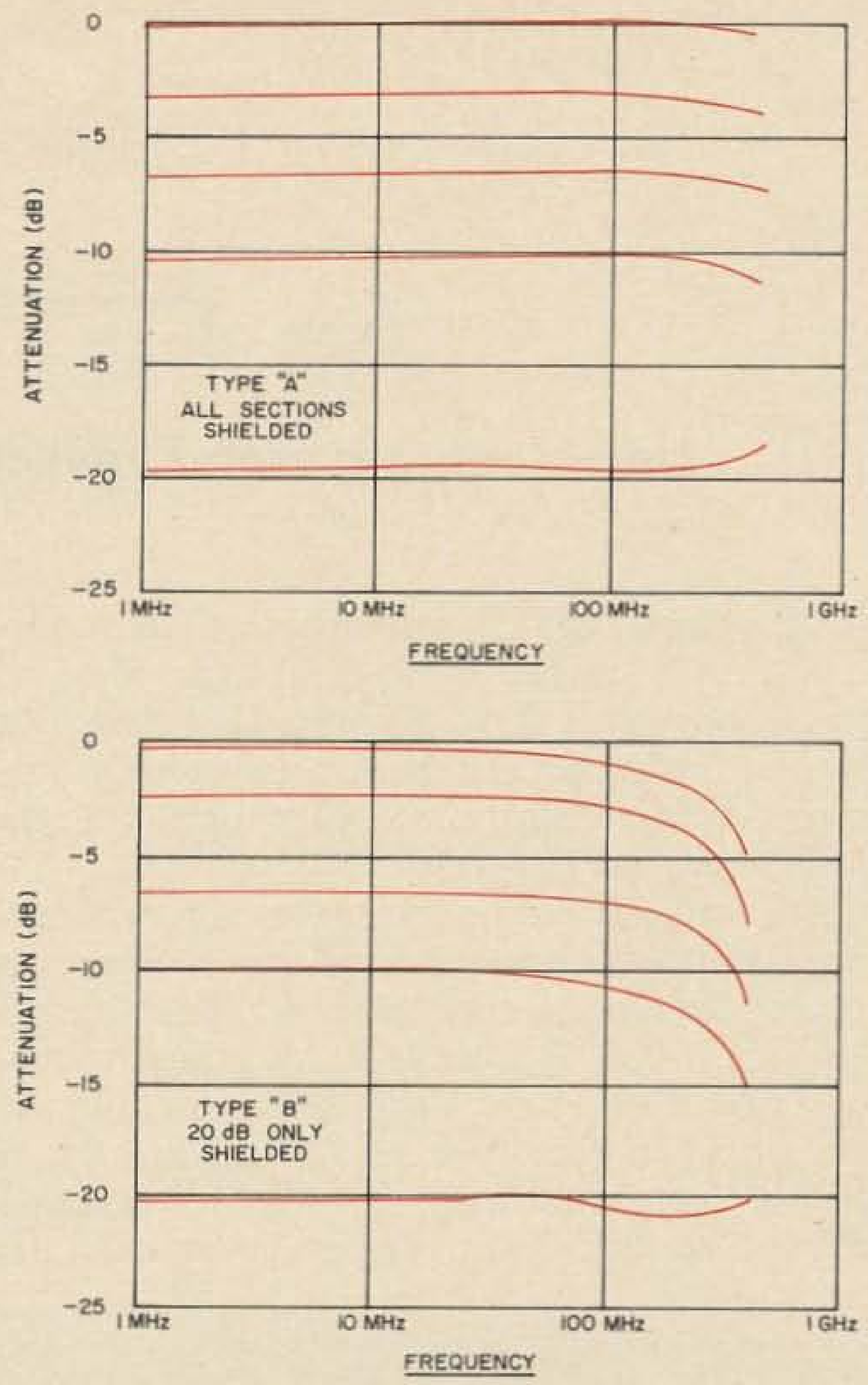


Fig. 3. Insertion loss versus frequency for the two types of attenuator construction: all sections shielded (A) and only the 20 db section shielded (B).

Hank Olson W6GXN
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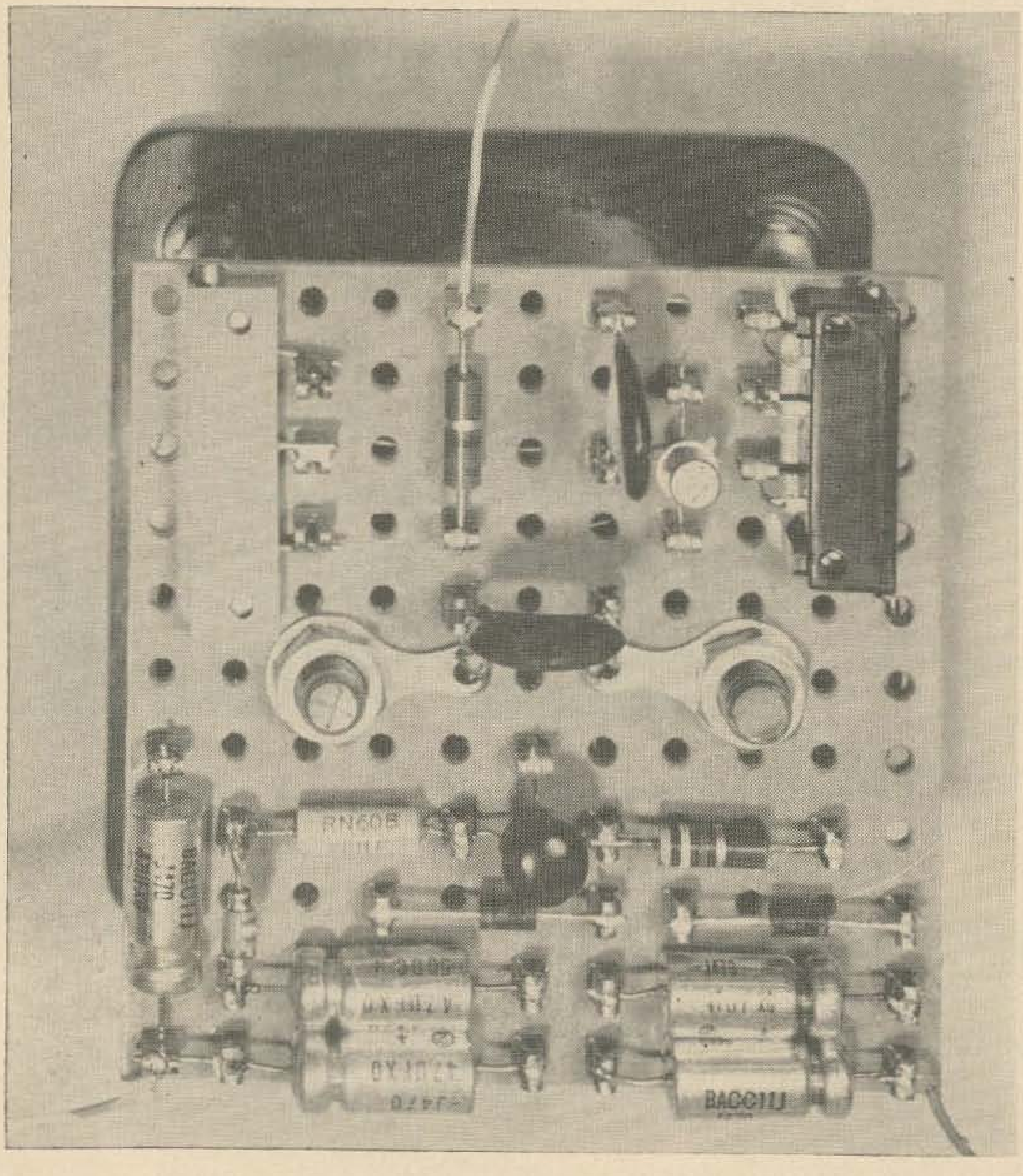
An FET S-Meter

Here's another useful application of field effect transistors.

For the ham "who has everything" the addition of an "S"-meter is no problem; the "S" meter comes with the "S" line. However, for those of us who build our own or modify surplus receivers, adding a signal strength meter is not always an easy task.

Most communication receiver manufacturers design their S-meter into the receiver as an *if* amplifier plate-current meter. This allows the use of a 0-1, 0-2, or 0-5 mA meter movement, which is about the cheapest of the movements. In this type of "S"-meter, the *if* plate current decreases as the (negative) AGC voltage increases. In other words, *the meter reads backwards!* For a manufacturer making a large production run, "backwards" meters are only slightly more expensive than standard meters; so this simple method has economic advantages. But for the homebrewer of receivers, a standard meter must be used upside-down, and a new scale put on it.

Another approach to an "S" meter is to use the "VTVM," circuit, or differential triode amplifier. Such a circuit can be made to drive the meter in either direction, depending on which meter terminal is connected to which triode. In **Fig. 1**, the meter is connected as it would be for use with the negative AGC line



FET S-meter circuit built on a piece of Vector board that is fastened to the back of the meter used. The linear, 15 turn pots in the upper corners can be Bourns E-Z Trim types costing only $1.85 apiece.

of a receiver. A variation of this circuit replaces V2 with a resistive voltage divider, as in **Fig. 2**. In either the circuit of **Fig. 1**, or that of **Fig. 2**, an extra tube must be added to the receiver.

One way to implement the VTVM circuit is to remove a dual diode-triode (second detector, first audio amplifier, like a 6SQ7, 6AT6, or 6AV6) and replace it with a compactron and a couple of semiconductor diodes. The newer GE 6C10 and 6D10 are triple-triodes, that could serve as both audio amplifier and VTVM differential. Such a modification requires a socket change, of course.

A simpler solution to the "S"-meter problem has the negative AGC voltage drive a "P-Channel" field effect transistor (FET). The "P-Channel" FET compares to a vacuum tube except that it is a tube's complement. That is, drain (plate) voltage is *negative* with respect to the source (cathode), and a *negative* voltage applied to the gate (grid) increases drain-to-source current flow. If we use this "P-Channel" FET as a meter driver, *negative* AGC voltage applied to the gate will *increase* the meter reading, as we desire.

The FET "S"-meter is shown in **Fig. 3**. It can be operated from the AGC line of nearly any tube-type communications receiver. Notice that the circuit is complete with a −11 volt regulated supply that takes its power from the 6.3 volt heater circuit. Therefore, only three connections are necessary; heater, AGC line, and ground. The photo shows the circuit as it was constructed on vector board, to mount on the back of a 3", 0-1 mA meter.

In **Fig. 4** are shown the characteristic curves for the 2N2606 through 2N2609 family of P-Channel FET's. The family of curves shown really represent only the 2N2608, but by applying the scale-factors in the accompanying table, the rest of the family can be calculated. The near-equivalent industrial versions of these FET's have been added to the table, because these less expensive types are the ones hams will be most likely to use.

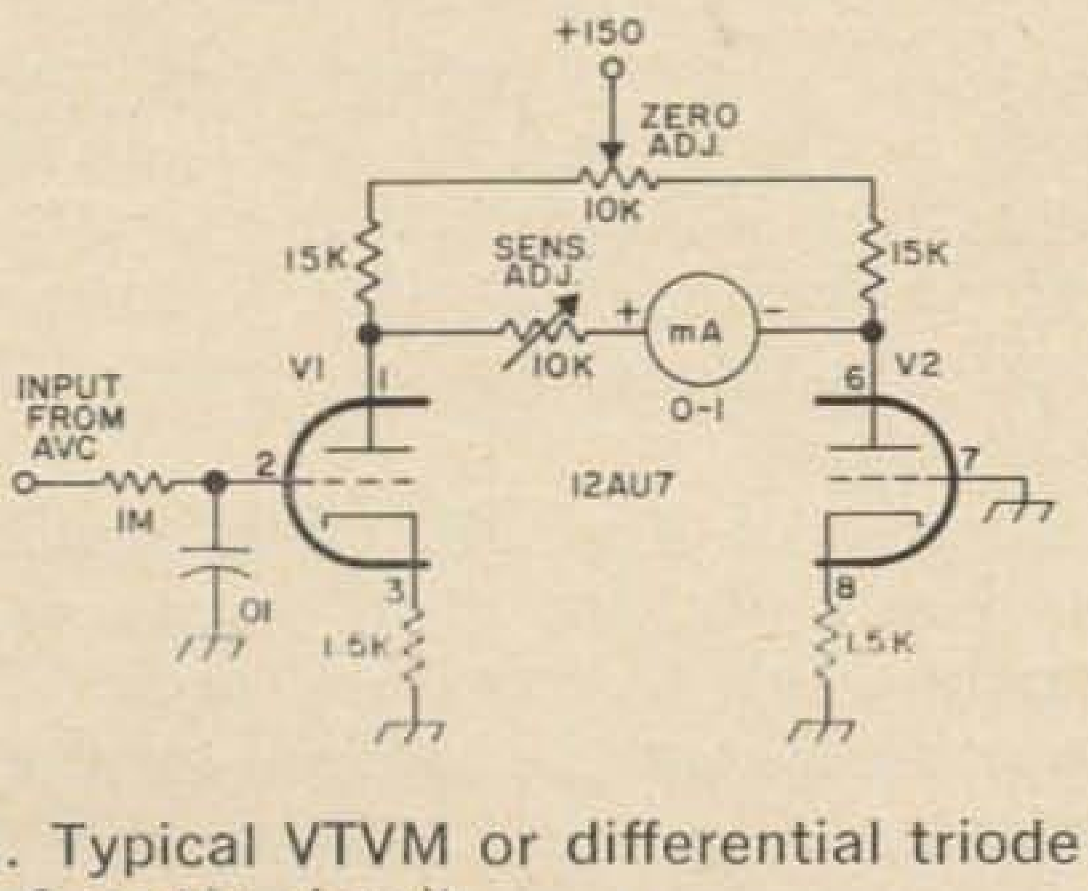


Fig. 1. Typical VTVM or differential triode amplifier S-meter circuit.

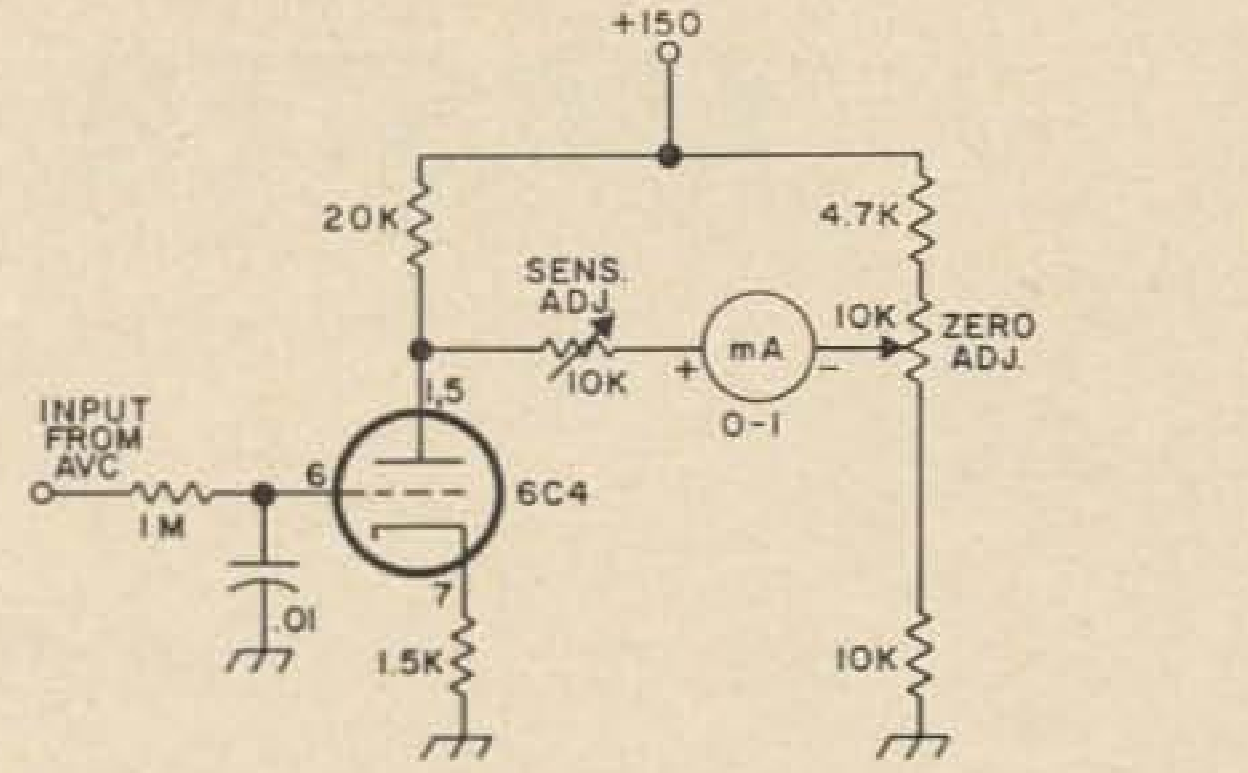


Fig. 2. Variation of Fig. 1 with resistive voltage divider replacing one triode.

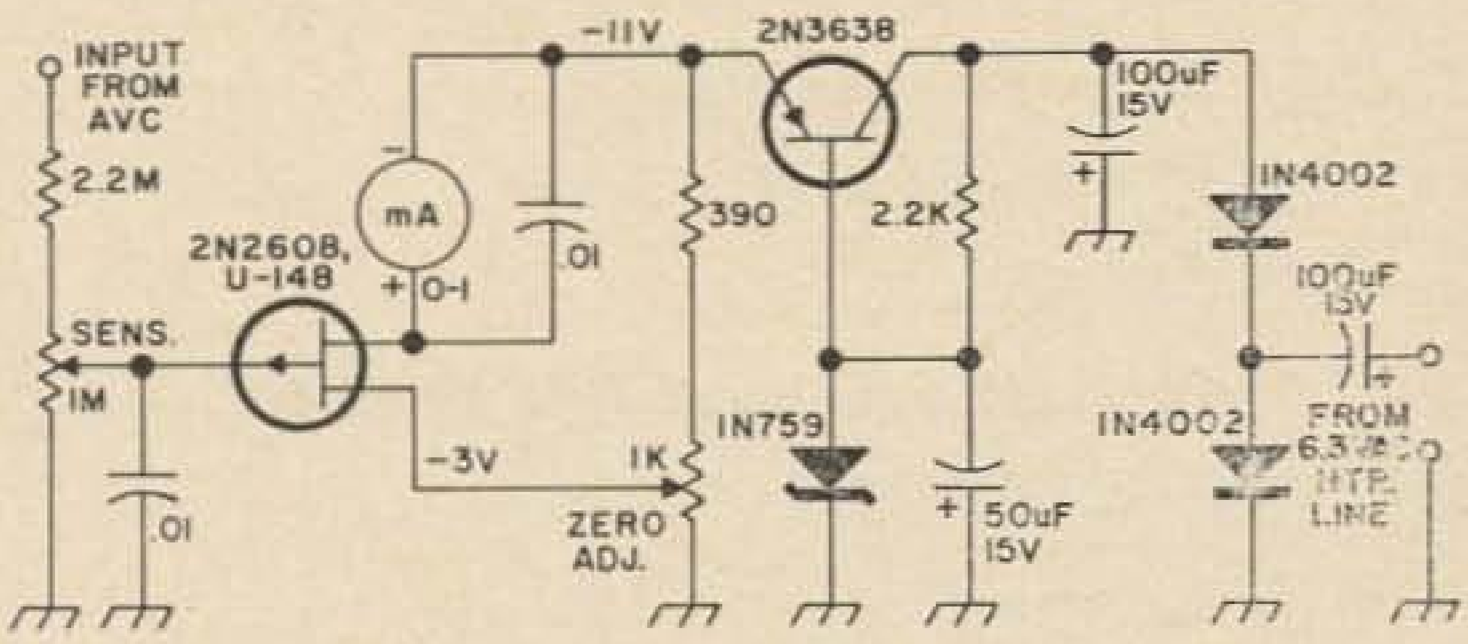


Fig. 3. FET S-meter circuit and regulated power supply that operates from 6.3 volt ac filament line.

INDUSTRIAL TYPE	JEDEC TYPE	MULTIPLY I_D SCALE BY
U-146 U-147 U-149	2N2606 2N2607 2N2609	0.11 0.33 2.25

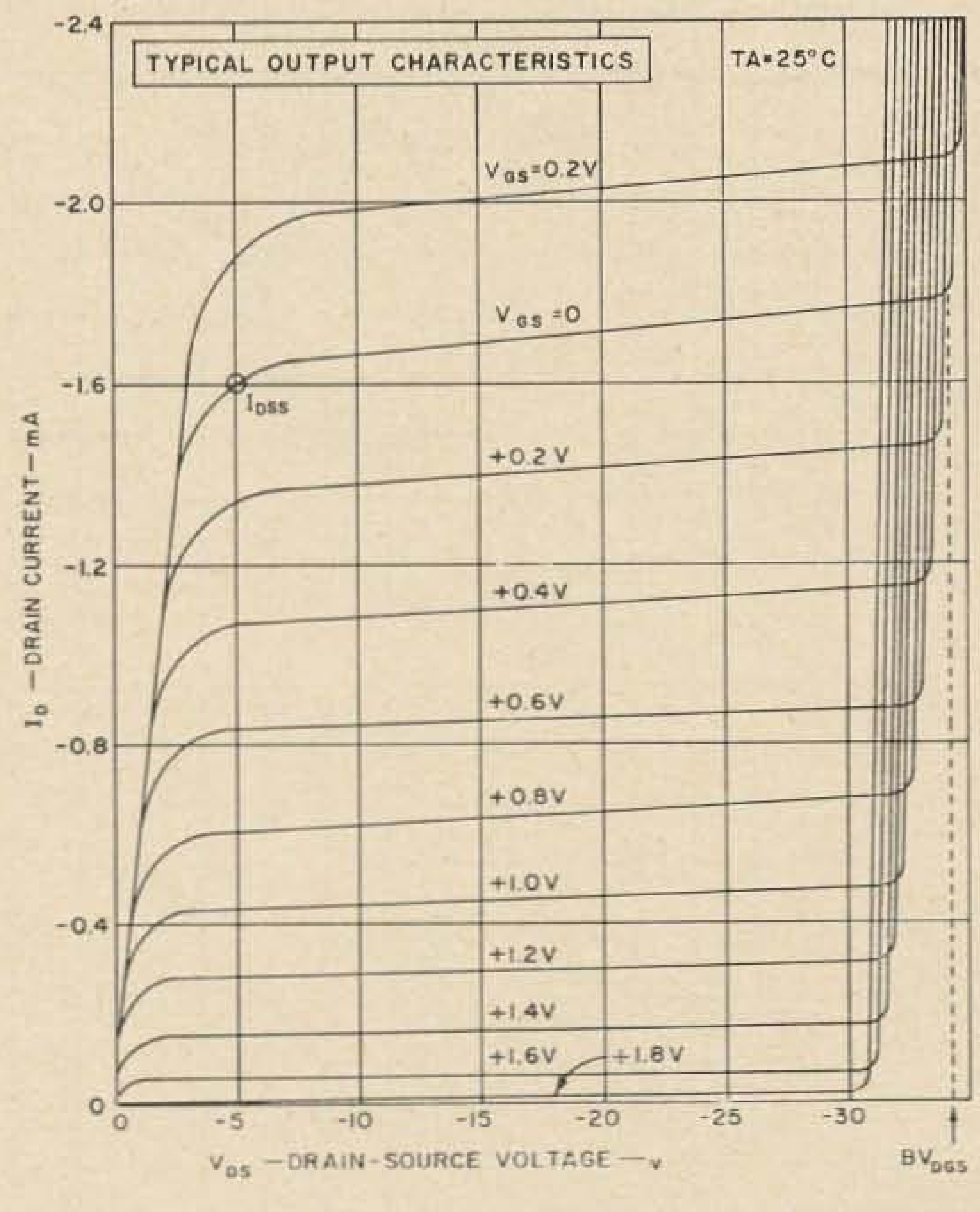
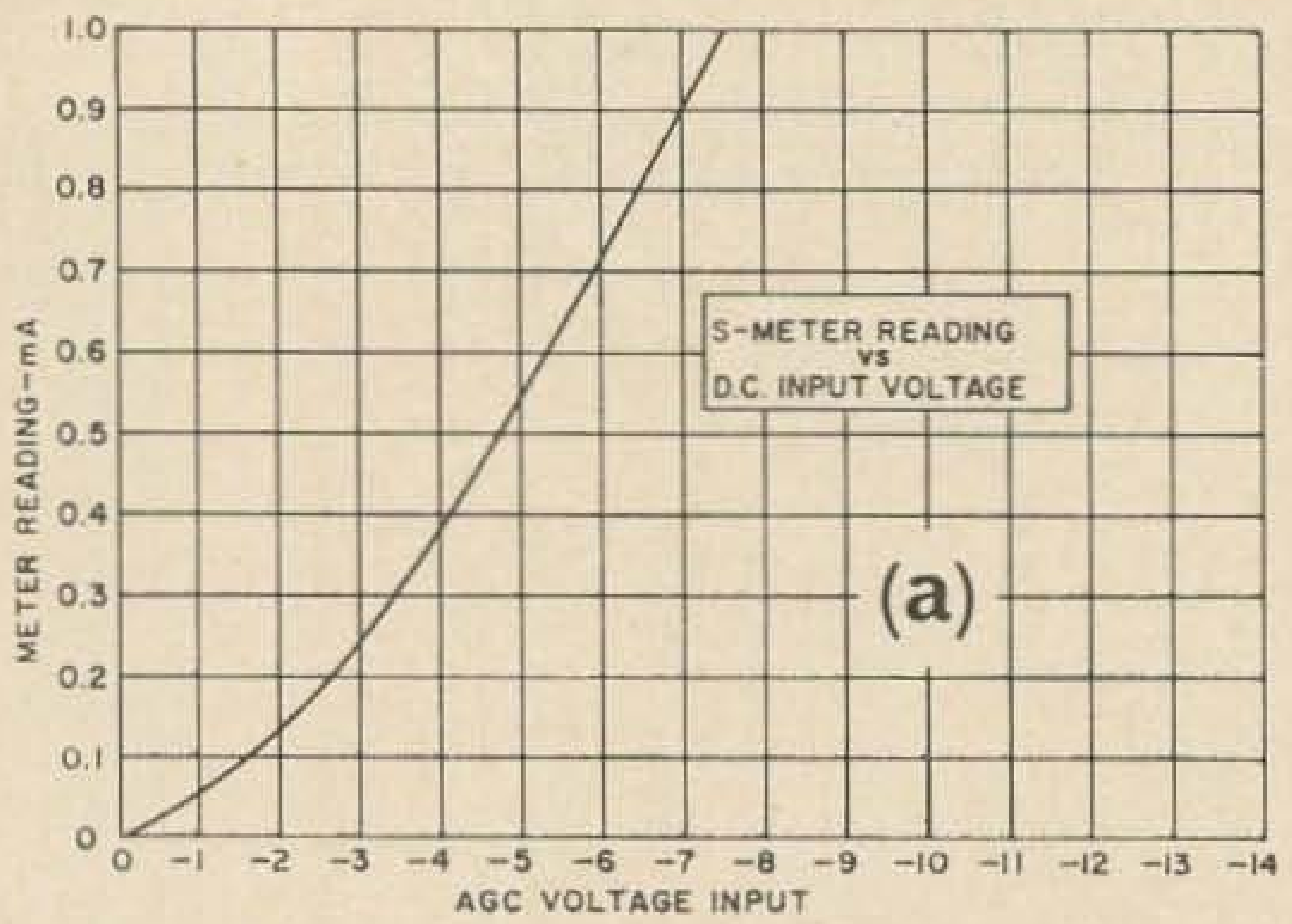


Fig. 4. Characteristic curves for the 2N2606 family of P-channel FET's. The curves apply to the 2N2608 and correction factors as shown in the table at the top should be applied for the other transistors listed.



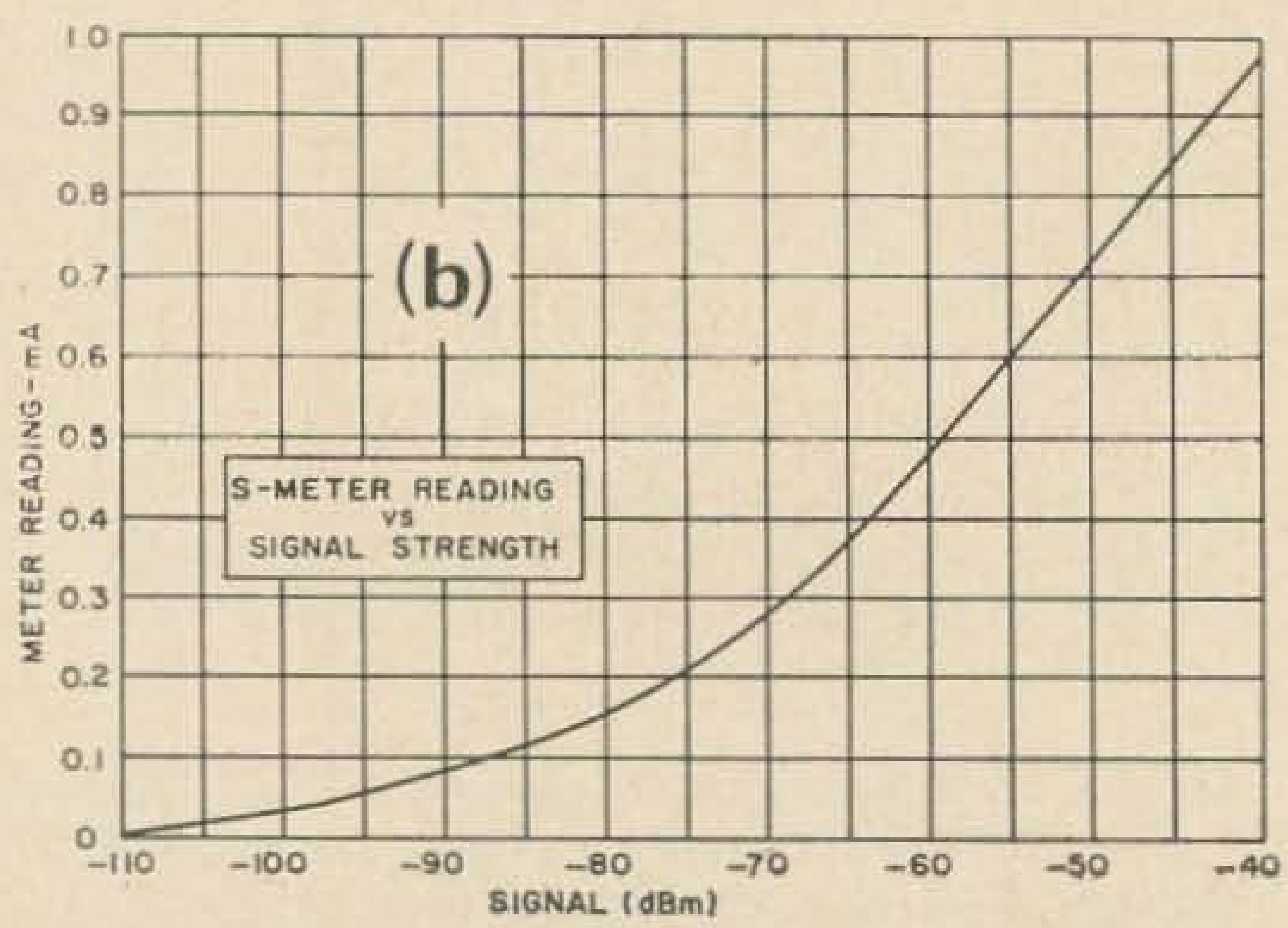


Fig. 5a. S-meter reading vs. dc input voltage.
Fig. 5b. S-meter reading vs. signal strength.

Since these four types of Siliconix FET's differ in both price and current ratings, we have a tradeoff situation. The U148 will drive a 1 mA movement, and it costs $4.10. The U147 will drive a 500 μA movement and it costs $2.95. The U146 is more expensive than the U147, and has less transconductance, so represents a poor choice for this application. The U149 will drive a 3 mA meter, but the price is $6.50. The prices of the four FET's and the prices of the various meters must be considered in deciding which to use. It appears that the U147 and a 500 μA meter would represent the best combination, if one is buying all new parts.

The circuit of **Fig. 3** was constructed and set up to give a full scale reading of 1 mA when −7.5 V dc was applied to its input. The response is shown in **Fig. 5A.** With this sensitivity setting, the circuit was connected to an ancient Hallicrafters S-series communication receiver, and the sensitivity curve of **Fig. 5B** taken.

The curve of **Fig. 5B,** while nonlinear in terms of mA per dB, is still quite useful. If one really wants a scale that reads "S" units, a paper scale can be added to the meter movement.

. . . W6GXN

Here's the sparkling new GSB 6 Six-Meter Communicator offering all three modes, SSB, CW and AM (20 Watts Peak), and a new budget price of $299! Mate this new transceiver with the Gonset 913A power amplifier and you'll be king (or queen) of your frequency until the QSO has been completed. There's nothing finer on the air today — the quality is superb in each mode. **Each unit is 100% operational-tested in the Gonset laboratories, by super critical engineers; your assurance of trouble-free operation from the moment you open the carton.** OM's, XYL's and YL's will cheer the simplicity of its operation. Note the specs and then hurry to your Gonset dealer to see the new Gonset GSB 6!

SPECIFICATIONS

GSB 6 TRANSMITTER

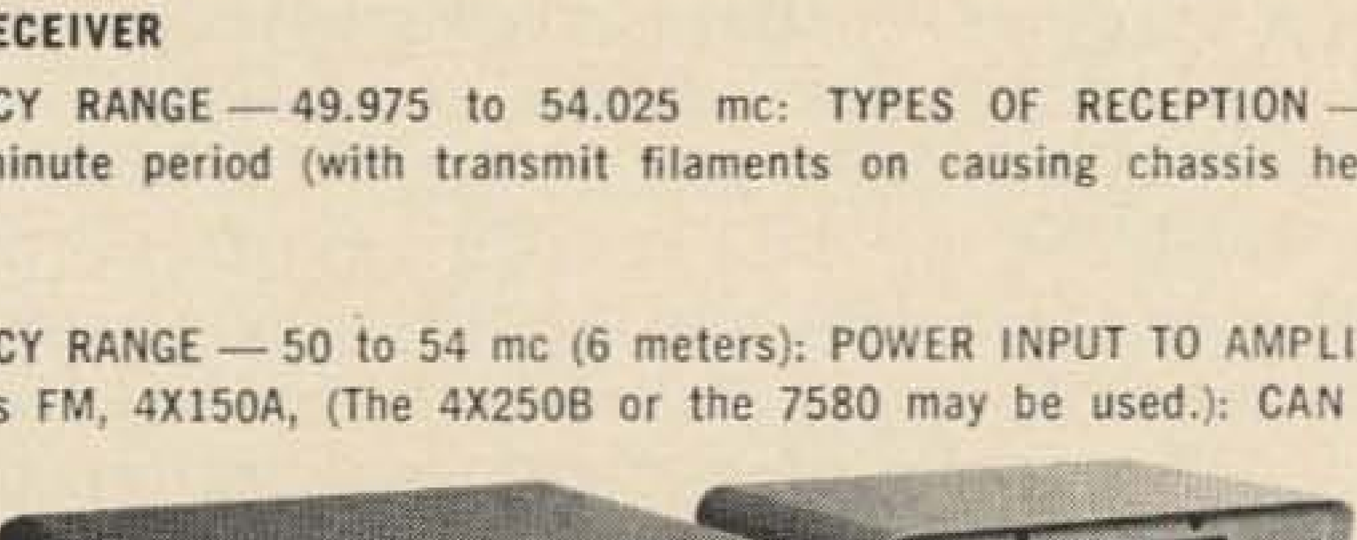
FREQUENCY RANGE — 49.975 to 54.025 mc: EMISSION — AM, SSB, and CW: FREQUENCY CONTROL — Crystal HF Oscillator, Stabilized LF VFO: NOMINAL FREQUENCY STABILITY — 50 cycles per 15 minute period (with transmit filaments on causing chassis heat rise).

GSB 6 RECEIVER

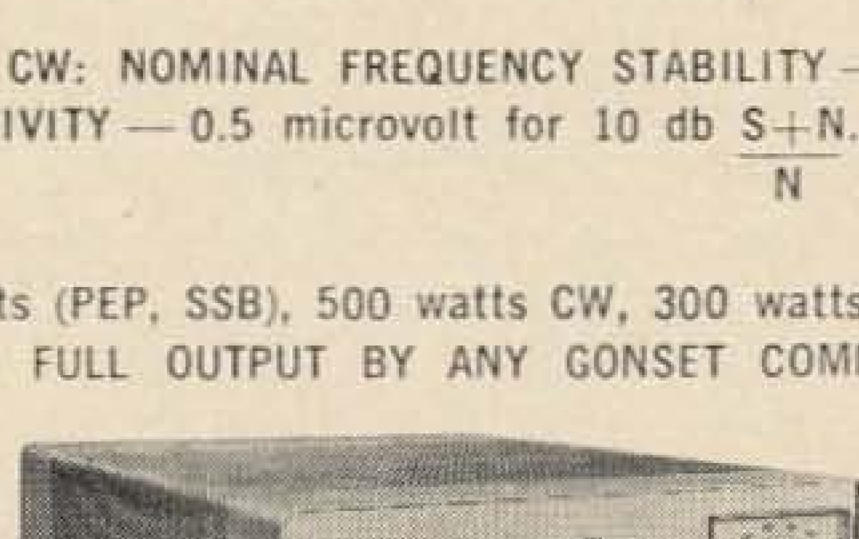
FREQUENCY RANGE — 49.975 to 54.025 mc: TYPES OF RECEPTION — AM, SSB, and CW: NOMINAL FREQUENCY STABILITY — 50 cycles per 15 minute period (with transmit filaments on causing chassis heat rise): SENSITIVITY — 0.5 microvolt for 10 db $\frac{S+N}{N}$.

913A

FREQUENCY RANGE — 50 to 54 mc (6 meters): POWER INPUT TO AMPLIFIER — 500 watts (PEP, SSB), 500 watts CW, 300 watts AM (peak), 500 watts FM, 4X150A, (The 4X250B or the 7580 may be used.): CAN BE DRIVEN TO FULL OUTPUT BY ANY GONSET COMMUNICATOR.



GSB 6 WITH POWER SUPPLY



913A POWER AMPLIFIER

GONSET®, INC.

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1515 SOUTH MANCHESTER AVENUE, ANAHEIM, CALIF.

James Ashe W2DXH
R.F.D. 1
Freeville, N.Y.

Unwanted Feedback

It's happened to all of us! It happened to me. I built a high-gain audio amplifier. I proudly believed I had thought of everything. Let's see, now. Output and input circuits well isolated. In two separate chassis, in fact. A 140 μF capacitor across the power supply output. Decoupling of all the circuits and double decoupling, with large electrolytics, of the input circuits. Feedback? Hah.

Report: Feedback. Motorboating at two seconds per cycle (½ Hz). Also oscillations at 120,000 cycles per second (120 kHz).

Solution: Imaginative application of the following.

Feedback theory

The key to the entire problem of unwanted feedback lies in **Fig. 1.** This illustration shows in block diagram form a 'feedback loop'. The two boxes and the circle add up to a circuit having the special property that, in some direct or devious way, part of the output signal finds its way back to the input terminals of an amplifying element. This key concept is applied to any particular problem by looking for the parts of the actual circuit which correspond to the different parts of the diagram.

More complex feedback loops may be made up by elaborating this diagram. But accidental loops are increasingly unlikely in proportion to their complexity. Such circuits are used in design work, however, for better circuit performance than single loop designs can deliver. A quite elaborate system is shown on page 42 of the February 1965 issue of Popular Electronics. And Jim Kyle, in his article on selective filters in the July 1965 issue of Electronics World, describes a filter circuit having two feedback loops around a single transistor.

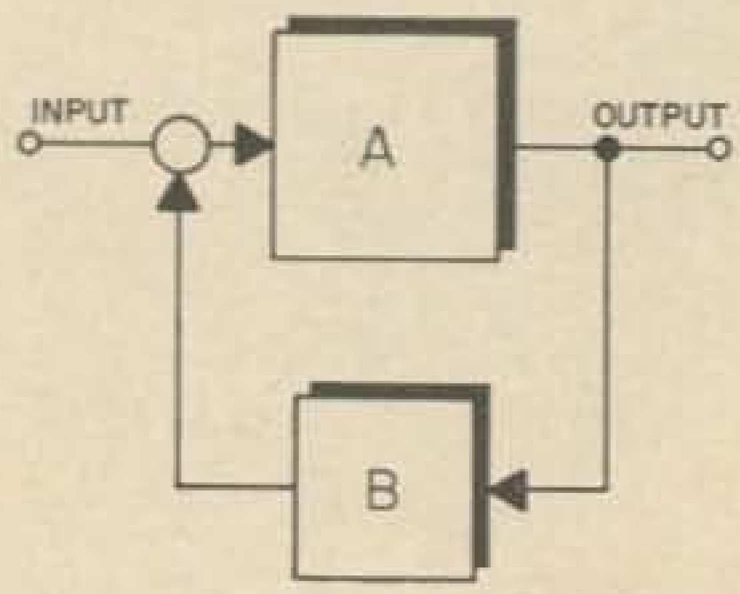

Fig. 1. The basic feedback loop, an essential tool for modern circuit design but a great troublemaker when it occurs accidentally.

The summing point, represented in **Fig. 1** by a circle, is a good place to start explaining this circuit. It is the point where the input signal and the unwanted return signal meet to continue along the same route through the amplifier A, which may be anything from a single transistor to a complete chassis. In feedback problems, the amplifier A probably involves only two or three tubes or transistors. The amplified signal leaving A proceeds mostly to the output, but a little bit of it finds its way back through the return network B to the summing point. The properties of B are very important, since this usually is the part of the loop most easily attacked to get rid of the unwanted feedback.

When the return signal passes through A it is delayed. It comes out a little after it goes in. The signal is further delayed in B, and the total amount of delay has a powerful effect upon the results of the unwanted feedback. For engineering design work, this delay and its detailed effects receive careful attention. It's not so important here, where the major purpose is merely to find and remove the offending, parasitic circuit.

However, one question may be asked. Is it possible that an accidental feedback loop might cause no trouble? Except for unwanted loops whose effects are so weak they cannot be detected or at least do not disturb normal operation of the circuit, the answer is no. The reason is that the properties of accidental loops will generally show a strong frequency dependent factor. If the feedback is strong enough to be noticed, there will almost certainly be one or several frequencies at which everything will add up the worst way. The only safe course is to eliminate the feedback.

For engineering purposes there are several basic types of feedback. These can be sorted out into two types: feedback which leads to oscillations, or positive feedback; and feedback which reduces circuit performance, or negative feedback. There is no reason why accidents of nature or construction should emphasize one over the other. The two kinds are equally likely!

Positive feedback acts to increase circuit gain. In extreme cases it leads to uncontrollable oscillations. Motorboating is a form of

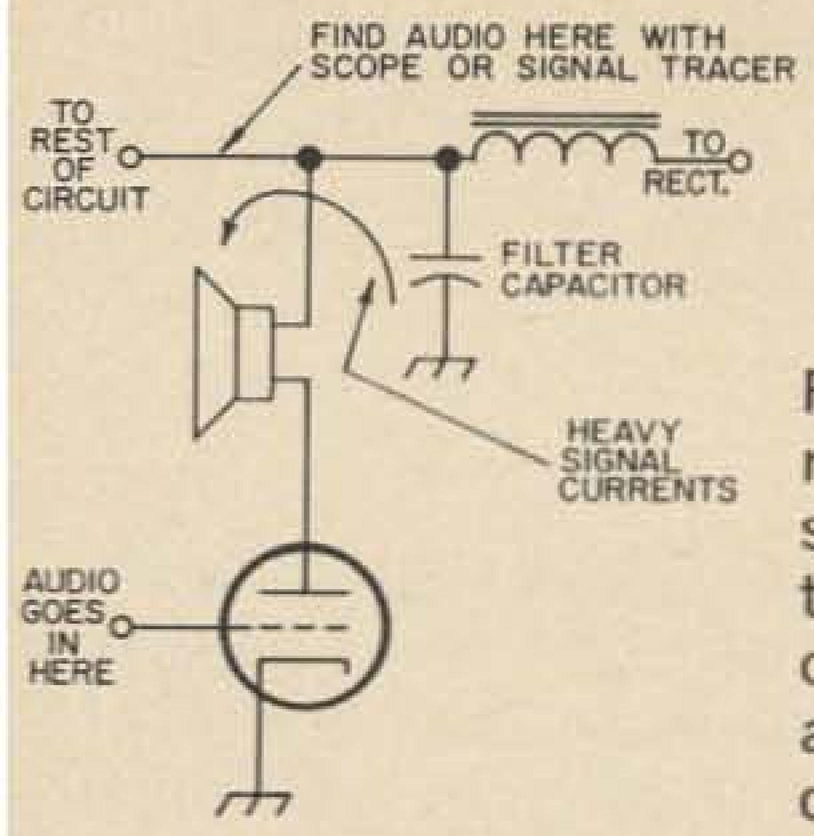

Fig. 2. Showing the route of output stage signal current through the power supply filter capacitor, which feeds audio back to the rest of the circuit.

oscillation, commonly involving a loop through several stages of amplification, and back through a supply line to the input stage. Other effects are increased noise, snapping, clicking and ringing, gain variations greater than control adjustment should produce, and disturbance of tube and transistor operating points leading to severe distortion, or in extreme cases, apparent failure of the circuit to do anything at all.

Negative feedback is less obvious, and may seem to result in improved operation of the circuit. The trouble shows up when estimated circuit gain is much greater than measured circuit gain, when filters show less selectivity than they should be capable of, when gain controls appear ineffective, and when the general performance of the circuit seems to vary from time to time.

Feedback routes

When a feedback problem has been identified, the next question is: which parts of the circuit are involved? In general the exact route will not be obvious, or it would have been eliminated while constructing the circuit. And if a particular lead or component is definitely found to be carrying some unintended signal, is that signal cause, effect, or irrelevant? For example, if the first two stages of an amplifier are oscillating, their signal will be found right down through the rest of the system.

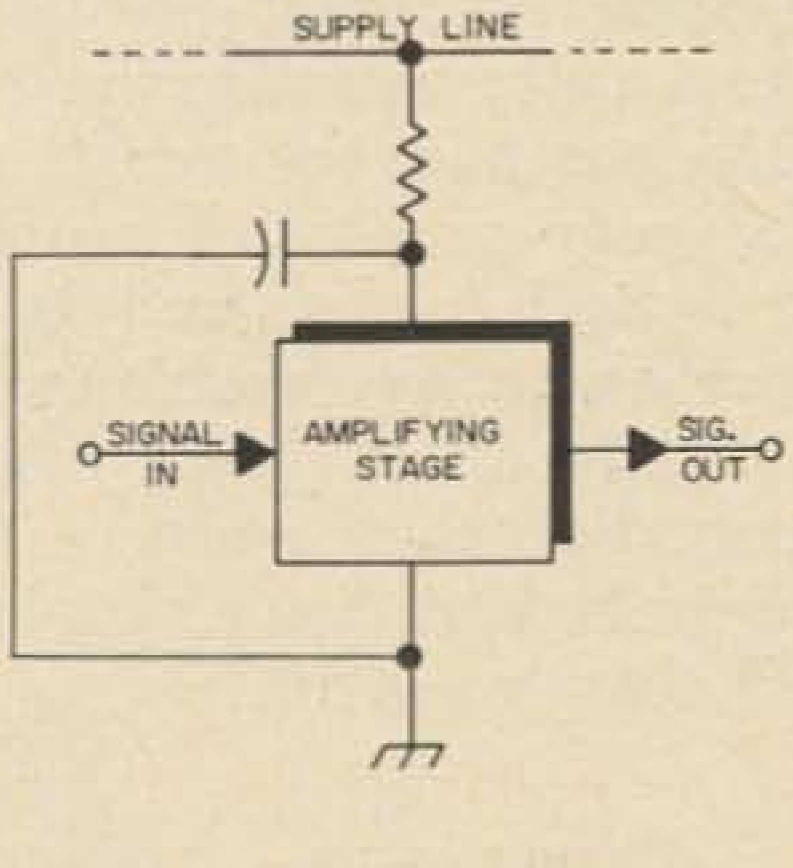

Fig. 3. A single gain or oscillator stage supplied through an isolating resistor and grounded at a single return loop for nearly-perfect isolation. Very good for BFO's.

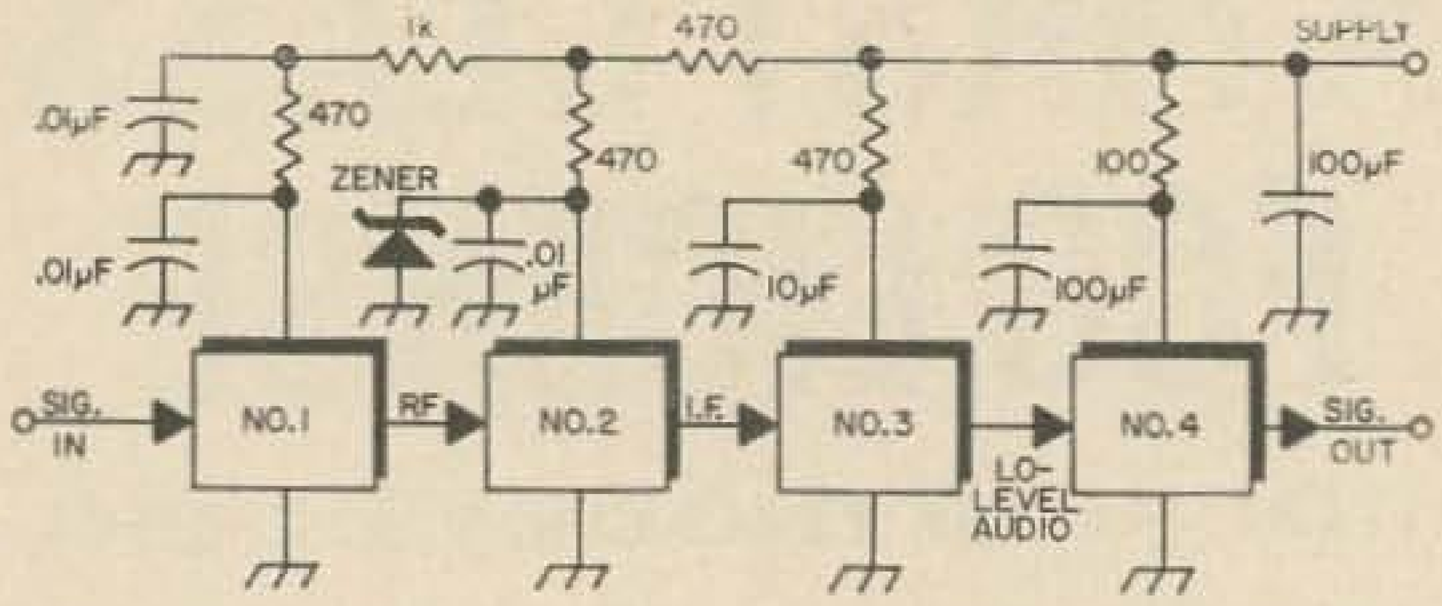

Fig. 4. A decoupling system that might be used in a receiver. Stages 1 and 2 are super-decoupled. The zener improves voltage regulation, spoiled by the decoupling resistors. Zeners are sometimes noisy and should be bypassed in audio and oscillator circuits.

Supply wiring, which goes all over the chassis, is the most likely candidate for feedback routes. In general, this supply wiring is inadequately bypassed. The supply filter will often have the smallest possible capacitors, as estimated from a hum viewpoint. This may be a false economy. For example, motorboating at around twenty hertz is not unusual. What are the reactances of various sizes of filter capacitors at this frequency? A 20 µF capacitor will have a reactance of 400 ohms. A relatively small audio output stage can produce 10 volts across that! And at high rf frequencies supply lead reactance becomes an important factor. Valley and Wallman cite about 8 ohms per inch of wire at 60 MHz. Prorate that to 420!

Common capacitance between two points is another cause of unwanted feedback. Builders of compact equipment probably see a lot of this. Even at audio frequencies two inches or so of clear space between two tubes may not be sufficient. This kind of coupling is avoided by building the system in a straight line, and by some careful positioning of components.

Inductive coupling is a third possibility. All components, from wires to transformers, are surrounded by magnetic fields produced by the currents flowing through them. The field is generally weak and other components are little affected. Sometimes there is trouble. The two cases in which magnetic coupling is most likely are those in which ordinary chokes or solenoidal coils are being used in selective audio amplifiers, and rf amplifiers with tuned input and output coils located on the same side of the chassis.

Waveguide coupling, saved till last, is perhaps the most surprising kind of unwanted feedback. A closed chassis . . . very good practice! acts as a waveguide even though the wavelength may be much greater than its dimensions. It's a very poor waveguide, but it's good enough. Valley and Wallman cite 30 dB per length equal to width. If the chassis is 5 inches wide, a popular size, that's 30 dB per five inches, far less than the circuit gain now possible in the same distance.

Removing feedback

Very few feedback problems require more than one or two small changes for complete elimination. The problem is to find out what change is required. By putting in additional capacitors, new decoupling, revised grounds, different tubes and transistors, cut and try methods may more or less solve the problem. But there's a better way to do it. Identify the loop and tackle it at its weakest point.

No rules can be given for this. What has to be done depends on the situation. One problem will be obvious, another may be quickly seen through by a seasoned veteran. The third may require the complete treatment by an expert. In general, the method is to disable everything that doesn't seem to affect the feedback, search around in what's left, and try to find out which part of the circuit corresponds to each section of **Fig. 1.** Here are some hints. Microvolt sensitive VHF converters oscillate at volt, not microvolt, levels. The oscillations are easily picked up with probe or absorption meter. If a supply line is suspected, look at it with a scope. Metal plates will shield electrical and magnetic fields at rf but electrical fields only at audio. A tuning stick, iron slug at one end and brass at the other, can be poked into suspected rf circuits to identify parts in the loop, when a screwdriver or your hand will detune everything. If you can't identify the feedback loop, suspect a wiring error that mimics regeneration. Set an alarm clock; if you haven't licked the problem in two hours, put it away and come back next day.

Summary

A newly completed circuit can be a bundle of joy or occasionally a wellspring of terrible frustration. Do not fear the worst! A careful application of your powers of analysis aided by some theoretical background is the most effective approach to any problems that may arise. Unwanted feedback has a cause, a circuit that embodies that cause, and unless you're terribly unlucky it has a simple solution. Read up, and then go at it!

. . . W2DXH

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Valley and Wallman, *Vacuum Tube Amplifiers*. New York, McGraw-Hill, 1948. p. 323.

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Oklahoma City, Okla.

Equipment Protection

Eliminate the devilment of Poof—the Magic Dragon that destroys electronic equipment in seconds.

Something goes wrong in the circuit. The tube plate glows pink, then rapidly red and an orange-white. A bright bluish flicker as the grid shorts to the plate and melts, then all is over. And although your hand was on the plate switch all the time, you never had time to throw it.

Has this ever happened to you? If not, you're an unusual homebrewing ham—or else you don't need to be reading this article. But the odds are it has, at least once. Maybe it was an expensive power tube that went, maybe a power transformer—but few of us have escaped what the reliability engineers call "catastrophic failure" of a component at least once.

The reasons for protective circuitry are obvious; the one most often thought of is to protect the shack from fire caused by overload wiring. Others, frequently of more practical importance, include protection of individual components (such as tubes) from overloads, and the protection of complete items of equipment (such as power supplies) from the same source of possible harm.

To achieve all these aims of protective circuitry, the conventional power-supply-primary fuse (the one most often included in the rare cases that any fuse appears at all) is not enough. After all, a fuse which will permit enough power to pass to light several dozen watts of heaters can hardly protect a screen circuit from a 60 mA destructive overcurrent!

On the other hand, individual fusing of each stage could rapidly turn into a supercomplex project when the full complement of gear in a well-equipped station is considered. Obviously, some form of compromise is necessary.

The nature of this compromise is such that you'll have to determine for yourself just where to make it. To give you the information on which to base your decision, let's look at the places that fuses can provide protection.

Fig. 1 shows a typical HV power supply, while **Fig. 2** is a partial schematic of a transmitter's rf section. The possible places for fuses are indicated in each case.

In **Fig. 1**, note that each transformer is *individually* fused. While this admittedly requires a few more fuseholders and fuses, it also allows you to install a fuse which will pass the required amount of current to each transformer, yet will blow on slight overload.

The secondary fuse shown from center-tap to ground in **Fig. 1** protects the transformer itself against overload; if its value is properly chosen it can also protect the chokes and (to a lesser extent) the rectifier tubes.

In **Fig. 2**, the fuse in the driver plate circuit serves a dual purpose. It protects the tube against extreme overloads, while protecting the power supply and divider circuitry in case the tube shorts out.

In the final, two fuses are recommended as shown. The one in the screen circuit should be selected to blow instantly when maximum screen input (determined from tube charts) is exceeded. When you realize that high-power tetrode can destroy itself within less than a second with excessive screen current, you understand the necessity for a fast-acting fuse here. The plate-circuit fuse, on the other

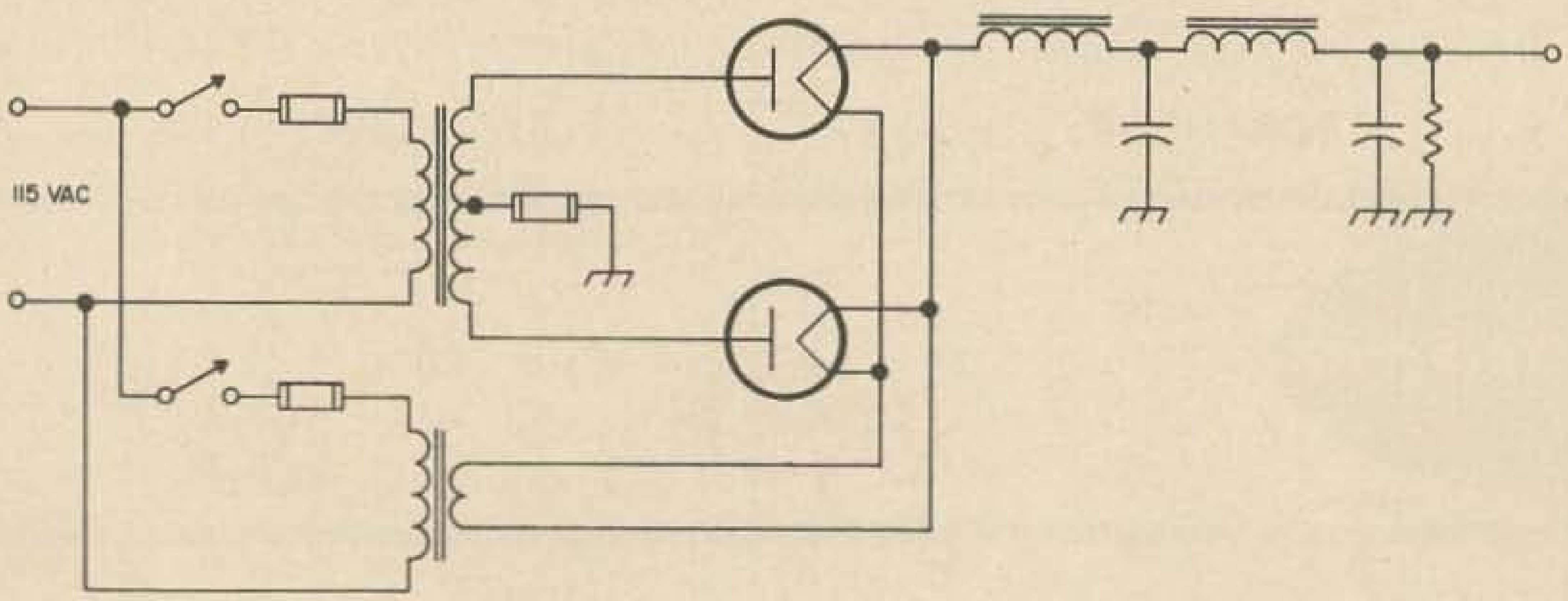

Fig. 1. Fused power supply.

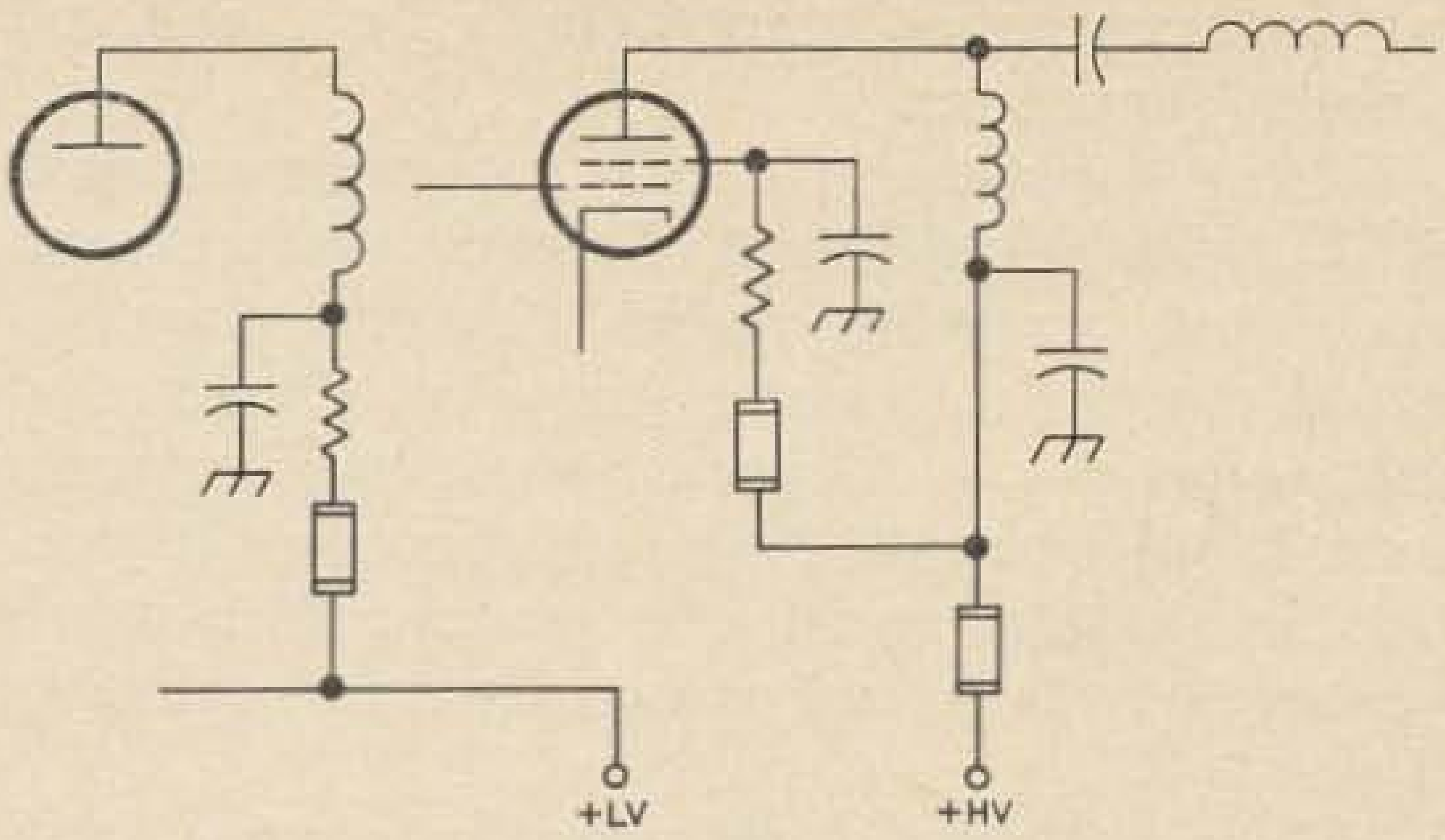

Fig. 2. Fusing the transmitter.

hand, offers only conventional overload action.

If protection of the supply is the major item of importance, all the low-power stages can be grouped through a single fuse. If, on the other hand, protection of the tubes is the important thing, then a separate fuse in each circuit is the way to do it. Usually, you'll want to protect the final tube, but in the driver stages it may be more worthwhile to simply protect the supply and let the tubes take the risk.

In the case of receivers and test equipment, the power supply fusing shown in **Fig. 1** is usually adequate. This is especially true if the secondary fuse is chosen to just pass the normal maximum operating current so that it will blow at overload.

At this point a look at some of the various types of fuses is in order. The "ordinary" fuse actually comes in three varieties—and use of the wrong type can easily rob you of the protection you think you have.

Most widely known, of course, is the garden-variety fuse. This type normally carries its rated current without damage, but blows within 10 seconds when double the rated current flows. More severe overloads blow it faster, but the time required to interrupt the circuit seldom falls below a couple of seconds.

When protecting equipment which cannot stand such overloads for even this short time, the "fast-acting" fuse is the one to use. This type has a spring in it to speed the action (in the smaller sizes, the spring may consist simply of the fusible wire itself) and may be used to protect the screen circuits of such power tubes as the 4X250 and the 4-1000.

Circuits containing heavy inductive loads, such as motors which must start under load, frequently draw 10 or more times their rated current at the instant they're switched on. If either a normal or a fast-acting fuse is used to protect such a circuit, it would blow every time the switch were thrown. The "slow-blow" fuse was developed for this type of circuit; it withstands heavy overload for several

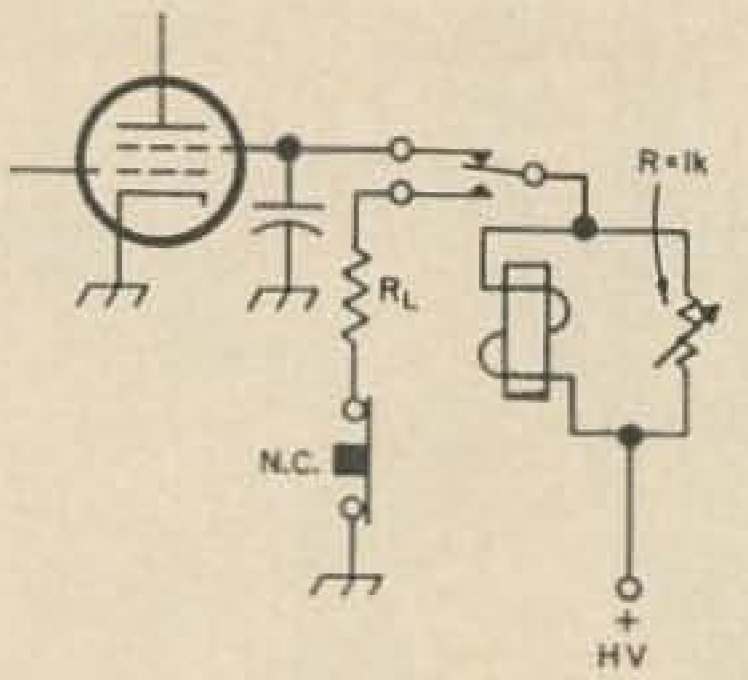

Fig. 3. Homebrew overload relay.

Example

Relay coil: 5000 ohm @ 3 mA

R setting (ohms)	Trip current (mA)	RL (ohms)
1000	18	50 x HV
500	33	28 x HV
300	53	18 x HV
100	153	6 x HV

seconds and blows only on sustained overload. Such fuses have no place in radio circuits; they're mentioned here only to warn you against them. Many a lost power tube can be traced to the inadvertent use of slow-blow fuses in screen circuits!

So far, we've talked only about fuses. This suicidal little component is one of the simplest and surest ways of protecting electrical circuits—but it's not the only way.

Another protective device which does the same job but doesn't destroy itself in the process is the circuit breaker. Within the past few years, small circuit breakers have been developed for television sets which trip at 2 or 3 amps and can be purchased for only a dollar or two at most suppliers. These are ideal for primary-circuit protection in power supplies wherever their ratings apply.

A similar device is the overload relay; this can be a special unit (with correspondingly high price) or, in many cases, can be a conventional relay wired to interrupt the critical circuit whenever current drain exceeds a specified limit and to then hold the circuit broken until it is reset. Since such a device acts faster than most fuses, it is correspondingly better for screen-circuit protection. **Fig. 3** shows one way of using an inexpensive relay in such an application. The pot across the coil acts as a shunt and is used to set the current at which the relay will trip. The normally-closed pushbutton is the reset switch. The load resistor (RL) is chosen to draw slightly more current than the tripping value, to insure that the relay remains closed after it trips.

Often, the circuit to be protected with a fuse, breaker, or overload relay happens to be one in which you would also like an indication of relative current flow. If the accuracy of a meter is not required, and if the current flow is normally between about 30 and 250 mA, you can kill two birds with a single pellet by using an ordinary pilot-lamp bulb as a combined "meter" and fuse.

These bulbs are normally rated for currents of 60, 150, and 250 mA. At half rated current, they emit a readily visible dull red glow. At rated current, of course, they have their normal appearance. At approximately 25 percent over rated current, their light becomes a searing blue-white, and if the current goes much higher they burn out as rapidly as an ordinary fuse.

Thus a 60 mA bulb provides a good indicator in the range from 30 to 75 mA, with protection at about 100 mA. A 150 mA bulb covers the range from 75 to about 185 mA, blowing somewhere around 250 to 300 mA. And a 250 mA bulb covers the range 125 to 310 mA, letting go about 450 mA or so.

It's best to use the highest-rated bulb that will give you both the indication you seek and some measure of protection, because bulb life is related directly to current flow. At 5 percent under rated current, bulb life doubles—but at only 5 percent *above* rating, the life of the bulb is cut in half! This means that, at 200 mA in the circuit, a 250 mA bulb would outlast a 150 mA bulb by dozens of times over. However, it would require half again as much drain to blow.

In the old days, before World War II and the resulting inexpensive surplus meters, this bulb-fuse trick was widely used in even sophisticated gear. Now, it's hardly ever seen. However, it's still good and is especially handy in portable and mobile apparatus where it helps hold down size and weight.

Since the bulbs *do* have limited life, it's recommended that you use sockets for them. The socket can easily be mounted on a quarter-inch standoff insulator, providing a handy tie point for the high-voltage line.

Incidentally, you don't need to worry about the *voltage* rating on a bulb used in this application; it will take care of itself when rated current flows. As a case in point, the author has successfully used a single 250 mA bulb in the high-voltage line to a pair of 6DQ6's operating at 500 volts, 200 mA. Once the parasitics were removed from the rig (they turned the bulbs brillant blue instantly), bulb life proved to be almost indefinite. And as an aside, the variation in brightness during tuneup was far easier to see than the gyrations of a plate meter!

Which brings us to the end of this roundup of equipment protection tricks and techniques. Remember, next time you build something—put in what the designers left out! It's not only safer that way, it's cheaper, too!

. . . K5JKX

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An Etched Circuit UHF Dipmeter

These dippers cover 130-480 MHz, yet aren't critical, hard to build or expensive.

In the December 1965 issue of 73, Paul Franson WA1CCH, described a simple UHF dip meter. It worked well, but was difficult to package satisfactorily. I did some playing around with the circuit and found that it wasn't hard to modify it slightly, put it on an etched circuit board, and make a nice looking, convenient set of VHF-UHF dippers. The etched circuit board construction makes the dippers easy to duplicate, and the flat, U-shaped inductors are convenient to fit into tight places that conventional coils can't reach.

For a discussion of the circuit, see WA1CCH's article. There was a minor error in the article. In **Fig. 1**, the oscillator should be described as a grounded base rather than as grounded emitter oscillator.

I made three models of the dipper. They cover 130-175 MHz, 175-250 MHz, and 250-480 MHz. The first two models use the same size inductor, with the 130-175 MHz model using a larger capacitor for tuning with a ceramic trimmer across it. This trimmer is not shown in the schematic; its value is 7-45 pF and it should be adjusted to cover the proper range.

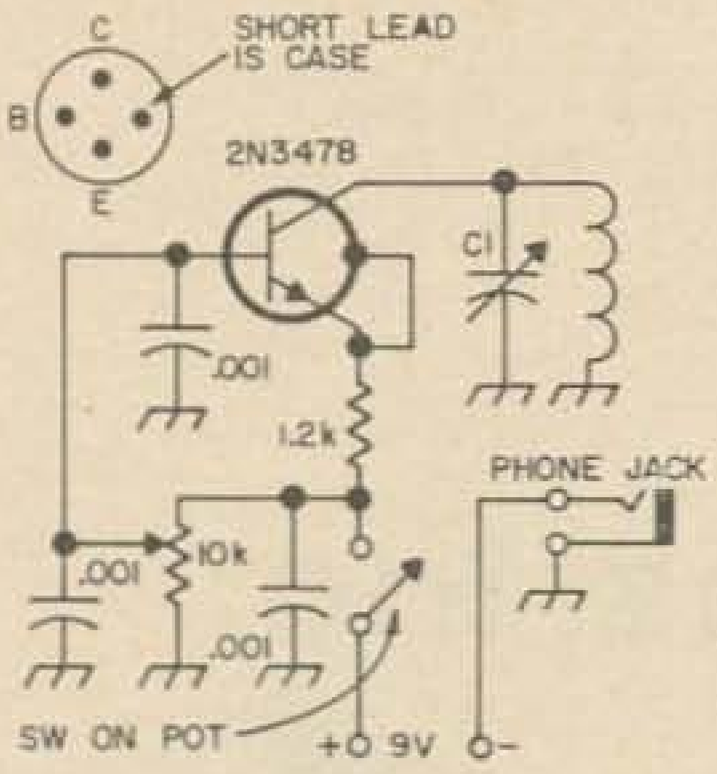


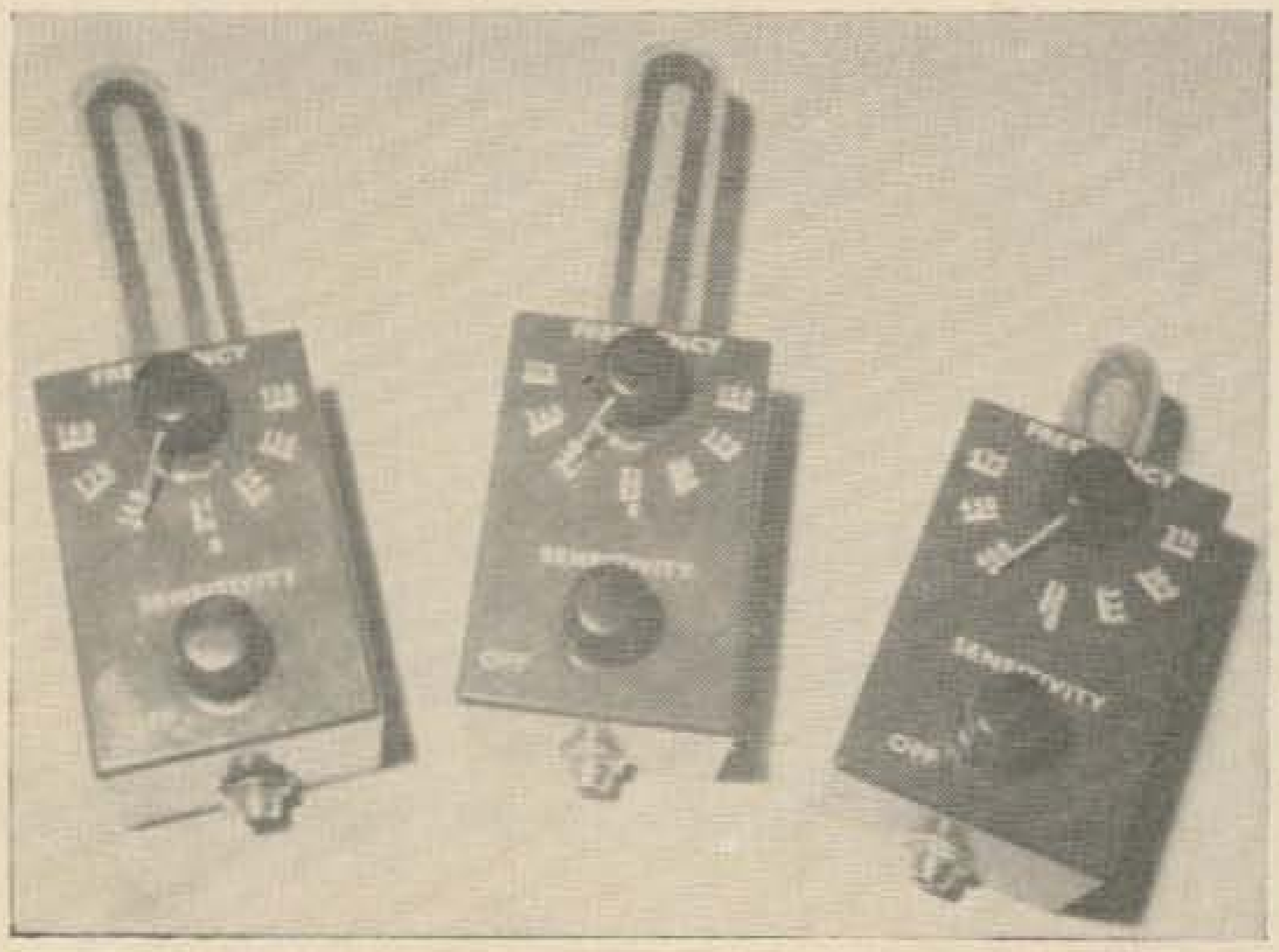
Fig. 1. The etched circuit dipper is very simple. The circuit is almost identical to the one described by WA1CCH in the December 1965 73, but the construction is quite different. C1 is Johnson 160-104 (9 pF) for the two higher frequency dippers, and 160-107 (14 pF) for the 130-180 MHz model. There is a trimmer across C1 in the 130-180 MHz model; see text.

The 250-480 MHz dipper uses a smaller inductor than the others. It also has a copper jumper (shown in the layout) that the lower frequency dippers don't have.

Each dipper is complete (including the battery) except for the meter. The meters were omitted to save space and money, but can be included if you wish to use a slightly larger case.

Each dipper uses one RCA 2N3478 NPN silicon transistor. These transistors cost only $1.90 apiece, but it's likely that other transistors that are even cheaper could be used. The 2N3478 has odd basing—the only reference is the short case-shield lead—so don't shorten any leads until you're sure that you can keep track of the connections.

The copper side of the board for the dipper is shown in **Fig. 2** with the component side in **Fig. 3**. You can buy the boards already etched for $1 apiece from the Harris Co., 56 E. Main



The three dippers shown here cover 130-480 MHz.

St., Torrington, Conn., or make your own. Use glass or Teflon based board. Paper or bakelite board probably wouldn't be satisfactory. Trim the board to the proper shape with a nibbler. The inductor should be coated with coil dope to keep from shorting it when you use it.

To mount the boards, you'll have to cut a thin slot near the edge of the Minibox used as a case. One way to do it is to drill a number of holes of the proper size in a row, then use a file to finish the slot. You'll have to bend that side of the Minibox out to get the board in. It's held in place by an extra set of nuts on the shafts of the potentiometer and the tuning capacitor. Be sure to trim the leads projecting from the copper side of the board so that they won't touch the metal of the case. The battery is held in place with a simple clip made from scrap metal.

The dipper is very easy to use. But before we get to that, let's check it out and calibrate it.

Plug a 2 to 5 mA meter into the meter jack. You can use a more sensitive meter if you shunt it with a resistor that gives the proper scale. Put the resistor across the meter jack terminals in the dipper if you use the meter for other things.

Turn on the dipper by twisting the potentiometer knob clockwise until it clicks. The meter should show very low current. As you turn the pot, the current should suddenly jump to about 1 mA. That means that the transistor is oscillating. If you touch the coil, the meter reading should drop and the dipper may stop oscillating completely. Now tune the capacitor through its range. There should be a little variation in current, but not too much.

Now you're ready to calibrate the dipper. The easiest method is a sensitive wave meter that covers the range, but it's quite easy to do the job with a TV set. A TV set covers 176 to 216 MHz (channels 7-13) for the low calibration. Then the second harmonics of the dipper tuning 235 to 445 MHz can be received on a UHF TV set (470-890 MHz). If you have a two meter receiver, that gives you another maker at 146 MHz. You can put on the panel markings with Ami-Tron or Datak rub-on lettering.

The dipper should be complete now, and ready for use. Bring the dipper near a resonant circuit in the dipper's range and tune the frequency control. You should get a prominent dip in current when both circuits are tuned to the same frequency. The amount of dip depends on the setting of the pot in the dipper, the distance from the tuned circuit, the Q of the circuit, and the type of coupling.

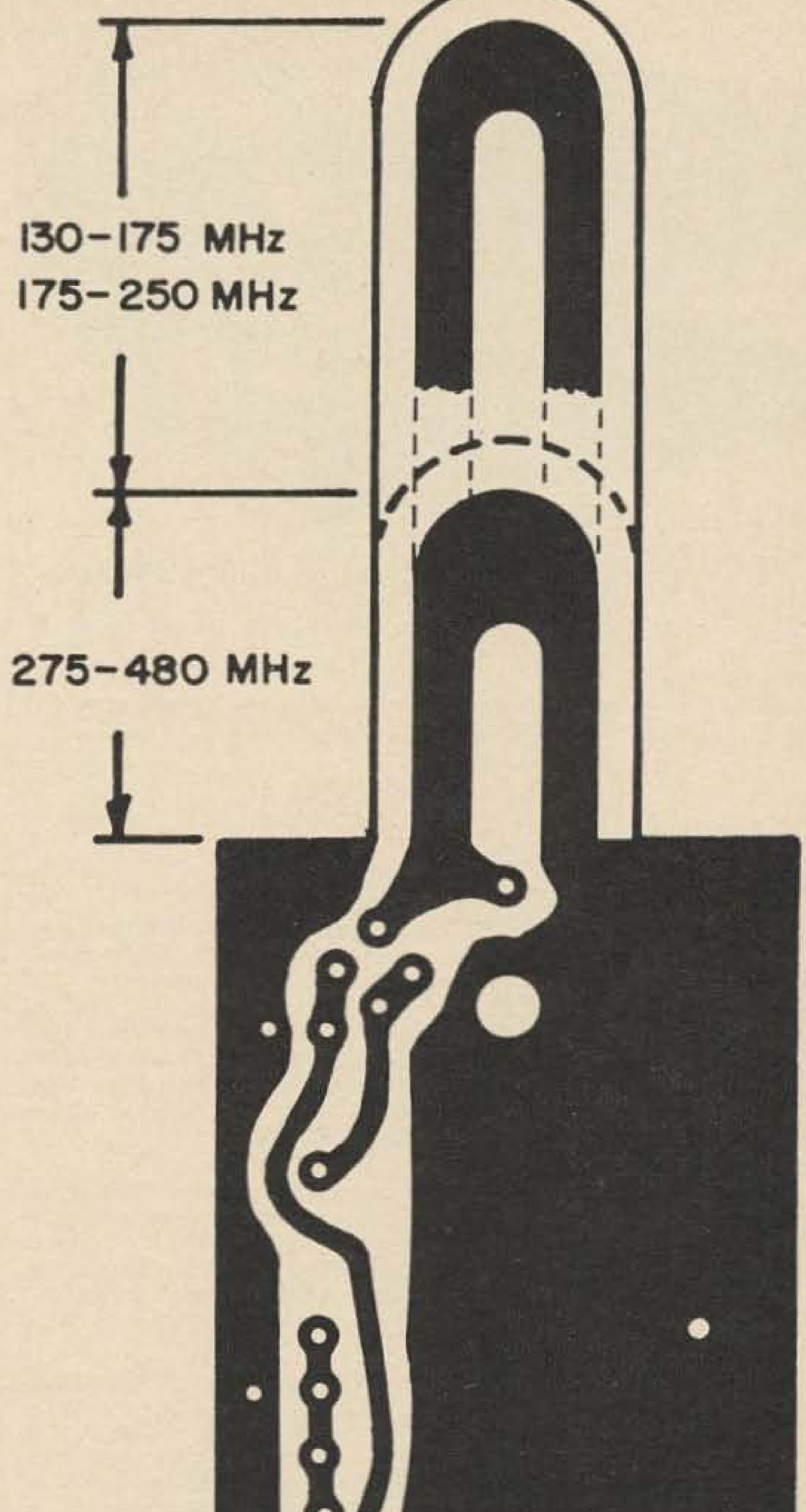
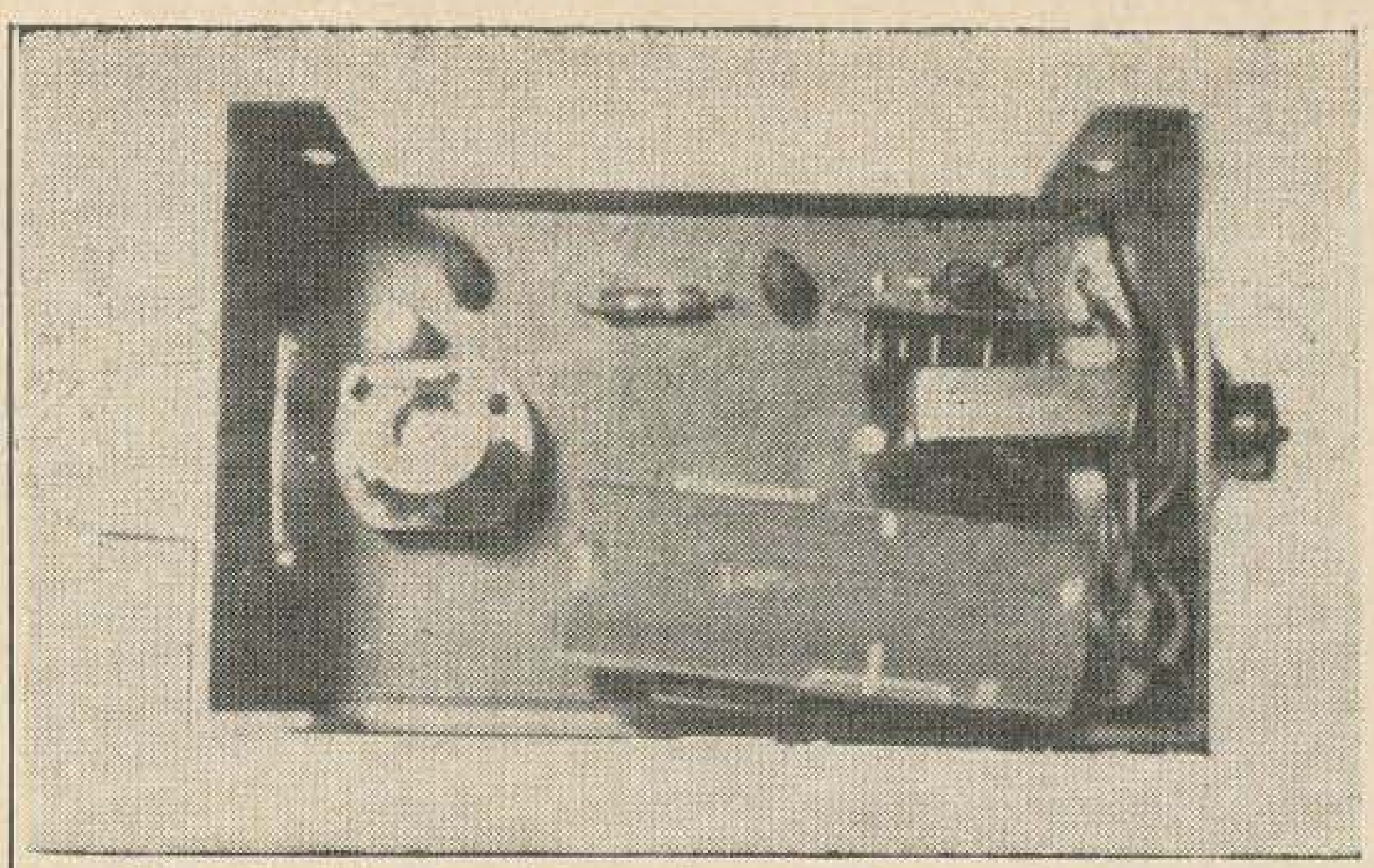


Fig. 2. The copper side of the etched circuit board used in the dipper. This layout is full size. Use board suitable for these frequencies: fiber glass or Teflon. You can buy boards already etched, but not drilled or trimmed to size, for $1 apiece from the Harris Co., 56 E. Main St., Torrington, Conn.

In many cases it's easiest to leave the dipper stationary and tune the other circuit.

The dipper can also be used for monitoring AM transmitters by plugging a set of headphones in the meter jack and adjusting the tuning and pot. You can also use the dipper for determining the frequency of another oscillator. Simply tune the oscillating dipper with headphones plugged in until you hear a slight



Here's the inside of one of the dippers.

click. You probably won't be able to get a zero beat at these frequencies.

Be careful that you don't use the dipper around an energized transmitter of more than a few watts output or the dipper may be damaged.

These dippers are simple, inexpensive and non-critical to build. After you've build them, you'll wonder how you ever tried to build UHF equipment without a good dipper.

. . . W1JJL

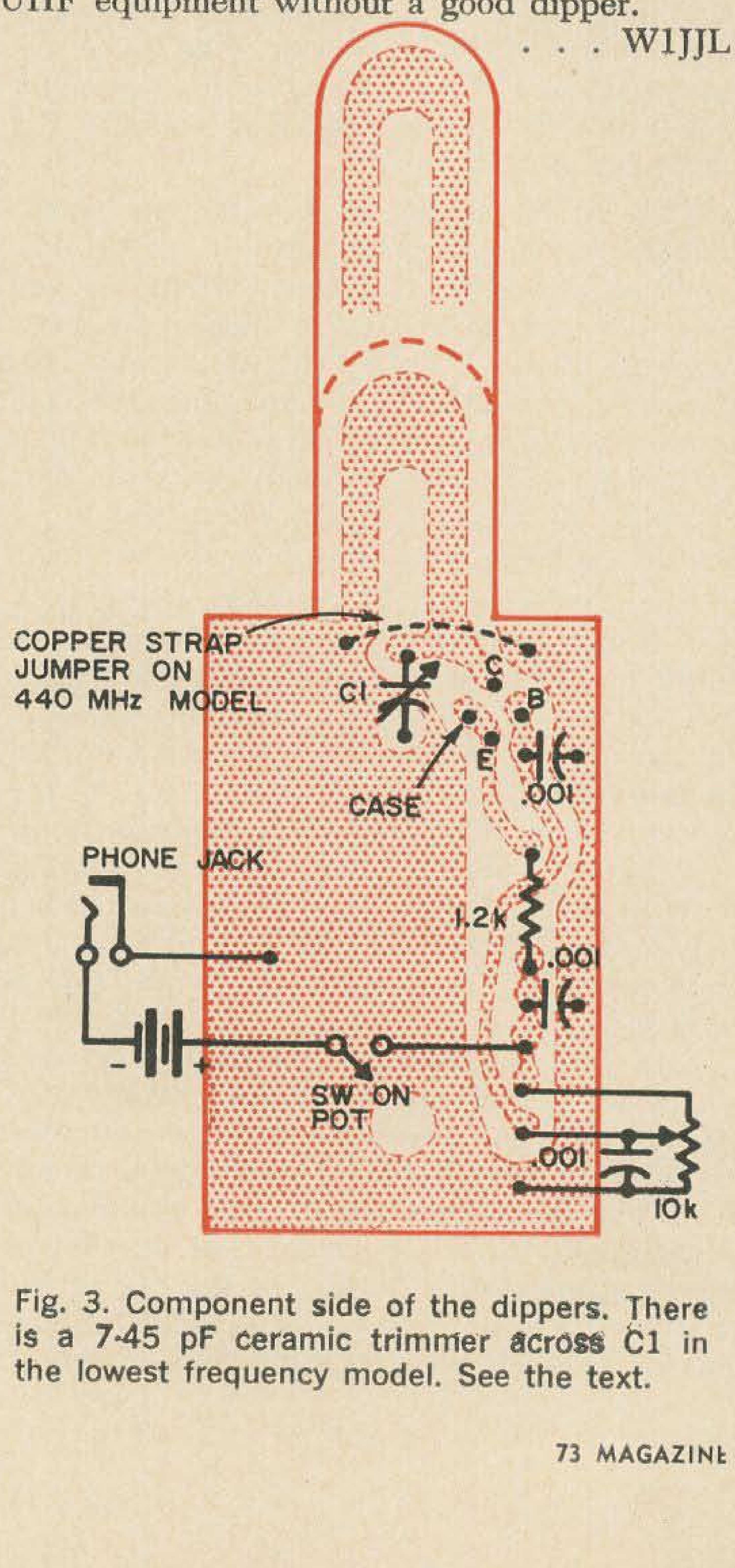


Fig. 3. Component side of the dippers. There is a 7-45 pF ceramic trimmer across C1 in the lowest frequency model. See the text.

Rev. Ted Gencuski VK9TG, ex-K9TXM
2924 Nagamiska Avenue
Delafield, Wisconsin 53018

Hamming VK9-Style

How'd you like to have to put up an 85 ft. tree trunk for your antenna tower without any skilled help or machinery? Read how they did it on New Guinea.

Truthfully, there is something dramatic about operating a DX-station, but after some of the nasty pile-ups, one soon begins to lose that spine-tingling experience. However, it is still fun to work DX when the conditions are good and some of the signals are of fabulous strength. Then too, while operating a DX-station in Australian Territory, one really begins to respect the capabilities of the Australian gallon, 150 watts. A person can do so well with 150 watts that he might be accused of running a kW, such as I was accused of on a number of occasions. (Incidentally, I had an HT-37, Johnson match-box and rhombic about 5,000 ft. above sea level.) Speaking about power capability, I am reminded of the time when two Florida stations were "chewing the rag" and I heard, "Yeah, we know those fellas in Australia. . . . They *say* that they run *only* 150 watts. It's impossible to work DX unless you have a kW."

During the course of the conversation I learned that both operators were running a kW and they lived only a couple of blocks away. I guess they were carried away and forgot the possibility of having an audience and were unaware of being copied all the way down in New Guinea. Anyway, I enjoyed myself and laughed myself sick during the whole conversation. The crowning-point of the whole incident would have taken place if I would have broken in the QSO. I'm sure that there would have been a lot of "hms and haws" especially if I would have told them,

"The rig here is an HT-37, 144 watts dc."

But I didn't break, however, I had a ball of a time enjoying the QSO of two fellows with the shoe-fever.

I suppose all of the kW-boys have stopped reading. But don't take offense fellas, and be assured that if I could have a kW in New Guinea, that there wouldn't be a happier man. Really, I would be satisfied with a half-a-gallon, but "it's agin the law." Besides it's more fun working with low power after you get an S9-plus report and you are able to say, "144 watts here."

Another thing which makes life in DX-territory interesting, is the lack of equipment and parts. It's a lot of fun to be able to scrounge around gathering parts, bits and pieces for a master plan. There are no tube checkers, generators kick-out, there is poor regulation on the ac power supply and you blow up the dc power supply on the rig, etc. I remember the time that I blew up one of my silicon rectifiers. . . . I felt like I lost my right arm. But I had a left-handed substitute, an old 5R4G, which I was fortunate enough to have with me. Yes sir, there are no parts stores around here. About the only thing that we have around the corner in New Guinea is maybe a banana tree.

Assembling and erecting antenna systems are no snap either. You don't have ham-friends to help you when your station is miles from nowhere. As a rule I didn't need an antenna party since labor is cheap in New Guinea. The only problem is that one can't persuade the natives to readily produce said cheap labor.

One of my first antennas was a vertical ground-plane. I built it with scraps of wire, nylon cord from an old parachute, pieces of scrap timber, a few old nails and no soldering iron. It's surprising what one can do while in a pinch. The VGP wasn't too good, though. I was able to get the thing up only 8 feet. The best report that I got was a 5/9, but the usual report was 5/5 to 5/6 and very often the report was 5/3. The good Lord knows how many stations I tried to call and wasn't able to raise with the VGP.

Then I decided to raise the VGP to 50 feet. It took me about three weeks of half-hearted labor from the natives to cut, trim, and drag in a 55 foot tree. After we finally got a hole dug (I had to do most of it myself), I corralled a bunch of school kids from Fatima College. I was superior of the college and the kids had to show-up or else. After raising the pole a few degrees, I was able to mount the VGP. Then in a matter of a few minutes I had my 50 foot VGP. It's surprising what a couple of hundred kids can do if you give them a little direction. But to make a long story short, the VGP was not the antenna for me. Reports were similar to the 8 foot VGP. I guess it was the location in the Waghi Valley. Even though I was located 5,000 feet above sea level the valley mountains bottled-up the rf quite well since the mountains towered over my location another 3,000 to 5,000 feet in some places. With the mountains to the north and the south the only good direction for propagation was toward the east, and a little south of east. Big deal! True, I contacted some of the stations from state-side but signals were poor. The reasons for poor transmission and reception could have been a poor location, poor conditions, or maybe the antenna wasn't up to snuff, and possibly everything together. Your guess is as good as mine in this matter. But one thing I knew for certain was that my heart was not set on developing the VGP. I suppose that I could have narrowed down some of the possible aggravating factors which were causing trouble to the antenna system, but I soon gave up after toying with the probability of moving a mountain or two. But I didn't look at the situation as hopeless. If one can't move a mountain one can still move away from the mountain.

The day of moving to a new location finally came. My stay at Fatima College was completed and the superior, whose place I was taking, returned to New Guinea. I was then re-appointed to a mission station called Minj. What a place! It was situated on the south wall of the Waghi Valley with a clear shot to the north and northeast. Shortly after I arrived at Minj I hung up an old scrap antenna and fired up the SX-100. . . . What a shock! Fabulous! State-side was smashing in 20 to 40 dB over S9. Real state-side QRM! That did it. The next day I called for the local tribe leaders and told them that I would like to have four long poles in a week. Surprisingly, the fellows agreed, naturally, for a price. After the leaders left I immediately started digging in my junk trunk. By the time I finished I found enough wire for the big move. I was so happy that I could have jumped up and clicked my heels, but then I began to feel sick with disappointment. Where was the wire for the feed line? Then there was a bout of turning trunks upside down, and clawing through my belongings in hopes to find that wire. Just then, during the height of the confusion, my houseboy arrived on the scene. It was apparent to him that I was looking for something and he asked whether or not he could help. I explained what I was looking for, the roll of wire and all that. The boy got the message for I sensed that the boy felt as if he had done something wrong. Sheepishly, the boy said, "I put that wire in a box in the Tool shed." Man, I could have skinned him alive! But anyway it was a relief to find that wire for the feed-line. Now I could build myself an antenna, the antenna I always dreamed about—the rhombic.

Having located all the wire, parts and rough materials, I was far from being finished, so I discovered later. If anyone tried to cut 6" x ½" spreaders for a fifty foot feed-line, he will know and understand what I mean, especially when all one has is a hack saw and a jack knife. Man, that fiber board was tough!

Finally the poles were brought in and they ranged from 45 feet to 85 feet. They were perfect since I had to build the antenna on the side of a hill and this would help me to shoot the rf over the other mountains in the horizon rather than burn all the grass in the valley. There was still some time left that day after the natives brought in the poles so I had them prepare four big holes and everything was finished by late afternoon. The boys were tired so I thanked them and told them to go home and rest up so that they would be fresh the next morning for the antenna raising.

That night, although I was tired, I was not able to get to sleep. I guess I was a little anxious about the new rhombic, but the biggest problem that bothered me was getting up that 85 foot pole in such a way that there would not be a funeral after the antenna raising. Morning came too soon. I was happy with the fact that I would have my first rhombic, but inside I was sincerely hoping that nobody would get hurt.

It was about 8 o'clock that day when about 15 fellows showed-up. Since I wanted to get the job moving we began on the 45 foot pole. In about 45 minutes or so the pole was pulled into an upright position and secured. The boys were really keyed-up so we tried our skill on one of the 65 foot poles. It went up beautifully, and hardly a sweat! Shortly after we got the second pole in an upright position the other mob came, so off we were grunting and pulling with a snort now and then and finally got the third pole up. Three poles were up and it was just a little after 11 o'clock in the morning. As far as I was concerned we did pretty good so I told everybody to knock off for a while to rest. Usually the natives are only too ready to knock off from work, but this time one of the tribal leaders said that the men would rather work since they were all loosened-up. It was unanimous that they wanted to finish the job and go home. Surprised, but slyly happy, I went over to the big 85 foot pole and tied the rope at about the 65 foot mark. The natives were a little suspicious whether we would be successful in raising that pole (I could feel the unrest), but most of them were too proud to "chicken out." I suppose that I felt the same way. Everybody lined up and ready, I gave them the go-sign and with a big shout everybody heaved and began to ease up the pole. It was amazing how easily the pole went up, but then we hit a stand-still. When the pole was raised to a 45 degree angle all progress stopped. We pulled and shouted, pulled and shouted again, but we couldn't budge the pole. This went on for about a half an hour. Actually, it was then that I seriously doubted whether we were going to raise the pole. Sort of disgusted I told the men to secure the "X" supports and tie-up the rope to a stake. Then we rested for a few minutes and got our breath. In the meantime I went around among the natives and told them of the story how all the kids raised a pole while I was staying at the Fatima College QTH. I guess I rubbed the fur in the wrong direction with that school-kid stuff, because everybody went to the pole and lined up and were waiting for me to give the sign to heave. Man, you should have heard those natives shout, snort, grunt and wheeze! Those fellows dug in and raising the pole was like letting it fall. The pole was then straightened and secured. All the poles were ready. Everybody was feeling good, they had a right to, since this was a tough job, and most of all, nobody was hurt. After a job well done I paid everybody. The total cost was $10.00 and a carton of smokes.

But the job was not finished yet. We had to string up the antenna. I suppose that I could have had the wires and insulators mounted before we raised the poles but I was afraid that things would get tangled and the ropes on the pullies would run off the wheels. I didn't like the idea climbing an 80 foot pole without any climbing gear so I asked for volunteers. For a while I thought that I was going to get stuck with the job, but my boss-boy shyly stepped forward and volunteered. Why he was so shy about the whole business beats me. In a matter of about a half an hour that fellow shimmied up those four poles, tied insulators and pulleys, and fed the nylon cord through the pulleys as if it were nothing at all. He and I were good friends from then on. A guy like that is valuable if a pulley jams on an 80 foot pole.

After that we spread out the rhombic, then we went to the feed point and tied in the feed-line and hoisted up the ladder-like outfit. Finally we went down the side of the hill and wired in the terminating resistor (a blob of carbon resistors soldered in parallel, series, and any other way possible). Up went the terminated end, and the pulley ran smoothly. Everything was tightened and the rhombic looked beautiful. I finally had my rhombic!

Since it was nearly sun-down and time to turn on the power, I made a mad dash to the shack and made the necessary connections. After having fired-up the generator, I came back to the shack and tuned up the HT-37. It took me a while to fiddle with the Johnson match-box, but it was worth it. The SWR at the feed-point was 1 to 1! I then tuned around on "20" and heard KC6BK, old Stan from Ponope. Excitedly. I zeroed in on Stan's frequency, switched over to vox control and shouted,

"Break, Stan!"

"Man, who is the breaker?", replied Stan.

I was able to feel that Stan was surprised, so elatedly, I answered,

"VK9TG, Stan. How copy?"

"How do I copy! What did you do? You sound like you are running a kW."

Man, I felt like a guy with a brand-new 40 element beam for "20"!

That's when all the DX-ing started. Good old Minj—the best DX and rhombic location a ham could have. . . . VK9TG

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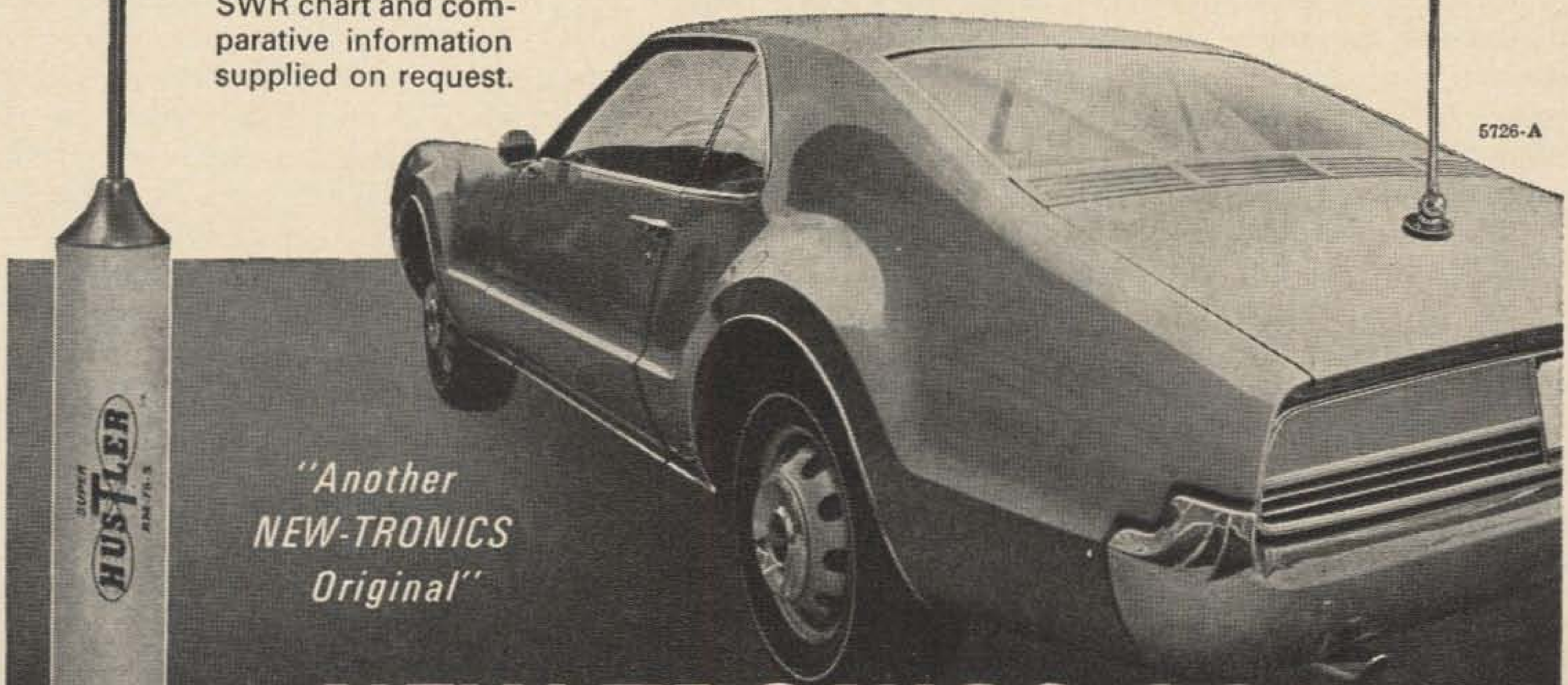


NEW-TRONICS CORP.

3455 Vega Avenue · Cleveland, Ohio 44113

Al Brogdon DJØHZ
Fuerstenberger Str. 147
Frankfurt/Main, Germany

SINPO and SINPFEMO

It seems that the old faithful RST system of signal reporting is questioned quite regularly as to its effectiveness in communicating the desired meaning. As we all know, it is capable of communicating only three elements of information—those pertaining to readability, strength and tone. However, because of the general laxity of its use, the RST report seldom conveys any useful information at all.

You CW operators look back over your log for the past few weeks of operation. You will find (unless you have an extremely strong signal or an unusually weak one) that over half your received signal reports were 579. When I receive a 579, it conveys a single bit of information to me: "I am too lazy to carefully examine your signal and give you an accurate report; therefore, I am taking the easiest way out." This same fellow who gives you a 579 report can turn around and lose you completely on your next transmission! Strange, isn't it?

Let's take a close, objective look at the three elements of the RST system, and see how our amateur fraternity is using them.

R—readability. The average ham, even while digging through several layers of interference to copy you, will give you an R-5 if he can copy as much as 75% of your transmission. If he copies less than 75%, but more than 50%, you are R-4. If you are practically unreadable, he will give you an R-3 report.

S is for strength. About 95% of the S reports on CW fall within the range of S-6 to S-9. Hams are just too friendly to come right out and say, "You have a weak signal." This situation points out that the old five-point (S-1 to S-5) scale was better, since the five levels of that scale were generally used. We could go back to the old five-point scale at the present time simply by subtracting four from the present S reports. Thus, most reports would become translated to the range of S-2 to S-5.

T stands for tone. Most ham signals originating from the USA today are either T-8 or T-9. Since few hams realize the stringent requirements for a T-9 signal, all of these T-8 and T-9 notes get grouped in the T-9 category. If a ham has a signal like a buzzsaw going through ten-penny nails, he might get a T-7 or T-8 report. Again, hams are too good-natured to come out and say, "I have heard better notes come out of a soprano saxophone with a split reed." So for all the use it gets, the T might just as well be dropped from the RST system.

The above comments pertain to normal operation. There are two cases which lead to slightly different but equally consistent RST usage—contest operation and reports to DX stations.

During contests, most CW reports are either S-7 or S-9, with R-5 and T-9 reports in all cases. One ham told me he gave *everybody* a 579 report during contests, and I'm sure he isn't the Lone Ranger.

When working non-rare DX stations, ap-

	S	I	N	P	O
Rating scale	**Signal strength**	**Interference (QRM)**	**Noise (QRN)**	**Propagation disturbance**	**Over-all readability (QRK)**
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely audible	Extreme	Extreme	Extreme	Unusable

Fig. 1—SINPO signal-reporting code for CW.

	S	I	N	P	F	E	M	O
Rating scale	Signal strength	Interference (QRM)	Noise (QRN)	Propagation disturbance	Frequency of fading	Modulation quality	Modulation Depth	Over-ll rating
5	Excellent	Nil	Nil	Nil	Nil	Excellent	Maximum	Excellent
4	Good	Slight	Slight	Slight	Slow	Good	Good	Good
3	Fair	Moderate	Moderate	Moderate	Moderate	Fair	Fair	Fair
2	Poor	Severe	Severe	Severe	Fast	Poor	Poor or nil	Poor
1	Barely audible	Extreme	Extreme	Extreme	Very fast	Very poor	Continuously overmodulated	Unusable

Fig. 2—SINPFEMO reports for phone operation.

proximately two points may be added to each element of the RST system (i.e., a domestic 347 signal is identical to a DX 569 signal). For rare DX stations, this increases to four added points per element. If the reporting station does not have a QSL from the country in question, another two points may be further added to the S scale, and an X appended to the tone report.

Now that we have made this studied analysis of the existing situation, and have discovered the fallacies in RST usage, let us take an objective look at the hams' need for reporting. As mentioned before, the quality of most ham signals today is very good, with either no defects at all or slight, unobjectionable ones. Because of this, there is no need for commentary on signal quality (i.e., note) in the normal report. Rather, it should be commented upon as an exception, whenever necessary. The primary purpose of the report then is to communicate the factors related to the copiability of the signal—the signal strength, the readability, and any reduction of readability due to interference, noise or propagation disturbance.

A system of reporting that meeting these requirements was proposed in London away back in 1953 by the Comité Consultatif International Radio, in their recommendation number 141. This recommendation was for the SINPO reporting code for use with CW signals. This system covers Strength, Interference, Noise, Propagation disturbances, and Over-all readability—each on a five-point scale Further, the CCIR proposed simple one-word definitions of each point of the scale, rather than the long explanations of the RST system. The SINPO code is shown in **Fig. 1.** The advantage of the SINPO code is that it not only tells you what your signal strength and readability are at the receiving stations, but what type of degradation is present.

The comments thus far have pertained primarily to CW operation, although many of them can be applied equally well to phone operation. One exception is the signal strength reporting on voice. A report of "sixty dog biscuits over sugar niner" means, "I have a meter attached to my receiver with a very wide scale and markings up to 80 or a hundred on it." Some of the more forward-thinking receiver designers are considering S-meters with scales starting with S-9 at the meter zero point, and divisions at 25 dB intervals, up to 500 dB above S-9.

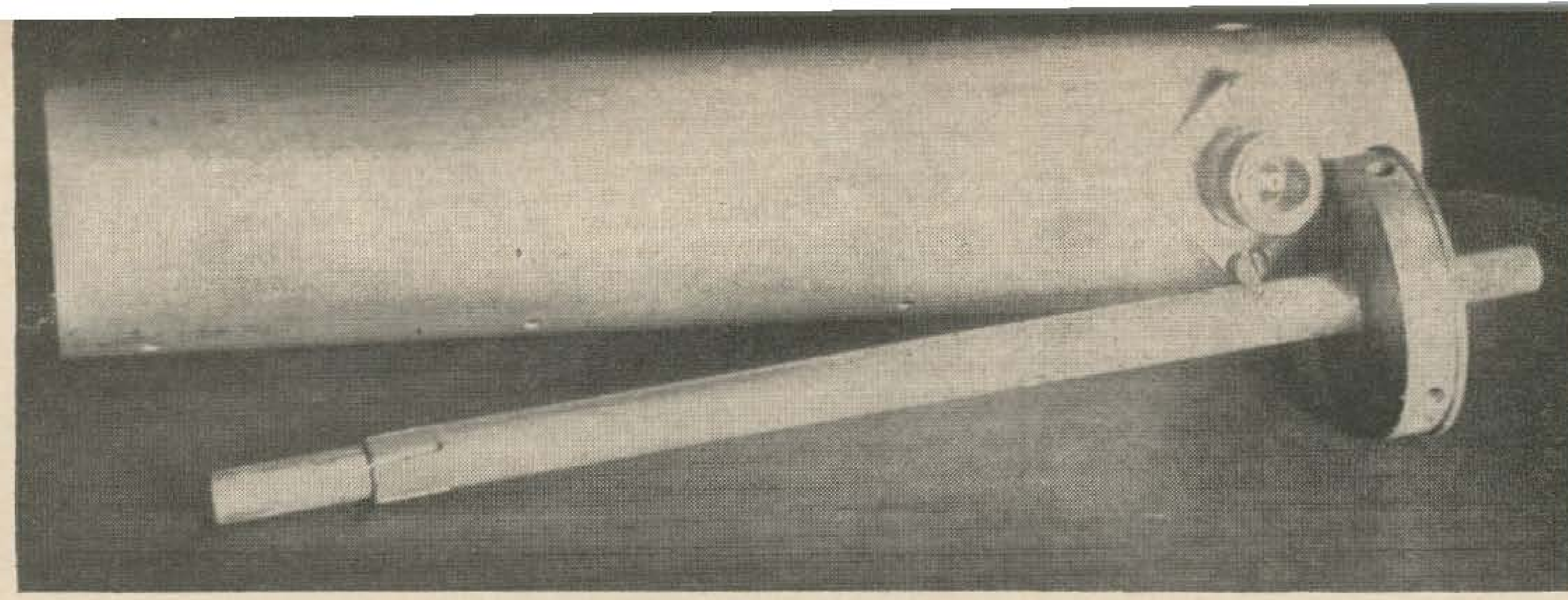
In any event, the CCIR did not forget phone operators in their recommendation number 141. They provided the phone men with the SINPFEMO signal-reporting code. This system covers Strength, Interference, Noise, Propagation disturbance, frequency of Fading, modulation quality (E) and depth (M), and an Over-all rating. The rating scale is shown in **Fig. 2.**

The SINPFEMO code provides all the advantages of the SINPO code, plus the ability to comment on modulation quality and depth —something that has long been needed in phone reporting. It is to the operator's advantage to keep his modulation quality high and percentage of modulation as near 100% as possible, and a SINPFEMO report would help inform him how successful he is in maintaining an effective phone signal. Such a system is especially needed on the VHF bands, where modulation is generally of poorer quality than that of the average high frequency phone station.

A few months ago, I received an SWL card from what was obviously a brand-new and self-taught short-wave listener. His signal report was a carefully thought-out and critical one based on the SINPO code. It won't take this young squirt long to join the conformity that is amateur radio and start giving 579's to all CW stations (for the short time he continues to use this bourgeois mode of transmission), and multitudinous dog-biscuits to all phone stations.

Me? I enjoy being a non-conformist!

. . . DJØHZ



Frank Jones W6AJF/AF6AJF
850 Donner Avenue
Sonoma, California 95476

432 MHz Antenna Filter

The 432 antenna filter unit shown in the June 1966 issue of 73 magazine functioned all right on low power and for receiving, but tended to drift in tuning with high power transmitter service. This single tuned coaxial 432 MHz cavity should have an unloaded Q of about 4000 and when loaded down to a working Q of 40 or so, will have quite low-loss (a fraction of a decibel). The detuning with from 100 to 150 watts of carrier on phone and 300 watts or more on cw going thru it produces very little effect. The heat loss is quite small. The photograph shows an unassembled line with the inner variable length line and shorted end piece lying in front of the outer shield. It is a quarter wave line which can be adjusted from 6 inches to over 7 inches in length to tune the cavity to exactly 432 MHz. All copper and brass tubing was silver plated.

The outer tube was made of brass 1¾ inches in diameter and about 8 inches long. Two coaxial type N fittings were mounted about one inch from the shorted end. A piece of number 12 wire about 1¼ inches long, bent into a flattened loop, connects from the center connector back to one of the type N mounting screws on each fitting. The 12 wire was made to parallel the inner conductor of the coaxial line but not touch it. Two ⅜ inch diameter holes in the outer shell permits some adjust ment of coupling by shoving vigorously with a small screwdriver against the coupling loops.

The inner line was made of ⅜ inch OD material, rather thick walled with saw slots in one end. The other end was silver soldered into a piece of 5/16 inch thick brass which had been turned down to a snug fit for the large outer pipe. This inner line extends up about 6 inches from the brass end plate. Originally the end piece was drilled and tapped for three 6-32 mounting screws. Later it was modified to have 6 mounting screws. This whole unit was silver plated also.

The adjustable line was about 5/16 inch in diameter and about 8½ inches long. It makes a nice snug fit inside of the ⅜ inch diameter section with a friction bearing from the slightly pinched-in ends of the saw slots. This is the rf connection and is near the high voltage end of the quarter wave circuit where the current is low. This adjustable line was also silver plated heavily. It is adjustable by pushing or pulling the rear extension part. The outer large section should be more than a quarter wave long and acts as a coaxial shield around the tuned inner conductor. The actual resonant length of the inner conductor will be about 6¾ inches long for 432 MHz.

The filter should be connected into a 50 ohm coaxial line at the antenna side of a coaxial antenna switch. This puts it into the circuit for both transmitting and receiving. The input and output links should be long enough to load the filter circuit to some value of Q = 30 to 80. This means good attenuation of undesirable signals outside of the 432 MHz (narrow band generally used).

The loading as well as resonant length adjustment can be made with either a transmitter or receiver. The length is set for maximum signal from the antenna into a 432 MHz receiver. The link coupling is adjusted to give minimum loss when the filter is in the antenna feeder as compared to no filter. A good SWR-power meter can be used with a transmitter to make these same adjustments as a double check. Measure the forward power into and out of the filter and also the SWR at both points. These pairs or readings should be practically identical with a well designed SWR meter in these tests. . . . W6AJF

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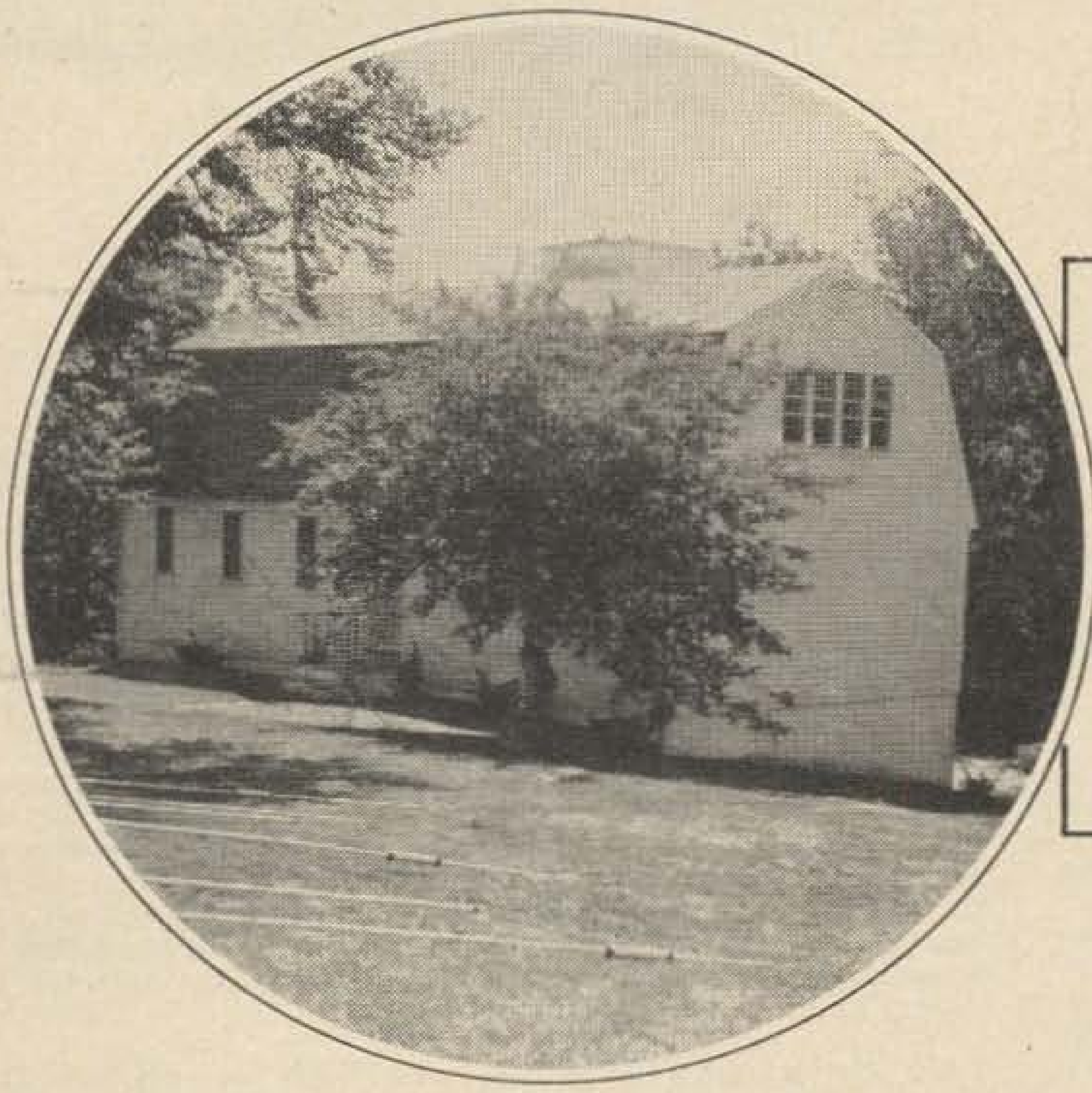

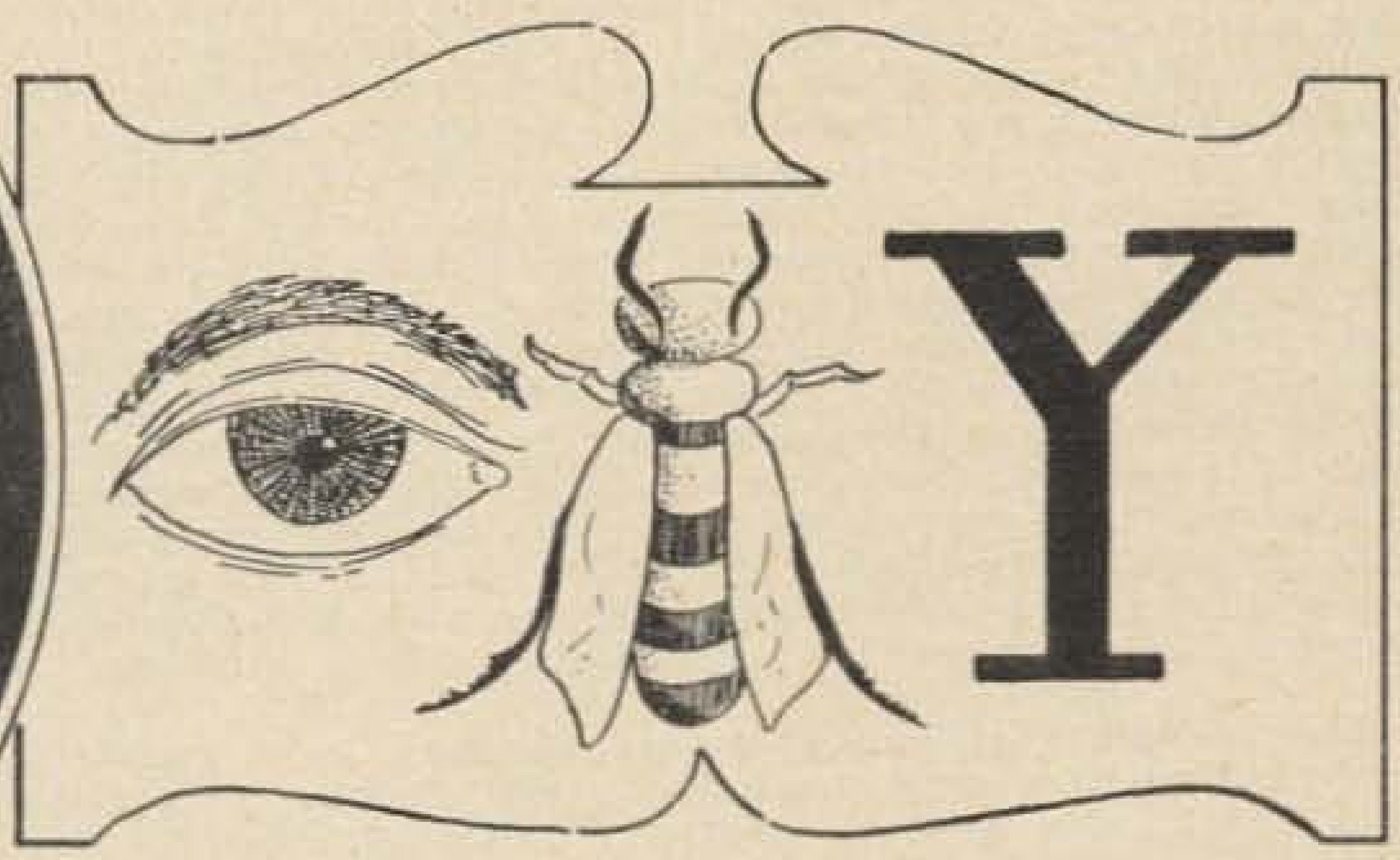

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For those north and south, Route 495 to Route 111 will do the trick.

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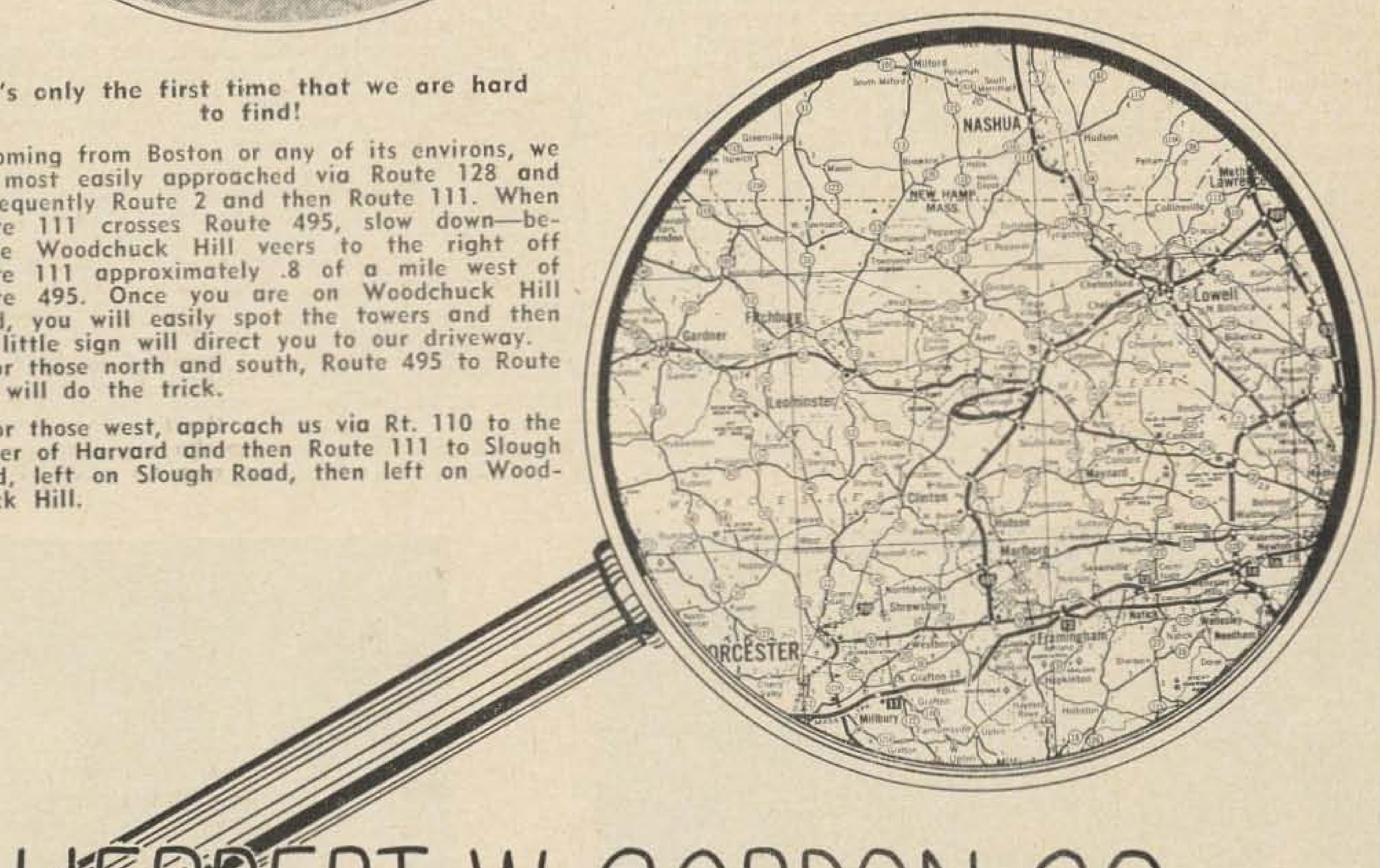

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Herb W1IBY at his desk.

The concept behind our business is different than that found in a radio store. This business has been established exclusively for the ham. It isn't as though the ham business were a small part of an electronic business. We don't cater to the commercial, CB, Hi-Fi, T.V. and radio repair businesses. Because we are 100% in the ham business, we have to provide a different set of facilities to take care of this specialized trade. We are not downtown, nor are we in any shopping center. We are, by contrast, located in a somewhat remote, rural atmosphere, actually a beautiful old New England town which was specifically chosen because of the low signal-to-noise ratios and because of the relative freedom from highway traffic noises. Some of the fellows seeing us for the first time have said that we have an antenna farm. Others have described us as "electronic acres." We have no name for the place. It can only be identified by the four towers plainly visible from the street and by the innocuous small sign, cryptically pictured by the eye, bumble bee and the letter "Y." Here at Harvard you will find an unhurried atmosphere—a place to sit down and relax and, of course, a chance to try all of the latest amateur equipment. Our very large inventory includes respective gear from most periods since 1930; and so, if you are a student of our hobby, you will be able to examine a constant improvement which takes place in our art.

The building in which we are housed is a gambrel-roofed, barnlike structure of colonial design, consisting of 3 levels. We are set back from the street some 500 feet, and of course there are adequate parking facilities for the maximum number of cars. In designing our structure, everything which might contribute to noise had to be left out, and so you will not find any fluorescent or neon signs on the premises. Indeed, each lamp is a special long-life incandescent bulb which positively creates no noise. Even the heating system was specially shielded, and all conduit cable, telephone, or signal circuits that are used approach underneath the ground. The four towers that we have support a combination of 32 antennas, phased arrays, yagis and a large assortment of dipoles, extending from 1.8MC through 435MC. Transmission lines are low-loss heliax, and the special series sequence of coaxial relays was built to our specification by Dow Key. Using these facilities, we can take a 60-watt transmitter and operate consistently on 14 MC during the peak of evening QRM, which proves over and over again that it is the antenna and its installation which affects station performance the most. Needless to say, the combination of antennas is fed to any combination of equipment that you would like to try out. We have a total of fifteen operating positions, eight of which are in the display building. You can make a side-by-side comparison of Swan, Hammarlund, National, Gonset, Johnson, Hallicrafter, Collins and Drake equipments. Isn't it about time that someone provided a means of allowing you to test equipment out under **favorable** circumstances?

The three levels are, respectively, component stock, equipment display, and equipment stock. In the basement, bright, cheery aisles with new clean shelving provide a quick means of finding most amateur desired components. Tubes, diodes and other solid-state devices are found here. Resistors, condensers, controls, relays, chassis and connectors may be found. Rotors, lightning arresters, coaxial cable, head phones, speakers, microphones and toroidal filters are found. All of the popular types of coaxial cable will be found plus the special multi-conductor cables required for rotators and selsyn systems.

Our shipping and receiving department is right around the corner and we strive to effect shipment on the same day that your order is received. Although we use parcel post most of the time, we are also able to ship via REA from Ayer, Massachusetts, or by local truck at your command. The man in charge of our shipping has had considerable experience in packing properly and we have never had a complaint.

On the ground level you will find our display facilities, and here you will meet our smiling receptionist-secretary. It is she who has control of switches for antennas and power to the various equipments that you would like to try out. And when you come in, our gal Friday will want to know your name, address and call sign, if you have one, so that she can properly prepare a stencil and add your name to our mailing list. Those making inquiry and purchasing for the first time will likewise be put on the mailing list; and when we can afford to send out bulletins and special announcements, you will automatically receive them. Our large sales area stores new equipment. A somewhat smaller room displays several hundred pieces of used equipment. The used equipment bears the same guarantee as the new gear. We have arranged display facilities in both rooms equally. Acoustically our ceiling is specially treated and, because we have a rug on the floor, we can dampen out all sound reflections and make reproductions as lifelike as possible. Reproductions can be effected through any

Herb trying out one of the many stations on display.

Part of the lab used for repair and tests.

of our ceiling mounted speakers or through any speaker of your choice to be associated with the equipment that you are interested in.

Going upstairs one more flight you will find our crystal bank with over 10,000 crystals in stock including many, many special types. You will find part of our new stock inventory and you will find hundreds and hundreds of used pieces stored on steel shelves for display and trial. Special cabinets for the storage of microphones, RF converters and test equipment are likewise available.

A major difference in our merchandising is the lack of loud, pretentious selling devices. We are not cluttered with display upon display of merchandise for impulse buying. Because we are in the country and do not attract large numbers of people at one time, we prefer to give a homelike atmosphere to our friends. We don't pressure-sell you anything. We would rather that you inquire and buy from us. Our terms likewise will come as a surprise.

Because our business has so large a percentage of the personal element in it and because there is such a variety to this ham world of ours, we sell according to a fixed policy, as outlined below. Study these simple points and see if they don't fit your need:

A. Our prices quoted are regularly established selling prices. No discounts are ever offered. Somehow or other and over a long period, manufacturers catering to our trade have rountinely established a maximum discount to us which is but 25%. Our experience is that we cannot properly accommodate our friends without having the full use of this "commission."

B. We will use our discretion and ship in the most economical way consistent with the safety of the equipment involved. All transmitters and receivers will be shipped Railway Express unless otherwise noted. Normally costs are considered the burden of the customer unless otherwise indicated. Please allow enough for postage, insurance, etc.

C. We guarantee what we sell and what we service, and to the extent possible we act as an authorized service agent for all brands that we represent. We will, therefore, abide by the original manufacturers guarantee and in addition warrant you satisfaction on every purchase, whether new or used.

D. Merchandise purchased may be exchanged or returned for refund within 2 weeks or exchanged for credit within 30 days from the date of the original purchase. Used equipment is subsequently guaranteed 90 days from the date of purchase while new equipment is guaranteed a minimum of 6 months or longer depending on the manufacturer.

E. Merchandise to be returned must be prepaid to us and returns should only be made after permission is granted.

F. Until you receive your newly ordered material and until it performs to your satisfaction you may keep it and continue using the material which you have agreed to subsequently trade in.

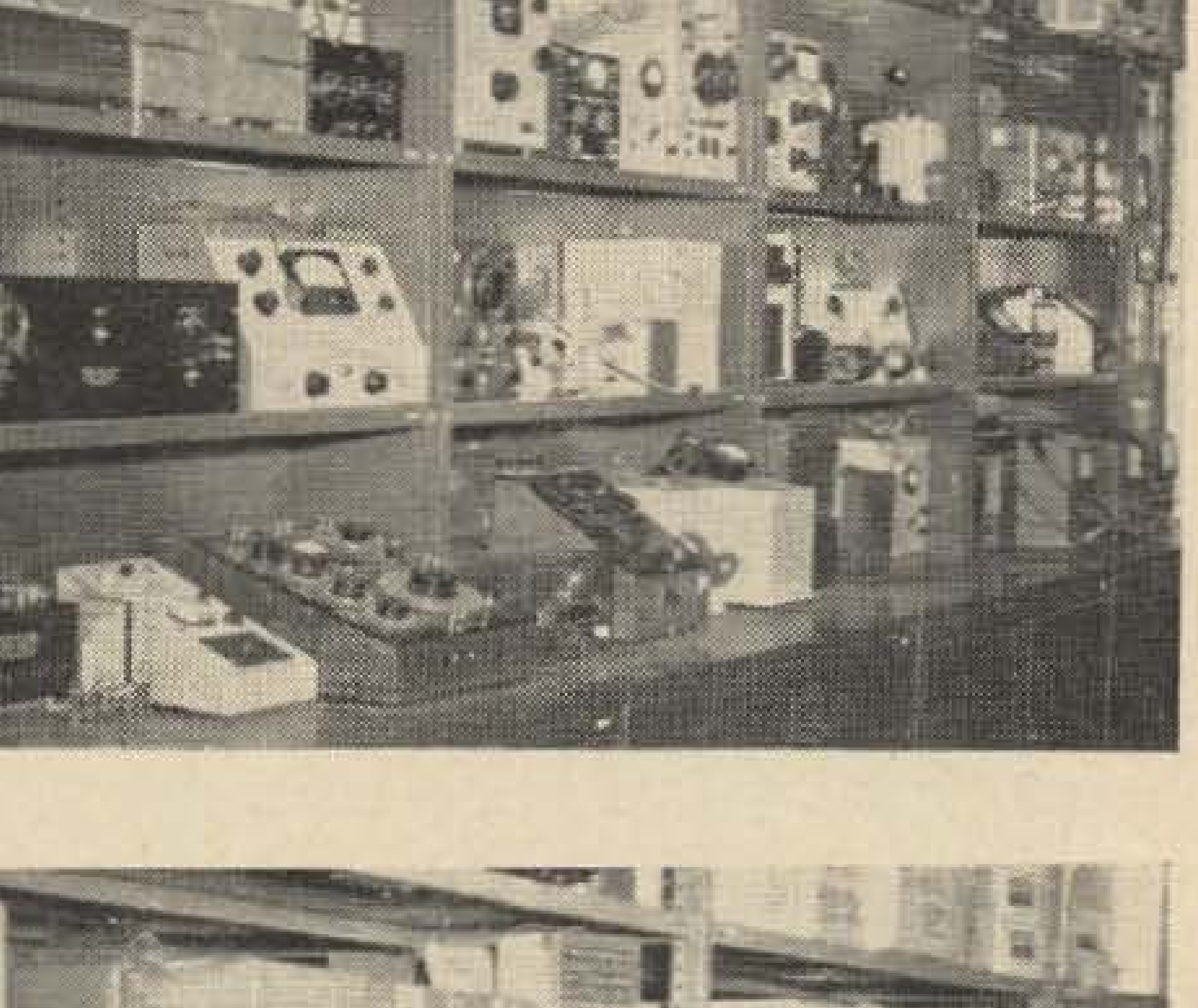
All of the standard, regular amateur equipment may be purchased from the Herbert W. Gordon Company. Items such as log books, periodicals, callbooks are always available. Publications of the ARRL, CQ and 73 are likewise here for sale. An extensive listing of surplus manuals and technical books are available for reproduction and/or sale at modest cost. A technical consulting service is always available at no charge; so if you have a problem, do not hesitate to put this in writing and ask for our help.

If you are a resident of Massachusetts, don't forget that we have a sales tax that we must collect. Please make provision for this.

And so, we welcome our ham friends to visit us and to inspect our plant. We hope it pleases you and we hope that we may be enabled to serve your needs for years to come.

73
Herb Gordon, W1IBY

Here are a few views around the Herbert W. Gordon Co. At the top is a part of the tremendous stock of used ham gear on display. The second photo shows a fraction of the basement stock of new components. Below that is part of the display of used, high quality test equipment such as General Radio, Hewlett-Packard, etc. And at the right is a view of part of one of the many shelves containing new, factory-fresh ham gear.



Hammarlund

The Hammarlund name has been connected with amateur radio since ham radio began. It is a tradition for American hams to be associated at some time in their lives with this fine product. Today Hammerlund's new factory in Mars Hill, North Carolina is busy turning out hundreds of sets for government military application. But we are still able to secure a limited quantity of receivers for amateur use and we carry in stock the HQ180A, HQ170A, HQ170AVHF, HQ110A, HQ11AVHF, HQ145, HX50A and the HX1LA. We also have the HQ100A in quantity and the HQ105 referred to elsewhere in this catalog. This is a rather broad line of equipment and obviously encompasses most of what hams want. Study the specifications and price structure. We carry these models in stock and their matching speakers as well. Remember that clocks are available at $10 extra.

HQ180A—$449.00

Frequency Range Covered: .54-1.05mc/s; 1.05-2.05mc/s; 2.05-4.04mc/s; 4.0-7.85mc/s; 7.85—15.35mc/s; 15.35-30.0mc/s.
Bandspread Calibration: Dial markings every 5 kc/s on 15, 20, 40 and 80 meter bands; every 10kc/s on 10 meter band; plus arbitrary 0-100 logging scale.
Maximum Audio Output: 1.0 Watt (Undistorted)
Passband Tuning Range: plus/minus 3KCS with calibration every 1 KC. 8:1 vernier tuning ratio.
Output impedance: 3.2 Ohms (E1A Standard) plus 500 Ohms.

AVC Action: Operates on RF and 3 IF stages. Provides fast charge—adjustable discharge smooth acting AVC. Delayed AVC applied to the RF stage. Better than .001 second attack time and .01-.1-1 second decay time. Off position.
Sensitivity: An average of 1.5 microvolts produces 10:1 signal-to-noise ratio on AM approximately .7 uv on CW and SSB.
Antenna Input: 50-600 ohms; balanced or unbalanced.
Antenna Compensator: Permits compensation for loading effects of various type antennas, or balanced transmission line.
Beat Frequency Oscillator: Variable from zero beat plus/minus 2KCs plus fixed position for SSB.
Slot Filter: Range plus/minus 5KCS of center frequency. Attenuation over plus/minus 5KCS range provides over 40db. Calibrations every 1kc. Maximum attenuation using slot depth control is 60db. 8:1 vernier tuning ratio.
Power Supply: 105-125 volts 50-60 cps. ac power consumption. 120 watts.
"S" Meter: Calibrated 1 to 9 in steps approximately 6db. Also includes db scale, above 5-9 to plus 40 db. (Meter deflects on all types of signals.)
Noise Limiter: Adjustable series type provides both positive and negative clipping.

HQ110A—$249.00

The HQ 110A is an amateur band superheterodyne with full frequency coverage. 160 meters, 1.8-2mc, calibrated in 5 kc divisions. 80 meters, 3.5 to 4mc calibrated in 5kc divisions. 40 meters, 7.0 to 7.9 mc calibrated in 5kc divisions. 40 meters, 7.0 to 7.3 mc calibrated in 5kc divisions. 20 meters, 14.0 to 14.4 mc calibrated in 10 kc divisions. 15 meters 21.0 to 21.6 mc calibrated in 10 kc divisions. 10 meters, 28.0 to 30.0 mc calibrated in 20kc divisions. 6 meters 50 to 54 mc calibrated in 50 kc divisions. There is also a two meter scale provided for use with an external converter having an output at 50 mc. This set is double conversion starting at 7mc. There is a very excellent noise limiter and equally good Q multiplier. The receiver is equipped with an S meter and a Beat frequency oscillator. This receiver has a linear detector for SSB and cw signals. The tube line up in the HQ 110 is a 6BZ6 RF amplifier. A 6BE6 mixer, another 6BE6 converter, a 12-AX7 Q multiplier and first audio. A 6BA6 IF amplifier. A 6AZ8 linear detector. Second IF amplifier and BFO. A 6BJ7 detector, noise limiter and AVC tube. A 6AQ5 audio output tube. A 6BZ6 crystal calibrater, a 6C4 high frequency oscillator. An OB2 voltage regulator and a 5U4 full wave rectifier. The HQ110A is a very popular amateur receiver and is widely used on 6 meters. A VHF version with built in converters for 6 and 2 is available at $299.00.

HQ170A—$369.00
HQ170AVHF—$429.00

The HQ 170A is virtually the best Hammerlund receiver for amateur use. Study the specifications listed below and bear in mind that the same receiver is also furnished as a VHF model with the addition of converters for 2 and 6 meters.

Amateur Bands Covered: 6, 10, 15, 20, 40, 80 and 160 meter bands.

Calibration: Dial markings every 5 KCS on 20, 40, 80 and 160 meter bands; every 10 KCS on 15 meter band; every 20 KCS on 10 meter band; every 50KCS on 6 meter band. Plus 2 meter calibration scale.

Number of Frequency Conversions: Dual on 160 and 80 meter bands. Triple on 40, 20, 15, 10 and 6 meter bands.

Frequency Range Covered: 1.8-2.0MCS, 3.5-4.0MCS, 7.0-7.3MCS, 14.0-14.4 MCS, 21.0-21.6 MCS, 50.0-54.0 MCS. Converter Scale 144-148 MCS.

Maximum Audio Output: 1.0 Watt (Undistorted)

Passband Tuning Range: plus/minus 3KCS with calibration every 1KC. 8:1 vernier tuning ratio.

Output impedance: 3.2 Ohms (E1A Standard) plus 500 Ohms.

AVC Action: Operates on RF and 3IF stages. Provides fast charge—adjustable discharge smooth acting AVC. Delayed AVC applied to the RF and (1) IF stage. Better than .001 second attack time and .01-1.1. Second decay time. Off position.

Adjustable Selectivity and Selectable Sidebands: 6db bandwidths Upper sideband—1-2-3 kcs. Lower sideband—1-2—3KCS. Both sidebands—.5—2-4—6kcs.

Sensitivity: An average of 1.5 microvolts produces 10:1 signal-to-noise ratio on AM approximately .7 uv on CW and SSB.

Antenna Input: 100 ohms nominal balanced or unbalanced. Provision for separate 50 ohm coaxial 6 meter antenna. Plus SO239 (UHF) Antenna connector accessory socket.

Antenna Compensator: Permits compensation for loading effects of various type antennas or balanced transmission line.

Beat Frequency Oscillator: Variable from zero beat plus/minus 2kcs plus fixed position for SSB.

Slot Filter: Range plus/minus 5 kcs of center frequency. Attenuation over plus/minus 5kcs range provides over 40db. Calibrations every 1kc. Maximum attenuation using slot depth control is 60db. 8:1 vernier tuning ratio.

Power Supply: 105-125 volts 50-60 cps. A.C. power Consumption. 120 watts.

"S" Meter: Calibrated 1 to 9 in steps approximately 6db. Also includes db scale, above S-9 to plus 40 db. (Meter deflects on all types of signals.)

Noise Limiter: Adjustable series type provides both positive and negative clipping.

Front Panel Equipment:
Main Tuning
Vernier or Bandpass Tuning
Sensitivity (RF Gain):
  on/off switch
Selectivity: 0.5-1-2-3 KCS
  (per sideband)
Sideband: Upper-lower-both
Audio Gain
Antenna Compensator
Tuning Range (Band Selector)
Function Switch: AM-SSB-CW
Slot Freq. Calib.-Slot Depth
CW Tone (BFO Pitch)
Noise Limiter, adjustable
  on/off switch
AVC, off-slow-medium-fast
Send-Receive-Calibrate
Phone Jack
"S" Meter
Dial Scale Reset

Rear Panel Equipment: Terminals for speaker connections
3.2 ohm for voice coil
500 ohm for line or VOX

Accessory socket for preamp, Q-multiplier or converter. System socket for simplified associated transmitter/receiver control.

Phono-type coax fitting 455 KC output for Q-multiplier or other use.

S-meter controls.

Antenna input terminals plus SO239 for HF input and phono-type coax input for 6 meter antenna or converter unit.

Dimensions: 10½"H x 19"W x 13"D
Wt. 38 lbs.
Shipping Wt. 45 Lbs.

24 hour clock-timer: Combination clock and automatic timer. Aids in meeting prearranged schedules. Optional extra at 10.

Other Hammarlund Products

HX50A—$495.00

Matching speakers:
S200 $20.00
S100 $15.00
Twenty-four clock $10.00
HX 50A Sideband transmitter, 80-10 meters, $495.00
HX 50A Sideband transmitter, same as above plus 160 meters. $515.00
HXL-1 150 W PEP input 1000 W CW linear amplifier. 80-10 meters. Matches the appearance of the HX-50A. $395.00

Heights Towers

This picture illustrates a new type of tower designed for the radio ham. It is a product of the Heights Manufacturing Co. of Detroit, Michigan. That which makes the Heights tower unique and particularly suitable for ham use is the fact that this is a self-supporting tower which, excepting for its base, is made entirely of aluminum. It is a tapered tower designed for 80 MPH winds. The Heights line includes towers rated at 2 sq/ft antenna wind-load all the way up to 26 sq/ft wind-load—translated in another way, from a wind-load of 60 lbs to a wind-load of 520 lbs.

A typical tower for ham use using a single TA33 trap triband beam should be mounted on a tower rated at least 5 and preferably 8 sq/ft. Now here is the surprise. A 72′ tower rated at 8 sq/ft weighs only 188 lbs, yet this same tower is designed for folded-over operation and when in the vertical position positively does not require guying. All tower sections are 8′ long and are shipped in nested bundles for ease in transportation and handling.

Let me cite some typical examples of Heights towers. The 72-footer that we have is a fold-over. The fold-over mechanism by and of itself has a list price of $250. This is a winch-operated, hinged assembly, the base of which weighs 200 lbs and requires a concrete pad approximately 4′ square by 4′ of depth. This is catalog number WOHB-22. The 22 means that it will mate with 22″ triangular sections. Similar bases are available for 18″ triangular sections and for 26″ sections. There are also roof mounts that are hinged should you want to mount the tower on a roof. These are available for 14″, 18″, 22″, and 26″ towers. When purchasing such a tower you would naturally want a top section. This top section is tapered and includes a bearing for the antenna mount. The top sections are called AT units. They are the AT-11 at $25, AT-14 at $33, and the AT-18 at $64. All prices are list.

Beneath the top section there is a tapered junction section and this bears the nomenclature of AJ. Thus we have AJ-14 at $25; AJ-18 at $50; AJ-22 at $75; AJ-26 at $100. Again these are list prices. The J sections serve to trnasfer one smaller dimension tower section to a larger dimension section. Thus, if you started with an 11″ top, your next dimension would be 14″ and then 18″ and then 22″ and finally 26″. The maximum number of straight sections (which merely couple together) that you can hook together in one series is 6, and this limit of 6 applies only to 26″ triangular tower widths. For 22″ widths, the maximum number is 3; for 18″ and 14″, 3; on the 11″ width, the maximum is only one. These straight sections which couple together are called AC units. They are priced at $25 for AC-11 and AC-14; $50 for AC-18; $75 for AC-22; $100 for AC-26.

It is possible to thus make up any combination of tower height from 80′ all the way up to 136′. All of these are self-supporting and all of them have pre-determined wind-load limits.

So that you will understand what a typical wind-load might be, most TV antennas and small two-way radio antennas or small 2- and 6-meter beams should carry a tower rated at 2 sq/ft. Very large TV and two-way radio antennas or 6- and 10-meter beams and small tri-banders should have a tower rated 5 sq/ft. Medium 20- and 40-meter beams and medium tri-banders require 8 sq/ft. Large 20- and 40-meter beams and the largest tri-banders should be rated 11 or 14 sq/ft. The very largest 20 and 40-meter beams and multiple antenna arrays would require between 18 and 26 sq/ft.

All of the prices referred to in this Heights Manufacturing Company ad are list prices and are subject to a 33% discount.

All Heights towers are delivered drop-shipped on a prepaid basis so that once you compute your cost, it is in reality the delivered cost. We have charts showing how you can compose your own tower for every rated load and for every height. Bear in mind that these towers are light—they are aluminum—they are constructed by certified welders. You can get some idea of their mechanical rigidity by observing the weight imposed upon the tower in the illustration.

A typical tower such as the one we have here in Harvard is 72′. It is a winch-operated, hinged unit and were we to have sold this to a customer direct, it would have cost only $432. It is rated at 8 sq/ft. The aluminum part is only 188 lbs. The steel base on which it rests is 200 lbs. Once erected, these towers will last and last with no corrosion, and no painting.

We are very sold on these towers and recommend them highly.

Rohn Towers

Early in our business history, it became necessary for us to handle a popular line of towers. Investigation revealed that the most widespread tower used in our country was Rohn, made out in Peoria, Illinois. They are probably the largest tower manufacturing company and their line is very broad. The hams that I talked with indicated that two numbers were particularly applicable to ham work. These are what Rohn calls #6 shown at the right in the illustration and #25 shown at the left. Whereas the number 6 weighs 31 lbs per 10′ section, the number 25 will weigh 40 lbs. These tower sections can be made up into practically any length up to 300′. They should be guyed every 2 or 3 sections.

We have most every item in both lines. The #25 line is considered to be slightly better. For example, #25 will support a downward thrust on the bottom tower section of 15,540 lbs where the #6 section is rated at 12,500 lbs. On the #6, the siderail diameter is 1″ O.D. and #16 gauge. On the #25, the siderail diameter is 1¼″ o.d. at 16 gauge.

Each tower section has packed within its legs the nuts and bolts necessary to lock securely the next telescoping section. The #25 which is zigzagged is as easy to climb as the #6 which has no zigzag. Both towers are heavily galvanized after fabrication which means that the interior of the tubing is covered with zinc as well as the outside.

Tapered top sections for both sizes are available and there are various base devices such as you might want if you were going to put the tower on the top of a peaked roof or a flat roof.

Rohn towers can be crudely estimated costwise by figuring $2 per lineal foot of heiight for #6 and $2.50 for #25. This takes into consideration all the accessories that will be required such as guy wires, turnbuckles, clips, and the accessory shelf on which to mount the rotor.

We normally have several hundred sections of Rohn towers in stock and we can arrange so that the factory can drop-ship Rohn to you if you do not want to have them shipped from this point in Harvard, Mass. More hams use Rohn than any other type. There must be a good reason. Remember, also, that we have the Rohn fold-over towers, the Rohn crank-up towers in stock, and that we can get for you the motorized type of crank-up and even their self-supporting type tower.

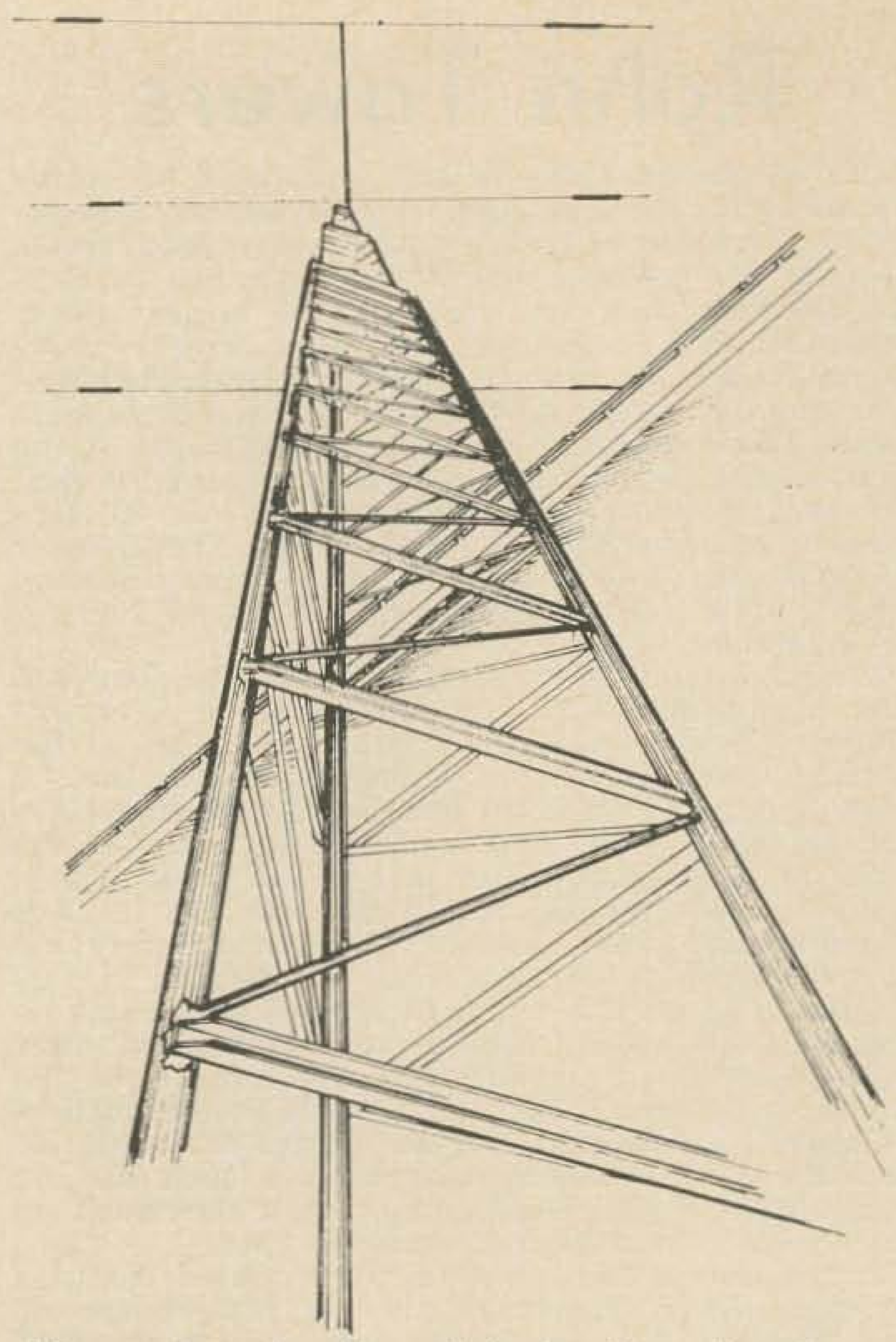
Here is a listing of #6 and #25 showing your cost and the individual weights:

#6 Cat. No.	#6 Price	lbs.	DESCRIPTION	#25 Cat. No.	#25 Price	lbs.
6G	$15.95	31	10′tower section	25G	$18.50	40
6AG	17.25	31	10′ top section (#25—9′)	25AG	19.50	31
SS6G	10.75	14	5′ top section	—	—	—
SB6G	7.25	11	3′4″ short base section for concrete	SB25G	8.50	10
BPC-6G	15.65	25	Concrete base plate	BPC-25G	15.65	25
FR6G	14.30	22	Flat roof mount	FR25G	17.40	22
PR6G	21.50	14	Peak roof mount	PR25G	21.50	14
RP6G	1.75	2	Rotor post	RP25G	1.75	2
BP6G	5.65	10	Base plate (for drive-in base)	BP25G	5.65	10
DR6G-4	5.00	7	4′ drive rods (set of 3)	DR25G	5.35	8
DR6G-2	3.25	4	2′ drive rods (set of 3)	—	—	—
DT6	3.00	1	Drive tool	DT25	3.00	1
BHP6G	21.50	15	Hinged Base plate	BPH25G	21.50	15
EF-6-45	45.00	18	Aluminum erection fixture—fits models with 1″ and 1¼″ side rails	EF-6-45	45.00	18
P-6-45	25.00	11	Pole only for EF-6-45	P-6-45	25.00	11
H-6-45	25.00	7	Head only for EF-6-45	H-6-45	25.00	7
HB6AG	4.50	8	Adjustable house bracket (up to 15″)	HB25AG	4.50	8
HB6BG	5.75	10	Adjustable house bracket (15″ to 24″)	HB25BG	5.75	10
HB6CG	7.75	12	Adjustable house bracket (24″ to 36″)	HB25CG	7.75	12
HB6P	5.25	11	Adjustable house bracket (universal)	—	—	—
EB615G	3.50	4	Eave bracket (15″)	EB2515G	3.50	4
EB624G	4.00	5	Eave bracket (24″)	EB2524G	4.00	5
EB625G	3.50	7	Eave bracket (universal)	EB2525G	3.50	7
AS6G	9.00	5	Accessory shelf—circular plate for mounting rotor inside of tower	AS25G	9.00	5
TB50	.60	¼	Tower bushing—1¼″ I.D.	TB50	.60	¼
TB75	.60	½	Tower bushing—1½″ I.D.	TB75	.60	½
S-1	.80	½	Rubber grommet (1 pc.)	S-1	.80	½
L-2	1.95	½	Rubber grommet (2 pcs.)	L-2	1.95	½
UHF6G	3.50	4	Side arm mount for UHF & FM antennas	UHF25G	3.50	4

Tristao Towers

At the Boston ARRL Ham Fest this past Spring, we were introduced to Mr. John Hultquist who represented the Tristao Tower Company. Although I was impressed with his literature, I was more impressed with the proven claims about one of their products and so I ordered one of each of their CZ-454 and their CZ-437. When these towers subsequently arrived, I showed them to many of the visiting firemen and we all agreed this was a very fine product. It is possibly the best value for a similar product made in this country. The important feature of this design provides a crank-up tower with maximum strength-to-weight ratio which does not require any guy wires if the unit is bracketed to the side of your house. Accordingly, this tower presents an unusually clean appearance. It will easily support a tri-band beam at 60′. It will quickly and safely lower to a twenty foot level when high winds are expected. This CZ series includes a new-style winch with an automatic-locking disc brake for constant safety. If you should take your hand off the winch, for example, the tower will go neither up nor down. The winch is capable of supporting up to 1500 lbs of downward thrust. The design of the winch permits you to padlock against unauthorized use.

This tower is a complete package. Besides the heavy diagonal bracing on all three sides, the package includes the rotating plate cut for the CDR rotators, a hinged base plate for easy erection, steel brackets for attaching the tower to the house, and even the bolts necessary to clamp the base to the concrete pad. There are no extras to buy and this CZ line is hot-dipped galvanized inside and out after fabrication for long, long life.



The CZ-454 is a 3-section tower, each 20′ long. It is complete as described and weighs 380 lbs. The face width at the top section is 12⅜″. When extended, the tower is 54′ long. Lou Tristao recommends a pad 30″x30″x2′ deep of concrete. The price on this model is $350.

Similarly designed, is the 37′ tower comprising two 20′ sections and weighing 235 lbs. It is available for $240. The concrete base recommended for this is a 2′ cube.

Both towers include a 2″ I.D. mast shelf so as to support your masting. Pound for pound, this is one of the best tower values ever offered and we have, since taking on the line, sold a considerable number of them. We carry the 37-footer, the 54-footer, and the new CZ-472 which is a 72-footer selling for $485.

The Tristao is one tower you can have confidence in and feel safe about.

Mosley

TA-33

The Mosley TA-33 is considered to be a most popular tri-band beam. When listening on the air, you will hear many references to its use. Carl Mosley has succeeded in making trap antennas which will keep out the moisture and not break down at a kilowatt. In the early days of trap antenna design, the replacement of traps was indeed a problem but I can assure you now that this has been mastered and once erected, the trap seam itself will not cause any difficulty.

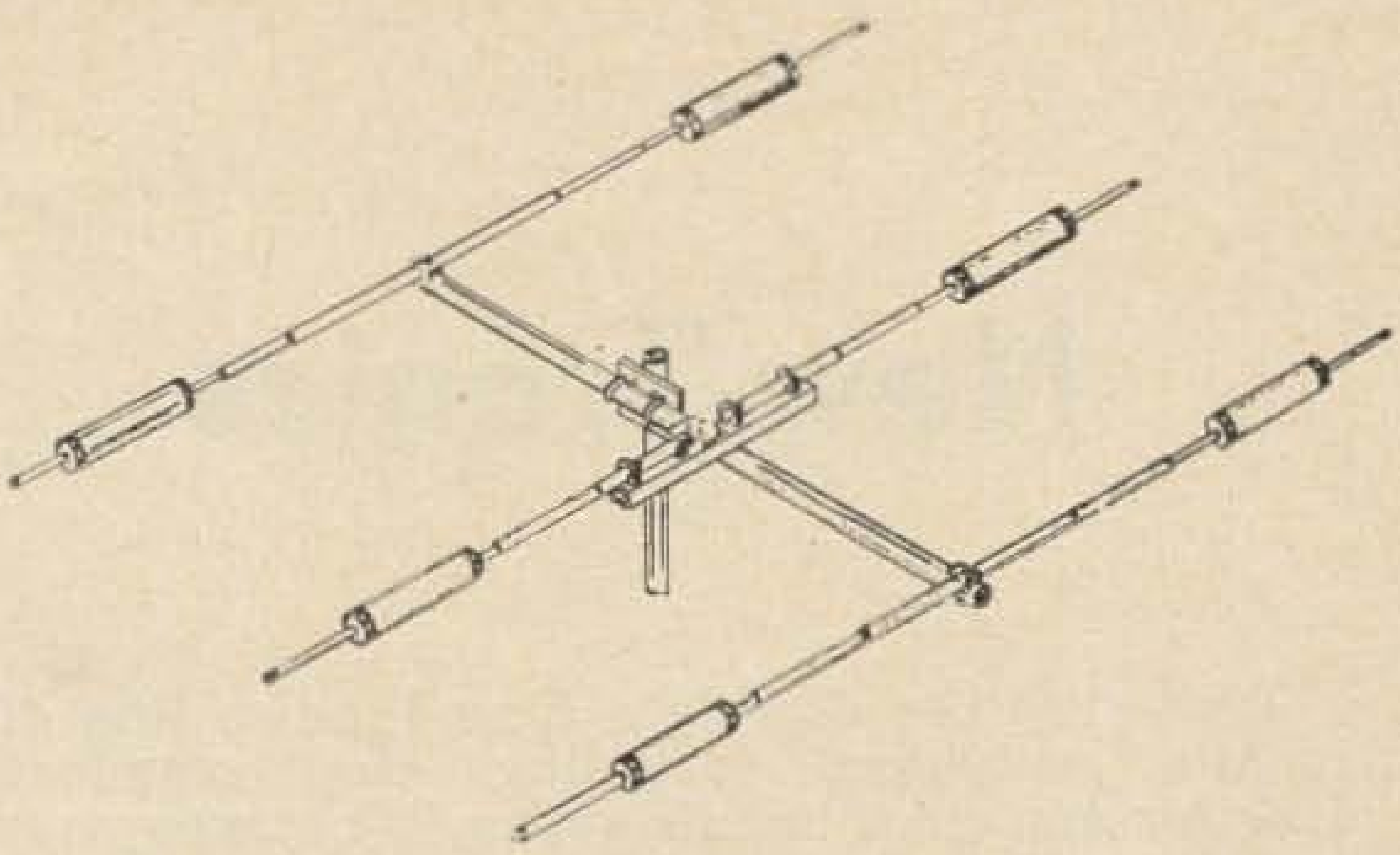
The TA-33 is a 3-element beam and provides outstanding performance on the 10, 15, and 20 meter bands. It is exceptionally broadbanded and provides for very low VSWR on each band. For example, on 20 meters, you can cover the entire range from 14 to 14.35 with a ratio of less than 2.0. This is naturally better on 15 meters and on 10 meters the highest ratio for the entire band is 2.2. The TA-33 is rated at 1000 watts DC input. It will provide up to 8 db of gain. Its front to back ratio is 20 db or better. The maximum element length is 28'. The boom length is 14'. The turning radius if 15½'. The wind-load is 114 lbs and the wind-surface is considered 5.7/sq.ft. The actual weight of the assembled antenna is just under 40 lbs. The TA-33 sells for $120.99 now, having recently gone up because of the increased cost of materials.

TA-33 Jr.

The same antenna in a slightly smaller design called the TA-33 Junior, is rated for 300 watts AM or 1000 watts PEP on sideband. It provides essentially the same gain and performance and costs but $84.30.

Classic 33

For those wanting the best possible 3-band beam, the Mosley Classic 33 is available at $131.95. This is rightly called the Trap Master. The essential specifications are similar to the standard TA-33 except that the gain on this antenna is approximately 0.3 db better; the maximum element length is 29' instead of 28'; the boom length has been increased from 14' to 18'. The turning radius has been increased from 15½' to 16'. The wind surface rating on this antenna is 6' and the weight is 60 lbs. The improvements in this antenna are primarily mechanical although they do feature a new matching system. The feed on all of these antennas is a standard 52-ohm RG-8 coax. The entire family of TA-33's mechanically matches with 2" masting and should be used with the TR-44 or the ham M rotors.



Mobile Antennas

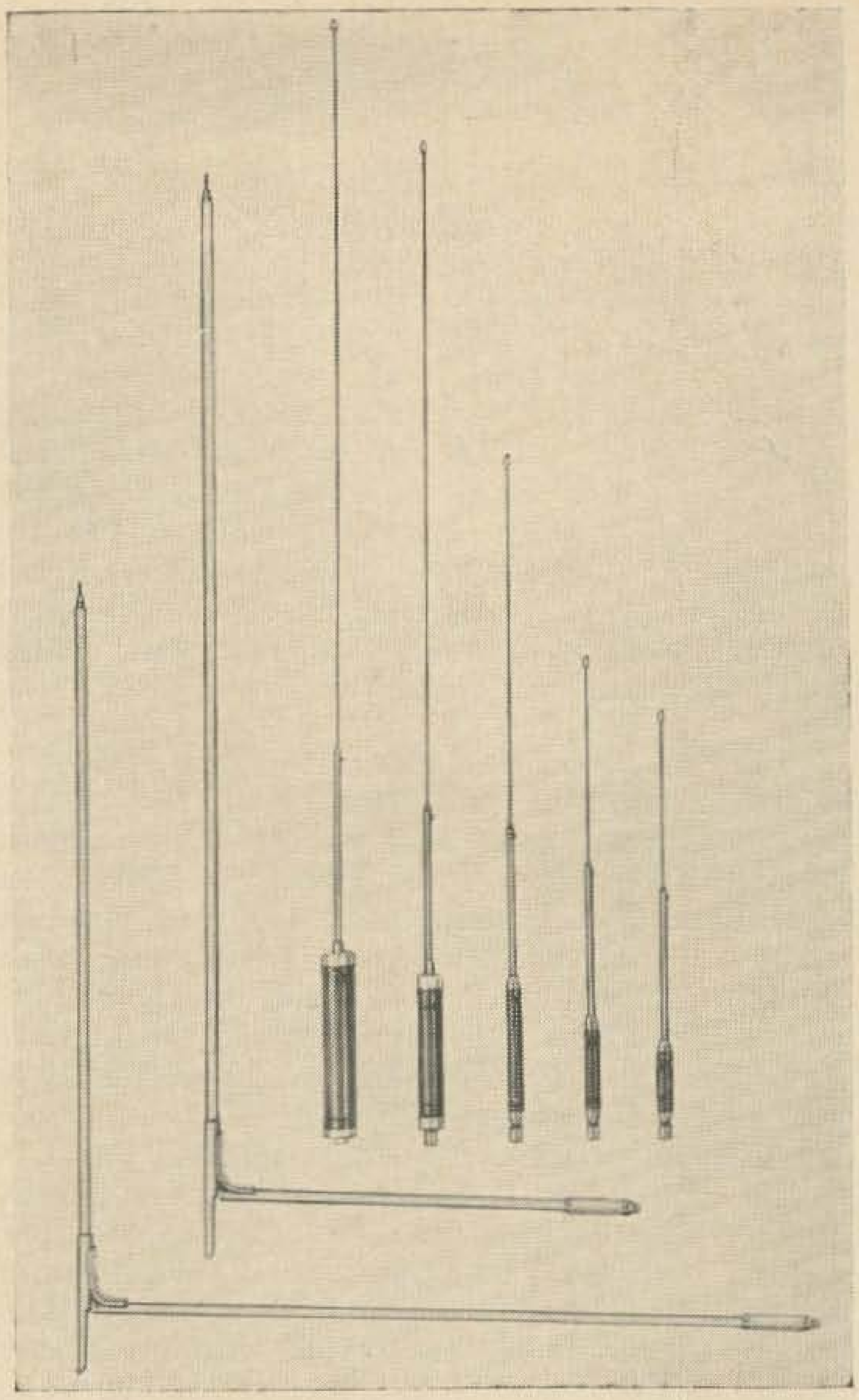
The new Lancer 1000 by Mosley is the first 5-band operated mobile antenna rated for a full kilowatt which comes in a coiled caddy case. The tip on the Lancer includes a corona ring. Each antenna is mechanically adjusted to the desired band frequency by means of an Allen wrench and each lower whip section is hinged securely by means of a wing nut assembly. The basic antenna operates on 10 meters without a coil and each coil as may be required for the other bands is designed for optimum Q at an SWR of 1.5 to 1 or better. The range on 80 meters is approximately 25 KC; on 40—35 KC; on 20—60 KC, on 15—100 KC; and on 10—300 KC—before new adjustment is required. The price on these mobile Lancers for the complete antenna is $79.61. The basic antenna for 10 meters alone is $32.31; the 15 meter coil is $8.07; the 20 meter coil, $8.64; 40 meter, $10.90; 75 meter, $17.05. The basic top whip section is $8.09 and the coil caddy carrying case is $6.63.

We carry the TA-36 in stock. This is a 6-element configuration using 4 elements on 10, 3 on 15, and 3 on 20. This antenna is rated at 1000 watts DC input and matches 52-ohm cable. Its gain on 10 meters is 9 db; on 15, 8.5 db; and on 20, 8 db. The front to back ratio is 20 on all bands. The boom length is 24'. The wind surface area is 10.7/sq.ft. and the assembled weight is 69 lbs. Its cost is $152.59.

We carry most of the Mosley line including the El Toro trap dipoles, the vertical antenna RV-4 for 10, 15, 20, and 40 meters and priced at $35.13; the V-48 which is the best trap vertical is available for 80 and 40 meters at $103.09. We also carry the VHF ScotchMaster series including the A568 providing 5-elements for 6 meters at $31.91. The 876-S has 7-elements for 6 meters at $39.78 and the 892-S has 9-elements for 2 meters and is priced at $18.59.

The Mosley line is well received in the amateur fraternity and we are pleased to state that we stock it heavily—And use them, too. See the picture on the back page.

New-Tronics



We carry the complete New-Tronics line of mobile antennas including the standard Hustler and the Super Hustler. Whatever your mobile needs may be, you can be assured of perfect performance with the New-Tronic's Hustler. The standard rating for any standard Hustler is 300 watts pep. This is conservative. And many Swan equipped mobile units with 500 watts of PEP rating work with these standard Hustlers. The Super Hustler has a rating of 1000 watts.

There are two folded over mast assemblies. One of these is the MO1 folding at 15" when the base is used on rear deck or fender mounts. And the other for bumper mounts folds at 27" and is their number MO-2. Because the Hustler is specially constructed with multi-strand Litzendraht wire, the Q of their coils is relatively high with the VSWR being less than 2 to 1 from any center frequency setting within the following band widths:

10 meters—Approximately 100 to 120 KC
15 meters—Approximately 100 to 120 KC
20 meters—Approximately 80 to 100 KC
40 meters—Approximately 40 to 50 KC
75 meters—Approximately 25 to 30 KC

Antenna Assembly Consists of One Mast and One Resonator

MO-1 54" mast folds at 15" from base swivels 360° (for rear deck or fender mount). Wgt. 2 lb. $7.95

MO-2 54" mast folds at 27" from base swivels 360° (for bumper mount). Wgt. 2 lb. ... $7.95

RM-10 10 meter resonator. max. 80"—min. 75". Wgt. 11 oz. $5.95

RM-15 15 meter resonator. max. 81"—min. 76". Wgt. 12 oz. $6.95

RM-20 20 meter resonator. max. 83"—min. 78". Wgt. 13 oz. $7.95

RM-40 40 meter resonator. max. 92"—min. 87". Wgt. 1 lb. 4 oz. $9.95

RM-75 75 meter resonator. max. 97"—min. 91". Wgt. 1 lb. 7 oz. $11.95

RM-10-S 10 meter resonator. max. 80"—min. 75" $11.95

RM-15-S 15 meter resonator. max. 81"—min. 76" $13.95

RM-20-S 20 meter resonator. max. 83"—min. 78" $15.95

RM-40-S 40 meter resonator. max. 92"—min. 87" $19.95

RM-75-S 75 meter resonator. max. 97"—min. 91" $24.95

BM-1 Stainless steel strap fits against any shape bumper yet is inconspicuous. Length of strap permits mount to be attached to any bumper. Assembly is held rigid by two 5/16" "J" bolts at the top of the bumper and strap clamp at bottom. Minimum clearance between bumper and car body required. Base is standard New-Tronics, Model C-32. Hardware is cadmium plated. Wgt. 1 lb. 13 oz. $6.95

BM-2 Same construction as Model BM-1 except without base. Wgt. 1 lb. 4 oz. $4.95

Hustler Trap Vertical

The newest trap vertical, the Hustler Model 4BTV selling at $32.95, is now in stock. It operates with better than 2-1 SWR and with the legal limit of power on 40 meters through 10 meters. 52-ohm coax is required. You may operate on 80 meters by adding a standard RM75S Super-Hustler when you use high power or a regular RM75 for 300 watts or less—to the top of this antenna when you install it. No guys are required. The clamps furnished are stainless steel. The overall height is 19' 8". This antenna promises to be a most popular item.

We also carry in stock the Coveya-6 six meter cardioid pattern antenna at $39.90 and the Cliff Dweller, which is the only remotely tuned dipole for limited antenna space of 75, 40 and 10 meters all in one antenna. The price is $149.50.

Coaxial Cable And Connectors

RG58 COAX BARGAIN. We were just able to find on November 17, 300 10" metal spools, each wound with 100' of factory-fresh RG58 coax. This material, made by Phalo, is priced as a special at $6.95 in one of our great mail order catalogs. You can buy it from me for **$4.95.** This is standard 52 ohm cable which can be used for general amateur or TV purposes—a remarkable value when you consider that the regular price is about double. So, stock up now and save.

We have over 100,000 feet of coaxial cable in stock including all of the popular types. We carry the multi-connector cable for the CD Ham M, the TR44 and the AR22 in stock. Space does not permit the complete listing of all of our cables and connectors.

In the past two years civil unrest and nationalist independence movements have made headlines. The declaration of independence in Rhodesia has vitally affected the copper production in nearby Zambia. The continuing unrest in Chile and Peru, the formenting of strife and strikes has likewise taken our attention. The constant eroding shrinkage of the dollar is known to us all.

Nowhere has the impact of these movements been more pronounced than in the prices of metals and especially in brass and copper mill products. The London market price on copper today is close to three times what it was barely eighteen months ago, and we don't know from day to day where the price will stop. To protect themselves, manufacturers who supply this company with coax are now quoting me May and June deliveries at a price to be established then. Based upon these facts, the prices that we charge are as follows for common numbers.

For the RG8—16¢ a foot in quantities of less than 100 feet, for more than 100 feet —14¢ a foot.

For the RG8 foam—quantities of less than 100 feet—19¢ a foot, for more than 100 feet—16¢.

For the RG58—less than 100 feet—9¢ a foot, 100 feet or more—8¢.

For the RG59—less than 100 feet—9¢ a foot, 100 feet or more—8¢.

For Multi-connector cable, 8 wire type as used with the Ham M—12¢ a foot.

For use with a TR44, 7 wire cable is likewise 10¢ a foot.

For AR22 the price is 5½¢ a foot.

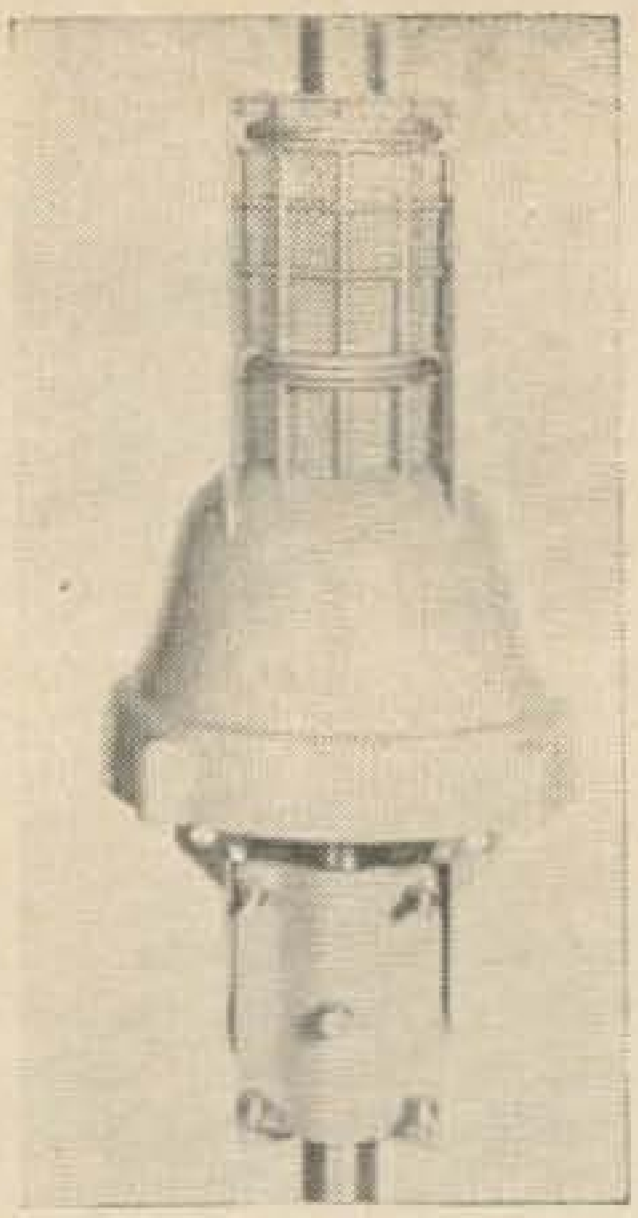
PL 259 connectors are 50¢ each when purchased five at a time, otherwise they are 59¢ each. The adaptors to convert them to small coax are 16¢ each. The adaptors which convert the UHF fittings to the RCA phono fitting are $1.15. This is the M44. We have all of the other types normally found or wanted including the BNC, the type N, the type HC and so forth. For your specific needs write describing the RG number that you wish and we will quote you promptly.

The W2AU Balun

This is our most popular Balun. It sells for only $12.95. It includes a built-in lightning arrester. It matches standard UHF coax, RG8, RG9, RG11 and RG13. The balun is a matching device which couples an unbalanced coaxial feed line to a balanced dipole. As such it improves the propagation efficiency of your transmitting antenna. The W2AU balun is made in two models. Either the 4 to 1 ratio for coupling a 300 ohm antenna to a 75 ohm feed, or the one-to-one ratio normally used with RG8. This balun serves as a center insulator. You do not need a separate center insulator when constructing your long wire dipoles. The physical design of this unit will withstand a 650 lb. antenna pull and the balun is broad banded to operate between 80 and 10 meters. We have a companion PL259 which is engineered to withstand tremendous pull. This is a special unit which ties together differently. It assembles like the type N connector and we recommend them specially for use with these baluns. When so used you will have no fear of the coax becoming loose from the PL259 no matter at what height you suspend the balun. The special PL259 is $1.50 each. We have had hams come in who have tried this balun and want a second and a third. The results, they say, are worth it, and I agree.

C D E Rotators

Many years ago I put up a tower and put a full-fledged 6-meter beam on it of educated aluminum made by my friend W2BDS. This beam had a 24′ boom and since I was naive about the subject, I proceeded to buy and install at the top of an 80′ tower the best rotator that the XYZ Distributing company had to sell. It lasted about 8 weeks. Oh, these people were good to me. I shinnied up the tower and on a cold blustery day wished I was never born—but somehow or other I got the rotor down, took it back, whereupon these kind people gave me a replacement. Again I went up the tower and again I had operation for about 6 to 8 weeks. With the second failure, I decided then and there that I would use only the best rotor I could buy which proved, of course, to be the HAM-M Model made by CDE.



TR-44

Now that I am in business for myself, I carry the complete CDE rotator line. They all have the same appearance and, in effect, the same housing. The smallest number selling for $33.95 is the AR22. This model is entirely suitable for small 6 meter beams, most 2 meter beams, and practically every TV antenna.

The next model up, the TR44, surpasses all TV-FM rotators in wind resistance, torque, and dead weight load carrying capacity. One of the features of the TR44 is a built-in braking system that insures that the antenna will be held in place. This is a disk clutch brake arrangement which is disengaged when the motor is energized. The TR44 includes a zener regulated meter indicating system and the whole package sells for $69.95.

The advanced Ham-M is the best rotor system available to the ham at a moderate price. It is capable of supporting a 1000 lb. dead weight. It includes a heavy solenoid brake which will withstand up to 3500 lbs. of torque from wind pressure. The Ham-M is designed for either tower or mast mounting as is the case with the AR22 and the TR44. It is supplied with a precisely calibrated meter control unit to indicate position through 360° of travel. The Ham-M sells for $129.95.

If you will look on the back cover of this catalog, you will see an illustration of one of our towers and the Christmas tree which is on it. Here we use a Mosley TA36, a Cush-Craft 10-element 6 meter-beam, an 11-element 2 meter beam and a Kreco 10 meter ground plane. This assembly is very large and yet the whole kit and kaboodle is handled with ease by the Ham-M. This shows the confidence I place in these products.

Ameco

TX-62

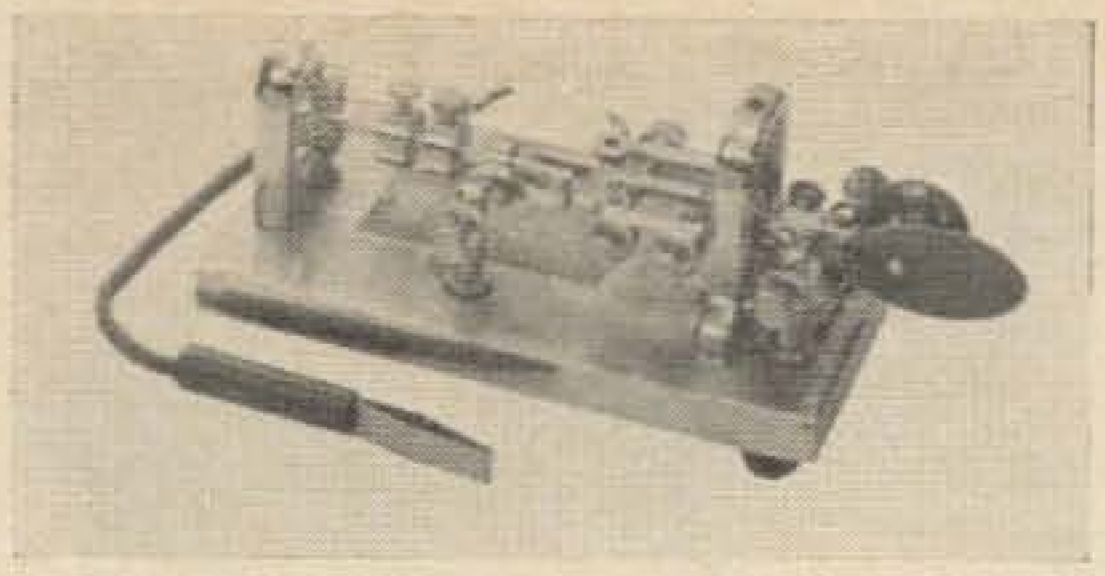
CB

In the Ameco line, we have chosen to stock the TX-62 and its companion VFO, the 621. We have their NuVistor preamplifier for 6 and 2 meters. We have their CB line of converters of 6 and 2 meters. We have a limited number of CN line high-quality converters. We have their all-band amateur converter, their CMA, and we have their code model oscillator CPS, and their code practice records and radio amateur license manuals.

The TX62 is an inexpensive compact VHF transmitter. It is easy to tune because all circuits excepting the final are broad-banded. The meter will read either RF output or grid current and the transmitter will work efficiently on both 2 and 6 meters. The crystals used are inexpensive 8 MC types. The power input to the final is 75 watts, phone or CW. The unit includes a solid state power supply and will cover 50—52 MC on 6 meters and the whole of the 2 meter band including MARS and CAP frequencies. The price of this unit, factory wired, is but $149.95.

Ameco makes a very fine companion VFO. It is a highly stable unit, transistorized, with zener diode regulation. It operates from 115V AC and provides 8—9 MC output as may be required for 6, 2, or 1¼ meters. The factory wired price of this VFO-621 is only $59.95.

Ameco is a very popular line, well thought of, and very practical for most hams to use.



Vibroplex

Many good ham stores have to carry most of the usual ham accessories. When we first opened we were asked for Vibroplex and we were obliged to get these. We are now pleased to advise our friends of the availability of a complete line of Vibroplexes including the Vibro-keyer which is used with automatic electronic keying circuits. This is the paddle type device with three terminals which will enable you to properly operate any of the standard popular, automatic, electronic keying circuits. We do not carry in stock the Vibroplex carrying case, but we certainly can get it for you quickly and we can arrange to have any Bug engraved with your name on the base for only $1.50 extra.

The Improved "Original" Vibroplex

This great new Vibroplex is a smooth and easy working BUG. It has won fame on land and sea for its clarity, precision and ease of manipulation. Can be slowed down to 10 words per minute or less or geared to as high rate of speed as desired.

Standard—Chromium top parts, grey base. **$24.95**

DeLuxe—Chromium base and top parts, with jeweled movement. **$29.95**

New Super De Luxe "Presentation" Vibroplex

New patented adjustable main spring affords wider range of speed than ever obtained before in semi-automatic transmitting key. Beautifully-designed with polished chromium precisioned machined parts mounted on a 24K gold-plated base top with colorful red switch knob, finger and thumb piece. This new Super-DeLuxe "Presentation" Vibroplex key affords a life-time of sending enjoyment. Harder than metal, the jewels in this key reduce friction, maintain smoother, easier operation and prolong life. **$39.95**

The "Lightning Bug" Vibroplex

Flat pendulum model. Weight 3 lbs. 8 oz.

Standard—Polished Chromium top parts, grey base. **$23.95**

DeLuxe—Polished Chromium base and top parts, with jeweled movement. **$29.95**

The "Champion" Vibroplex

Without circuit closer. Standard finish only. Chromium finished top parts, with grey crystal base. **$19.95**

The "Blue Racer" Vibroplex

Standard—Finish Chromium top parts, grey base **$24.95**

DeLuxe—Polished Chromium base and top parts, with jeweled movement. **$29.95**

Over the years, we have had many requests for Vibroplex parts to be used for construction of a keying mechanism for an electronic transmitting unit. This beautiful and most efficient "Vibro-Keyer" is ideal for this job.

Beautiful beige colored base, size 3½" x 4½", weight 2¾ pounds. Same large size contacts as furnished on Deluxe Vibroplex. Same main frame and super finished parts as Deluxe Vibroplex. Colorful red finger and thumb pieces. Has the same smooth and easy operating Vibroplex trunion lever. **$18.95. Deluxe Finish $24.95.** A real "Gem" adjustable to suit your own "taste."

Dow-Key

Practically all of the antenna relays sold in this country to individual hams come from Broomfield, Colorado where they are made by Dow-Key. Gordon Dow has succeeded in specializing in one kind of product and has done very well with it. We carry practically the entire Dow-Key line in 12V, 48V, 110 AC configurations and we carry the double male connectors which Mr. Dow originated.

DK60 Series

The Dow-Key DK60 series of coaxial relays are ruggedly built and individually inspected for complete dependability. Because of the quality and adaptability of the relays, they are now being used in a multitude of applications—including military, industrial, the amateur field, etc.

COIL RATINGS: 6, 12, 24, 28, 32, 48, 110 and 220 V DC @ 2 watts. 6, 12, 24, 110 and 220 V AC @ 6 VA, 50 - 60 cps. Special coil voltages available on request. Coil terminals are solder connections feed-through insulators.

r.f. RATINGS: 1 kw power rating to 500mc. 20 watt power rating to 500 mc in DK60-G and DK60-G2 in **de-energized** position. The DK60-G and DK60-G2C have a special isolation connector in the de-energized position to reduce crosstalk to a minimum.

AUXILIARY CONTACTS: Form 2C (DPDT) on DK60-2C and DK60-G2C, Bifurcated contacts rated at 5 amperes at 110 V AC non-inductive.

VSWR: Less than 1.15:1 from 0 to 500 mc (50 ohm load). 72 ohm relays available.

ISOLATION: Greater than 60 db @ 10 mc in DK60 and DK60-2C. Greater than 100 db from 0 - 500 mc in DK60-G and DK60-G2C when in the energized position.

OPERATING TIME: Less than 30 milliseconds from application of coil voltage; less than 15 milliseconds between contacts.

STANDARD RELAYS WITH TYPE UHF CONNECTORS INCLUDE:

DK60-SPDT r.f. switch $12.45

DK60-G-SPDT r.f. switch with special "isolation" connector in deenergized position, ... $13.70

DK60-2C-SPDT r.f. switch with DPDT auxiliary contacts, ... $14.35

DK60-G2C-SPDT r.f. switch with DPDT auxiliary contacts and special "isolation" connector in deenergized position, ... $15.65

DK2-60 Double Pole Throw Switch

A DPDT coaxial switch for switching two coaxial lines simultaneously.

SPECIFICATIONS: Frequency range — 0 to 500 mc; Power rating—to one kilowatt; VSWR—less than 1.15 to 1 from 0 to 500 mc; Isolation—greater than 30 db at 500 mc, increases 6 db per octave below 500 mc; Loss—less than 0.03 db at 30 mc; Life expectancy—over 1,000,000 operations; 50 ohm impedance.

COIL VOLTAGE AVAILABLE: 6, 12, 24, 28, 32, 48, 110 and 220 D.C. and 50-60 cps A.C. (additional charge of 90c for 110 and 220 vDC)

R.F. CONNECTORS: Type UHF are standard. Type N, BNC, TNC and C connectors are available.

GUARANTEE: Guaranteed for a period of one year. If faulty within one year the switch will be repaired at no charge other than 75c for handling and mailing.

Coaxial Connectors and Adapters

Type	Connector Description	Net Each
DKF2	UHF Double Male	$ .95
DK60-P	UHF panel mount female	.70
DK201	UHF panel mount male	1.25
DK202	UHF double female	.85
DK210	UHF female to male phono	1.25
DK211	UHF male to male phono	1.25

DKF2-Connector
Double Male

A favorite everywhere. Precision made, rugged locking type. Silver plated.

DKF-2 .... $.95

DK78 Series
Manual Coaxial Switches

Dow-Key Company's manual series of coaxial relays with excellent R.F. characteristics (not wafer switches). Available in four configurations—single pole two throw (DK78-2), single pole three throw (DK78-3), single pole six throw (DK78-6), and transfer switch (DK78-T).

SPECIFICATIONS: R.F. Ratings: 1 KW to 500 mc. VSWR and Isolation: See curves. Impedance: 50 ohm. Contacts: Fine silver, others available upon request. Connectors Available: UHF are standard, types N, BNC, TNC and C are also available. Operating Temperature Range: —55 degrees C. to Plus 85 degrees C. Finish: Coaxial connectors—silver plated, Body—black anodized. Mountings: Requires one 7/16" dia. hole and one 5/32" dia. hole. Weight: 10-oz. Size: 3" diameter x 1⅛" deep. Guarantee: Guaranteed for a period of one year. If faulty within one year the switch will be repaired at no charge other than 75c for handling and mailing.

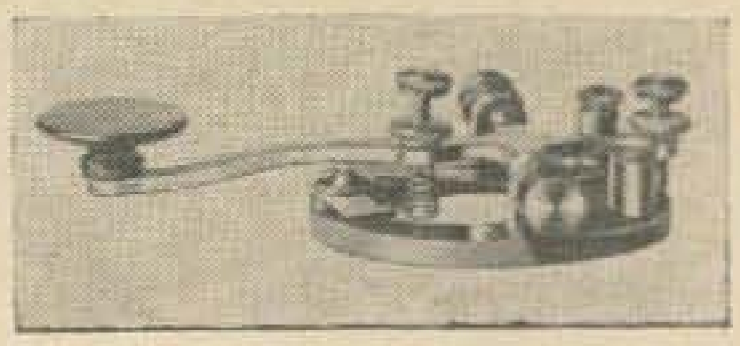
PRICING

Model	Standard Model with UHF connectors	With type N, BNC, TNC or C connectors*
DK78-2	$12.75	$15.75
DK78-3	12.75	15.75
DK78-6	15.75	21.75
DK78-T	15.75	18.75

*Specify type of connectors desired if other than UHF.

E. F. Johnson Telegraph Keys

We carry almost the complete line of E. F. Johnson Company telegraph keys and are pleased to make them available to our friends.



PRACTICE KEY

An inexpensive practice key, perfect in design for the beginner. All the metal parts are nickel plated. Furnished with an adjustable key arm, spring, and smooth action bearings. Contacts are 1/8" coin silver.
114-300 molded phenolic base $2.40

PHENOLIC BASE KEYS

High quality key with adjustable bearings. Improved spring-pigtail connection. 1/8" coin silver contacts, nickel plated metal parts.
114-301 molded phenolic base, no switch $2.50

STANDARD KEYS

Heavy diecast base. Smooth adjustable bearings. Provision for plugging in semi-automatic keys. 1/8" coin silver contacts. A high quality key at low cost.
114-310 black wrinkle, no switch $3.50
114-310-3 black wrinkle, with switch 4.25
114-311 chrome plated, no switch 5.50
114-311-3 chrome plated, with switch 6.50

HEAVY DUTY KEYS

Heavy diecast base, chrome plated key arm, well insulated for heavy duty service. Large quarter inch coin silver contacts. Improved Navy-type knob. Adjustable steel bearings, spring design give light keying touch.
114-320 black wrinkle enamel base $4.95
114-321 polished chrome plated base 5.85

HIGH SPEED STANDARD KEYS

Fully adjustable spring tension, contact spacing and bearings. Brass base and binding posts, instrument lacquer finish .072" platinor contacts.
114-100 R48 key, satin brass, no switch $6.95
114-100-3 M-100 key, satin brass, with switch 7.95

Popular Johnson Transmitters

The Johnson Viking line has been sold by the tens of thousands to hams all over the world and many fellows have cut their eye teeth on this fine product. We carry and feature the following items:

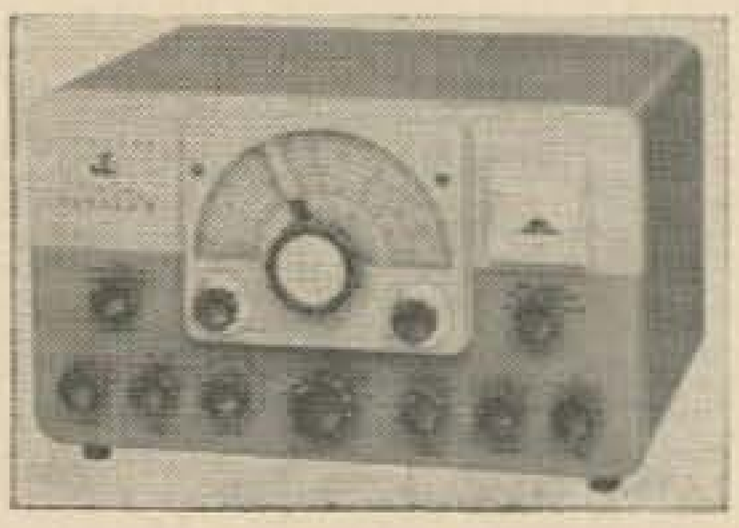
VIKING "ADVENTURER"

An ideal 50 watt CW transmitter for the novice or experienced amateur. Effectively TVI suppressed . . . built-in power supply . . . Handswitching 80 through 10 meters. Operates by crystal or external VFO control. Easy to build, easy to operate. Complete with tubes, less crystal and key.
Cat. No. 240-181-1 Kit .... Amateur Net $69.95

Adventurer

VIKING "RANGER II"

Tops for operating convenience—enough power for world-wide contacts! Also serves as an RF/audio exciter for high power equipment. Built-in VFO or may be crystal controlled. Bandswitching 160 through 6 meters. 75 watts CW input—65 watts phone. TVI suppressed—with tubes, less crystal, key, microphone.
Cat. No. 240-162-1 Kit .... Amateur Net $249.50
Cat. No. 240-162-2 Wired .... Amateur Net $359.50



Ranger II

VIKING "CHALLENGER"

Ideal for fixed station, portable or field day use, the "Challenger" is designed for fast, easy tuning, excellent stability and plenty of reserve drive. 70 watts phone input 80 through 6; 120 watts CW input 80 through 10 . . . 85 watts CW input on 6 meters. Wide-range pi-network output—effectively TVI suppressed—excellent keying system. For crystal or external VFO control. With tubes.
Cat. No. 240-182-1 Kit .... Amateur Net $124.75
Cat. No. 240-182-2 Wired .... Amateur Net $169.75

VIKING "6N2"

This Compact VHF transmitter is rated at 150 watts CW and 100 watts phone. Bandswitching 6 and 2 meters—may be used with the Viking "Ranger 11" or similar power supply/modulator combinations. Crystal control or may be operated by external VFO with 8-9 mc output. With tubes, less crystals, key and mike.
Cat. No. 240-201-1 Kit .... Amateur Net $149.50
Cat. No. 240-201-2 Wired .... Amateur Net $194.50

6N2

Gonset Linear Amplifier

Modern Gonset Amateur Equipment

We have the complete line of the modern Gonset ham gear including the popular Communicators, Sidewinders, and the respective linears.

Remember that Gonset makes the only 2-meter sideband transceiver and that this unit was designed to operate in either a car or at home.

The model G-50 has enjoyed an enviable reputation for years as an advanced type Civilian Defense communicator. It is really a complete station with 48 watt input, a dual conversion receiver and power supply all in one package. The G-50 covers the range of 50-54 mcs. All you need do is plug in the power, microphone, and connect up the antenna and you can thrill to the excitement of 6-meter DX.

The G-50 includes a 6146 tube with a pi network capable of matching all standard coaxial lines. The multiplier stages are tracked with the accurately calibrated VFO. There is a spotting control and a built-in low pass filter which attenuates all harmonics and spurious emissions above 65 mcs by 80 db or more. This package includes a built-in speaker, calibrated S-meter, and planetary dial drive. It measures 7½" high, 13" wide, 12½" deep and weighs but 29#. The price on the G-50 for standard operation is $367.30. For official CD use, the G-50 is priced at $389.95.

The 2-meter Sidewinder noted above is very small, measuring 8⅞" x 4⅞" x 7³⁄₁₆" and weighs only 10½#. Either AC or DC supply measures 8⅞" x 4⅞" x 5⁵⁄₁₆" and is intended to clamp onto and plug into the rear of the transceiver making what appears to be one complete package. The 2-meter Sidewinder covers the entire 2-meter band in four segments, 1 Mc wide. Completely transistorized, the set draws only 1.05 amps in receive position and 8 amperes in DC transmit position. When used on AC, it draws only 100 watts. The rating of the 2-meter Sidewinder is 20 watts PEP, 6 watts for AM and 20 watts for CW. The sensitivity is 0.5 microvolt for db signal plus noise to noise ratio while the bandpass is 3.1 kc from a specially designed crystal filter. The unwanted products are down 50 db. The Sidewinder sells by itself for $399.50. Its AC supply is $73.50 and its companion DC supply, $79.50.

We also carry in stock the 2-meter linear amplifier model 903A which is rated at 500 watts PEP or 300 watts on AM peaked. It requires only 5 watts of excitation and works into a 50-ohm nominal output. Its weight is 60#. Its dimensions are 8½" high,, 12⅝" wide, 17⁵⁄₁₆" deep. These units will cover adjacent MARS frequencies as well as the entire 2-meter band. They employ a 4X150A tetrode in an AB_1 configuration and require only 5 watts of drive.

The 6-meter Sidewinder is an original design and covers the range of 49.975 to 54.025 mc. Unwanted productions are down a minimum of 40 db. This transmitter has the same power rating as its companion Sidewinder and the receiver is likewise similar in sensitivity to its 2-meter brother. The model 910A transceiver measures 9½" wide, 5½" high, 9" deep. It is priced at $399.50. The DC and AC supplies are in physically similar cabinets but only 5⁵⁄₁₆" deep. The weight of the transceiver is 11# and of each supply 14#. The companion 500 watt linear amplifier is Gonset's 913A and is priced at $339.

Gonset Sidewinder

Swan 350

Get with it, fellows! Get Swan!

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.

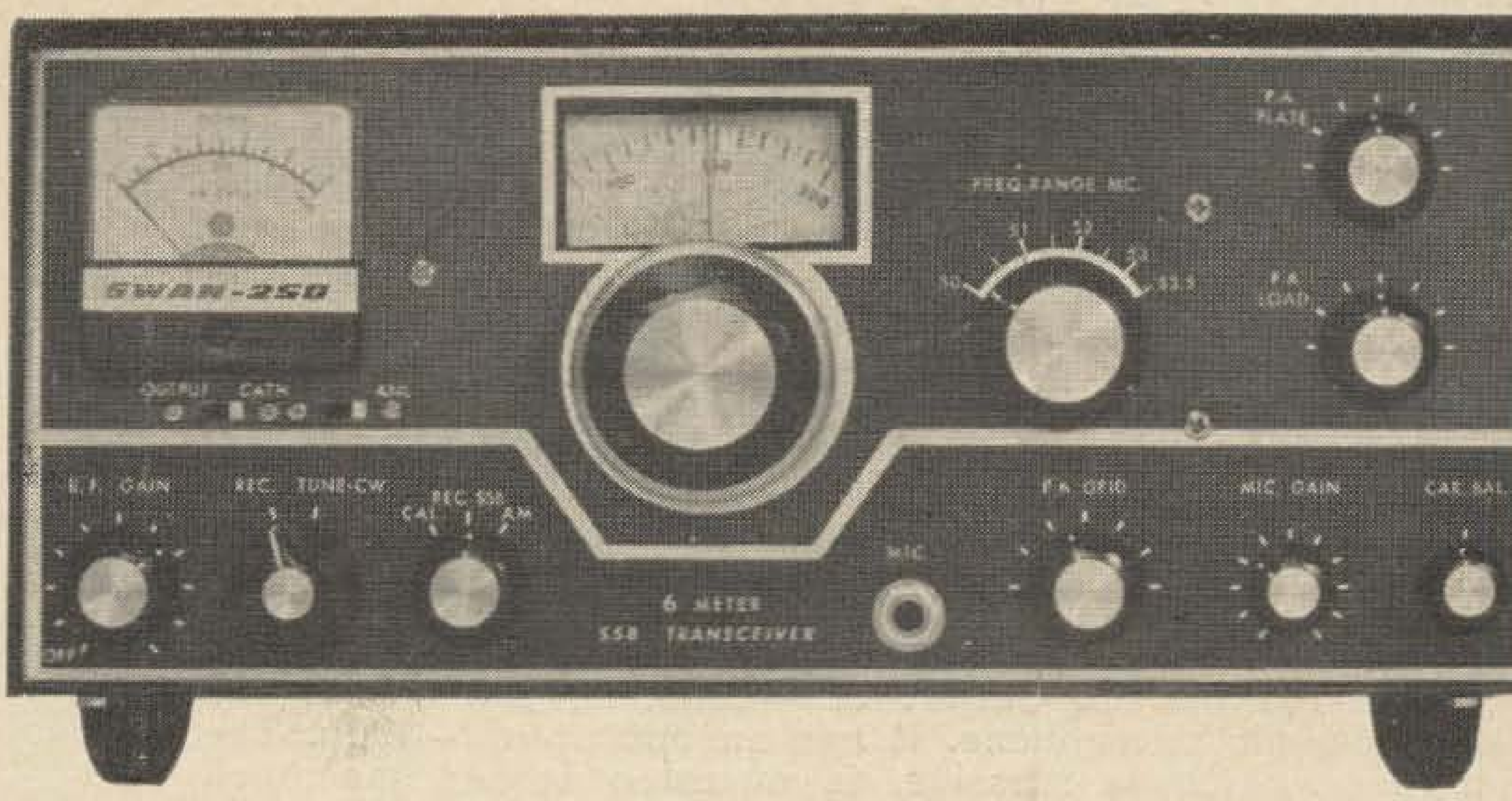
The largest seller continues to be the model 350. This is a 5-band complete-coverage transceiver providing AM, CW, and sideband operation. Its companion is the Model 400. Let me describe the difference between the two. The 350, with an appropriate power supply is a complete package requiring only a microphone 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.

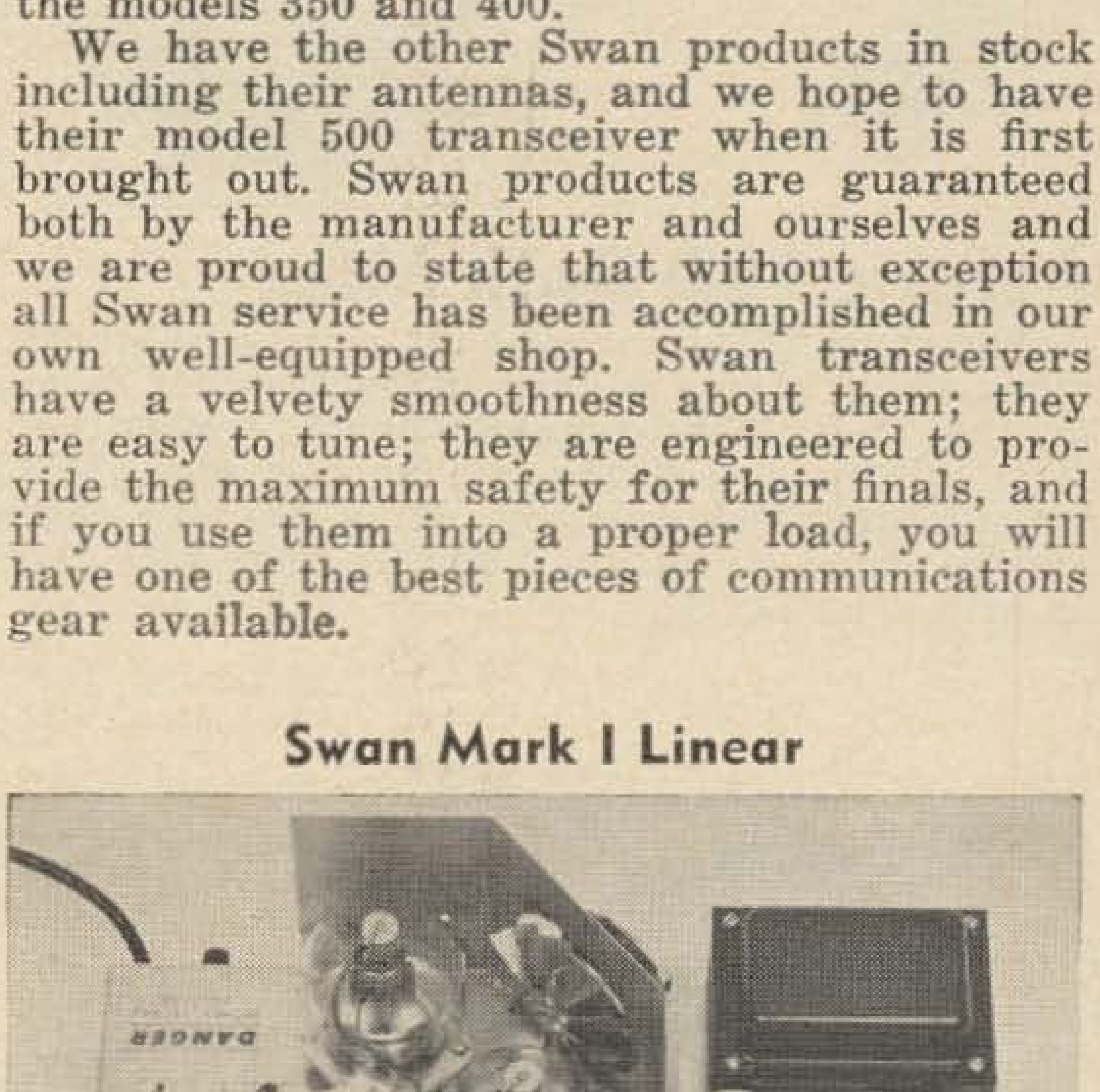
I think, when you evaluate the cost of other manufacturers' products, you will find it less expensive to put the Swan in the car to start with than other brands and certainly far less expensive to get a combination supply.

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

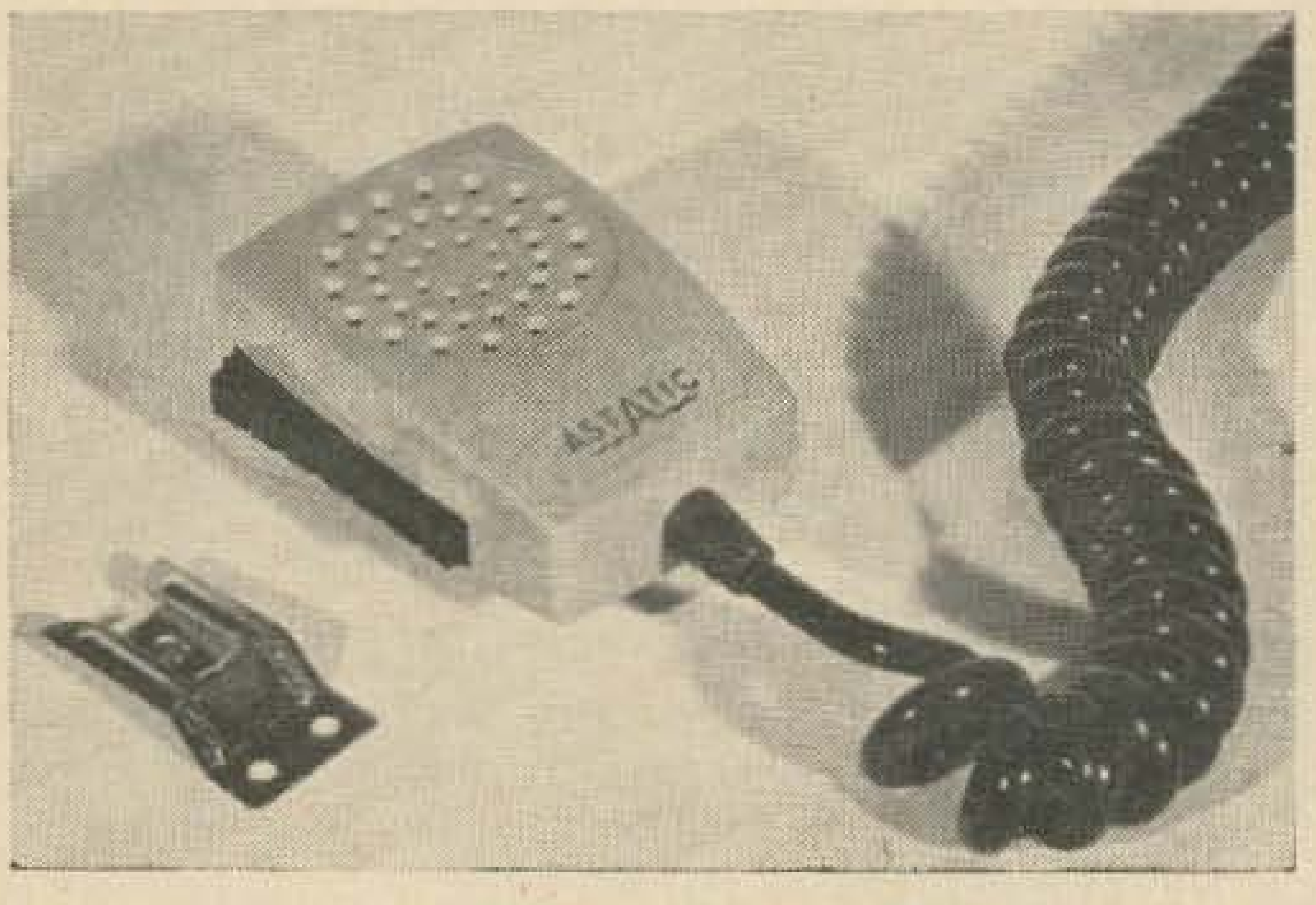


Astatic D104 Desk Mike

The illustration on this page discloses the most popular microphone that we have found for amateur application. The D-104 made by Astatic has been the ham's friend for better than 30 years. It was really the first piezo crystal microphone available and to this day, it is clear, crisp and of highly intelligible quality. It is easily recognized at thousands of amateur installations throughout the world.

One feature of the D-104, aside from its impressive chrome-plated appearance, is its relatively high output. This means that the microphone need not be talked into closely, with the accompanying raspiness of your breath made evident to the person you are talking to. Speaking in a normal conversational voice, between 6 and 12 inches away from the microphone, this D-104 will provide the output equal to many foreign imports which require close talking.

The D-104 has an output of —46db. If you choose the D-104 ceramic microphone, it has an output of —49db. The cartridge, which is massive, is mounted behind machined brass parts with a heavy mesh grille. The basic microphone is furnished with a standard ⅝-27 thread mounting but most of the hams buy the microphone complete with the G-stand with the push-to-talk feature as shown in the illustration. Our price for the microphone itself is $18.60. With G-stand, it is priced at $33.72.



Astatic 531 Hand Held Mike

A thoroughly satisfactory microphone for mobile application is Astatic's model 531 mobile mike which we sell for $7.50. This is a high performance ceramic microphone with a tailored response for maximum clarity and intelligibility for speech frequencies. It has a high impact plastic housing with a 3-conductor shielded coiled cable 5′ long. When a ham comes to us and wants a practical microphone for mobile operation, either sideband or AM, we recommend and sell many of these 531's.

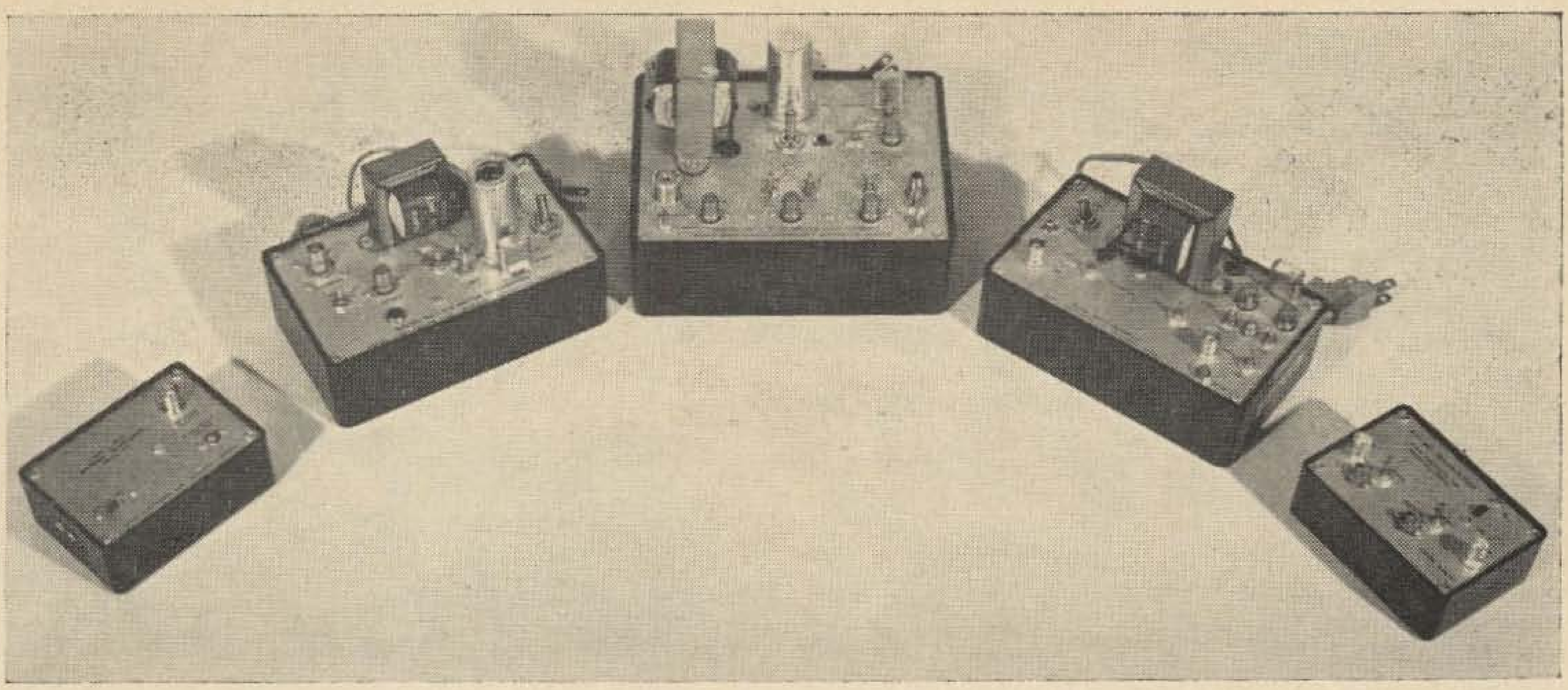
Astatic 10D Desk Mike

For those of you who want a velvety smooth reproduction when using sideband, try using a dynamic microphone such as the 10-D. This dynamic has an output of —52db. It is particularly suited for the special characteristics required in sideband transmission. It is heavily chrome-plated and can be supplied by itself for $18.04. With the PTT stand, it is priced at $38.94.

Astatic 10D Desk Mike

Turner +2 Crystal Desk Mike

The Turner +2 microphone shown in the illustration at left is the latest rage among hams who want to simulate broadcast or studio type of operation. This microphone has a transistorized preamplifier built into the metallically-shielded neck of the microphone. Uses a ceramic crystal cartridge and includes a self-contained 9V battery in the base. The all-over gain of this microphone is such that approximately —25db of output may be expected. There is a threshold volume control which can be set to the sensitivity desired. This microphone sells for exactly $30 and many hams are using it. I use one myself and I like it very much.



Parks VHF Converters

Loren Parks is a big guy in more ways than size. Having worked under Dr. Schmidt of Schmidt trigger fame, he knows his electronics and besides that, he's an avid ham. K7AAD almost single-handed has kept the VHFer Magazine going—and so he knows his ham friends as well. When, five years ago, Loren felt the need of a superior VHF converter, he did the obvious thing—he built his own; and when his friends heard this converter work, they wanted one like his. K7AAD and W7UHF got together and started building these artistic little black boxes in Loren's garage. The fact that Loren has a Tektronix background meant that he was most particular about quality.

Word spread and soon Parks Electronics was on the way. Today it can truly be said that his VHF converters span the globe and provide the most outstanding performance available.

Each converter is individually tested for gain, width, and noise figure. Each has its own self-contained power supply—even the latest transistorized 432-3 model.

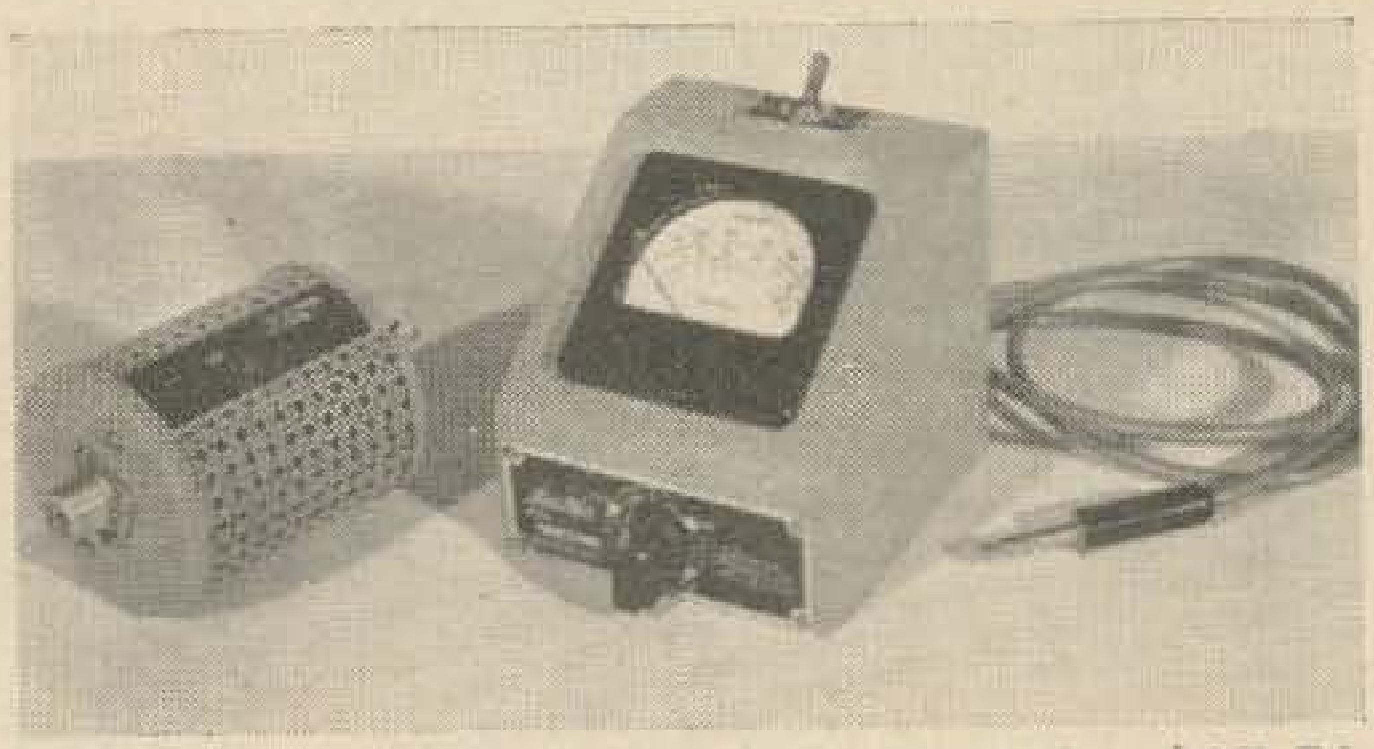
We stock all of Loren's models in most IF configurations and with the constant impedance BNC connectors. Here is the schedule of prices now in existence:

Model No.	*IF out*	*Input Impedance*	*Price*	*Noise figure better than*
50-1	7 - 11 MC	50-ohms	$38.50	2.5 db
"	10 - 14 MC	"	"	"
"	14 - 18 MC	"	"	"
"	26 - 30 MC	"	"	"
"	28 - 32 MC	"	"	"
"	30.5 - 34.5 MC	"	"	"
144-1	7 - 11 MC	50-ohms	$59.95	3 db
"	10 - 14 MC	"	"	"
"	14 - 18 MC	"	"	"
"	26 - 30 MC	"	"	"
"	28 - 32 MC	"	"	"
"	30.5 - 34.5 MC	"	"	"
220-1	20	50-ohms	$69.95	4.5 db
"	27	"	"	"
"	28	"	"	"
"	30	"	"	"
432-3	28	50-ohms	$61.50	4 db

Preamplifiers available at $25.00 for 144, 220, and 432 MC. The only distributor presently selling and stocking Parks, east of the Mississippi is the Herbert W. Gordon Company and we'd love to sell you. Allow 1½ lbs. for each Parks shipment.

VSWR Instruments

Cesco CM52-2 $35



Bendix Micromatch 261-2 $37.50

Having hammed for close to 40 years in an active way, I believe that I possess the experience to enable me to make certain statements concerning ham radio and for them to ring with a degree of authenticity. One such statement that I repeatedly make to my ham friends is this: "There is no better way to obtain a higher order of performance from your station than by improving the antenna and tower assembly and, once this is done, there is no better way of assuring yourself of top-flight performance than by monitoring the VSWR of your own station. In the old days, most of us used open-line and zepp feeder and nobody even heard of high standing wave ratios. But in the past 25 years, coax has been improved and used widely plus the fact that most modern commercial transmitters are designed around an unbalanced pi network and now nearly everyone of us use coax feed for our antennas.

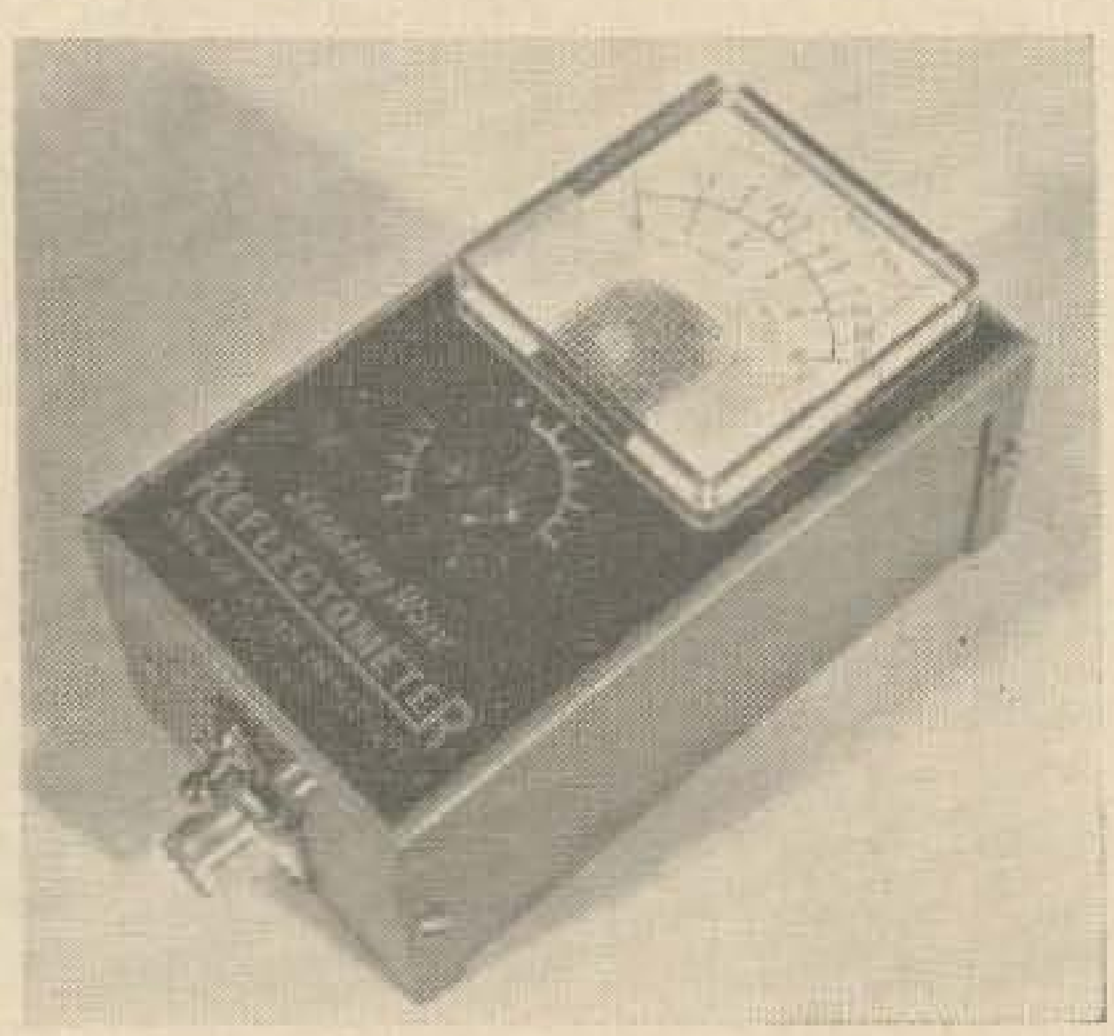
One simply cannot radiate power efficiently if the standing wave ratio is higher than 2.5 to 1. Indeed there is a more important reason for keeping this ratio down. Every commercial transceiver or transmitter is designed with fixed limitations of component values in its tank circuit. You will exceed the dissipation rating of the transmitter and its final if you operate with a ratio of more than 2.5 to 1. A good rule of thumb is to monitor your forward power at all times, and when reflected power exceeds 10% of the forward power, then you ought to reverse your frequency tuning your rig to its antenna and a consequent lower VSWR.

We stock four instruments here at Harvard which do this particular work and do it very well. Two of these are two-piece devices and arranged so that their directional coupler is in the line adjacent to the transmitter at all times while the monitoring device or the indicator may be placed anywhere within easy view. These instruments specifically are the Bendix Micro Match model 261-2 shown in the illustration and selling for $37.50, and the Cesco model CM52-2 which sells for $35. Both instruments are essentially similar in application but electrically different in design. Each is designed to measure power up to 1000 watts and over a frequency range of 3 to 200 MC. They weigh approximately 1½ pounds each. The little Cesco CM152 is a thru-line device with a meter mounted directly on its case. Its rating and frequency limitations are the same, but this instrument is priced at only $30. It is more awkward to use because the meter is not plainly visible in most installations. All are 52-ohm devices.

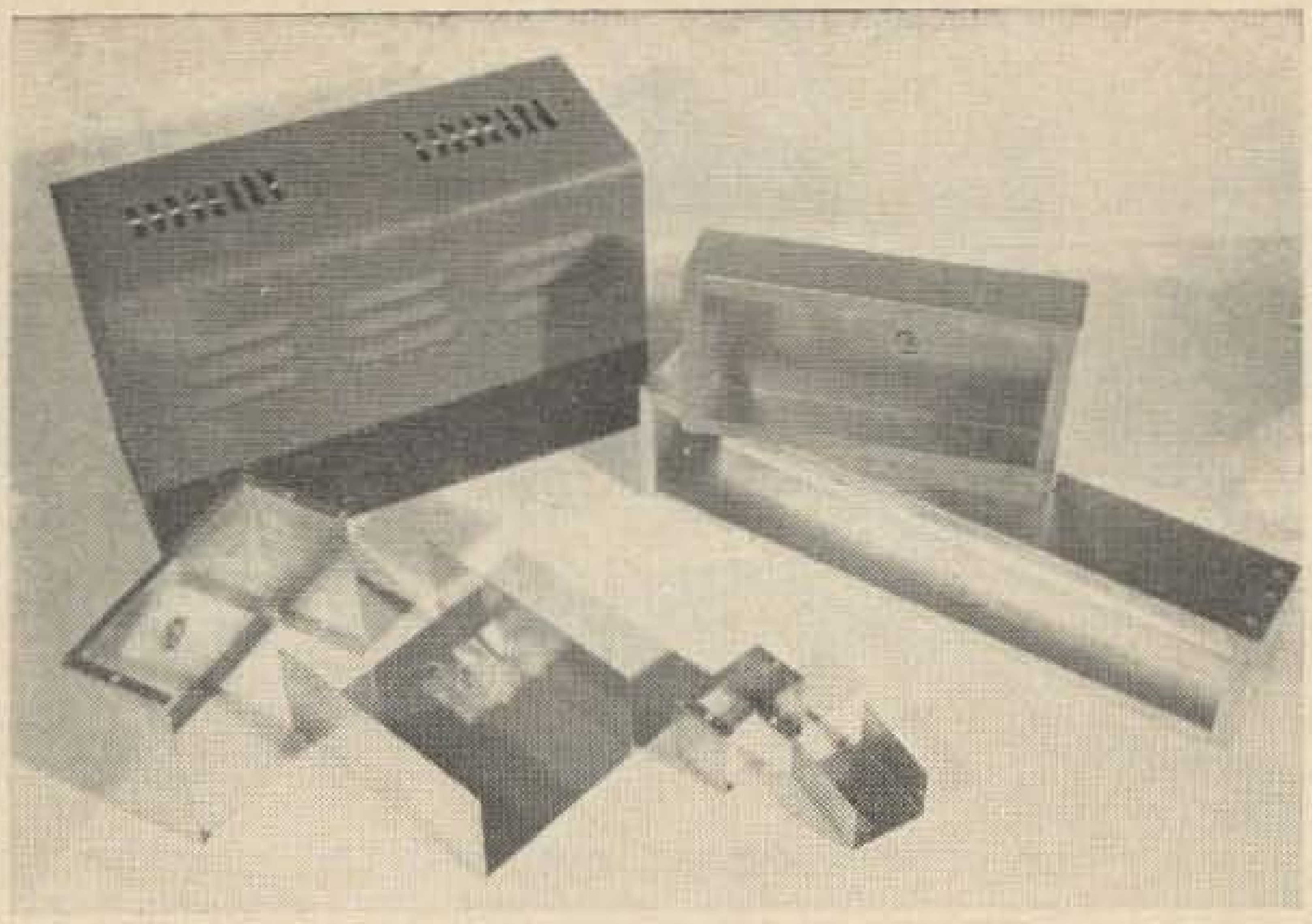
The Seco 520 Antenna Tester is a somewhat different breed of cat. This is an RF-indicating device consisting of a directional coupler and a signal indicator. The associated switching calibrator and resistor pad components are arranged so that the forward of incident power can be measured from 0.5 watt to 1000 watts. Standing wave ratio information is available on three selected scales from 1.1 to 8.1. An English scale states whether an antenna is good, fair, or poor. You might consider this Seco tester as a deluxe device since its price is $45. This unit is capable of providing good performance from 3.5 MC to 180 MC. It must stay in the line at all times.

In the model 520, the directional coupler consists of a short section of transmission line with an air dielectric. Two inductive circuits are placed back to back near the coaxial center of this line. The combination of inductive and capacitive coupling is such that the forward power is cancelled out and the indicator measures a true reflected power. Since the inductors are placed back to back, one actually measures reflected power and the other, forward power. The ratio of these separate components determines the SWR. There is a capacitive network for changes of frequency and multiplying resistive network for differences in power.

Left: Seco Model 520 Antenna Tester $45



Right: Cesco CM152 $30



Middletown Metal Ware

Everything that a ham would want in building material, aluminum or steel, is made by Middletown Manufacturing Company and stocked by us. For the little transistorized rigs you will perhaps want one of their Multi-mounts. For the bigger rig, rack panel and chassis combination. Remember that some items are available in aluminum as well as steel. If you want something considered standard, that is not listed here, write to us; we are likely to be able to supply it to you quickly.

Rack Panels

Cat. No. Steel (Blk. Wrinkle)	Cost	Height	Cat. No. Aluminum (Black Wrinkle)	Cost
R.P. 1	$ .85	1¾"	A.R.P. 1	$ 1.10
R.P. 3	1.02	3½"	A.R.P. 3	1.44
R.P. 5	1.23	5¼"	A.R.P. 5	1.94
R.P. 7	1.43	7"	A.R.P. 7	2.45
R.P. 8	1.76	8¾"	A.R.P. 8	2.86
R.P. 10	2.10	10½"	A.R.P. 10	3.60
R.P. 12	2:45	12¼"	A.R.P. 12	4.05
R.P. 14	2.87	14"	A.R.P. 14	4.79
R.P. 15	3.11	15¾"	A.R.P. 15	5.32
R.P. 17	3.52	17½"	A.R.P. 17	5.87
R.P. 19	3.70	19¼"	A.R.P. 19	6.37
R.P. 21	4.20	21"	A.R.P. 21	6.89
R.P. 26*	5.40	26¼"	A.R.P. 26*	9.18
R.P. 35*	7.50	35"	A.R.P. 35	11.94

Amplifier Foundations

This unit is designed to meet the most critical requirements. It has rounded corners, special Middletown designed louvres on all 4 sides and elongated holes on top to give maximum ventilation. Chassis are finished in Black wrinkle. Covers are finished in Grey wrinkle. Chassis are drilled for bottom plates which are listed separately. Covers all have a depth of 6".

Cat. No.	Size	Cost
A.F.-5109	5 x 10 x 9"	$4.20
A.F.-6149	6 x 14 x 9"	4.85
A.F.-7179	7 x 17 x 9"	5.62
A.F.-10129	10 x 12 x 9"	5.62
A.F.-10179	10 x 17 x 9"	6.38
A.F.-13179	13 x 17 x 9"	7.68

Multi-Mounts

These are all-purpose boxes with an unlimited field of application in radio and electronics. Made from prime sheet aluminum. Two-piece telescoping construction, each half forming three sides. Finish is natural aluminum or grey hammer-tone.

Natural Aluminum		SIZE			Grey Hammertone	
Catalog Number	Cost	H	W	D	Catalog Number	Cost
MM 122	$ .69	1⅝	2¾	2⅛	GHMM 122	$ .78
MM 132	.69	1⅝	3¼	2⅛	GHMM 132	.78
MM 142	.74	1⅝	4	2⅛	GHMM 142	.81
MM 242	.95	2¼	4	2¼	GHMM 242	1.05
MM 252	.98	2¼	5	2¼	GHMM 252	1.08
MM 354	1.15	3	5	4	GHMM 354	1.26
MM 253	1.12	2⅛	5¼	3	GHMM 253	1.20
MM 465	1.40	4	6	5	GHMM 465	1.50
MM 375	1.56	3	7	5	GHMM 375	1.88
MM 386	2.30	3½	8	6	GHMM 386	2.52
MM 3106	2.90	3½	10	6	GHMM 3106	3.14
MM 4127	3.21	4	12	7	GHMM 4127	3.60
MM 4175	3.80	4	17	5	GHMM 4175	4.23
MM 1102	1.15	1⅝	10	2	GHMM 1102	1.37
MM 2122	1.55	2¼	12	2½	GHMM 2122	1.65
MM 2420	.93	2¾	4	2	GHMM 2420	1.02
MM 1420	.95	1½	4¼	2¼	GHMM 1420	1.05

Chassis Brackets

Catalog Number	Size	Shipping Weight	Cost
C.B. 8	For 8" Base	2 lbs.	$ .96
C.B. 11	For 11" Base	3 lbs.	1.35
C.B. 13	For 13" Base	3 lbs.	1.82

Rounded Corner Cabinets

These are de luxe streamlined cabinets with front vertical corners rounded. Flush panel door, hung on full-length piano hinge, provided in top for convenient access. Ventilating louvres on sides. Opening at bottom of rear panel permits easy accessibility for leads, cables, etc. Front panel held in position with self-tapping screws. Grey wrinkle finish. Sturdily built of sheet steel.

	Size			Panel Space		Chassis Size			Cost
Catalog No.	H	W	D	H	W	D	W	H	
RC 8108	8	10	8	8	8	7	7	2	$4.47
RC 8128	8	12	8	8	10	7	9	2	4.91
RC 8168	8	16	8	8	14	7	13	2	6.27
RC 91711	9	17	11	9	15	10	14	3	9.35
RC 122012	12	20	12	12	18	10	17	3	11.59

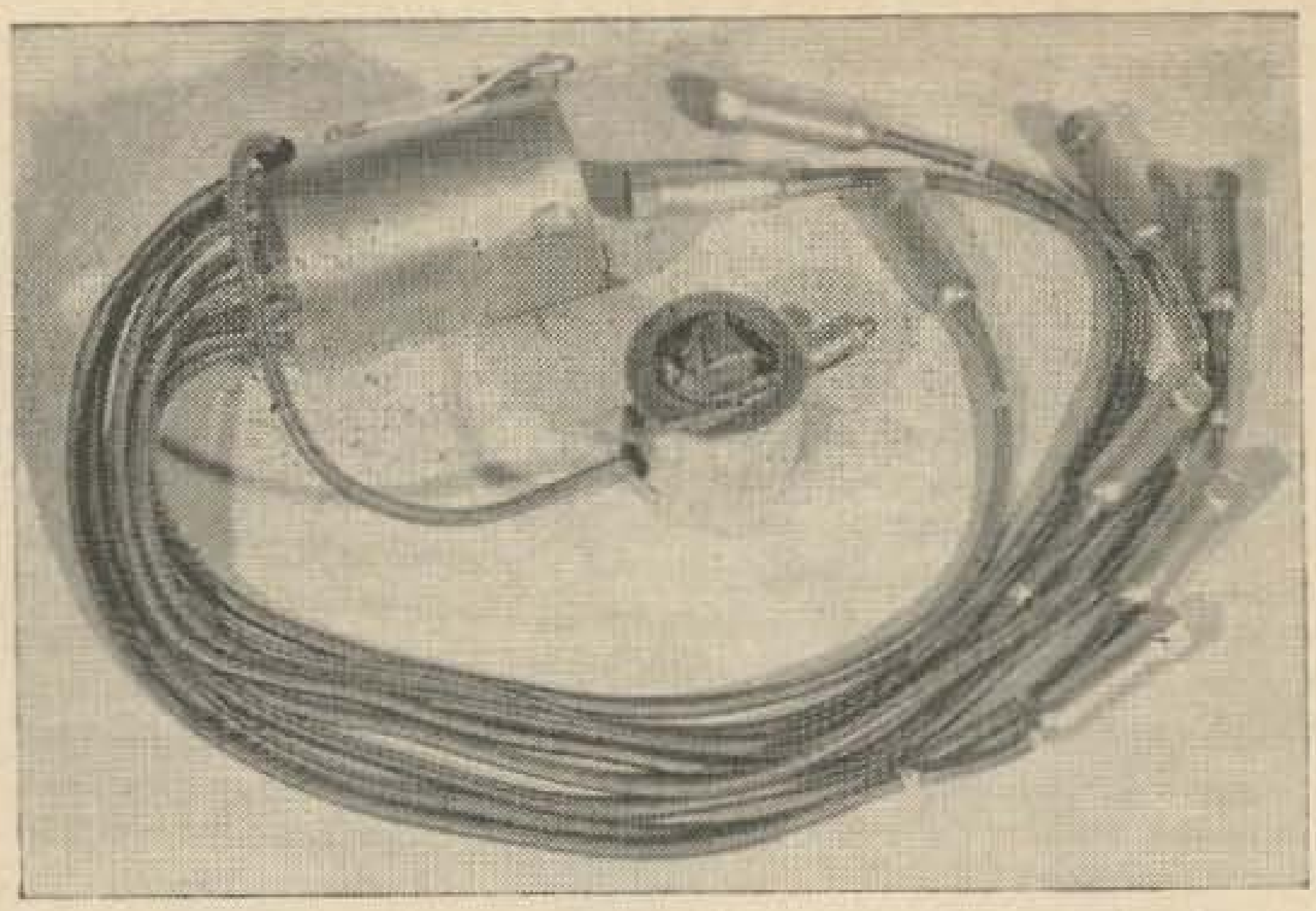
Chassis are not included unless ordered.
See chassis listings. Dimensions in Inches.

Chassis — Steel and Aluminum

STEEL		ALUMINUM		SIZE			COST	
Cat. No.	GAUGE	Cat. No.	GAUGE	D	W	H	Steel	Alum.
*BS 442	22	ABC 442	18	4	4	2	.94	1.10
BS 462	22	ABC 462	18	4	6	2	1.05	1.30
BS 463	20	ABC 463	18	4	6	3	1.07	1.35
BS 4173	20	ABC 4173	16	4	17	3	1.65	2.38
BS 572	22	ABC 572	18	5	7	2	1.05	1.35
BS 573	22	ABC 573	18	5	7	3	1.11	1.41
BS 591	22	ABC 591	18	5½	9½	1½	1.10	1.41
BS 592	22	ABC 592	18	5	9½	2	1.15	1.45
BS 5103	22	ABC 5103	18	5	10	3	1.25	1.62
BS 5133	20	ABC 5133	18	5	13	3	1.59	1.82
BS 6143	20	ABC 6143	16	6	14	3	1.68	2.55
BS 6173	20	ABC 6173	16	6	17	3	1.80	2.75
BS 772	22	ABC 772	18	7	7	2	1.10	1.35
BS 792	22	ABC 792	18	7	9	2	1.33	1.48
BS 7112	20	ABC 7112	18	7	11	2	1.37	1.59
BS 7123	20	ABC 7123	18	7	12	3	1.52	1.94
BS 7132	20	ABC 7132	18	7	13	2	1.48	1.68
BS 7153	20	ABC 7153	16	7	15	3	1.76	2.90
BS 7173	20	ABC 7173	16	7	17	3	1.97	2.88
BS 8123	20	ABC 8123	16	8	12	3	1.82	2.33
BS 8172	20	ABC 8172	16	8	17	2	1.79	2.65
BS 8173	20	ABC 8173	16	8	17	3	1.97	2.95
BS 10123	20	ABC 10123	16	10	12	3	1.89	2.70
BS 10143	20	ABC 10143	16	10	14	3	1.98	3.21
BS 10172	20	ABC 10172	16	10	17	2	1.98	3.15
BS 10173	20	ABC 10173	16	10	17	3	2.05	3.40
BS 10174	20	ABC 10174	16	10	17	4	2.40	4.25
BS 11172	16	ABC 11172	16	11	17	2	2.60	3.52
BS 11173	16	ABC 11173	16	11	17	3	2.85	4.23
BS 12172	20	ABC 12172	16	12	17	2	2.13	3.79
BS 12175	20	ABC 12173	16	12	17	3	2.45	4.42
BS 12174	20	ABC 12174	16	12	17	4	2.58	4.88
BS 13172	16	ABC 13172	16	13	17	2	3.00	3.94
BS 13173	16	ABC 13173	16	13	17	3	3.45	4.62
BS 13174	16	ABC 13174	16	13	17	4	3.85	5.37

Steel Chassis available in zinc plate at additional cost
*No flange on 4 x 4 x 2 Chassis

Estes



When the Estes Electro-Shield ignition harness was opened up from the carton, the photographer asked me what we were doing with a milking machine and, I agree, it does look like that. Stan Estes, out in California, has engineered a remarkably effective noise eliminating kit for automotive or marine use. On FM equipment you don't have to worry too much about ignition shielding, but most of us hams use AM equipment and down on 20, 15, 10, 6, and 2 meters, we who try to operate AM equipment in an automobile are severely hampered by the impulse noise originating in the ignition system of the car. Many gimmicks have been produced over 20 years, with varying degrees of success. The military, of course, had to lick the problem and if you were to study a military jeep or a six-by-six, you would soon find a very expensive metallically shielded ignition system costing hundreds and hundreds of dollars. What Stan Estes has done is to bring out a reasonably priced version of this metallically shielded military system. The Estes Electro-Shield features a brand new distributor cap installed in a metal shield. A set of specially tailored shielded cables with a stainless steel center conductor terminates in a hexagonal spark plug shield which fits completely around each plug. The inserts on each plug are made of silicone insulators and mylar films with teflon sleeves. The whole thing is designed to take up to 450° without melting. The Estes system includes a distributor coil shield and filter assembly. The whole assembly is tested for better than 35,000 volts breakdown in accordance with military specifications MIL-STD-826 and MIL-E-55301. We carry these kits in stock for most cars and with the aid of these kits you will have an effective, reliable water-proofed ignition system which doesn't permit any desensitization of your receiver, nor will the effectiveness of your motor be impaired. As a matter of fact, your motor will most likely work better than ever.

This ignition kit will positively eliminate all ignition noise permanently. It is an economical way of doubling the range of your mobile operations.

Basically, the Estes kits break down into three models:

for a 4 cylinder car $61.95
for a 6 cylinder car 61.95
for an 8 cylinder car 69.95

Estes makes an alternator and generator kit for nearly all applications to sell at $11.50. This is the #6400 and includes thru-line filters, hardware, and specially shielded conduits. It is rated at 50 amperes. If you purchase a transceiver or wish to operate on VHF frequencies in your car with maximum effectiveness, you should buy an Estes shielded system. Simply order according to your car, model and year, mentioning of course, the number of cylinders, and I can ship from stock at once. You don't know how heavenly ham radio can become until you operate in a car which is completely shielded.

Amateur Crystals

We have the largest stock of quartz crystals amongst the radio jobbers in New England. I should have had a photograph taken of our crystal bank. It is at the head of the stairs on the top floor of our new building. John Goullis, W1HQA, spent weeks in arranging the crystals of our stock so as to make them easy to find and orderly with respect to frequency and type.

We maintain stocks from four or more crystal manufacturers and can provide, from stock, practically any amateur frequency within a kilocycle. Over these many years, we have been supplying crystals to the special tolerances required by MARS and we have a considerable number of the special Air Force, Army, and Navy crystals in stock.

All of our crystals are unconditionally guaranteed and all are made to high standards of performance. The standard type FT243 crystal is $2 each plus 5¢ for postage, or 10¢ if it is to go by air. The following chart gives you a rough idea of how to order these crystals:

Band	Freq. Range	Multiplier	Order Crystal Freq. From—To
80-METER GENERAL	3500 to 4000 KC	FUNDAMENTAL	3501-3999
80-METER NOVICE	3701 to 3749	FUNDAMENTAL	3701-3749
40-METER GENERAL	7000 to 7300	DOUBLE	3500-3650
40-METER GENERAL	7000 to 7300	FUNDAMENTAL	7000-7300
40-METER NOVICE	7151 to 7199	DOUBLE	3576-3599
40-METER NOVICE	7151 to 7199	FUNDAMENTAL	7151-7199
20-METER GENERAL	14,000 to 14,350	DOUBLE	7000-7151
20-METER GENERAL	14,000 to 14,350	TRIPLE	4667-4780
15-METER GENERAL	21,000 to 21,450	TRIPLE	7000-7151
15-METER NOVICE	21,000 to 21,250	TRIPLE	7034-7082
10-METER GENERAL	28,000 to 29,700	×4	7000-7425
6-METER GEN. & TECH.	50 MC to 54 MC	×6	8334-8900
2-METER GENERAL	144 MC to 148 MC	×18	8001-8221
2-METER NOV./TECH.	145 MC to 147 MC	×18	8056-8165

We also carry a considerable number of HC6 hermetically sealed crystals for both fundamental and overtone applications. All fundamental types are made to match into a 32 p.f. load capacity. All overtone types are designed for series resonance unless otherwise specified. The following chart indicates our price structure on these:

FUNDAMENTAL FREQUENCY

800KC to 999KC	$9.50
1000KC to 1600KC	7.50
1601KC to 2000KC	6.00
2001KC to 7000KC	4.50
7001KC to 10,000KC	4.25
10,000KC to 15,000KC	5.00
15MC to 20MC	6.50

OVERTONE FREQUENCY

15MC to 21MC, 3rd Overtone	5.50
22MC to 29MC, 3rd Overtone	4.85
30MC to 52MC, 3rd Overtone	5.50
52MC to 100MC, 5th Overtone	7.00
100MC to 125MC, Prices on Request	

MARS FT243's are $3 each and most MARS HC6 crystals are $6 each.

Remember that we carry marker frequencies in stock; that we have crystals for BC 221's in stock and that if you want to get a group of fellows together for the same net frequency, we can supply the crystals to you and at a special price.

Barker & Williamson, Inc.

We have selected from the extensive B&W line, those items having the greatest appeal to hams. We list them below for your convenience:

Coaxial Type Switches

B&W's Coaxial Switches provide simple solutions to complex switching problems. By the twist of a nob, test instruments, antennas, transmitters, receivers, etc., may be switched in and out of a circuit.

Specifications

Power Rating:	1 KW amplitude modulated (except phono-type connector)
Impedance:	52-75 ohms, non-reactive loads
Frequency Range:	Audio to 50 MC
Cross Talk:	—45 db between adjacent outlets (at 30 MC) —60 db between alternate outlets (at 30 MC)
Mounting:	Panel, through single ⅜" hole
Dimensions:	4" overall diameter, 2¼" depth behind panel, shaft 1" long, ¼" diameter with flat
Net Weight:	14 oz.
Shipping Weight:	2 lbs.

Prices

Model 550A—Single Gang, single pole, 5 position switch with UHF-type Connectors $10.35

Model 551A—Single Gang, 2 pole, 2 position special purpose switch with UHF-type connectors. Designed for switching any RF device in or out of series connection in coax line circuits $9.85

Miniductors

These are highly efficient miniature coils offering extremely low losses and real space-saving economy. They are ideal for compact circuits and available in the types listed below:

Cat. No.	Coil Dia.	Turns Per In.	Lgth.	Prices
3001	½"	4	2"	.68
3002	½"	8	2"	.86
3003	½"	16	2"	1.01
3004	½"	32	2"	1.26
3005	⅝"	4	2"	.80
3006	⅝"	8	2"	.95
3007	⅝"	16	2"	1.10
3008	⅝"	32	2"	1.32
3009	¾"	4	3"	.86
3010	¾"	8	3"	1.02
3011	¾"	16	3"	1.16
3012	¾"	32	3"	1.35
3013	1"	4	3"	.95
3014	1"	8	3"	1.10
3015	1"	16	3"	1.25
3016	1"	32	3"	1.55
3017	1¼"	4	4"	1.13
3018	1¼"	8	4"	1.32
3019	1¼"	16	4"	1.68
3020	1¼"	32	4"	2.10
3021	1¾"	4	4"	1.19
3022	1¾"	8	4"	1.40
3023	1¾"	16	4"	1.76
3024	1¾"	32	4"	2.18

Low Pass Filters

A B&W low pass filter installed in the coaxial lead of your transmitter will stop the radiation of spurious and harmonic signals which interfere with TV reception. Input/Output reversible on all models listed below:

Freq. Range 1.5 to 30 MC

Model 424 (52/75 ohms) for transmitters up to 100 watts, provides 50 db attention throughout the TV bands. Size: 4" x 2" x 1¾". Ideal for citizen banders and low power amateurs. **$14.50**

Model 425 (52 ohms) handles a kilowatt, starts cut-off at 40 mc, provides 85 db attenuation throughout the TV bands. Size: 11" x 3" x 2". **$22.75**

Model 426 (75 ohms) handles a kilowatt, starts cut-off at 40 mc, provides 85 db attenuation throughout the TV bands. Size: 11" x 3" x 2". **$18.00**

Freq. Range 30 to 54 MC (6-Meter-Band)

Model 423 (52/75 ohms) is a 3 section filter for transmitters up to 100 watts output. It reduces spurious and harmonic signals higher than 62 MC by at least 50 DB (a reduction of over 100,000 times). $16.50

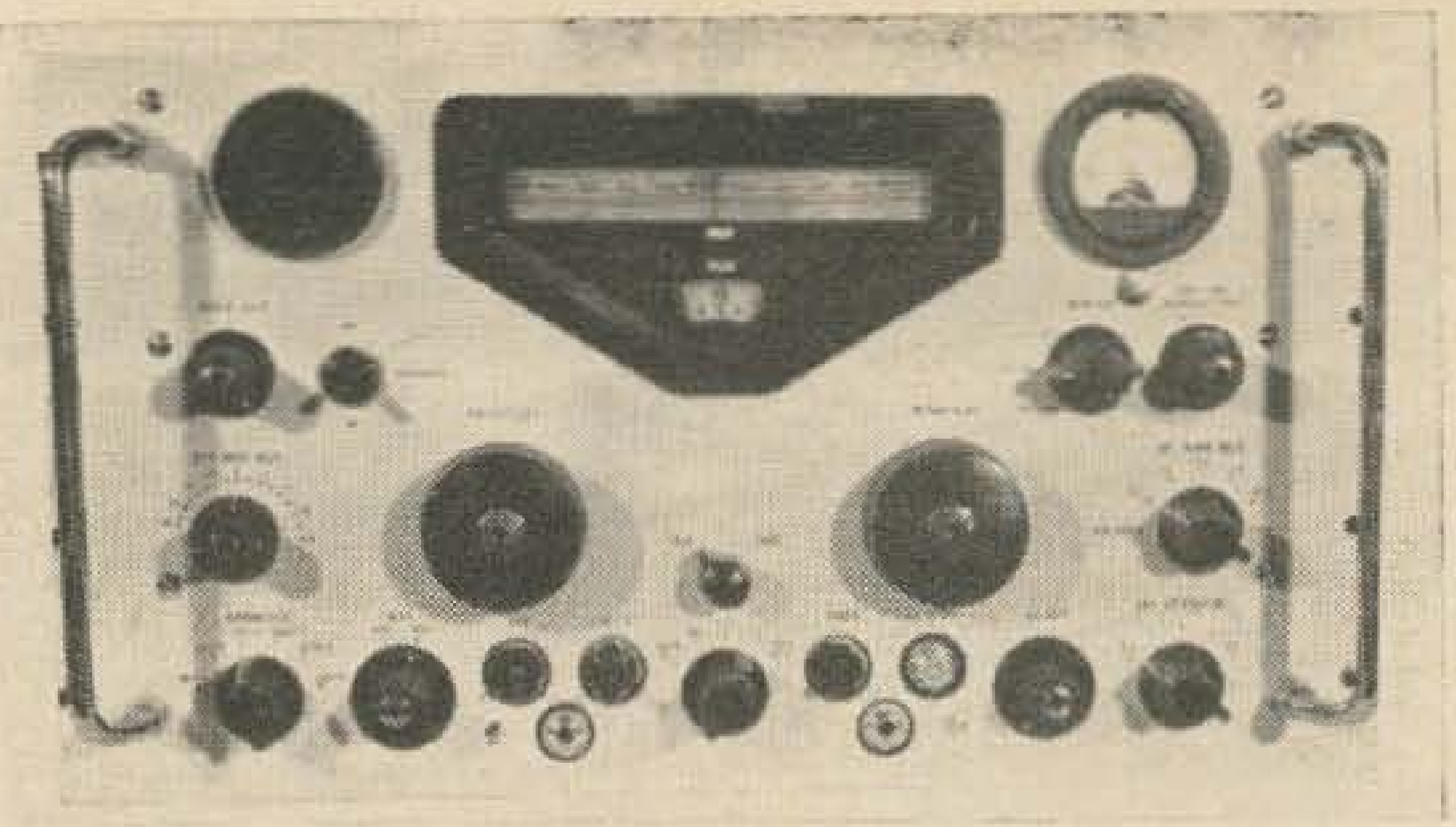
Model 427 (52/75 ohms) is a 5 section filter for transmitters up to 1 KW output. It reduces spurious and harmonic signals higher than 62 MC by more than 60 DB (a reduction of 1 million times). $31.25

We have many more B&W items in stock than this limited space provides including phase shift networks, coaxial antenna connectors, plate chokes, baluns, and band switching pi-network inductors.

Racal

We have 3 secondhand British receivers available for sale. These are the RA-17C's. This exceptional, high stability high frequency communications receiver was made to sell for $2450 in 1962. We offer these at $990 each subject to prior sale. This is a remarkable bargain. The RA-17C receiver covers the range of 1—30 Mc/s with an overall accuracy of better than 1 kc. The speed with which this receiver can change frequency is its acknowledged feature for there is no band switch. In effect, there is an electrical band switch which has never before been used in this type of circuit.

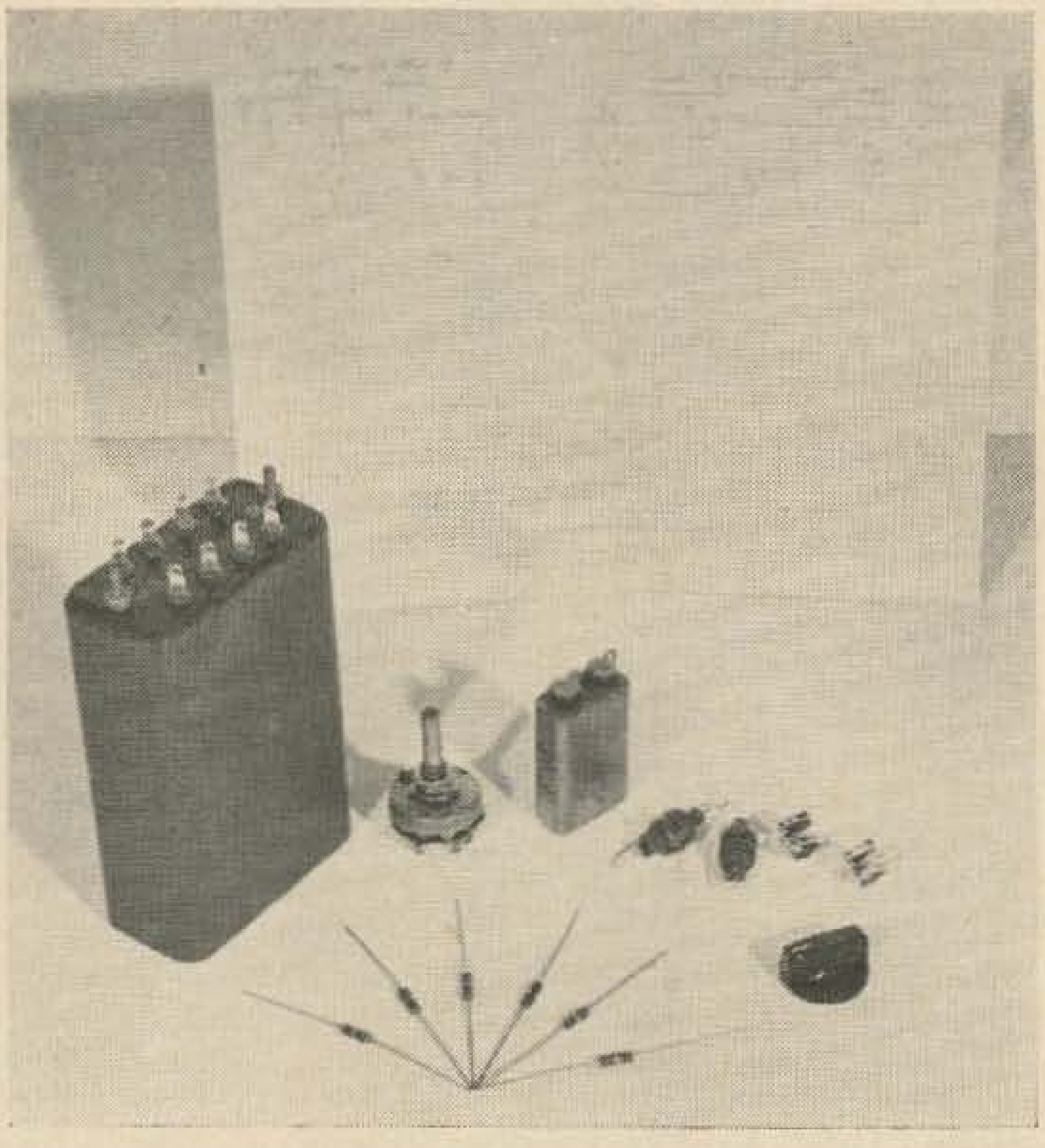
Electrically, the circuit provides that any incoming signal between 980 kc/s and 30 Mc/s be fed to either a wide band input or a double pretuned selection circuit which in turn is followed by a cascode amplifier stage. The signal then is channeled through a low pass filter to the first mixer where it is combined with the output from the first VFO to produce a wideband first i.f. centered on 40 Mc/s. The output of the VFO is also combined with a harmonic mixer which stems from a 1-Mc crystal and a harmonic generator. The output circuit of the mixer limits the setting of the VFO to integrals of 1 Mc. That is, when the original VFO minus the harmonic of 1 Mc gives a resulting frequency of 37.5 Mc/s, this latter signal is known as the "gated" output



and goes through a 37.5 Mc/s filter where it is mixed with the first i.f. frequency in a second mixer to produce a wideband second i.f. frequency of 2-3 Mc/s. The second i.f. is fed through a bandpass filter to a third mixer where it is combined with a second VFO operating between 3.6 and 4.6 Mc/s. The second VFO forms the basis of a conventional superheterodyne receiver which is displayed on a film strip scale 5' long. A final i.f. output of 100 Kc/s is used which has 6 different band widths available. The receiver includes a 100 Kc/s calibrator and an accurately scaled VFO.

This receiver is one of the best general purpose communications products ever built. It is remarkably easy to operate and provides a very high order of sensitivity and, of course, the stability is its best feature. We offer these units subject to prior sale, packed for export anywhere in the world. Thoroughly guaranteed of course.

Phone Patch Kit – Only $5.95



Imagine a high quality phone patch kit for this small sum and if you send us $6.95, we'll gamble and prepay shipping costs to any point in the continental limits of our country. This kit does not include the housing for we have found that most hams want to fit their patch into their console or the operating position. We have sold many of these kits and occasionally when I meet somebody on the air who purchased one, their first subject is how pleased they are with the performance of the kit.

All of the values have been carefully worked out for average volume and average line conditions. Each kit includes a very expensive repeating coil transformer. This transformer has four 600-ohm windings and is so made as to induce the least amount of hum. Worth over $60 by itself, the transformer could easily be sold for the price of our kit. Additionally, we supply a 4-pole switch and knob, the ½-watt resistor, the high quality wire, the oil condenser, 2 RF chokes, and 2 ceramic condensers. Naturally the instruction sheet with schematic is furnished.

This patch is designed to work from a 500-ohm output and into a 500-ohm mike circuit. Should your application require something different, we have small 500-ohm-to-grid transformers at $2.50 each and we likewise have a 500-ohm-to-voice coil transformer for $1.50. With the addition of these auxiliary devices, you can use this patch on any of the modern transceivers available today.

Waters Mfg. Co.

Although we carry the entire Waters amateur line, we have had personal occasion to use Bob's switches, watt meters and Q-multipliers with very favorable results. His double-pole double-throw switch is the only one I know of available at a reasonable price.

His watt meter is a thoroughly modern instrument that we could not do without. It provides visual indication of any 52-ohm output over the ranges of 0-10/100/1000 watts. This is a non-inductive device with essentially flat performance up through 300 MHz.

3001 Universal Hybrid Phone Patch	$ 53.00
3002 As above, with Compreamp	72.50
358 (Compreamp Kit for 3001)	19.95
334 Dummy Load/Wattmeter (1000w)	115.00
374 Dummy Load/Wattmeter (1500w)	135.00
384 Dummy Load (no wattmeter)	65.00
331 "Little Dipper"	129.00
359 "Compreamp"	27.95
372 "Clippreamp"	21.95
361 Codax Automatic Keyer	92.50
369 Reflectometer	120.00
371-1 Wide-Range Attenuator	29.95
371-2 As above, with BNC Connectors	32.50
372-3 As above, with Type N Connectors	38.95
346 Nuverter (6 & 2m Converter)	175.00
373-2 Coaxial Filter (2m)	29.50
373-6 Coaxial Filter (6m)	32.50

Coaxial Switches

335 SP6T (Antenna Switch)	$ 12.95
336 DPDT (Linears in & out)	11.45
341 SPDT (Antenna Switch)	11.45
351 Dual DPDT (in & out switching)	12.95
375 "PROTAX" SP6T (Antenna Switch)	13.95
376 "PROTAX" SP5T (Antenna Switch)	12.50
378 SP5T (Antenna Switch)	10.95
380 "PROTAX" SPDT (Antenna Switch)	12.45

"PROTAX" coaxial switches provide automatic grounding of unused terminals. Models 376 and 378 have radial terminals—all others have axial terminals.

Collins Accessories

337-SIA Q-Multiplier for 75S-I	$ 41.75
340A Q-Multiplier for KWM-2	54.95
349 "Channelator"	82.50
Crystals for above each	6.50
349-27 Adaptor for S-Line	17.95

Auto-Match Mobile Antenna

370-1 Mast	$ 12.95
370-2 Radiator Tip	9.95
370-75 75m Coil	15.95
370-40 40m Coil	19.95
370-20 20m Coil	13.45
370-15 15m Coil	12.75
370-10 10m Coil	11.95
370-48 Coax Cable Assembly	2.45

Headphones

Superex

We stock two brands of headphones. In the Superex label, we feature the SX-357. This is a double headphone, 50,000 impedance high fidelity ceramic transducer element, (100,000-ohm for single.) Response 80 to 12,000 c.p.s. Phone is wired mono-phonic. Cable is 7' of 2-conductor terminated with a standard phone plug. The net price is $16.95.

The best general purpose communications headphone that we offer is SX Model APS. High sensitivity, crisp clear speech, clarity and comfort-oriented design are featured in these amateur headphones. Faithful reproduction for that hard-to-read station fulfills the most exacting communications need. Soft, high-density polyfoam cushions the ears for hours of comfortable listening, even for the eyeglass wearer. Separate adjustment centers give wearer a custom fit. The phone is wired for 600-ohm impedance to match the phone output impedance of many communication receivers. However, it can be changed to 4-16 ohm impedance by a simple change of wiring at the plug. Available as a single headphone also. Specifications: Double headphone, dual impedance 600-ohm, 4-16 ohm, monophonic; frequency response 80 to 12,000 c.p.s., 7' four-conductor cable terminated with standard phone plug—boom mike attachment standard. The net price is $24.95.

For those wishing to go mobile or others requiring a boom microphone, we carry the Superex MB-3 which is a high impedance ceramic microphone. Recommended for the radio amateur, the unit offers exceptional speech clarity and is resistant to moisture and temperature changes. It is of rugged construction with light-weight metal and high-impact plastic construction with a shock resistant high-output ceramic element. A built-in blast filter assures cancellation of voice blasting. Frequency response is 80 to 8,000 c.p.s. -55 db. It is supplied with a 7' shielded cable and the net price is $12.95.

Trimm

A more conventional type of headphone having a tradition in the ham field is the Trimm product. We have selected what we feel are the most generally used numbers and recommend them highly. The world-famous feather-weight Model 106 is a 24,000-ohm general purpose headphone weighing but 5 oz. and is, therefore, very comfortable to use. It sells for $7.20 with pin tips. The plug to match is 50¢ extra.

The Trimm Dependable, Model 70-2K, nets at $3.32. Their 4,000-ohm equivalent, up-4K, is $3.60. We also carry their Model 660 Cushion by the pair which sells for $1.50 each.

COLLINS R388

Collins Communications Receivers

I have been selling Collins Communications Receivers for better than ten years. Because my standards are very high, I had to price these sets at proportionately high levels and relatively few are aware of my service in this field. I offer for sale the finest variety of the best communications equipment available in the United States, and in quantity. My prices vary from about $400 for a poor grade R388 to almost $2000 for the best grade R391. These receivers are all built around Collins permeability tuned oscillators (PTO), a device which in itself is a marvel of electro-mechanical engineering.

Collins introduced a radical departure in communications receivers in the year 1948 with the introduction of their 75A1 receiver. Amateurs may remember that this receiver defied convention at the time and opened up a whole new field for Collins. This device, in effect, had a crystal controlled front end and a variable tuned IF. By using relatively low frequency variable oscillators, Collins was able to vastly improve upon the stability of the communications receivers available at that time. Their 75A2. 3, 4, produced in the tens of thousands, were to become world famous in the amateur field.

It is not generally realized, however, that back in 1950, this same concept was incorporated into a general coverage receiver known as the 51J. The 51J covered the range of 500 KC to 30.5 MC. It did so with an overall accuracy of better than a kilocycle and provided a means for accurately tuning any CW, MCW, or AM signal within its frequency range. In the early days, these receivers were very much sought after by every branch of our Government who used such gear and they became the means for extensive monitoring by the FCC. The 51J went through a logical series of changes ending with the J4 which incorporated mechanical filter. Its predecessor, the 51J3, was widely reproduced as the military R388 and became known to countless amateurs as well.

By 1955, the first of the R390 series had been produced. This was a heavier, more rugged, receiver of somewhat radical design. Likewise general coverage, it provided for digital readout and a higher order of accuracy and stability over the range of 500kc thru 32MC. It was also a mechanical marvel and this model was purchased by the thousands by the military for use in point to point work and discrete frequency surveillance.

A somewhat less complicated version without voltage regulation was introduced about the year 1958 and known as the R390A. Versions which provided for remote tuning of up to seven channels were the R391 and for light weight limited applications, R392.

The R389, on the other hand, may be roughly compared with the R390 except that it covers the range to 15 KC and was obviously a particularly good receiver for the study of Doppler effect and reception of long wave signals. This set, like its sister, was a mechanical marvel even more so, however, in that it incorporated automatic band change and a refined servo system as well.

When we obtain these receivers, we painstakingly overhaul and rebuild them until the standard of performance is equal to or greater than the original specified performance. Particular attention is paid to the PTO and, if possible, the PTO's of these sets are replaced with rebuilt units available from Collins.

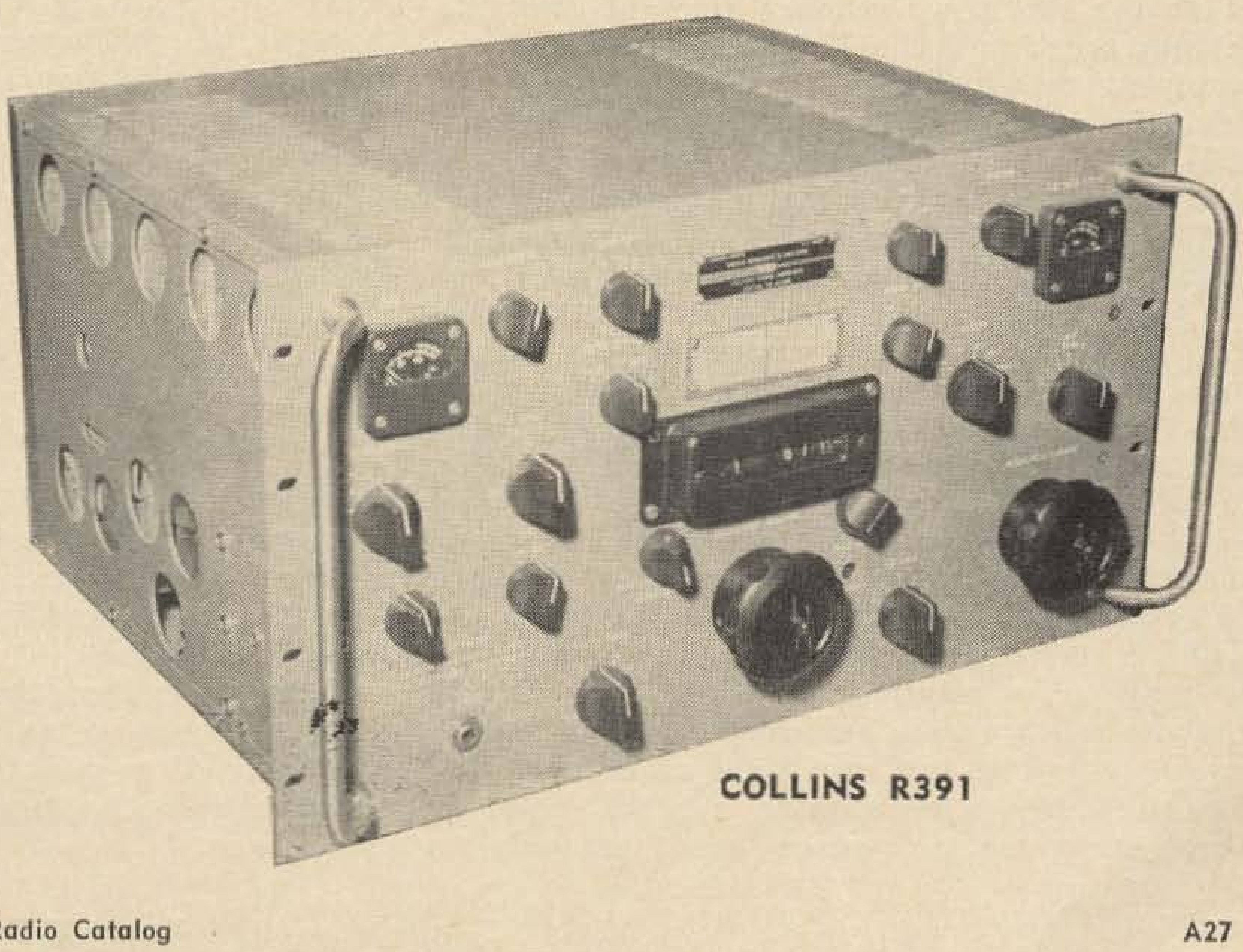
The degree with which the receiver provides linear operation over its range determines its price. Other features contributing to price are appearance and the degree of tracking from one megacycle range to another. With reference to the 51J (R388), as an illustration, it is interesting to note how our standards apply and determine the ultimate selling price. Assume for this illustration, that the receiver has been turned on for at least 10 minutes and that the dial has been set to an even megacycle mark. Set the fiducial or hair line at the exact center of the calibrated bezel. Turn on the calibrating switch and set the BFO to zero beat. Now, without touching the BFO control or the calibrating switch or for that matter any other control, tune the KC knob clockwise until the beat note will be observed at the extreme 500 KC point at the right of the dial. You will note a deviation error. Write down this error in KC or cycles and now rotate the main KC knob to the other extreme of the dial and observe the error at the left end of the main dial. The sum of these two errors will be known as the maximum deviation error in cycles or KC per megacycle. A very excellent set will have a total deviation error of less than 2 KC and such a set is worth between $750 and $1000. With the deviation error between 2 and 3 KC, the value of the set will range between $600 and $750; when the deviation ranges between 3 KC and 4 KC (the maximum allowable limit), the value of the set may be stated between $450 and $600. If the deviation is greater than 4 KC, the oscillator must be replaced and a new, or rebuilt, assembly obtainable at a cost of $190 from Collins be installed.

Now go back to the first part of this test and leave everything established for an even megacycle mark such as 2 mc. Observe the zero beat and then rotate the megacycle switch knob to an adjacent odd megacycle such as 1 or 3 mc. Then slowly tune the KC knob until the new zero beat has been obtained. Measure this difference as an error. For the best sets, this error will be less than 1 KC. For errors in excess of 2 KC, the value of the complete receiver has to be reduced proportionately.

The very best sets are those which meet these specific tests and whose appearance comes closest to being like new. It must be presumed that sensitivity and other performance factors will be equally high.

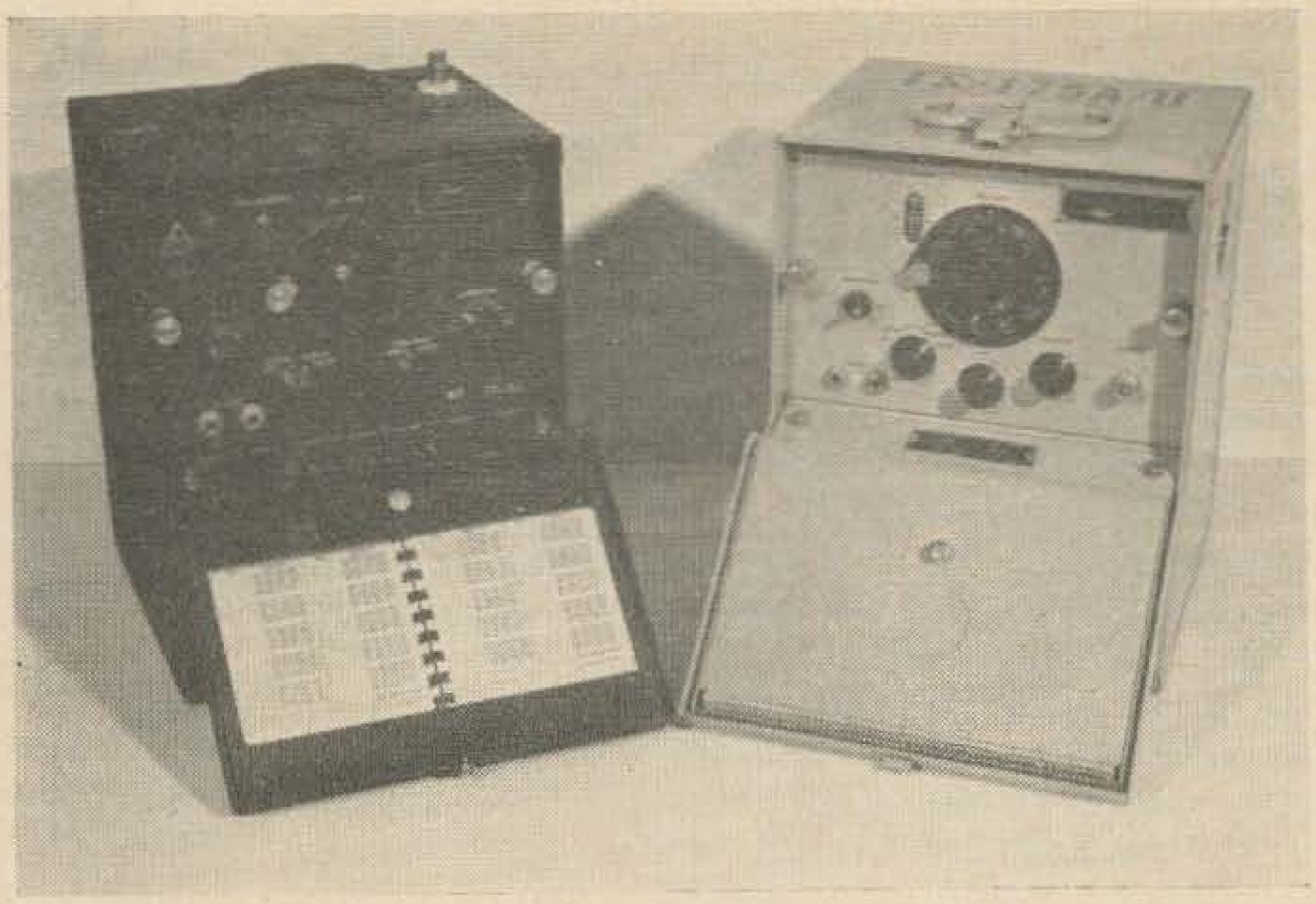
The specific range in price on the R389's varies from $700 to $1200; on the R390, from $1000 to $1400; on the R390A, from $1000 to $1500; on the 391, from $1200 to $1600. All of these sets are guaranteed and supplied with instruction manuals and adequately packed for shipment to any part of the world and are available in quantity. Do not hedge. These are the best quality communications receivers made in the world. They have no peer. Even Collins' latest sets do not excell in quality and except in size and in weight, there is nothing made today that can equal the outstanding performance of these communications receivers. Those interested should write for specific information and quotations.

Herb Gordon W1IBY



COLLINS R391

BC-221 and TS-175 Heterodyne Frequency Meters



The unit illustrated at the right in the photo is the TS-175AU frequency meter. It is similar in operation and use to the BC-221, but covers a frequency range of 85 to 1000 mc. Price on it is $220.

Nowadays solid state computer techniques are employed in a digital readout counter so as to measure frequency. Such instruments sometimes are available to the ham through his place of employment. Even more rarely, the ham can buy a secondhand or used instrument of this type.

Generally speaking, these wonderful modern instruments cost between two and four thousand dollars and are beyond the means of most of us. But hamdom must have a way of measuring frequency at a price it can afford and the old standby, the BC221, is still the best device of its kind to ever come down the pike.

BC221's can be had in various places in conditions that are good, bad and indifferent and you would never know how to determine whether the instrument would be a good one or a poor one without actually subjecting it to test or evaluation. We take all of the guesswork out of this for with hundreds of BC221's to choose from, we subject each of these to certain specified tests. Not only must each instrument match its calibration book but the linearity of each instrument must be acceptable within the tolerances specified by the Government in the technical manual TM11-300.

The term BC221 refers to a heterodyne frequency meter which covers two specific ranges —125 kc through 250 kc, and 2000 kc through 4000 kc. By means of harmonics, the instrument can be used to measure frequencies all the way up past 100 megacycles and by means of simple changes or modifications the details of which are expressed in a leaflet supplied with each instrument, the BC221 can be made to provide accuracy of the order of .0025% or even better. Indeed, it is possible with the additive or subtractive method of measurement to read to as small as .0002%. Each BC221 that we sell is thus a basically good instrument which will meet the conditions of accuracy as described hereafter and as a result each of these instruments can be used not only to measure frequency but to initiate a frequency for such purposes as modern sideband synthesis techniques require. If you wish to build your own exciter or VFO or to calibrate and measure filters for teletype and sundry purposes, this device will positively allow you to do it. The BC221 has stood the test of time. Each instrument is at least 20 years old now and you might say, it has been properly aged.

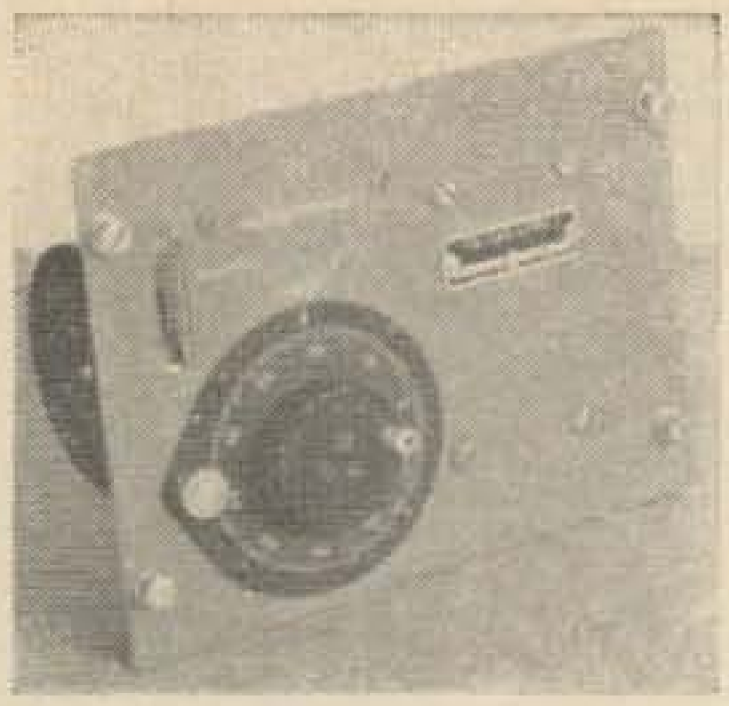
Before we ship out any instrument, we determine that both ranges are accurate according to the book. We also determine that on the low band, 130kc, 160kc, 190kc, 210kc, and 240kc fall within one-half a dial division accuracy as compared with our precision standard. On the high band, we check for similar error at 2100kc, 2400kc, 2900kc, and 3800kc. Our standard is a Motorola high stability oscillator used in conjunction with a Systron Donner digital readout meter providing better than one part in 10^{-9} accuracy per 25 hours. This is an amazingly good tolerance and guarantees the purchaser satisfaction within the intended application of the BC221 so when you fellows compare price, you should also try to compare accuracy.

Here is our schedule of pricing:

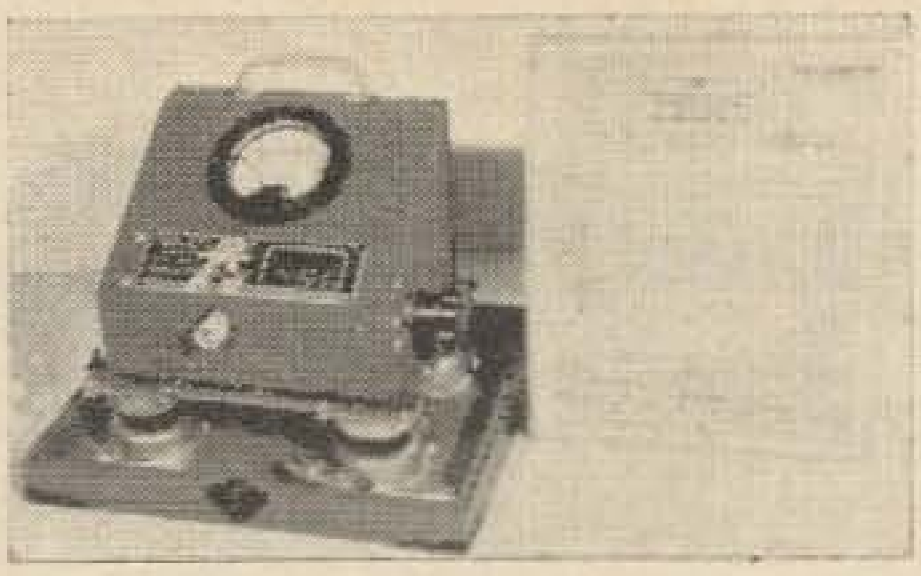
For standard nomenclature BC221's,	
models A through AH	$110.00
models AK and AN	165.00
For either model with certification........$20.00 extra.	

We have a power supply kit that we have assembled and which will provide this instrument with the perfect combination of voltages and current to operate at 115AC. We supply just the parts and instructions and the price on this is $14.50.

Remember that the BC221 can serve as a signal generator as well as a test oscillator and as well as a heterodyne frequency meter. Your satisfaction is guaranteed—no pig in the poke here.



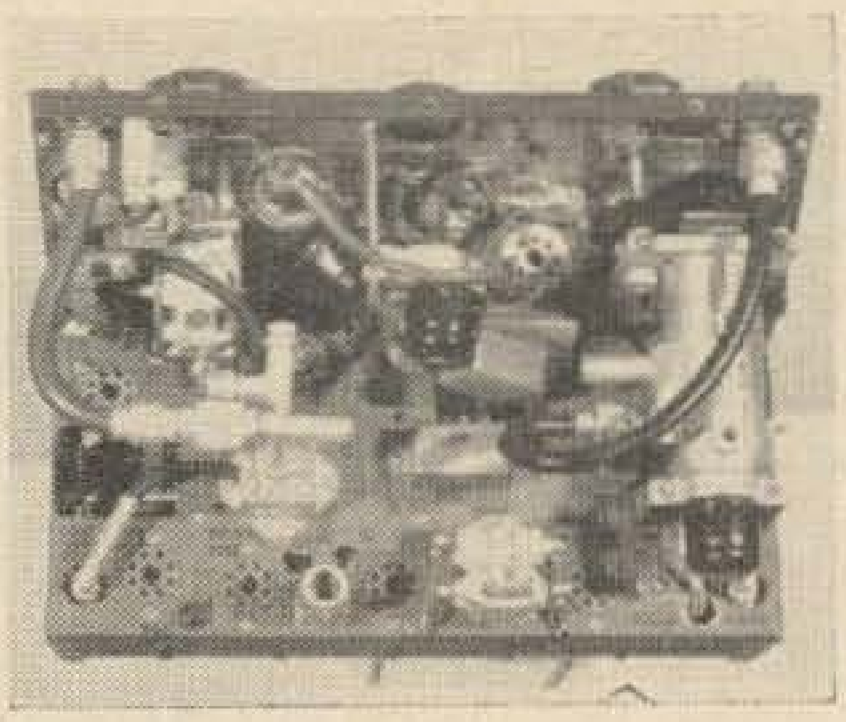
Wave Meter TS133/UPM-1. Covers the range 155-235 MHz. Each wave meter has a separate diode detector for indicating resonance and has an especially well calibrated BC221-type dial. Only $5 while they last. 5 lbs.



Wave Meter TS111. A coaxial cavity wave meter covering range 3000 to 3600 MHz with an accuracy ±1 MHz. Includes indicating meter, calibrator chart, and 1N21 rectifier. Controlled by precision micrometer. $44.00 45 lbs.

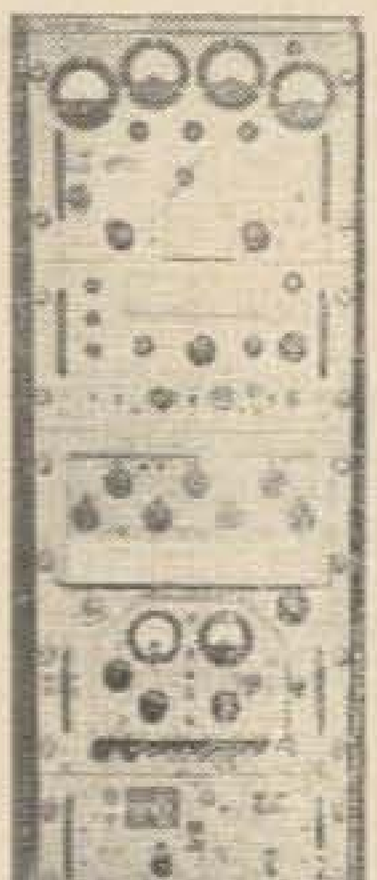
Oscillator 0-12. This is a signal generator operating between 155 and 235 MHz with a built-in attenuator assembly accurately calibrated to more than 100 db, below 1 volt. It employs a remote cutoff piston attenuator. These oscillators normally provide pulsed RF output but can easily be employed for CW with a simple change. $9.70. 7½ lbs.

Microwave Accessory Kit. Packed in hinged wooden box 12" x 12 x 3" intended for AN/MPM-3. Includes 1 each UG-81/U waveguide to coax adapter, 1—UG-163/U waveguide flange adapter, 1—CG-92/U cable assembly, 1—AT-48-UP X BAND HORN antenna and 1 UG-85/U connector. New merchandise 5 lbs. $5.00



S Band Transponder. RT-21/APN-21XR Measures 13"W x 13"H x 10"D and weighs 21 lbs. Supplied less tubes. A veritable wealth of S band components—pulse transformers and generally useful components. Basic cavity may be used in amateur microwave work around 3000MC and uses light house tubes. A Shepard McNally Klystron 707B used in 2nd cavity. 12 or 24 VDC and 400 cycle 115V AC single phase. Bargain priced at $15.00

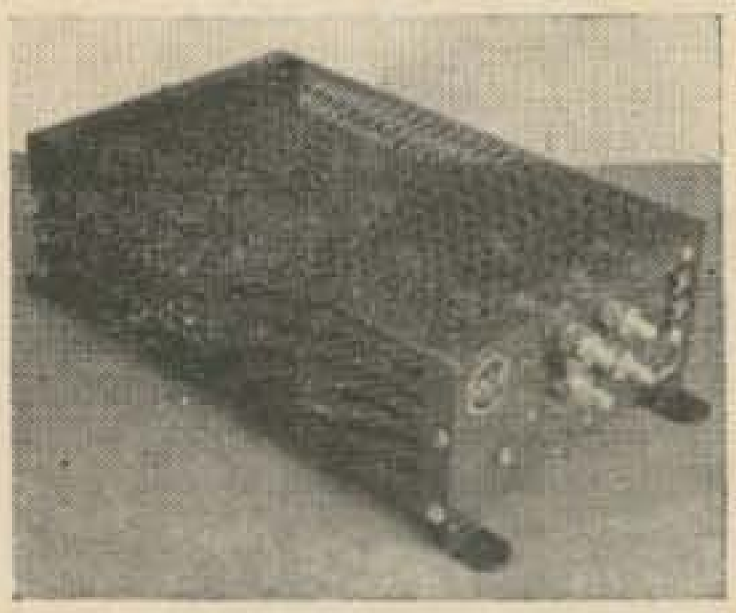
Radar Echo Box AN/UPM-30. A coaxial type resonant cavity used to monitor radar systems operating in the range of 1150-1350MC Decdy 3.5 lb per micro second. Sensitivity 1 db. power loss for 50 yard ringtime. Temperature coefficient .105% ringtime/degree F at 68°. Uses 3-IN21B diodes. New Weighs 25 lbs. Cost uncle $2000.00. Your Cost $70.00.



SRT Navy HF Transmitter. Includes Rf amplifier AM 1008/SRT providing 100 conservative watts output from a 4-400A with mechanically ganged servo controlled tuning system using vacuum variable condensers. The audio modulator MD-229/SRT, the RF synthesizer 0-275/SRT which generates any discrete signal in increments of 10 cycles between 300KC and 26MC, and the power supply PP 1094/SRT. The entire assembly weighs 650 lbs. and operates on 60 cycle 115V. $18000.00 original cost for $350.00.

X-Band Radar An early airborne radar set for X band includes receiver and pulsed magnetron. Allow 100 lbs. $50.00 each. Here's your chance to have your own radar trap or weather eye. Requires 115V 400 cycles and 28V DC.

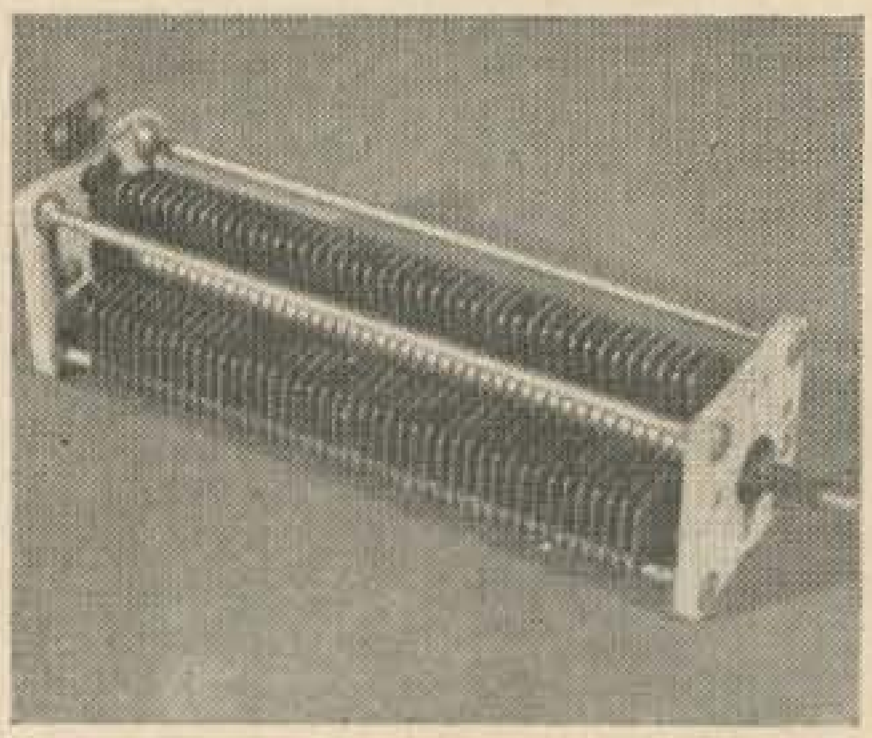
Good Surplus Values



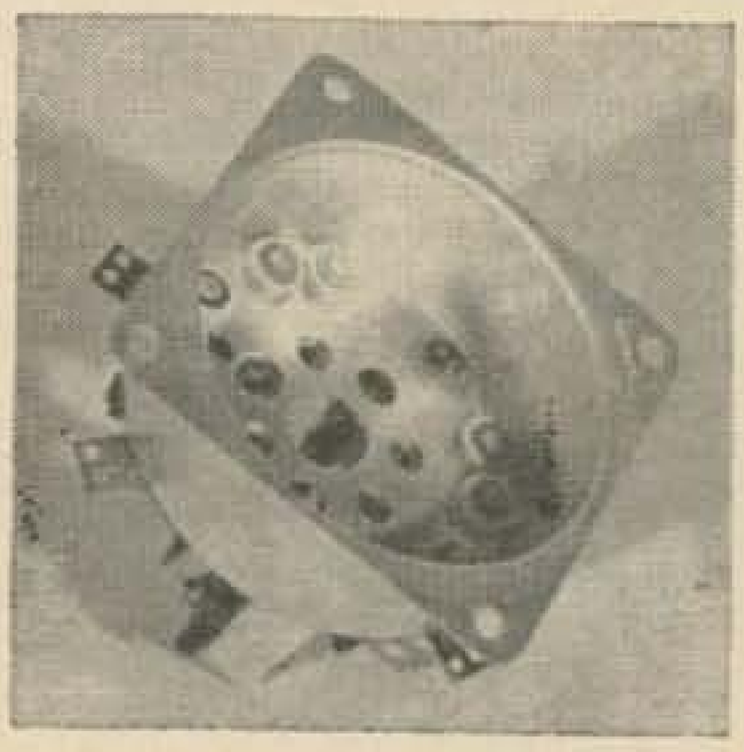
Attention! Volkswagen Owners—DC to DC Converters: For Volkswagen owners, we offer a DC to DC converter. This transistorized device converts 6 volts DC to 12 volts DC. It is capable of furnishing 6 amperes of power at 12 volts. This is RCA's #MI-17583 and measures 11½" deep x 6" wide x 3⅜" high. Only 35 pieces available at $12.50 each. 3½ lbs.

Bridge Rectifier Transformer suitable for solid state application. Capable of furnishing 600V at .5 amp; 115V primary; secondary rated 545V at .455 amps. 5¼" square x 5" high. $7.25 15 lbs.

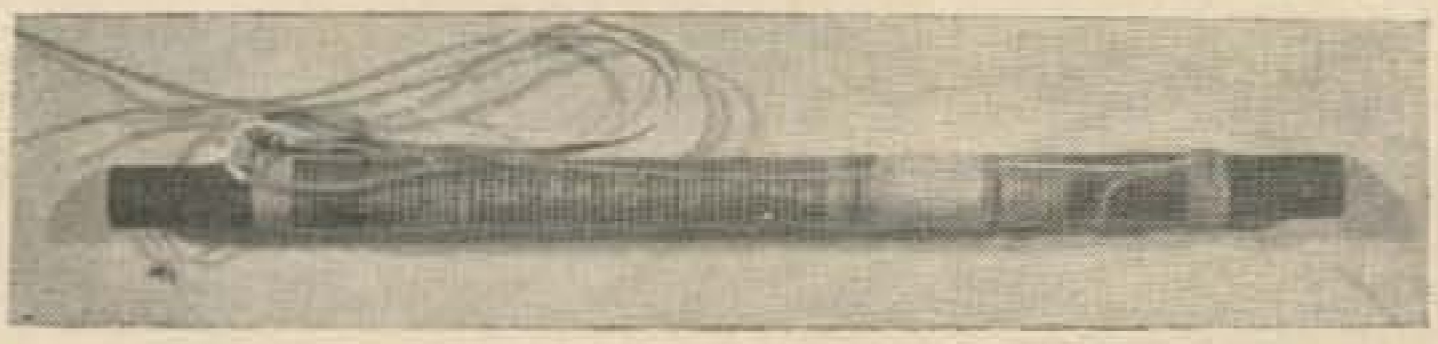
Matching transformer: Here is a very high quality line-to-grid transformer. Primary either 200 ohms or 500 ohms impedance and secondary 30,000 ohms grid-to-grid with a center tap. It may also be used as a low-level plate-to-multiple line transformer. UTC-4050 $2.50 ½ lb.



G.E. Air Capacitor. 20-440 pf, 7" long x 2" x 2" ceramic end caps with ¼" shaft. Heavy brass construction, .015 spacing. Excellent as a loading capacitor or for general purpose work. $4/ea. 1½ lbs.

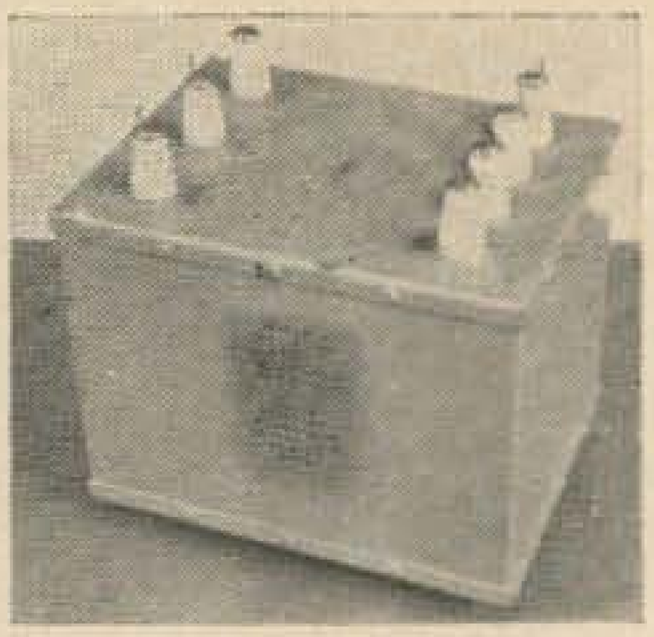


Sockets: RCA 9935 7 contact socket with built in capacitors. Semi-shielded for use with 829B, 3E29 and 832. Price $1.80. 100 available.

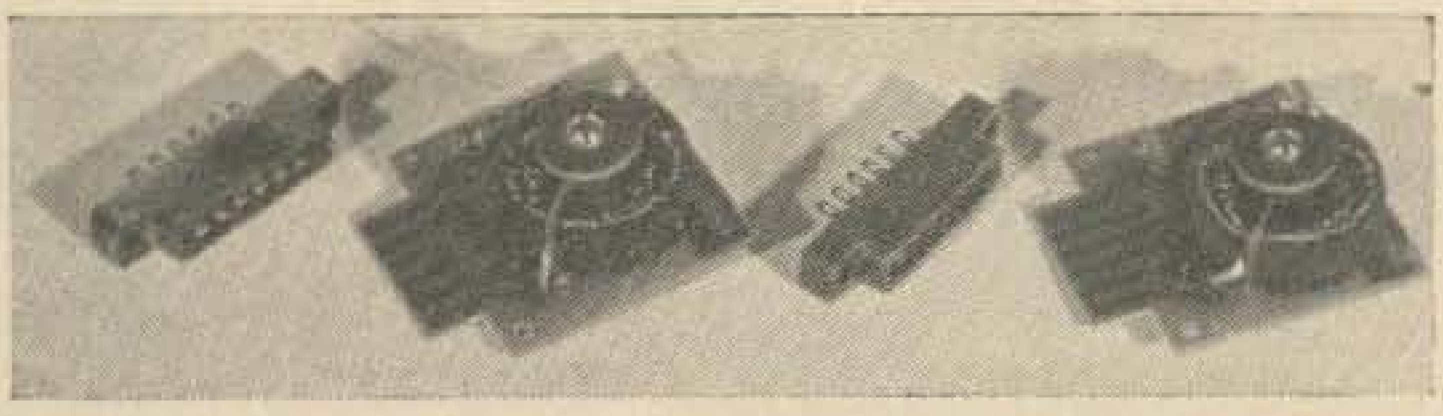


Ferrite Antenna Coil: 6⅝" long x 5/16" diameter. I bought these at a very low price and found them to be particularly attractive when bunched together as a core for winding filament chokes. Use 4 of them wound with electrical tape as a core for 4-1000. 59¢ each. 4/$2.00. 4 oz. each.

Plate Transformer: Center tapped secondary. 2100 volts either side of center, rated at 500 mils continuous duty and insulated for 4286 volts. The primary is intended for 207, 220 or 225 volts single phase. This merchandise, made by Union Electric & Manufacturing Co. in Jersey City, is offered in limited quantity at $34.95. The transformer measures 9½" wide x 7⅜" deep x 9½" high and weighs 59 lbs. Here is a tremendous value. Check the weight with copper and steel prices today and see what a value it is. Only 17 pieces available.

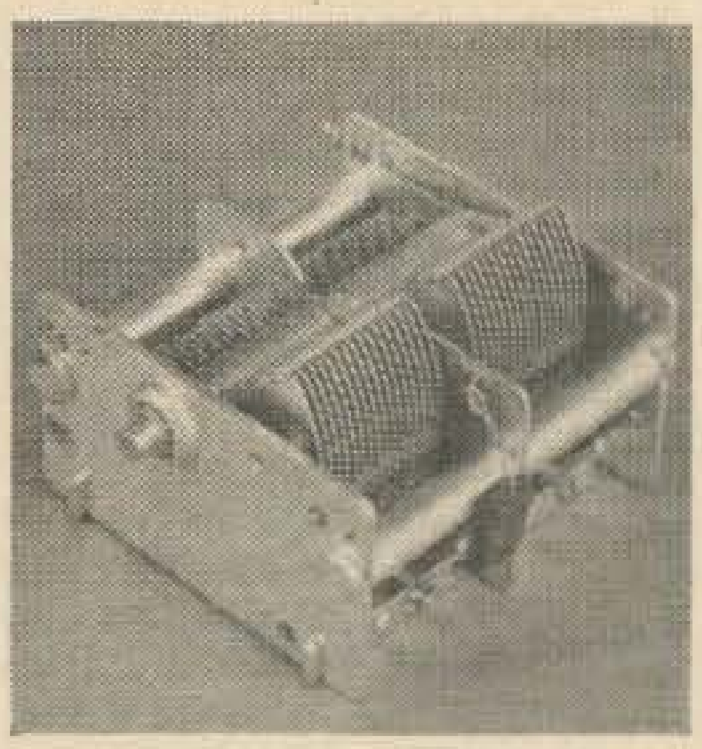


Solid State or selenium rectifier transformer made by Raytheon, their #UX9115A; primary 60 cycles; secondary tapped, from 28 to 48V; rated 2 amps but good for 4 amps. 4½" high x 3½" deep x 4" wide. $4 each 7½ lbs.

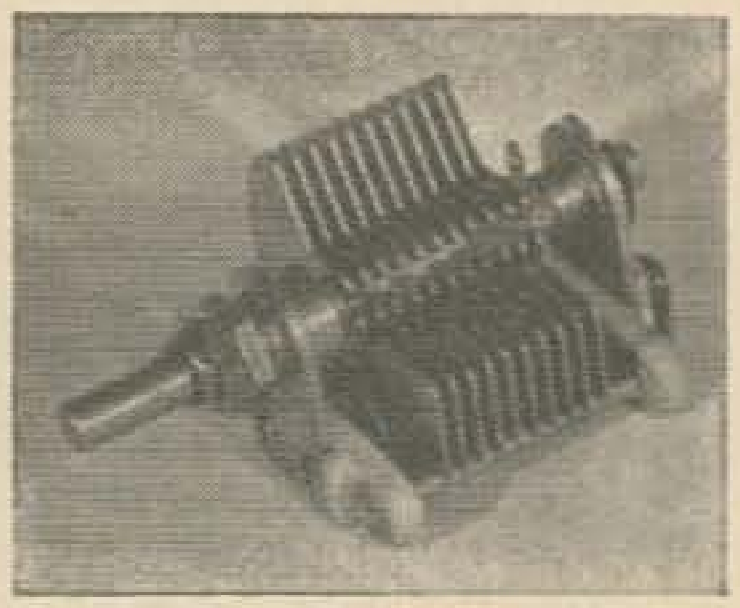


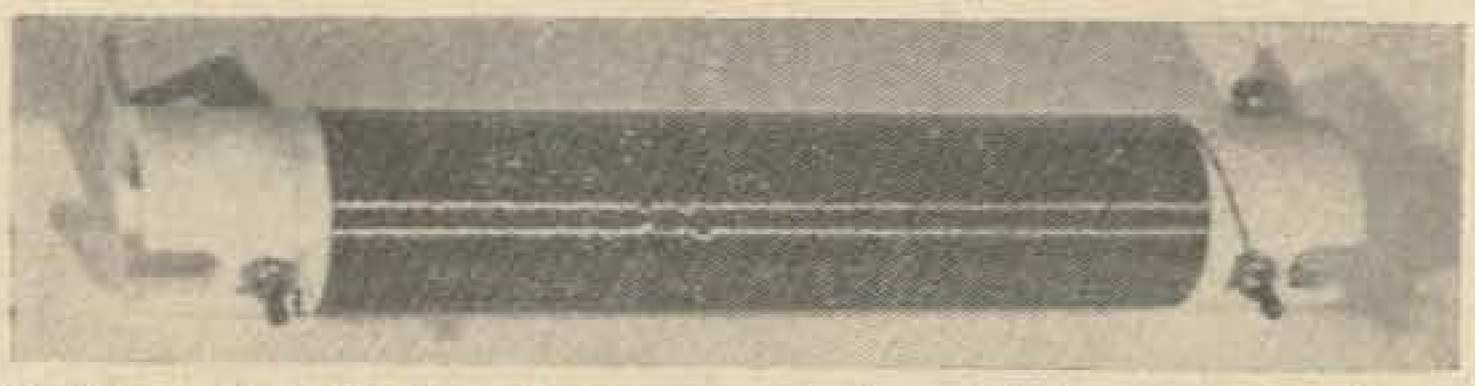
Toroidal Filter Assembly for RTTY. These new Humphrey units measure only 1¾" x 2". We have them complete with their sockets in matched sets tuned to 2125 cycles and 2975 cycles. $8.50 per set. ½ lb.

Loading Capacitor. Here is a two-section loading condenser each section varying between 20 and 600 pf so that the sum of the condenser will extend up to 1200 pf which is more than adequate for most high-powered finals. The spacing is excellent. The condenser measures 3⅜" behind the panel. Its width is 3¼" and its maximum height with the condenser open is 2¾". This is straight line frequency. A particularly good value at $3 each. ¼" shaft. 2 lbs.



Dual Bearing Hammarlund Capacitor. 100 pf straight line capacity. Excellent for a variety of general uses. 90¢ each, 10/$7.50. 4 oz. each.





Collins RF Plate Choke—good for high-powered final; capable of at least ½ amp and suitable for 80-10 meters. $4/ea. ½ lb.

The following miscellaneous listing is meant to portray a representive portion of our stock so as to convey an idea of the breadth of our inventory. With over 2500 pieces stored, and with a constantly changing variety, it would be very difficult to itemize each piece of gear available.

Similarly we have over 1000 used units of ham gear available; probably the largest stock anywhere. We do NOT put our price sheets on this classification of goods for you to compare us by. But we do publish a comprehensive listing in specific detail by set, serial number and condition and we will gladly send such an unpriced list to anyone—upon learning of your choice. We will then quote you directly. The best thing to do is to visit and see yourself the largest collection of ham goodies ever gathered together in one building. I am confident of our ability to please you.

AN/URM-13 Dummy Load 5-20W 100-400 MC	$ 7.00
MTR-2512 Marine Radio Telephone, 12V, 16A	$ 45.00
EE-8 Field Telephone	$ 7.50
Type 90281 Millen Power Supply, 700 V @ 235ma, 6.3V @ 4A	$ 40.00
Model 33 Reg. P.S. 350W, Mfg. by Lambda	$ 45.00
TVN-65E Klystron P.S., Mfg. by Weston Labs.	$330.00
Twin P.S., 115V IN-OUT 500V @ 150ma, —100V, 6.3V-3A	$ 65.00
TVN-9HG, Klystron P.S.	$105.00
Mod. 28, Reg. P.S., Lambda	$ 35.00
Mod. 206-PA HV Reg. P.S., IN 115V, OUT 1000V-200 ma	$ 90.00
Mod. MR-300-1 Mag. Research Corp. Reg. DC P.S. "Stablvolt" 300V-1A	$140.00
Mod. 32 Reg. P.S., Lambda, 380W, 105-125V	$ 80.00
CR-4, Microphone, Sony	$ 88.00
CR-4, Microphone, Sony	$ 88.00
Mod. 402A, Dynamic Micro Miker	$150.00
Mod. 714, Microphone, PTT Switch Electro Voice	$ 22.00
Mod. 799 Weston Insulation Tester, Indicates Leakage Res.	$ 32.00
TS-128/UP	$ 90.00
TS-377/U SWR Bridge W/Meter, 28V DC	$ 60.00
TS-111/CP Wave Meter, G.E.	$ 49.95
I-48-B Insulation Tester—Biddle	$ 45.00
I-177, Tube Tester, Mutual Conductance Type	$ 37.00
TS-117/GP Wave Meter Test Set—Andrew Corp.	$100.00
TS-125/AP Milli-wattmeter, 0-2 MW	$100.00
81TT4, Airplane Thermometer Tester	$ 62.00
Mod. 802 Microwave Oscillator, 9040-9145MC	$330.00
Type 675P, Piezo Oscillator by G.R.	$125.00
BC-1060A, Oscilloscope—Bolton Labs.	$150.00
AN/PRM-10, GDO, 2-400MC, 7 bands—Stamford El.	$190.00
TS-47/APR, Test Oscillator, 40-500MC Fairchild Cam.	$115.00
Constant V. XFMR, SOLA, SEC. V. 115-120, 180VA	$ 25.00
Type 10B, Powerstat Variable XFMR, 0-120V, 210VA, 0-132V, 230VA	$ 8.00
Type 20, Powerstat XFMR 0-140V, 3A	$ 12.00
Type W2, G.R. Auto XFMR 0-135V	$ 10.00
Plate XFMR, Bendik PRI 200/220/240 V 1Ø, SEC 2900/1450V, 2.8KVA	$ 70.00
Mod. 191 Hickok Xtal Controlled Microvolt Gen. 125-240MC	$ 65.00
AN/URM-26, RF Signal Gen., 4-8MC	$250.00
I-208, RF International Detrala Signal Generator 1.9—4.5MC, 19-45MC	$ 75.00
SG-8/U Noise Generator—Weston Labs—10-150MC ±10% accuracy	$ 90.00
Type 1002A, Pulse Generator	$330.00
TS-419/U, Signal Gen. 900-2100MC	$390.00
Mod. 75, Signal Gen. 4.8-410MC Measurements Corp.	$100.00
TS-403A/U Signal Gen. 1800-4000MC, CW and FM OUT	$450.00
TS-413/U Signal Gen. 75KC—40MC in 6 bands	$275.00
Mod. 20, Signal Gen. 85KC-40MC	$875.00
SG-38/URN-15, Signal Gen. 60-1000CPS	$575.00
Type 140A, Boonton Beat Frequency Generator 10-30MC	$300.00
Mod. DR-400, Ultra-Sonic Generator—Acoustica Assoc.	$400.00
PE-162C, Generator Set, 150 Watts	$100.00
RCVR, Mod. RBC-1, Freq. Range 4-27MC, 115V AC	$ 90.00
RCVR, BC-342N 1.5-18KC	$ 60.00
RCVR, Type BC-1206-CM, Freq. Range 200-400KC	$ 9.00
RCVR, Type BC-454B, 3-6MC	$ 12.00
RCVR, Mod. RDO, 300-1000MC, 105-125V	$200.00
RCVR, Type BC-1004 BC-40MC	$140.00
RCVR, Type RA-1B, .150-1.5 and 1.8-15.OMC, 6 bands	$150.00
RCVR, Type CRV-46151, 195KC-9.05MC IN 4 bands	$ 65.00
RCVR, R-264/GRD, 100-160MC, 115V	$170.00
RCVR—XMTR Set 1.5-12MC, RCVR Col—46159, XMTR Col 52245, Collins	$ 45.00
TS-15B/UP Fluxmeter	$ 75.00
ME-82/U, Wattmeter, 52 ohms, 50-600MC, 120 W. Max.	$ 90.00
VTVM, Type 726A, 1.5-150V RMS in 5 ranges, Gen. Radio	$ 50.00
Harmonic Wave Analyzer, Mod. 300F Hew.-Packard	$375.00
Coaxial Switch "Coaxwitch" Type 72-2, Bird El.	$ 35.00
Termaline Resistor, Mod. 80A, Bird El.	$ 15.00
TN-18/APR-4, Freq. Range 300-1000MC	$ 75.00
TN-54/APR-4 2150-4000MC	$190.00
TN-19/APR4 975-2200MC	$100.00
TN-16/APR4 38-95MC	$ 60.00
Hewlett-Packard 300A Harmonic Wave Analyzer	$375.00
Lambda 64, Reg PWR Suplly	$120.00
Kay Elec. Mega-Pulzer	$100.00
Hewlett-Packard 500A Freq. Meter	$110.00
HP-400A Voltmeter	$ 90.00
TS-155C/GM Sig. Gen. 2700-3400MC, 4 bands	$250.00
Hewlett-Packard 460A Wideband AMP	$120.00
LAE-2 RF Sig. Gen.	$300.00
TS-297/U, Multimeter, AC-DC 0-1000V	$ 14.00
SG-14/U Sweep Calibrator	$250.00
Antenna Bridge, Type 90672, Millen	$ 10.00
TS-130/URM, Summation Bridge, 5MW-5W, 1000-4000MC	$150.00
AN/URM-14, Microphone Simulator, Z-IN 500, IK, 50K	$ 67.00
TS-330/TSM Xtal Impedance Meter	$200.00
TS-254/AP, Power Meter, 0-2 MW	$ 65.00
TS-328/U, Freq. Meter, 380-420 CPS	$ 40.00
TS-587/U Noise Field Intensity Meter 200 MW OUT 15-400MC 4 bands	$300.00
ZM-14/tsm-2, Ohmmeter, 0-1000 mego 500VDC	$ 90.00
TS-375/AU, VTVM, 0-120VAC, 0-300 VDC	$ 35.00
Electronic VOM-Capacity Meter, Mod. 209, Hickok	$ 40.00
Mod. G-21, GDO, 6-120MC—Alto Scientific Corp.	$75.00
Mod. 200 BR H.P. Audio Osc. 20-200000 CPS	$ 75.00
Mod. 200-D H.P. Audio Osc., 7-7000 CPS	$ 65.00
OL-15B, Oscilloscope, 5" CRT Browning Labs.	$100.00
OS-51/USM-24C, Oscilloscope Waterman Prod.	$300.00

Business Hours

We open early at 8 A.M. and work thru 4 P.M. Then after a two hour respite we open again at 6 P.M. and stay until 10 P.M. Saturday till 5 P.M. Sundays by appointment. Try and make it soon—will enjoy that eyeball—and hope you will too.

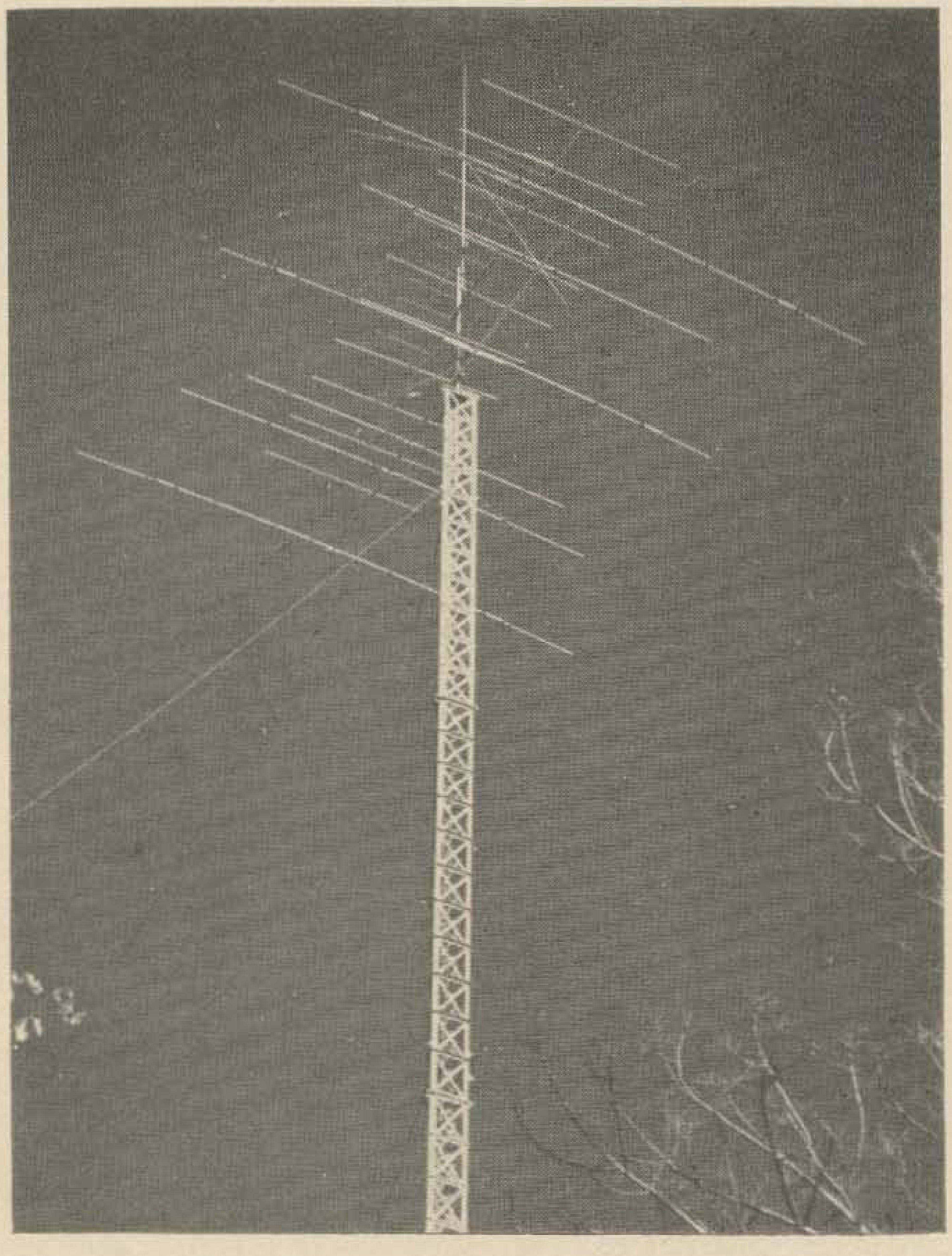
73
Herb W1IBY

Ham Radio is a Hobby

This catalog is our first attempt to describe our business and the nature of our service to the hundreds of thousands of amateurs throughout the world.

Ham radio is a hobby offering a tremendous amount of fascination and pleasure. Prince and pauper alike may share in this intriguing sport and whether your particular interest is to ragchew, experiment, or handle traffic, ham radio provides the means for such an outlet. To those busy with the problems of everyday life, ham radio provides the pause that refreshes. And to those handicapped persons who may be blind or in other ways afflicted, it is a window to the world. But we must not forget that it is basically a hobby and a hobby is basically a luxury. Luxuries can be taken care of only after necessities have been cared for and this fact has to be understood by the supplier of ham equipment. This is why we offer equipment in all categories of price and quality. It has been said that hams are scroungers and justifiably so. Why should a ham take away from his family's necessities so as to pursue his personal pleasure. We understand this and try, therefore, to provide a very broad assortment of material at all price levels. I don't blame or criticize the ham who is trying to get the best deal for his money for I understand that for many of us the acquisition of newer type gear can only be had by swapping in the old material with the least amount of additional funds. It is precisely because we understand these things and know the nature of Hamdom that I feel that our extensive stocks can be selected from most every class of ham and we will gladly lend a helping hand to those of you who are just getting started and need assistance in selecting your choice of gear.

Of course side band is the modern way of communicating with voice. It saves frequency space and permits a greater measure of enjoyment by a greater number of participants. Nearly every modern manufacturer is producing equipment for this mode of emission. So whether you are starting or merely wish to up grade your station or perhaps in company with a very few others can afford to buy new equipment and want to get the very latest gear possible, I say to you try us out and see what our figures will be. Get our listing or better yet, pick up the phone and call me collect. My operator will take your name and telephone number and I will call you back shortly thereafter. I think this is a personal way of giving the proper answers to you at the earliest time, then you will know before very few minutes have gone by just exactly where you stand so get in tune with the times, get in touch with me and enjoy your ham Radio to the fullest.



The photo above shows the sign which marks our driveway. To the left is one of our four towers. It's 105 ft. in height with a TA136, ten element six meter CushCraft, 11 element two meter CushCraft and a ten meter Kreco vertical.

HERBERT W. GORDON CO.
Woodchuck Hill
Harvard, Mass. 01451
Telephone 617-456-3548

Bob Heil K9EID
402 Border Street
Marissa, Illinois

Six Meter Final Amplifier

Get up to 75 watts output on six with a few watts input.

So many final amplifiers built today are complicated and difficult to adjust. The unit described here is very straightforward and extremely simple to construct and put into operation in your station. A few watts of CW input will give about 75 W output in class C service.

The final tube used can be either an 829B or 5894. The latter is easier to use on 50 MHz as it needs no neutralization. This is a prime factor for selecting the 5894 as neutralization can lead to the crazy house long before perfection is achieved! The bias is obtained by rectification of input power, and the 6BQ5 clamp tube protects the 5894 if drive disappears.

Layout is not critical and can be arranged to suit you. The clamp tube can be mounted under the chassis if necessary. I built my amplifier on a 7" x 11" x 3" chassis. This allowed ample space for the power supply at the rear with the amplifier placed up front. It was then mounted in a regular 19" rack panel but could be placed in a cabinet for table top use.

The grid components are mounted underneath the chassis and the plate components are above so that no interaction between the two occurs. The plate coil and capacitor is mounted up front on the panel with the grid components behind the 5894 as viewed from the front. A long phonelic rod is used to connect the grid tuning capacitor to the front panel so all tuning can be done from the front. An alternate method would be to mount the grid tuning capacitor on the chassis so the shaft would be accessible from the top of the chassis directly behind the 5894. The 6BQ5 is mounted to the left and behind the 5894. This allows for short leads between the two tubes.

After construction, insert the tubes and begin checking the unit by using a grid dip meter to set the resonant frequency of the coils and capacitors. Adjust the maximum dip at 50 MHz for both capacitors. At this time, apply filament voltage and check to see that both tubes are lit. Apply plate voltage only after making certain that the unit is connected to a dummy load and the exciter has been connected at J1. Then apply plate voltage and no excitation. The 5894 should draw approximately 20 to 30 mA. Begin loading with loose coupling to the antenna. Apply full grid drive to 5894 and dip the final loading control, C2. Adjust coupling for a plate current reading of approximately 180 mA full load with a plate voltage of 600 V. If trouble is experienced in obtaining these readings in standby condition due to the value of B+, adjust R1.

When using the amplifier on any mode of operation, the clamp tube will be a vital asset as it will always protect the 5894. The setting of R1 in the initial tune up procedure will limit the 5894 to draw only 20 to 30 mA with "key up" condition. This is ample to cut the tube completely off and allow for a safe and sane operation of your new final amplifier.

Have fun in your construction and enjoy its ease of operation and the terrific results for such little effort. . . . K9EID

Bob is a professional organist. He's worked for the past seven years for the Holiday Inn motel chain. He was once associated with the VHF Amateur and was CQ's VHF SSB editor.

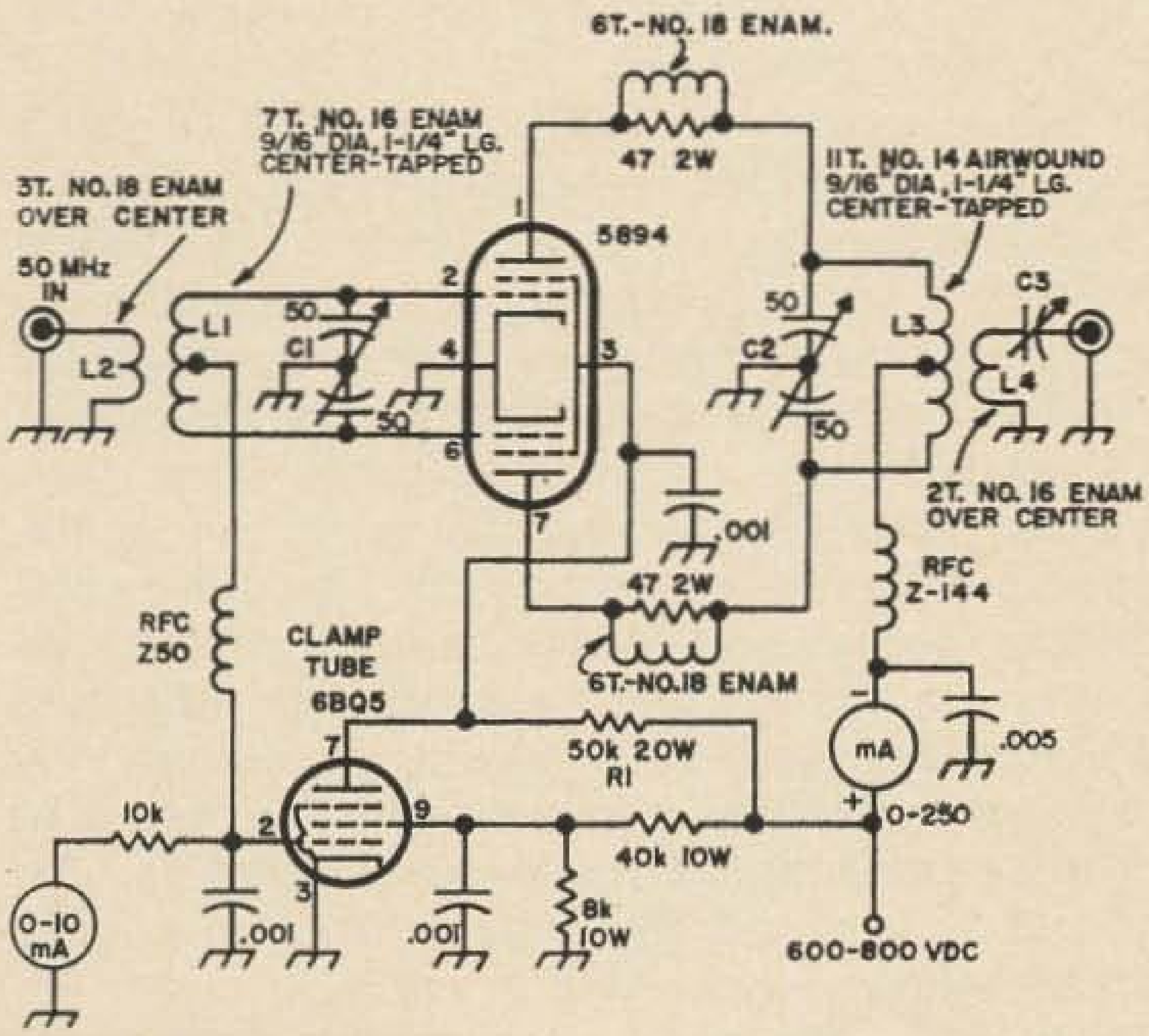


Fig. 1. 5894 six meter amplifier. The same basic circuit can be used with an 829B (or 3E29), but some changes will have to be made in the coils and resistors.

The Drake 2-NT CW Transmitter and 2-C Receiver

When the new Drake 2-NT transmitter and 2-C receiver arrived the other day, I had to rush right home and hook them up to an antenna. I have a base-loaded multiband vertical on 80 and 40, so I didn't know how well I'd be able to work out. After a quick perusal of the excellent instruction books, and connecting them together for semi break-in CW, I was all set to go. A quick three by three call on the 80 meter novice band netted three callers up and down the band; a WN1, a WN3 and a WNØ. I called the WNØ and asked the others to QRX. It turned out that the WNØ was out in Colorado and had never even heard a station from New Hampshire. After exchanging reports we had a nice little rag-chew at about 13 wpm. The 2-NT held up very nicely with 75 watts input—I was running 569 out in WØ land. Next the WN3—nice report from Philadelphia, 589. The WN1 was almost next door, so the 599 report wasn't too surprising. And so it went, nice reports from novices all over the country.

Next I changed the tap on the vertical and tried forty meters. Lots of QRM, but when I found a clear spot, the 2-NT didn't have any trouble at all working out with very nice reports. The excellent sensitivity of the 2-C picked up the weak ones and the selectivity took care of any adjacent rock crushers. Then up to 20, 15 and 10. For these bands I plugged in a VFO so I could move around a bit, connected up the tri-bander and looked for some DX around 14010. I heard lots of Europeans coming through; a short call to a PAØ in Rotterdam resulted in a 559X report followed by several stations calling from DL, SM and OZ lands. After cleaning up the minor pileup, I moved up to 15—same story in Africa. Some nice reports on the 100 watt signal from ZS6 and 5A3 stations. By this time it was pretty late in the evening so ten meters was pretty well closed down; I didn't hear any stations on CW, and very few on phone. Perhaps some other time.

After using the 2-NT for several hours, a few of the hidden features that aid in operating ease become apparent. Basically this transmitter is no different from many other low power CW transmitters; however these hidden features make all the difference in the world. Essentially, the transmitter is a three tube affair, with a crystal oscillator, driven amplifier and final power amplifier. The driven amplifier output and power amplifier input circuits are broadband tuned circuits that are factory adjusted, so no tuning is required by the operator. The pi-network in the output of the power amplifier is designed for 50 ohm coaxial lines, and the loading of this network is also factory set. All the operator has to do is turn the rig on, tune the plate tuning capacitor for a dip in plate current, adjust the *power set* for the desired power input, hook up the antenna and go on the air. And, if you don't want to tune for meter dip, you can tune for maximum brilliance of a built-in neon bulb. Operation is simplicity in itself and it takes longer to read about it than to do it. In addition, no external antenna changeover relays or receiver muting switches, no added TVI filters or "harmonikers"; they're all included inside the 2-NT!

The 2-NT transmitter uses grid block keying and extremely clean, crisp CW is obtained by a special pulse and delay circuit. Additional features of this circuit are afforded by the relay which it controls. This relay switches the antenna from transmitter to receiver, mutes the receiver, turns the sidetone off and on in time with your keying and grounds the cathode of your VFO if you use one.

A built-in transistorized 900 Hz phase shift oscillator generates a sidetone which may be used for monitoring your keying. There is a connector on the rear of the 2-C receiver for the sidetone signal; on other receivers it should be connected to the arm of the audio gain control. With these connections, the receiver works normally during receiving, but when it is muted for transmitting, the sidetone comes through the phones. In addition, when the transmitter is placed in the standby position, the 2-NT may be used as a code practice oscillator in conjunction with the receiver. In this mode, the key only controls the sidetone oscillator; none of the other stages are energized.

Another operating aid is the spot switch. With this switch you can spot the frequency that you are operating on without transmitting a signal. It is always good operating practice to listen before transmitting, and the spot switch on the 2-NT allows you to do just that. Only the low power frequency determining stages are energized during spotting, no power is applied to the final stage.

All in all, the 2-NT transmitter is one of the easiest to operate that I have ever used. All the controls have a purpose, and all the set and forget type controls have been adjusted at the factory. In addition, no accessories are necessary to put an outstanding signal on the air. For the novice, the 2-NT appears to be an ideal *starter* transmitter; even many generals will find it to their liking.

The Drake engineers really put their heads together when the 2-C receiver was on the drafting boards. What they have come up with is a neat combination of vacuum tubes and transistors that does a tremendous job. Vacuum tubes are used throughout the amplifier, mixer and *if* stages, but transistors take over in the high frequency oscillator, detector, BFO, AGC and audio stages. A total of five tubes and seven transistors do the bulk of the job; along with eight diodes for detecting and rectifying duties.

The rf lineup is relatively straightforward; a 12BZ6 rf amplifier, a 12AU6 high frequency mixer, two 12BE6 converters, and a 12BA6 50 kHz *if* amplifier. The two inputs to the high frequency mixer consists of the output of the rf amplifier and the output of the 2N3394 crystal oscillator. The output of the mixer stage is 3.5 to 4.0 MHz. This 80 meter signal is mixed with a 3955 to 4555 kHz VFO in the first 12BE6 for a 455 kHz *if* output. The second 12BE6 converter accepts either a 405 or 505 kHz input to put a 50 kHz upper or lower sideband into the 12BA6 *if* amplifier. A 50 kHz bandpass filter in the 12BA6 input provides an adjustable passband selectivity of

Drake 2-C Specifications

Frequency coverage:	3.5–4.0 MHz, 7.0–7.5 MHz, 14.0–14.5 MHz, 21.0–21.5 MHz and 28.5–29 MHz with the crystals provided. Accessory crystals will cover any 500 kHz segment between 3.0 and 30 MHz.
Modes:	SSB, CW, AM, RTTY
Selectivity:	Selectable passband filter provides: 0.4 KHz at 6 dB down and 2.7 KHz at 60 dB down. 2.4 KHz at 6 dB down and 9.0 KHz at 60 dB down. 4.8 KHz at 6 dB down and 16.8 KHz at 60 dB down.
Stability:	Less than 100 Hz after warm up or for 10% line voltage change.
Sensitivity:	Less than 0.5 μV for 10 dB signal plus noise to noise on all amateur bands.
Calibration:	Main dial calibrated 0 to 500 KHz in 10 KHz divisions; vernier dial calibrated in approximately 1 KHz divisions. Both the main dial and vernier are adjustable for calibration purposes.
AVC:	Amplified AVC system has slow or fast discharge and less than 100 microsecond charge. Less than 6 dB audio change for 100 dB rf input change.
Audio:	4 ohms output impedance. 1.8 watts with less than 5% distortion.
Antenna input:	50 ohms nominal.
Spurious responses:	Image rejection greater than 60 dB; *if* rejection greater than 60 dB on amateur bands. Internal spurious signals less than the equivalent 1 μV signal on the antenna.
Lineup:	5 tubes, 7 transistors and 8 diodes.
Accessories available:	2-AC 100 KHz calibrator, 2-LF low frequency converter, 2-CQ speaker/Q-multiplier and notch filter, and 2-NB noise blanker.
Power requirements:	120 volts, 50 to 60 Hz, 30 watts.
Size and weight:	11-5/16 x 6-9/32 x 9-3/32 inches. 13½ pounds.

Drake 2-NT Specifications	
Frequency coverage:	CW portions of the amateur bands from 80 through 10.
Input power:	Variable to 100 watts. Plate current meter redlined for 75 watts novice limitation.
Modes:	Break-in CW, semi break-in CW or manual CW.
Features:	Automatic transmit switching, built-in antenna changeover relay, sidetone oscillator, frequency spotting, built-in low pass filter and simplified tuning.
Antenna output impedance:	50 ohms nominal.
Lineup:	3 tubes, 1 transistor and 5 diodes.
Accessories available:	Antenna matching network, VFO, crystals.
Power requirements:	120 volts, 50 to 60 Hz at 2.8 amperes.
Size and weight:	9⅞ x 6-9/32 x 9-9/32 inches, 12½ pounds.

either 400 Hz, 2.4 kHz or 4.8 kHz at the 6 dB points.

The sensitivity and selectivity of this lineup is really tremendous. The 0.5 μV sensitivity for 10 dB signal plus noise to noise on all bands from 80 through 10 really pulls in the weak ones. Like the old adage says, if you can't hear 'em, you can't work 'em. And after a few minutes warm up, the drift is not detectable; even with a 10 volt change in line voltage the drift is only barely perceptible. When a strong local comes on the 2-C performs admirably. The 12BZ6 contributes a great deal to this because of its low intermodulation characteristics, but the variable passband filter does most of the work. When the going really gets rough, you can turn it down to the 0.4 mark; in this position the bandpass is still only 2.7 kHz wide 60 dB down.

The amplified AVC systems works extremely well. When the stations are weak, there is almost no AVC voltage applied to the rf and *if* stages, but let a strong signal come on and immediately it is at a comfortable listening level. In fact, there is less than 6 dB audio change for a 100 dB change in rf level. To give you an idea what this means, 6dB is about the difference between programming and commercials on TV; 100 dB is the same as comparing a 1 watt transmitter to a ten trillion watt transmitter; for different types of operation, the operator may choose slow or fast AVC release times, or he may turn the AVC off.

The 2-NT transmitter and 2-C receiver, working singly or as a pair provide an extremely convenient and economical starter station for the novice. And when the novice advances to the general ticket, many will find that this equipment is still ideally suited to their needs. For ssb and RTTY operation, the 2-C stands up right along with many of its more expensive cousins, so when the general ticket arrives there is no need to go out and buy another receiver. For portable or field day operation the pair is ideal. They are compact, easy to tune, require a minimum of outside accessories and require a minimum amount of power; perfect for low power gasoline generators.

. . . W1DTY

Space Age Soldering

I read K4CPR's article in the March 73 and it inspired me to look up the methods for space vehicle soldering. When you are putting equipment into orbit every solder joint must be perfect. This is how it is done.

Given—a cruddy old resistor to solder into the circuit.

1. The part to be soldered is never handled with the bare fingers. This puts oil where you want the solder. You use a pair of gloves or nylon finger cots when touching the leads.

2. Choose a soldering iron:

Wire gage 20 and smaller	35 watts
Wire gage 20, 16, 14, 12	50 watts
Wire gage 12, 10, 8, 6	100 watts
Wire gage 6 and larger	200 watts

3. Take a pink pearl eraser and shine the area to be soldered.

4. Dip a brush in trichloroethane, or equivalent, and wash the area to be soldered.

5. Take another brush and coat the area to be soldered with liquid rosin base solder, MIL F 4995.

6. Heat the iron, dip the tip in liquid rosin flux, apply solder to the tip of the iron, and wipe it clean on a damp cellulose sponge.

7. Tin the lead to be soldered by putting a heat sink next to the body of the resistor, apply rosin core solder to the iron tip, and within six seconds apply the solder to the wire for five seconds only. If you are not able to apply the solder within six seconds, wipe the iron clean and start with fresh solder.

8. After tinning the lead solder the part within an hour. If this is not possible wash off the flux with trichloroethane and reflux when you are ready to solder. After soldering the connections wash off the flux with a brush and trichloroethane.

If you follow the directions you'll find they work just fine but I find a good sprinkling of profanity to be of great service.

. . . Del Wininger WB6JNI

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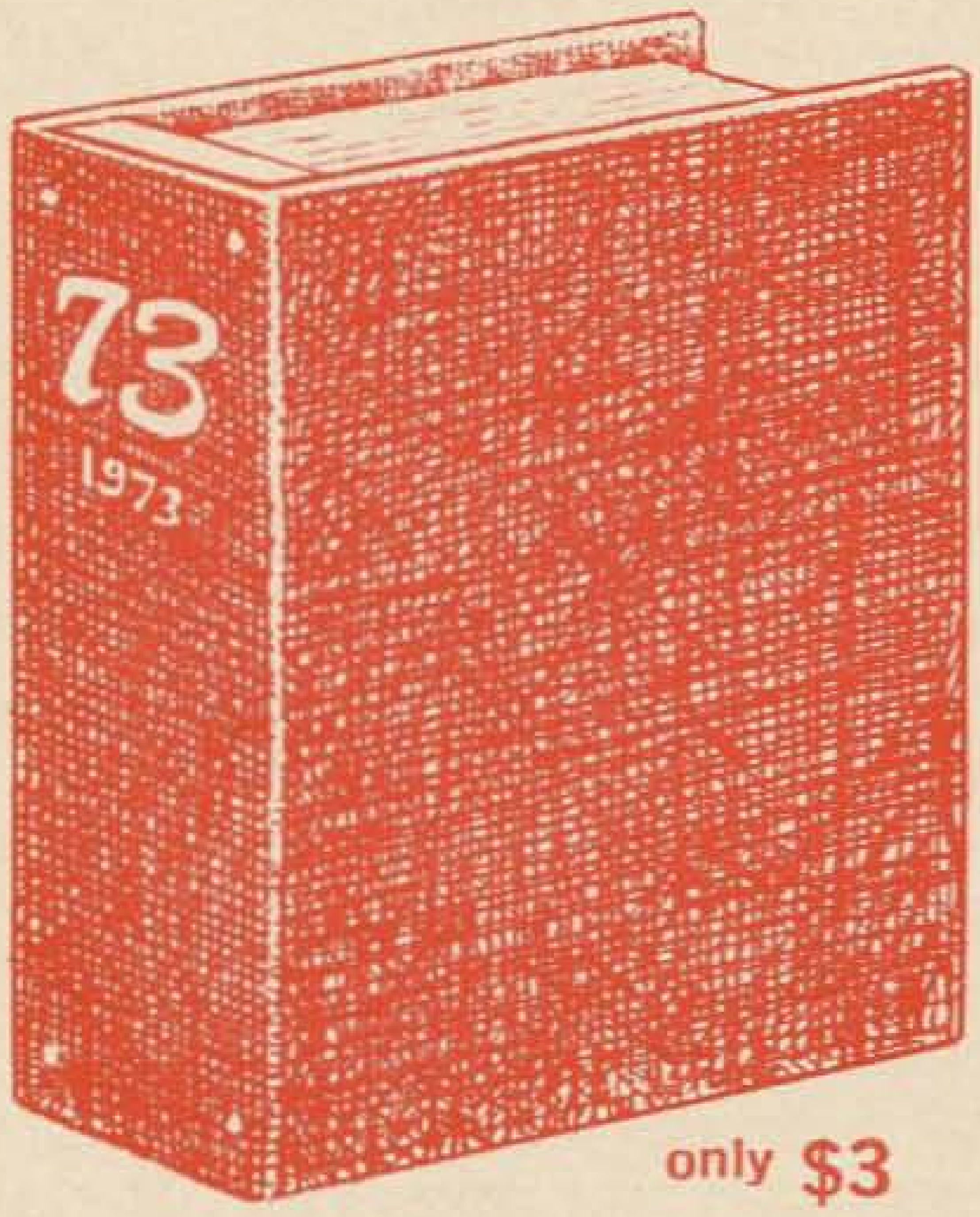

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James Ashe W2DXH
R.R. 1
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A Simple Voltage Calibrator

Are your meters lying to you? Most likely they are. In this article Jim discusses the causes and results of meter errors, and shows how they can be overcome.

There is a remarkable likeness between the archer who is aiming for his target and the amateur designer who wants to design a circuit. Both follow a procedure which is only partly based on clear, sharp textbook theory. Each depends heavily on intuition, on accumulated habits derived from previous successful experience. The archer who practices with crooked arrows can only hope to succeed in an average sort of way, with many discouraging events to try his patience and interest.

Not all instruments are accurate. There are various kinds of inaccuracy, and as with other machinery, the properties of instruments tend to drift with time. Calibration may also be violently altered by laboratory accidents. Suppose two meters which once behaved identically no longer do so. Which is wrong? Could they both be wrong? It appears that a third party, rather isolated from the usual events of the lab, is required. This article describes a sort of secondary voltage standard, very good in proportion to its cost and effort of construction.

Some notes on meters

The problem of meter calibration is best viewed against a brief background of some facts about meters. Further perspective development would result from a review of material appearing in handbooks and textbooks.

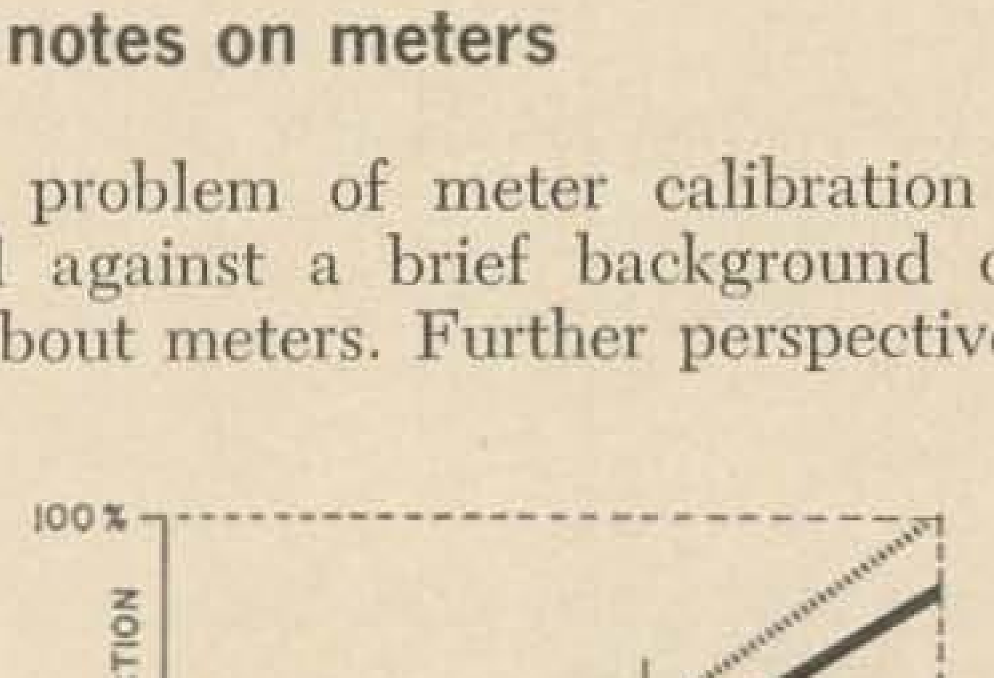


Fig. 1. Performance of a wrongly calibrated but linear meter.

It may come as a surprise that all moving coil meters are current-sensitive devices. They do not respond, except indirectly, to voltage. They appear, sometimes, to respond to voltage because of the constant influence of Ohm's Law upon the circuit, but in fact they are only indicating the current passing through them. This is because each meter movement contains, as an integral part of itself, a fixed magnet. A coil moving in the magnetic field experiences a force proportional to the current passing through the coil. Voltage does not produce a magnetic field as does current, so that conventional meters respond to current, not voltage.

Another valuable point will appear upon close examination of almost any multimeter, dc ammeter, or other indicating device. It is the fact that the scale is linear. That is, the angular deflection is directly proportional to the applied voltage or current. The divisions across the scale are equally spaced and each one represents the same increase. By contrast, an ohms scale on the same meter will be nonlinear: the range from zero to five ohms at one end may take up as much scale space as 200 ohms to infinity at the other end.

Meter manufacturers are very interested in linear meter movements. Design and calibration problems are simplest if a linear scale can be used with a linear movement since only a single adjustment is required to calibrate the entire instrument. This is the common full-scale adjustment, a simple calibration performed to bring the full-scale reading into agreement with the full-scale voltage or current. The manufacturer wishes to produce thousands of similar meters with least expense and effort; the user would like to check the entire calibration with one measurement. This is not possible if the meter response is curved,

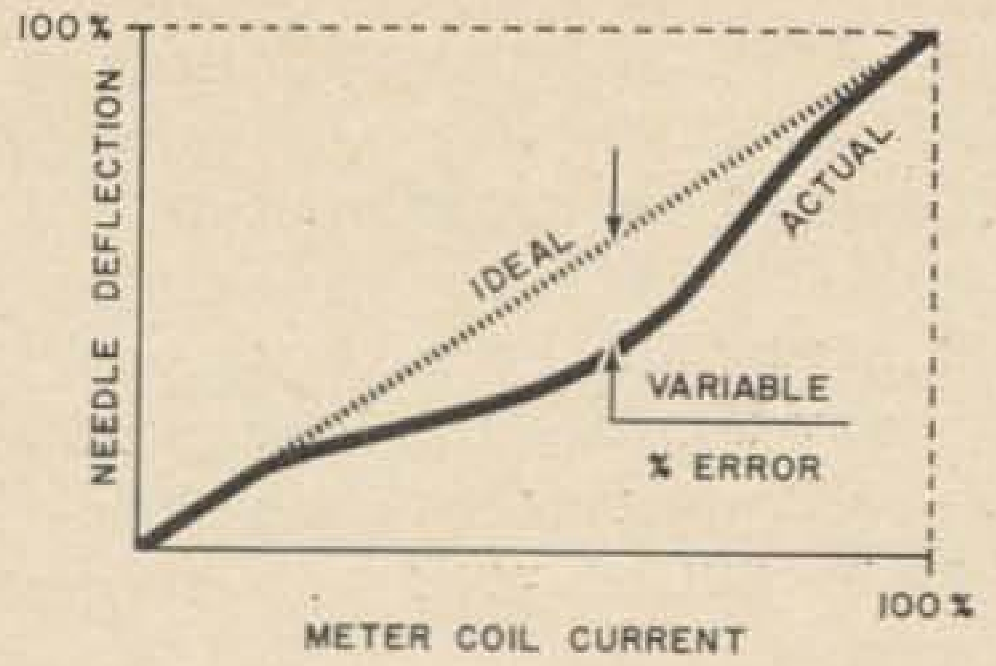


Fig. 2. Performance of a "rightly calibrated" but nonlinear meter.

since then the degree of curvature has to be measured, a much more complicated business than a single point calibration.

In 1882, D'Arsonval called attention to the virtues of a certain type of meter movement which combined durability, simplicity, linearity, and relative immunity to outside effects. It is now known by his name, and is used in virtually all meters made. This movement is mentioned in many publications, described in a few, and is very well worth looking up. An old pre-1900 physics or science book will yield surprising and interesting information on the elaborate predecessors of today's apparently simple multimeters.

Meter error

There is no such thing as a perfectly accurate meter. The readings of a particular meter may be accurate, for instance, within 10%, 3%, or 0.5%. The price rises rapidly as the accuracy improves, but there is no meter at any price without error. In order to keep the picture simple, the source of the error can be neglected, and reference made only to the reading observed on the meter together with its dependence on the applied current. Then the observed error can be broken down into three types: stiction, calibration error of a linear meter, and linearity error of a "properly calibrated" meter.

Stiction is observed in this way: you place the probe in the circuit and observe a reading. Without disturbing anything else, you tap the face of the meter with finger or a pencil; the reading creeps upwards slightly. The explanation is sticky friction: you can experience much the same thing by sliding your hand along a smooth surface. If it moves in a series of starts and stops, that is stiction. Another example is the peculiarly unpleasant way in which fingernails slide along a blackboard. Obviously this has no good function in the meter's bearings and much effort is made to eliminate it. Particularly in the less expensive meters the effort may not be so successful. Sometimes a readjustment of the meter bearings will improve the situation: this is very, very much like gambling, if you're not an expert. When making accurate readings, always assume there is some stiction and tap the meter face or the panel nearby. Use something light and don't overdo it.

There is a sort of relation between calibration error and nonlinearity. The separation made here is for purposes of explanation, and in any discussion of one the other should be assumed just offstage, waiting eagerly for an opportunity to make an unobserved and frustrating entrance.

Fig. 1 shows what is usually meant by calibration error. We assume that the meter's characteristics are strictly linear. That is, that a 1% increase in current through the meter produces a certain swing of the needle which is the same anywhere on the scale, and the swing is through an angle just 1% of the total swing from zero to full scale. That means the meter's characteristics will plot out as a straight line, shown as a dotted line labeled "ideal". The solid line labeled "actual" shows the performance of a meter with a calibration error. This kind of calibration error is usually corrected by a trimmer device added somewhere in the immediately adjacent circuit.

Fig. 2 shows what is meant by nonlinearity error. Note the full scale reading is just what it ought to be. Zero is also where it belongs, but there is a rather irregular deviation above or below the ideal between these extremes. When you have finished the Calibrator, you will very probably find this type of error in at least one of your instruments. If this error appears in a vacuum tube voltmeter or its solid-state equivalent, perhaps it can be reduced by a trial-and-error interchanging of tubes or transistors.

It is important to retain a correct perspective when dealing with calibration problems. A diagram like **Fig. 3** is very useful, because it shows that a deviation of perhaps one tenth volt can be a large error at the low end of the

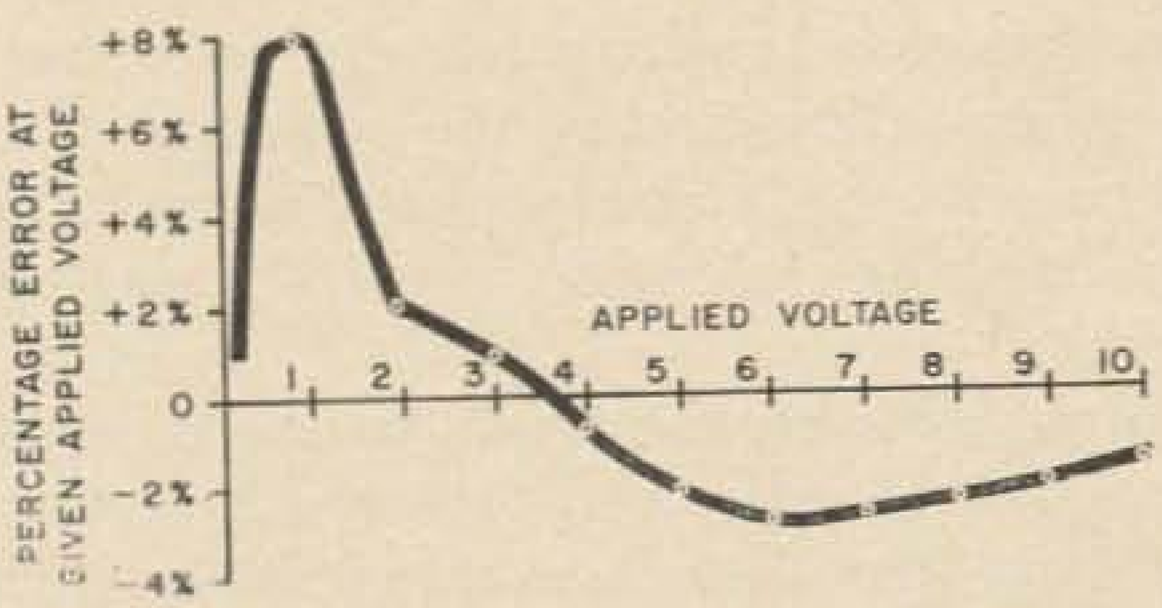


Fig. 3. Performance of a popular multimeter as measured with the Calibrator. Note unexpectedly large error at the low end of the scale.

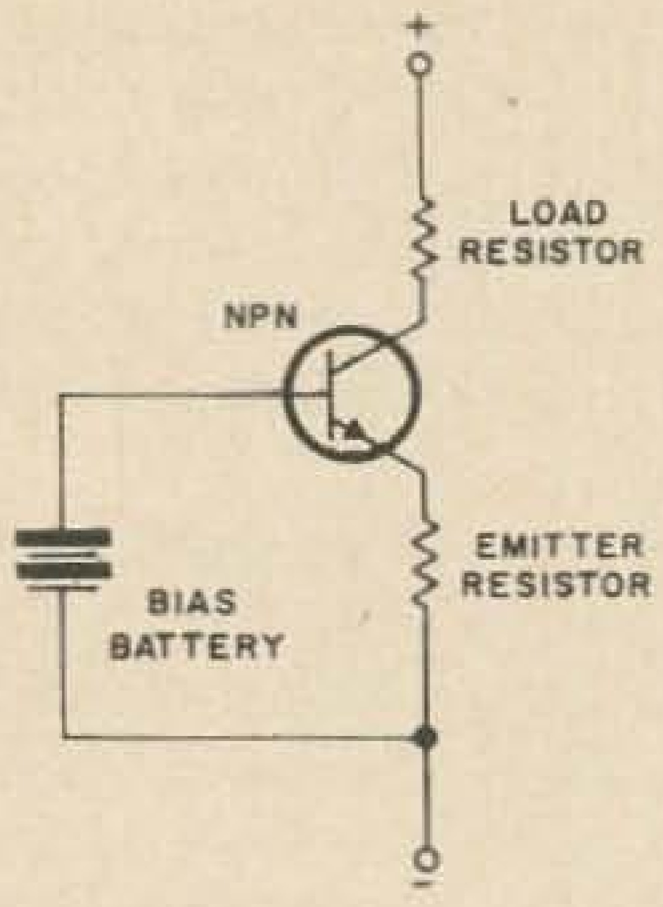


Fig. 4. Skeleton circuit of the Calibrator.

scale and a trivial error at the high end. Calibration and linearity checks will be most meaningful if plotted in this way. This curve was derived from a real instrument, a popular multimeter priced at $16.88.

Calibration using fresh batteries

It's popularly believed that fresh batteries can be used as accurate calibration voltage sources. This is partly true, but it is not true enough to meet modern requirements. The reproducibility of electro-chemical reactions and the similarity of one production-line item to another seems to imply that two batteries from the same manufacturer or even from two different manufacturers ought to be as like as two peas in a pod. Or at least that such differences as appear ought to be in some respect other than terminal voltage.

But differences do appear. Some policy has to be adopted permitting important differences to be weeded out from insignificant ones. Microvolt differences are clearly unimportant; differences of a tenth or a half volt clearly cannot be tolerated if batteries of around 1.5 volts are going to be used for calibration standards. It seems reasonable to suppose that for general-purpose work, a calibration source should be accurate within 1% or better; that is, at 1.5 volts the extremes would be 15 millivolts each way. A significant factor in thinking about tolerances is the possibility that one calibration may end up at one extreme, and some other calibration at the opposite extreme. An accuracy of 1% does indeed seem to be the upper limit on tolerable error for calibration purposes.

A large number of fresh pencells, standard carbon-zinc D cells, and assorted mercury batteries were tested to determine likely variation in terminal voltage. Variations as great as 50 millivolts were found in cells from the same box. This amounts to a range of nearly 2% each side of the mean voltage for that batch, and since few amateurs will have a method for determining whether the average is correct or skewed, it appears that the idea of using fresh dry cells for calibration purposes has been exploded. Perhaps it would be preferable to say the idea has been well undercut; the fresh cells are better than nothing but they appear to be not as good as a serious worker should require.

Calibrator circuit theory

This calibrator uses an unusual method for generating its output voltage. In most such devices, a voltage-determining circuit feeds the output directly, or is followed by some resistance-divider device to generate the variable output. This is a simple scheme, basically, but it suffers from a significant shortcoming. Calculation of the change in voltage due to load tends to be difficult, because there is no simple way to estimate the properties of the standard at most settings.

If the electronic circuit is designed to standardize a current rather than a voltage, Ohm's Law and the resistor manufacturer's engineering tend most reliably to the conversion of the current into a voltage. Computation of the error due to passage of some of the current into a load circuit becomes very simple if a wise choice of circuit parameters is used. In the case of the Calibrator, a constant current of 5 milliamperes is supplied to a 2000 ohm high-quality ten-turn potentiometer. The thousand-point scale (one hundred points, per turn, ten turns) thus cranks out 2 ohms per division from zero, and the voltage across this resistance is just that produced by 5 milliamperes less whatever current is delivered into the load.

The basic circuit of the Calibrator is shown in Fig. 4. A voltage reference source and a transistor fix the voltage across the resistor R. The transistor acts as an emitter follower. Since the voltage across R is fixed, the current through it is also fixed. The same current flows

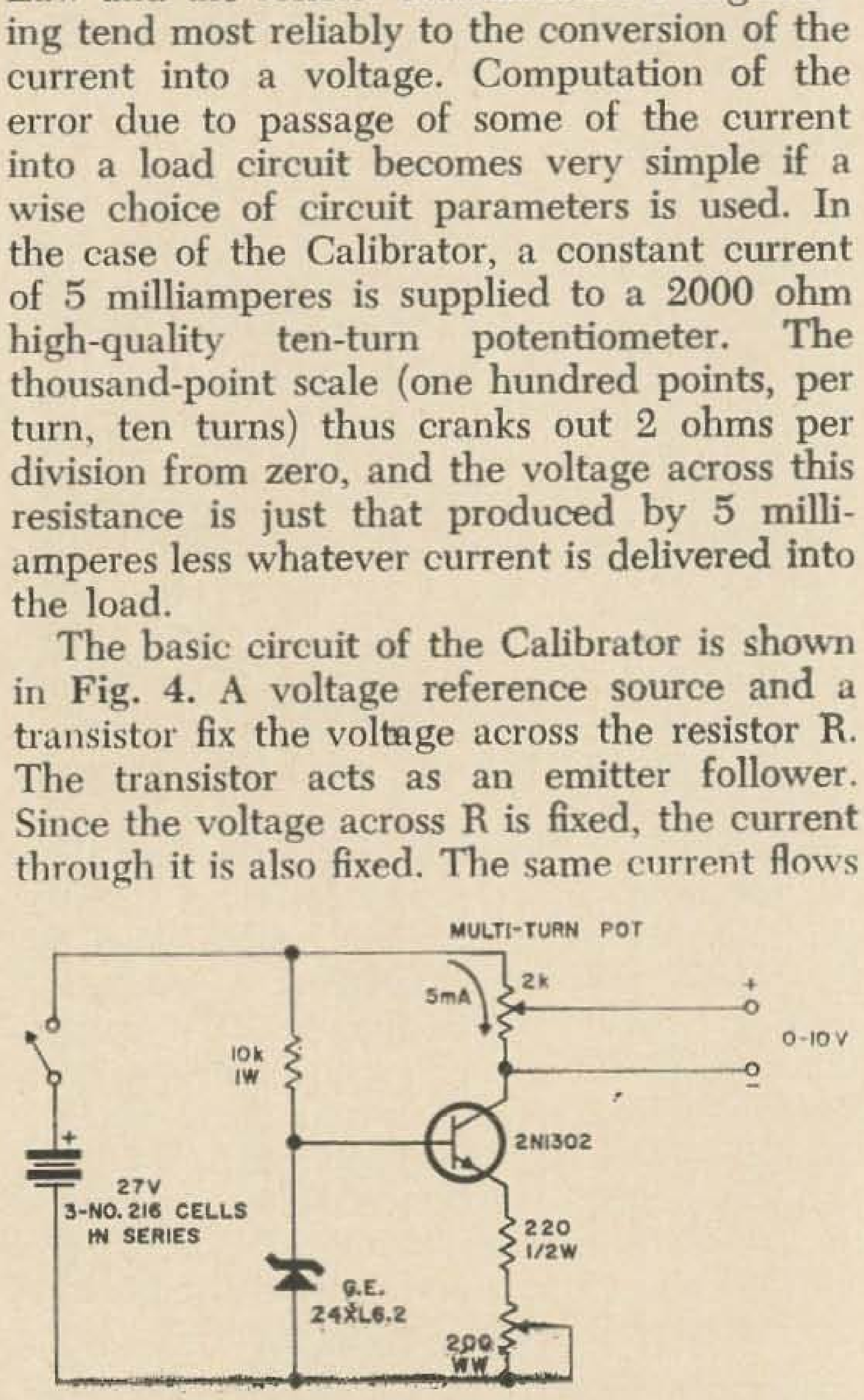
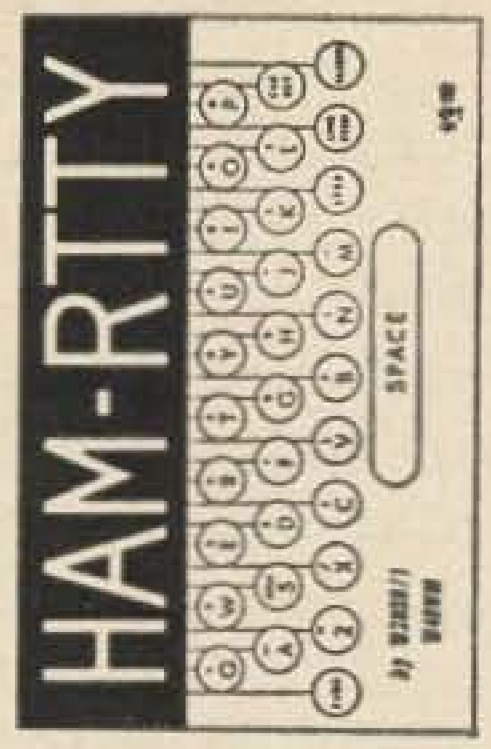


Fig. 5. Complete circuit of the Calibrator. Most of the parts are completely uncritical.

READ AND GET SMART

HAM RTTY



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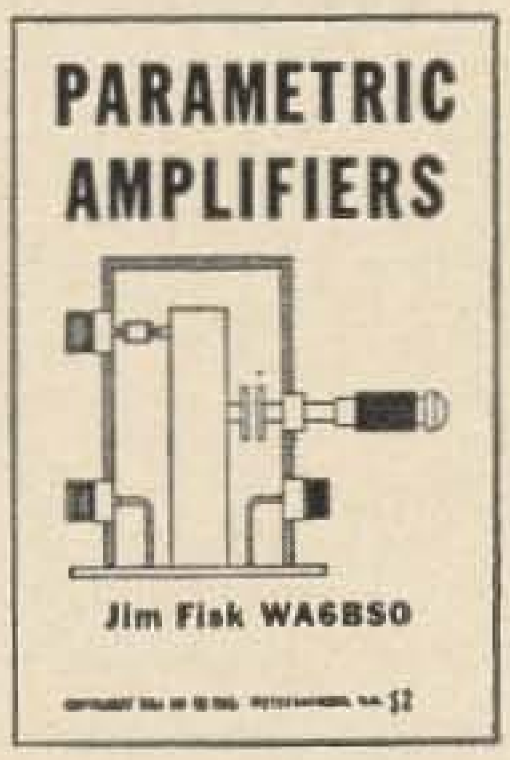

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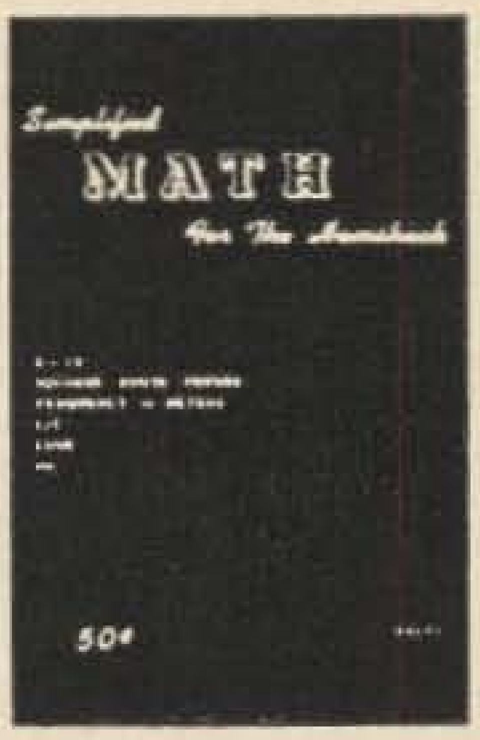

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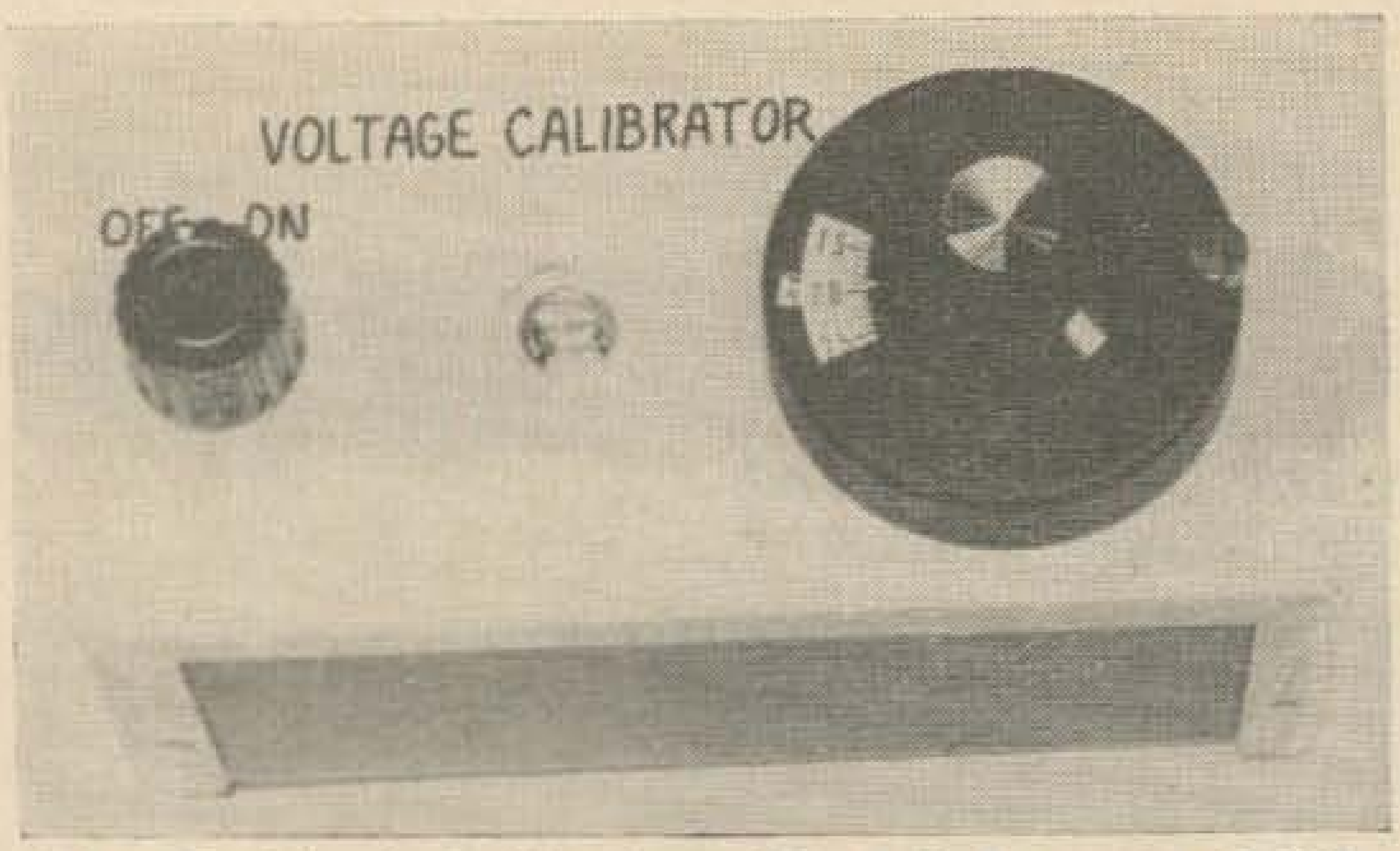
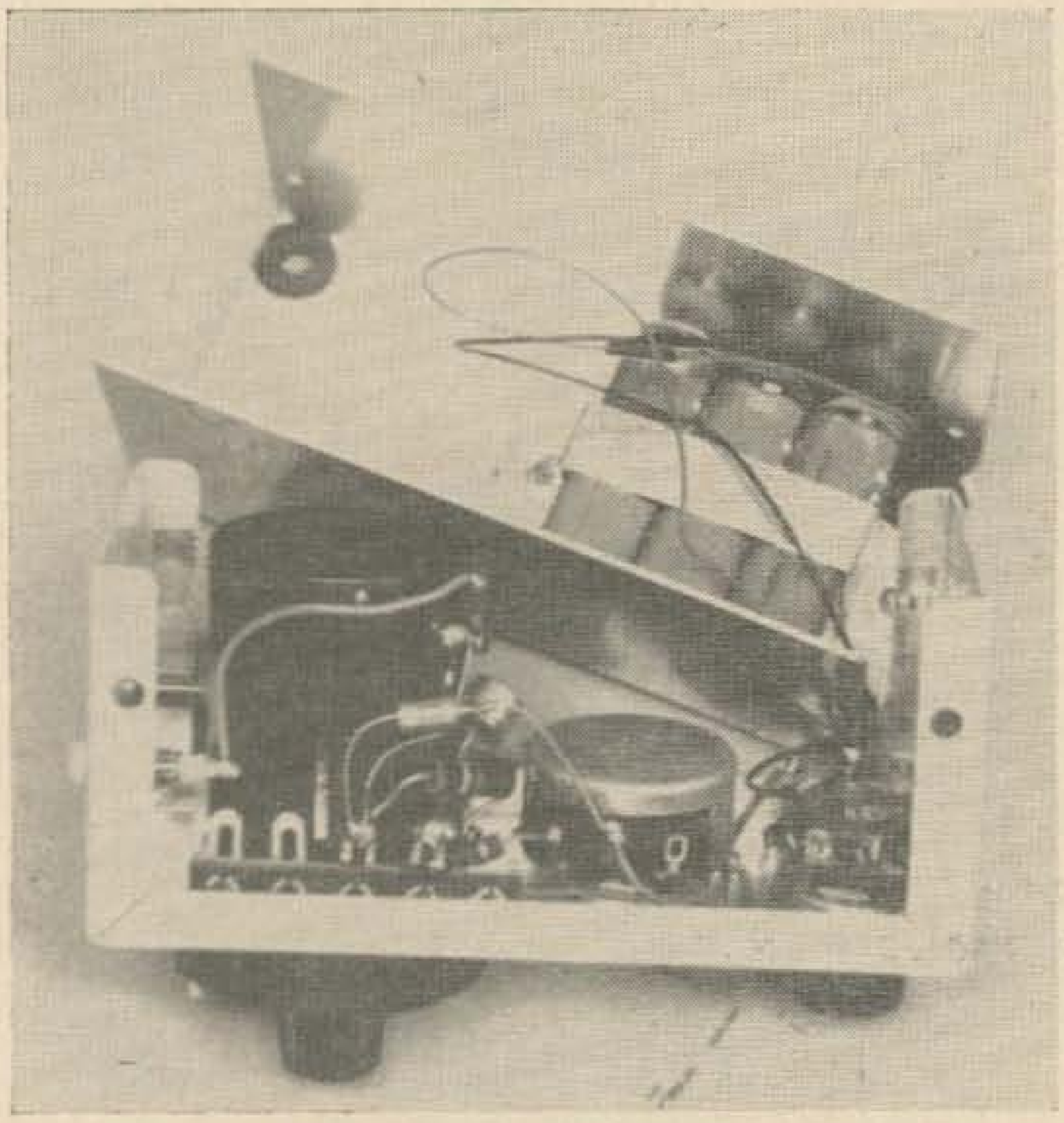


The finished Calibrator. The dial reads 2.20 volts. Adjustment for accurate output by screwdriver pot in the center of the panel.

through the load resistance that serves to convert the current into a voltage.

Fig. 5 shows the complete circuit, hardly more complicated. The resistor in the transistor emitter circuit is split into one fixed and one variable resistor, to permit vernier adjustments in current. The transistor base voltage is fixed by a zener diode, and a resistor has been added to supply the necessary zener current. A non-critical battery and a switch complete the circuit.

The voltages across the circuit have to add up to the battery voltage. From the battery to the zener biasing resistor, down through the zener to the other terminal of the battery, is the complete biasing circuit. Since the transistor has a beta of 100, it draws negligible current from the zener. It is only necessary for the zener to be safely out of its knee region; but not too far because current in this circuit loads the battery with no return in output.



Inside the Calibrator, showing point-to-point wiring.

The other current route is down through the load resistor, the transistor and the emitter resistor. Since the voltage across the emitter resistor is fixed by the transistor, the base-emitter voltage remains fixed at about 0.2 volts, and the voltage across the load resistor is fixed by the constant current through it, the only voltage that can vary as the battery ages is the transistor collector voltage. But collector voltage variations have practically no effect on transistor current. So long as the transistor remains within its operating range, the circuit works.

There are some nearly invisible second-order effects. The only one worth mentioning is a slight drift over the first few seconds after the Calibrator is turned on, due to the zener and the transistor warming up.

Calibrator construction

There is nothing critical about layout and construction. For best results, new parts are preferred, but junkbox or surplus parts should yield perfectly good results in all cases where you are properly suspicious and apply careful tests to the components. Since this circuit is a little bit odd in comparison to most of those appearing in the amateur literature, it might be breadboarded before construction and a few tests performed to clear up the facts about its performance. A milliammeter and a Diddlebox[1] in series with the transistor collector circuit will show clearly that the current is remarkably independent of changes in collector load, so long as the transistor is biased into its operating region.

The calibrator is built in a 2¼ x 2¼ x 5 inch Premier Minibox. The wirewound calibration pot and the multi-turn pot plus two insulated lugs on a standard lug strip provide enough terminals for point-to-point wiring of the entire circuit. A solid bracket holds three standard 9-volt transistor batteries in the bottom piece of the case; three 8.4 volt mercury batteries could have been used. They hardly seem to be required. The Calibrator is highly valuable when needed, but it does not receive the steady use of a VTVM or a scope.

Two GE zener diodes were purchased for this project, just in case. It turned out that one of them had a knee at around 7 mA; the other at well under 1 mA. This is within specs; they are apparently tested at the factory at 20 mA. The lower current is preferable; the zener

1. Diddleboxes are discussed in the April 1966 issue of 73, page 48.

has to hold the transistor base voltage only against a few tens of microamps plus the transistor leakage current of a few microamps.

If a zener other than the specified GE Z4XL6.2 is used, an appropriate revision of emitter resistors is very simple: the total resistance should be chosen for zener voltage less 0.2 V base-emitter voltage at 5 mA or whatever other fixed current is chosen.

If a surplus transistor is used, a fairly high beta is preferred, but not over 200 or so. It should show low leakage current; in any batch of ten or twenty similar transistors at least one will show up with good beta and remarkably low leakage. Choose that one. If the emitter resistor takes up six volts and the multiturn pot takes up 10 volts, the rest of the battery voltage has to appear at the transistor collector terminal. In the schematic of **Fig. 5**, this is about 11 volts. Some surplus computer transistors are good for only 15 volts.

Finally, if a surplus pot is used, it should be checked for noise and erratic operation. Put a battery across its terminals at sufficient voltage for a few milliamperes through the potentiometer. Add a load resistor or perhaps 20 kΩ from its slider, and listen with a signal tracer. A slight, almost musical, noise is permissible; erratically noisy regions or spots are grounds for rejection.

Calibration

A few final tests will quickly indicate whether the circuit is operating properly. A milliameter in the transistor collector circuit should show constant current against variations in battery voltage. Placing an additional resistor across the zener biasing resistor for a 10% current increase should have no more than a barely discernible effect upon collector current. Perhaps you can think of one or two other tests.

The calibration procedure is simply a matter of adjusting transistor current through the multiturn pot to the correct value. This may not be quite 5 mA, or it may be a little over, because of the 3% or 5% tolerance on overall resistance of the pot. This tolerance has nothing to do with the 0.1% or better linearity tolerance, which determines the accuracy of intermediate readings. The transistor current is adjusted to give a correct reading at any fixed pot setting, preferably full scale. Unlike many meters, the linearity of the pot is guaranteed, so that the full scale calibration is reliable in this case.

Of the various possible sources of known voltages or accurate indications for calibration purposes, batteries have already been discussed. A calibration may be performed by comparison with some meter believed to be correct, but this is a somewhat risky procedure. An expensive or a new meter is more probably accurate than an old or inexpensive one, but there is a distinct element of risk that cannot be eliminated when calibrating in this way.

A better and more reliable source of accurate voltage is a standard cell. High school physics laboratories frequently have inexpensive but quite good standard cells available, or one may be purchased from a scientific supply company. They are sealed in glass and last for many years if they are not subjected to overload, extreme high or low temperatures, or excessive vibration. The manufacturer is generally very specific as to what constitutes abuse and his notions should be respected. In most cases, a load of 10,000 ohms is about the minimum; this draws about 100 microamps from the usual approximate 1.0183 volts.

Fig. 6 shows a circuit for calibration by standard cell. The switch is a normally open push switch so that current is drawn from the standard cell only for brief periods. Any 0-50 microammeter will do. To make the calibration, the Calibrator dial is set to the standard cell voltage and locked in place. The vernier calibration pot is adjusted for a barely perceptible upscale deflection of the meter. Then the 4.7 kΩ resistor is shorted out, and the vernier calibration pot readjusted for a zero reading. This completes the calibration. The microammeter reading goes to zero because the Calibrator on one terminal and the standard cell on the other are putting out the same voltage: no current flows if no potential difference exists.

An amateur or experimenter sees a potentiometer as a resistance with a slider supplied in a little case and capable of a few percent resolution. A more elaborate potentiometer, perhaps costing over $1000, may be found in the high school or college physics laboratory. If one is available, certain accessories required for its use are probably also on the premises, and it may also be used for calibration of the Calibrator. Some reading in appropriate physics texts will be required, but potentiometer theory is not elaborate and you should have few difficulties with it.

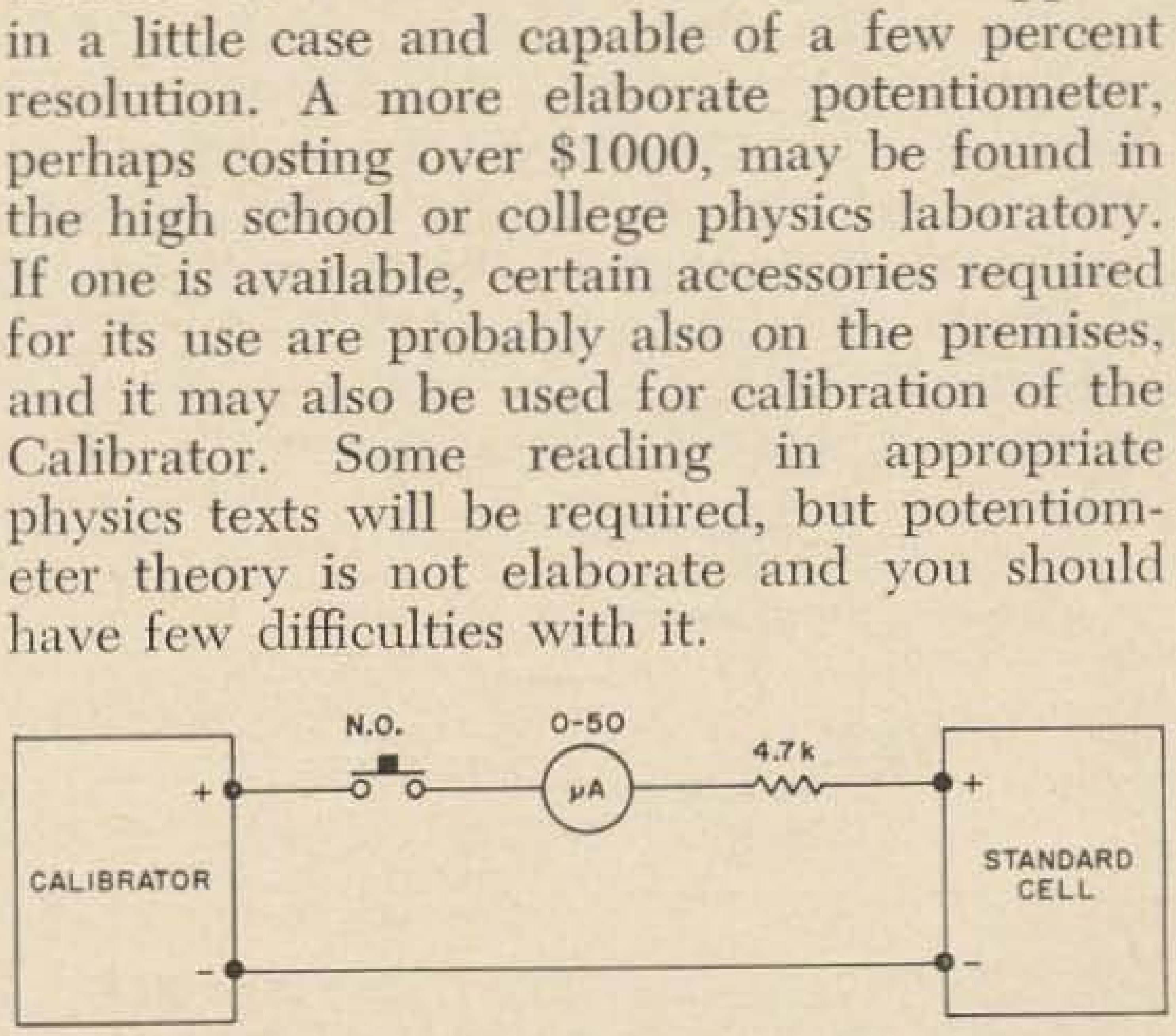


Fig. 6. Circuit for calibrating the Calibrator from a Standard Cell.

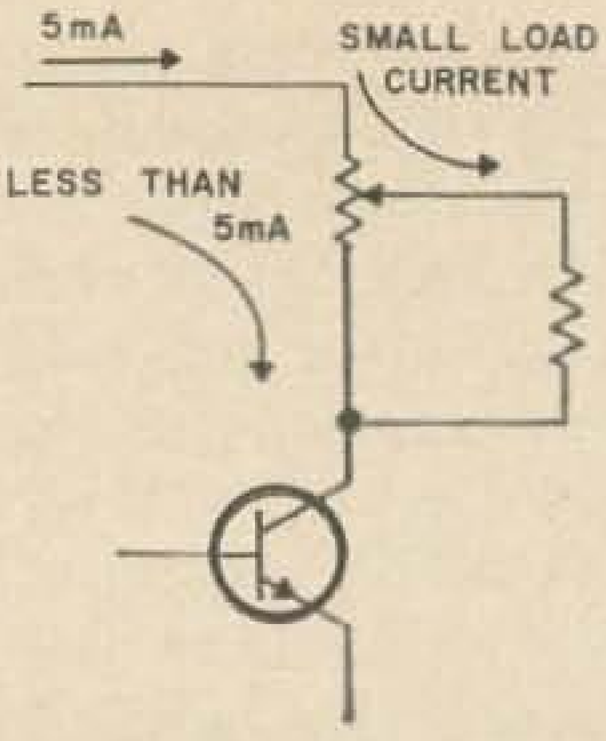


Fig. 7. Loading the Calibrator reduces its output voltage exactly in proportion to the current sidetracked around the multiturn potentiometer.

The very nicest instrument for calibration of the Calibrator is a digital voltmeter, frequently referred to as a DVM. It usually contains its own standard cell, and its design is inherently accurate. After checking the DVM calibration, connect it to the Calibrator, set the Calibrator to 9.95 volts, and adjust the vernier pot until the DVM gives the same reading. Then, just for kicks, crank the Calibrator pot down to various lower readings and watch the DVM produce readings agreeing within a millivolt or two. It's very impressive.

Operation

The calibrator dial reads 0-10 volts in ten turns of 100 points per turn. That is ten millivolts per point, one volt per turn. This direct reading is very convenient! It is the reason for choosing a scale of 0-10 volts rather than 0-5, 0-1.5 or some other range. 0-1 volt was considered, but a ten-volt range seems to be more appropriate for meter calibration and general laboratory work.

Many applications for the Calibrator will demand so little current that its calibration will be inappreciably altered. To achieve a 1% change in calibration, the load must steal 1% of the 5 mA supplied to the multiturn pot. That is 50 microamps. If this current is supplied from 10 volts, the load is 200 kΩ. If the load exceeds 200 kΩ, no correction is required for most applications. For example, an 11-megohm VTVM, a backbiased diode test, or a voltage comparison test in which two voltages are adjusted to equality so that no current flows, would require no correction at all.

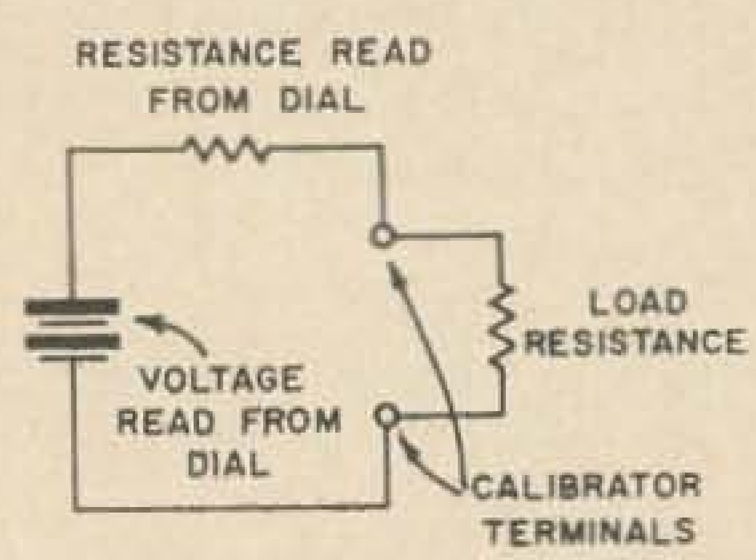


Fig. 8. Shorthand equivalent circuit for quickly estimating true voltage at the Calibrator terminals when supplying current to a substantial load.

But laboratory applications are so variable that no guarantee at all can be made as to the size of the load. The key to the problem of working out the calibration change under load rests in the constant current generator. It always supplies 5 mA, or something very close to it. The situation resolves to that shown in Fig. 7. The load current is subtracted from the constant 5 mA, the voltage across the Calibrator terminals must be that due to remaining current through the resistance from slider to ground. This resistance is two ohms per division, since the 2000 ohms of the pot are allocated equally to the 1000 scale points.

Fig. 8 shows an equivalent circuit which expresses the same facts. A generator always supplies the voltage seen on the Calibrator scale. The load current passing through R reduces the voltage to that seen at the output terminals. R is the resistance from slider to ground of the pot. The subject is more fully discussed under Thevinin Generators in many electronics texts: this concept is one of the greatest problem solvers going.

Some suggestions

It isn't necessary to build the Calibrator exactly as described. I've tried to describe it completely enough so you can see what the ideas behind it really are. You can work up your own model which might be very different from mine. Here are some of the variations which occur to me.

A single-turn pot might be used, preferably wire-wound, although 5 mA through 2 kΩ will dissipate only 50 milliwatts so that a composition pot could be used. But in such a case you probably cannot trust the linearity, which greatly simplified and improved my Calibrator. A resistor or a set of resistors could have been used, which would limit the number of voltages available, but would avoid the expense of a multiturn pot. The voltage out or the transistor current could have been chosen at other values, but there are problems here too. If a very low maximum voltage is chosen, you may find yourself involved with thermoelectric effects. If a high transistor current is chosen, you may find, for some applications, more drift than you like resulting from variation in transistor dissipation as the battery runs down. Well, have at it! Make up a breadboard and don't be afraid to try out some new ideas starting where I've finished.

. . . W2DXH

W. R. Lingenbrink W6HGX
1809 Hill Ave.
Hayward, Calif. 94541

The Link

Like to try a two meter yagi with a semi-cylindrical reflector?

If you are interested in making your "Five Watter" sound like a big rig, then read on.

The "Link" I am about to describe has been the volume producer here for sometime now and I feel that it warrants passing on to the brotherhood at large.

There is no great cost involved, in fact five dollars should cover the Link quite well.

The materials involved are a length of tubing for the boom (the boom from an old TV antenna works quite well) and a roll of aluminum clothes line wire for the elements. The rest of the hardware should be handy around the "shack."

The basic components of the design are by no means new, but putting them together in this configuration I feel is now or at least novel and for good measure it works.

The basic theory behind the antenna is a modified corner reflector used as a launching device for the yagi antenna. An added bonus is the unusual front-to-back ratio gained by this method.

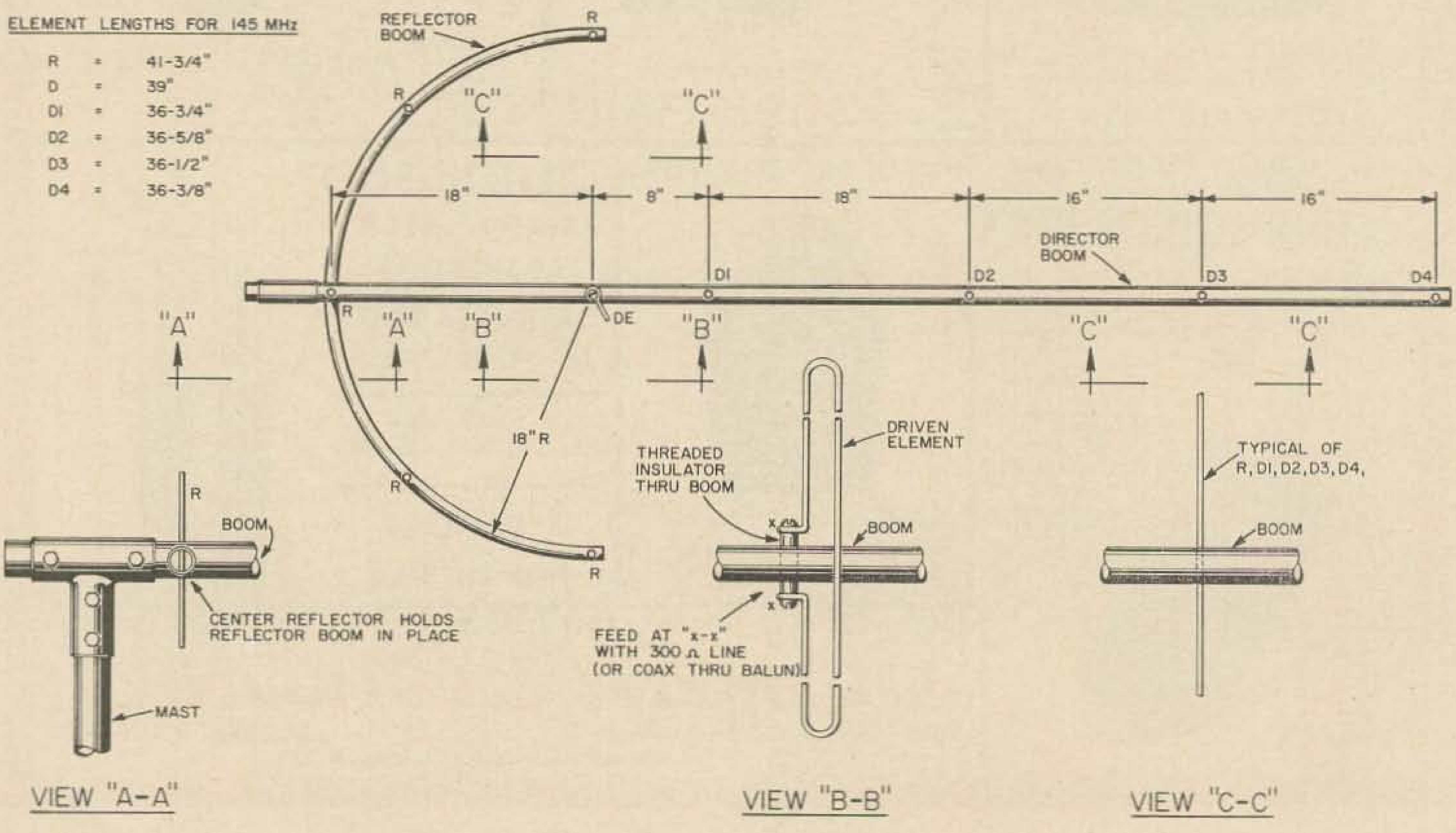
It might be well to add here that if you are only interested in local rag-chewing in the big cities and don't care to rotate your antenna for each contact, forget it and go on to the next article. This antenna is for the stations that are hard to copy.

The method of mounting the antenna makes it quite adaptable to either horizontal or vertical polarization depending on the locality.

The method of construction should be quite clear from the diagrams, but there are a few things that are hard to show in a drawing such as the method of mounting the boom for the corner reflector part of the antenna.

The boom is first drilled to take the reflector boom. When this is in place then the hole for the reflector element is drilled through both pieces of material and the reflector element set in place. This will then hold the whole assembly ragid.

The next step is the driven element. A hole is drilled in the boom and an insulator that is about one inch longer than the boom is thick is inserted through the boom. This then becomes the anchor point for the folded dipole



driven element. The beam is also fed at this point, either through 300 ohm line or with a balun.

As for tuning the antenna, well if the beam is constructed using the measurements given I think you will find little if anything gained by shifting the elements. A bit might be gained by clipping the elements for spot frequency operation, but that's up to you.

The tests given this antenna were with a fellow ham W6RGG across the valley from my location about four airline miles away.

The test equipment used for this evaluation? A "Gooney Bird" and a receiver with an S meter. The antenna was mounted on a thirty foot mast and pointed toward the receiving location, the rig was turned on and a steady tone was used for modulation.

The S meter at the receiving location was set for twenty over nine, then the antenna was rotated. The main front lobe seemed to be about thirty degrees wide. The side lobes showed a reading of S2 and the back was all but unreadable on the meter.

A word about the mounting feature. It may seem at first glance that the beam will be off balance, but in practice it has been found that with the beam so light and the advantage gained by this type of mounting there is nothing to fear.

I can only hope that those of you who construct this antenna get as much enjoyment out of it as I have had.

. . . W6HGX

William is a transmission man for the Pacific T and T Co. He enjoys VHF and UHF antenna design and construction and home building of equipment.

Stop Slipping Dial Drives

Does the cord and pulley dial drive system in your receiver slip occasionally? If so, here's a good emergency substitute for cake rosin or commercial non-slip compounds.

Place the tip of a hot soldering iron or gun on a clean area of the chassis and tilt the iron so that the tip forms a small angle with the chassis. Feed rosin-core solder into the gap. The cold metal of the chassis will conduct enough heat away from the molten solder so that the flux, instead of vaporizing, will form a "puddle" on the chassis. Remove the soldering iron, allow the flux to solidify and scrape it onto a clean piece of paper. Finally, crush the flakes of flux with a fingertip and rub the resulting powder onto the dial drive cord. . . . Bradley Thompson

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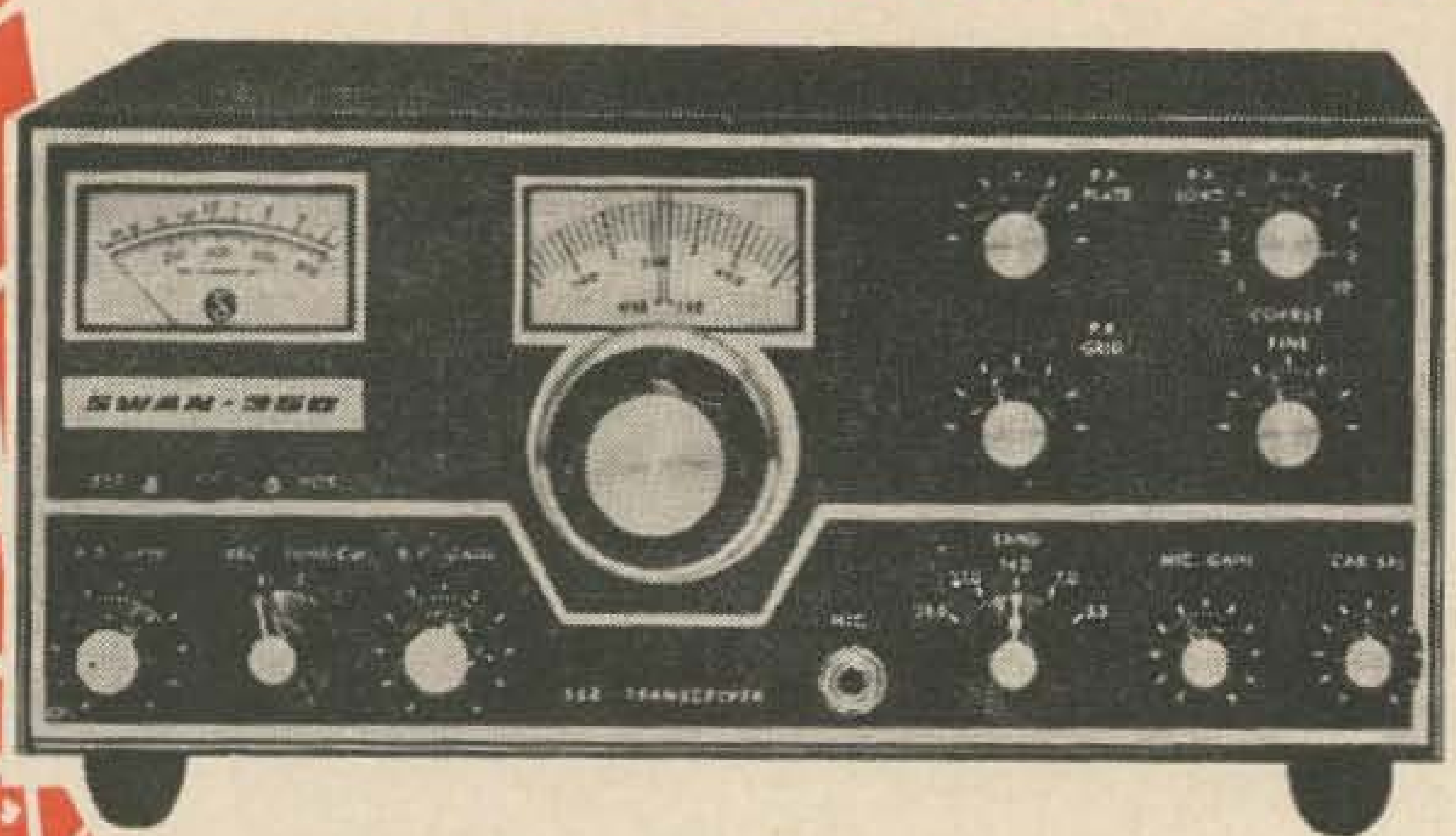

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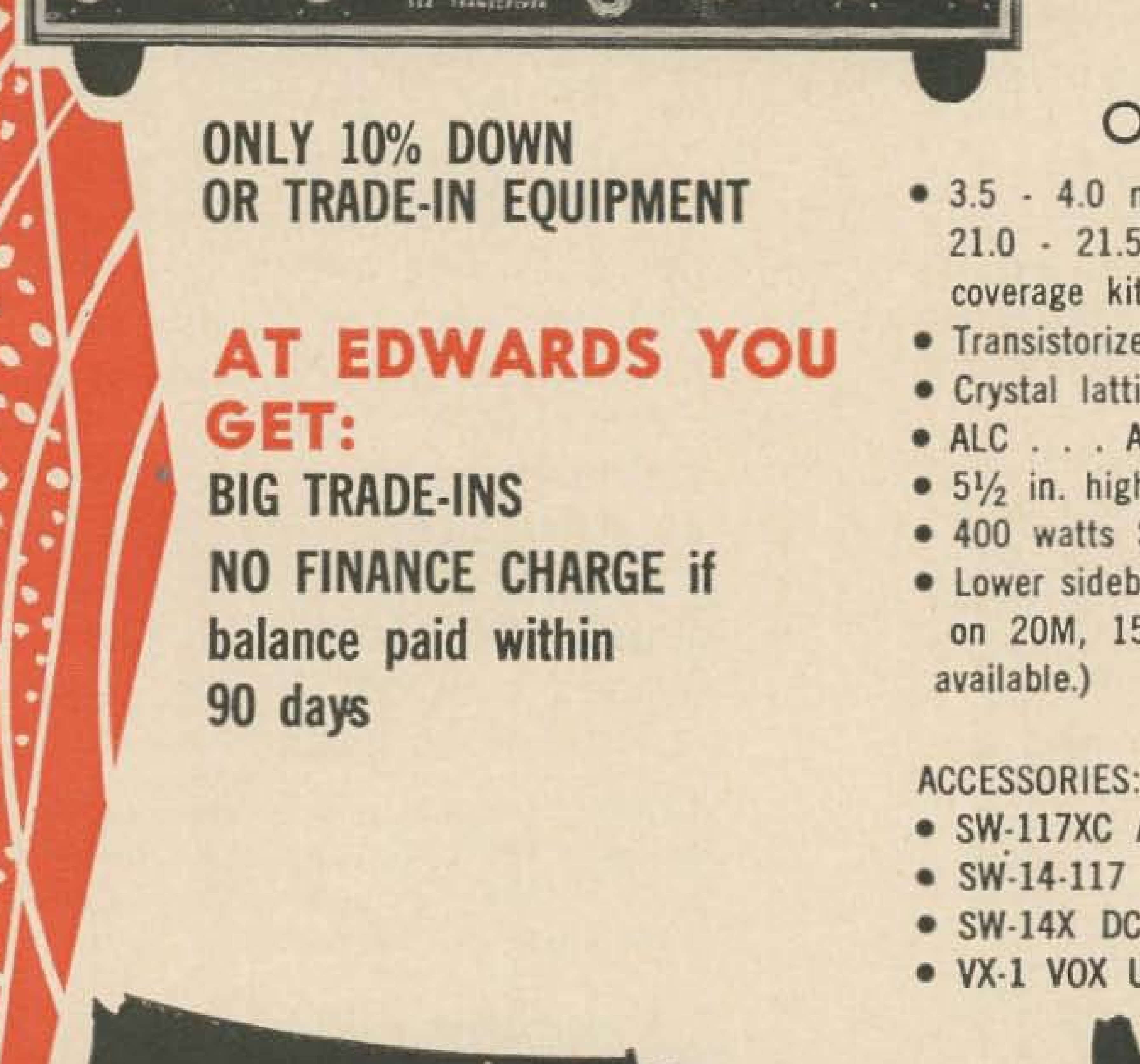

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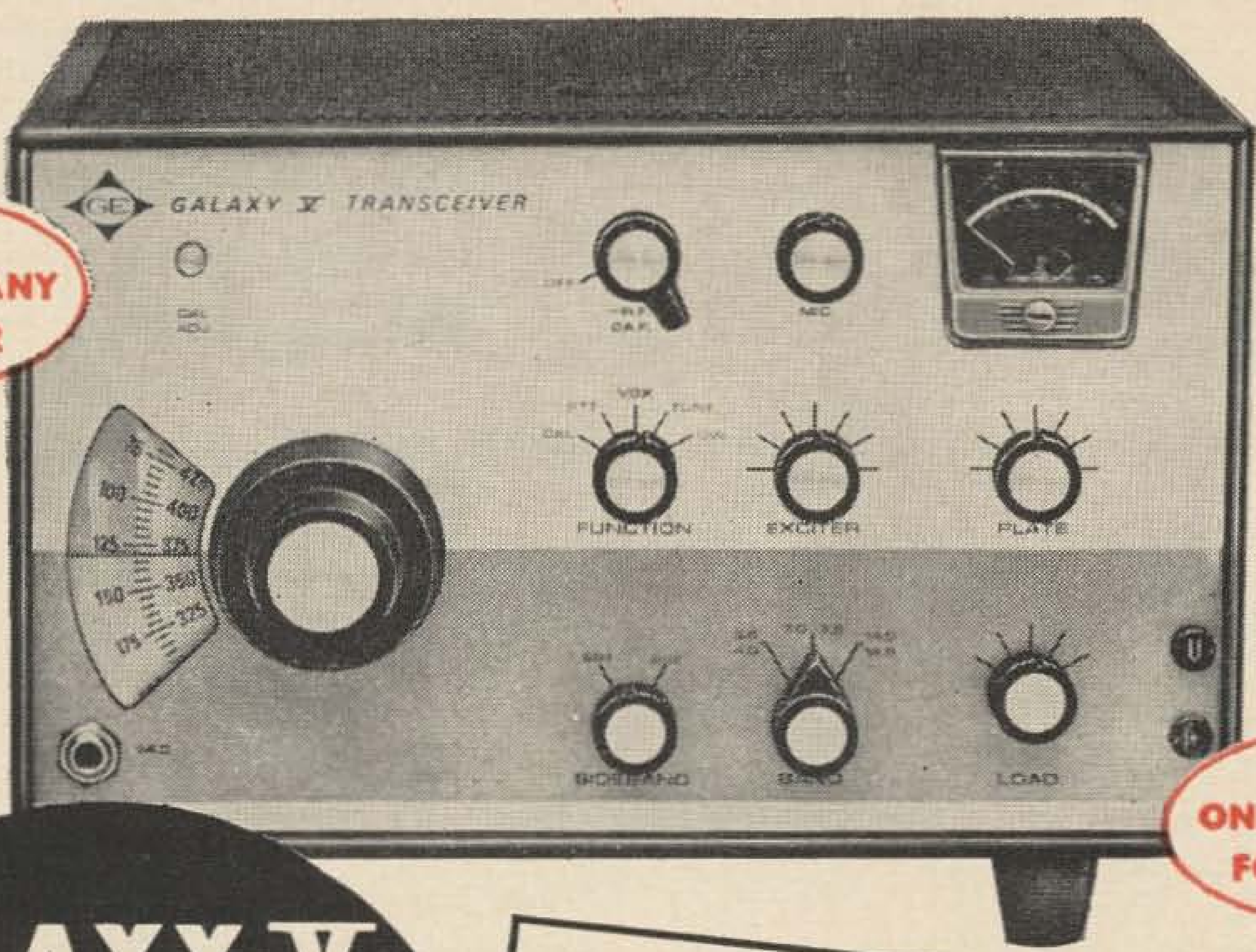

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21018 Stagg Street
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Some Techniques in Tone Signalling and Decoding

Tone signalling has many uses in ham radio, especially in VHF emergency and other nets. This article describes a few things that should be considered in using tones.

It is perhaps time to admit that the manufacturers of citizen's band equipment have in one respect gotten a bit ahead of amateur radio progress. Amateur RTTY operators have for sometime used various "auto start" systems to good advantage, but the typical amateur hasn't really put to much use any automated transmission start-stop system such as is presently employed by many CB two-way stations.

Naturally, in the course of everyday operation the typical ham doesn't have much need of the system described here, but increasingly more amateurs are going to remote operated equipment to obtain better advantage of physical surroundings. Although the authors cannot vouch for the legality* of operating such a system, it seems reasonable to assume that an amateur could operate his home station by remote signals from his mobile station. This would allow any non-amateur in the home to speak with the mobile station, since the home station would in effect be directly controlled by the mobile station and hence under the direct control of a licensed amateur. The possibilities of this situation seem very intriguing, particularly in the case of businessmen who must remain away from home for extended periods or at long distances. With the system to be described here, a particular sequence of tones modulating either an SSB or AM transmitter (either A3, A3a or A3j modulation) could be used to trip a receiver, turn on a second transmitter and then turn on or turn off either or both the receiver or transmitter in any prescribed sequence. Similarly a different sequence of the same tones, or different frequency tones, could be used to shift frequency, rotate the antenna or perform any number of functions at the receiving end. The possibilities are limited only by the desire and ingenuity of the operator.

* It is likely that the operation described might require a remote station authorization. Check before you try it.

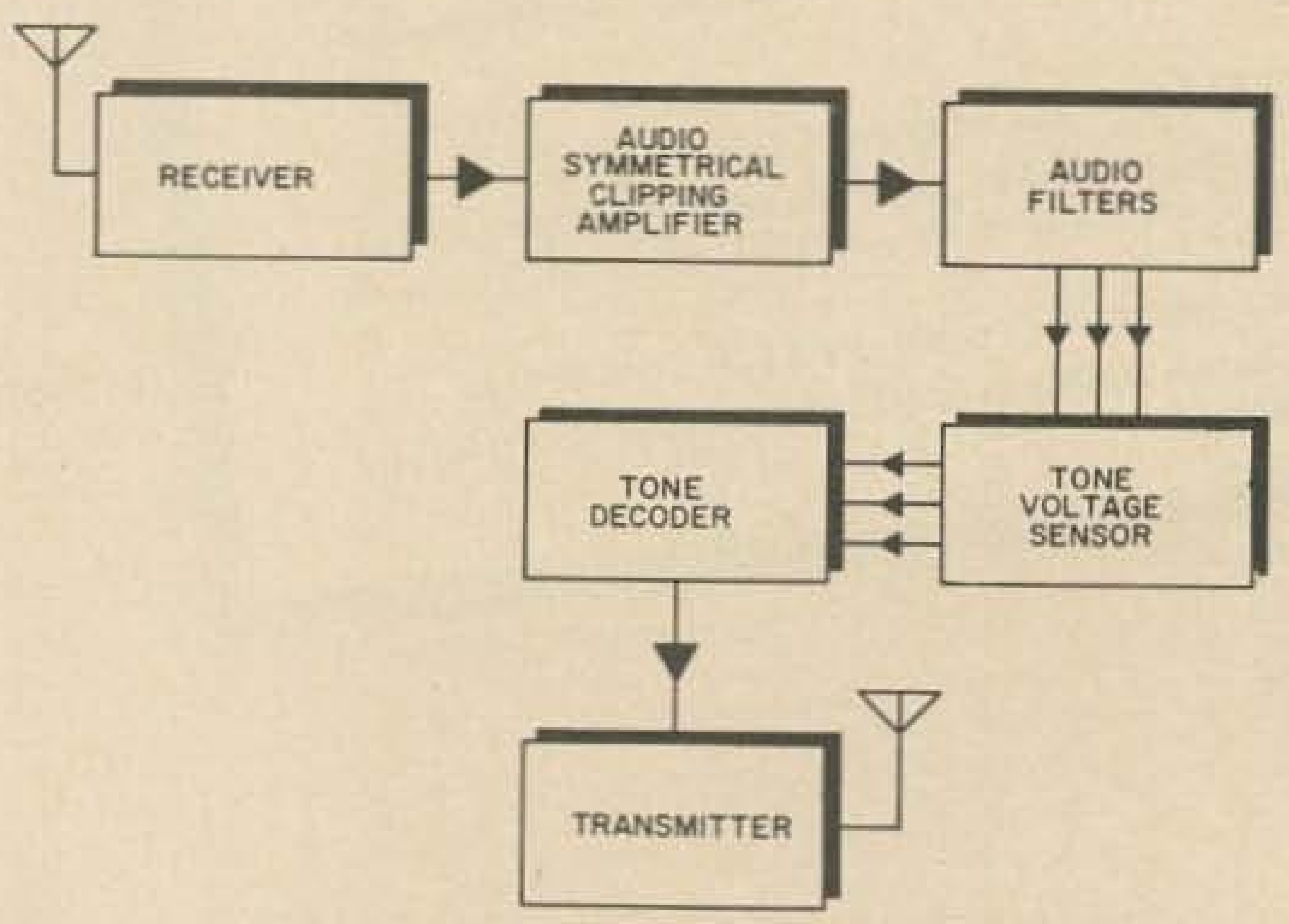

Fig. 1. Block diagram of a tone signalling repeater system.

System theory

The system block diagram (**Fig. 1**) shows the general configuration for the use of the sub-units to be described later. A signal coming in the antenna to a receiver preset to the desired operating frequency is passed onto an audio clipper and amplifier. The purpose of this first operation is to ensure that all the tone signals are of equal amplitude before reaching the audio filter. This not only relieves the filters of the requirement of undue selectivity but also ensures that the output from the audio filters is about the same for all tone channels.

The next block, the audio filters themselves consist of a number (depending upon the number of tone channels used) of simple L-C filters resonated to the frequency of the tone channels. In this article a three channel, and hence three filter, network is described, but again more or less channels and filters may be used depending upon the desired complexity of the end result. Obviously, there is one filter resonated to the tone frequency of each tone channel used.

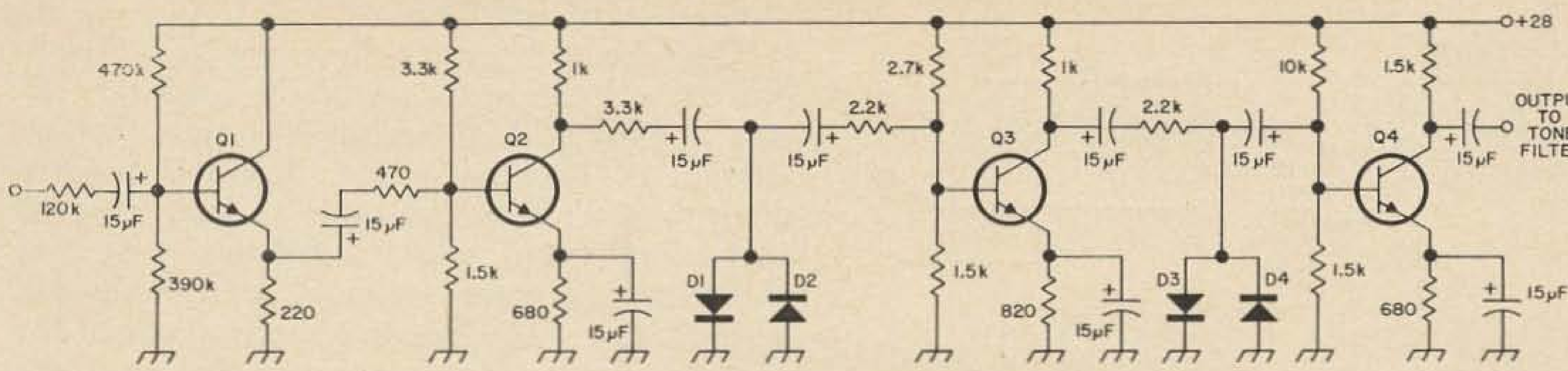

Fig. 2. Symmetrical clipping amplifier. See text for transistors and diodes.

Following the audio filters are the tone voltage sensors, one sensor for each filter, hence one sensor per tone channel. The function of the tone voltage sensors is to detect the audio tone when present at a filter output and convert the tone to a dc level appropriate for driving a switch. This is accomplished by a variable threshold gate and Schmidt trigger arrangement to be described later.

Dc voltages which correspond to the presence of a tone are passed on to a tone decoder which consists of nothing more than a series of relays interconnected in such a way that the sequence of tones received must be in a certain prescribed order before an output is obtained. Certainly more sophisticated electronic switches could have been used in this application, but for purposes of explanation the sequence of operations is perhaps most easily understood when presented in terms of relays. This also lends itself to direct junk-box production by the amateur in most cases.

Connection is shown from the tone decoder to a transmitter, but obviously the piece of gear being controlled might be anything the operator desires, multiple operations or multiple equipment functions can be controlled as pointed out previously.

General

Although each circuit to be described here is complete and correct, the intent is that the circuit function to be detailed is of more importance than the actual hardware of the circuit itself. Consequently, no direct examples are given for building duplicate units though duplicates may be constructed quite easily. Actually there is nothing the least bit critical about construction save that the usual precautions to prevent rf energy from entering the audio stages should be observed. As mentioned previously, the number and types of equipments controlled by this type system is practically unlimited dependent upon the resources of the individual amateur.

Audio symmetrical clipping amplifier

As explained, the purpose of this circuit is to provide a constant amplitude signal to the tone filter regardless of the audio output amplitude of the receiver at any given time. The input to the circuit is a sine wave at the audio frequency, and because of the particular design here, the output is very nearly a square wave of the same audio frequency. Looking at **Fig. 2**, it may be seen that the input stage is an emitter follower which is biased at about half the B+ voltage. This stage is used simply to provide a high input impedance as well as low output impedance to drive the second stage. This second stage is an amplifier driving a diode clipper. Since the voltage gain of this stage is high (about hfe x 1k) the sine wave at the collector is heavily clipped by the D1-D2 pair, then passed on to another amplifier and diode pair where the signal is again amplified and clipped. Notice that no type has been called out for in the diodes or transistors: any transistor with hfe greater than 100 at 1 kHz will surely do, and any good silicon diode will fill the bill. The one and only requirement that must be carefully met is to be sure that all stages are biased in the mid-range of their operating conditions. The "Q-point" must be

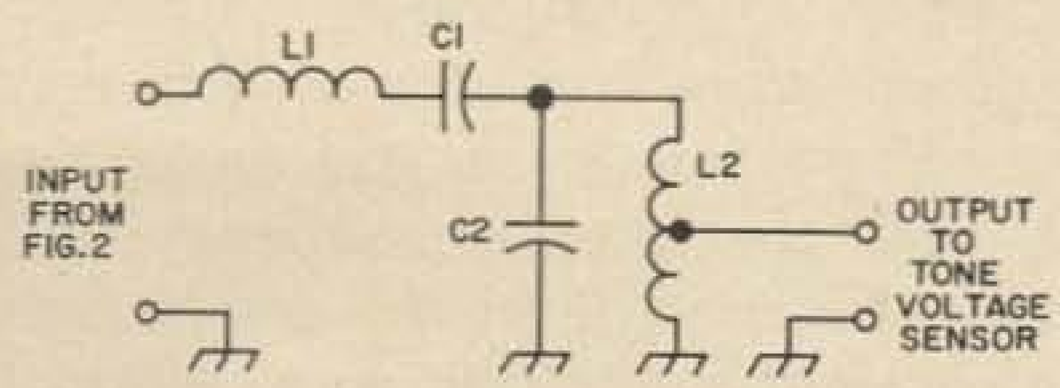

Fig. 3. Tone filter. L1-C1 and L2-C2 should be resonant at the desired audio frequency.

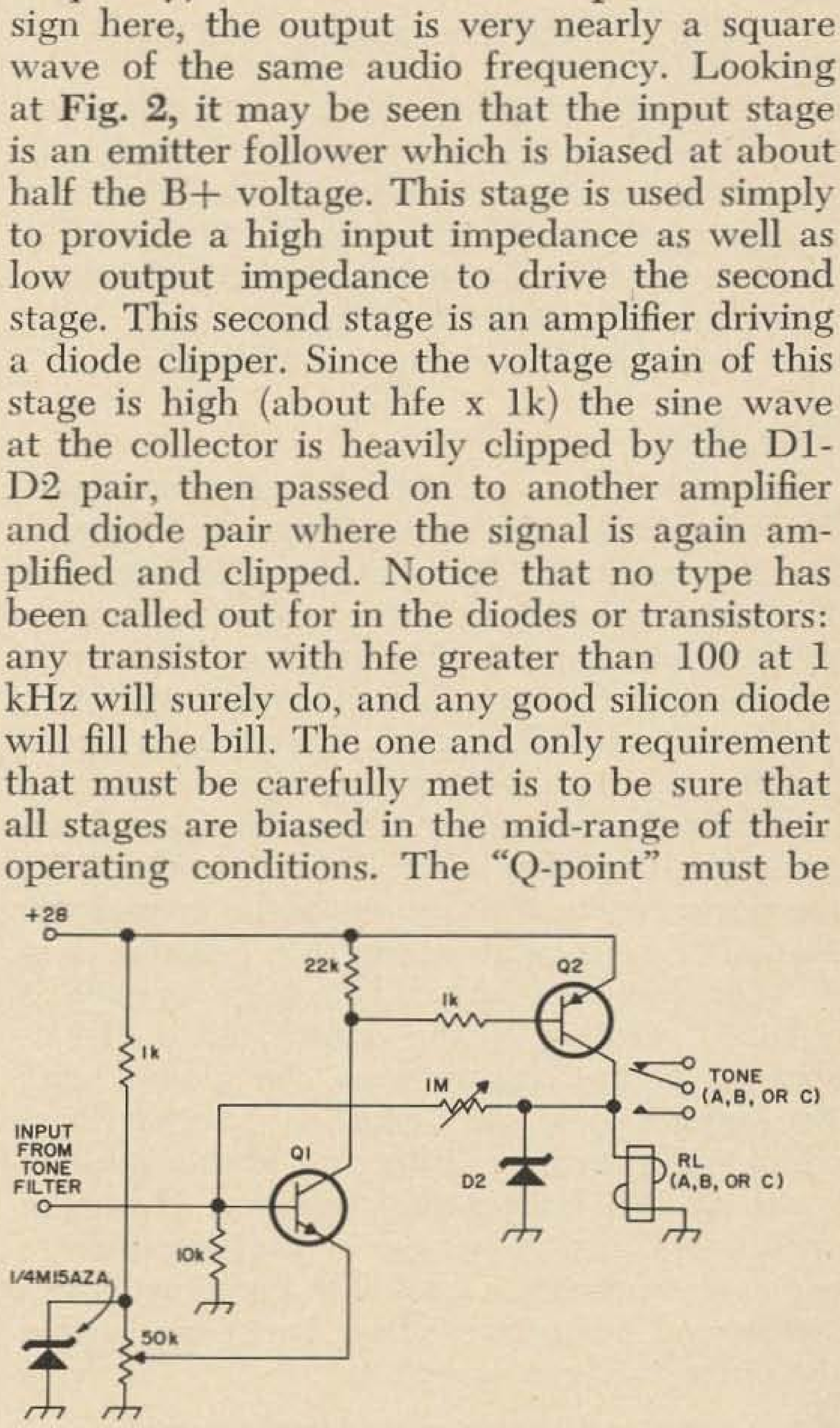

Fig. 4. Tone voltage sensor for use with a tone filter such as the one shown in Fig. 3.

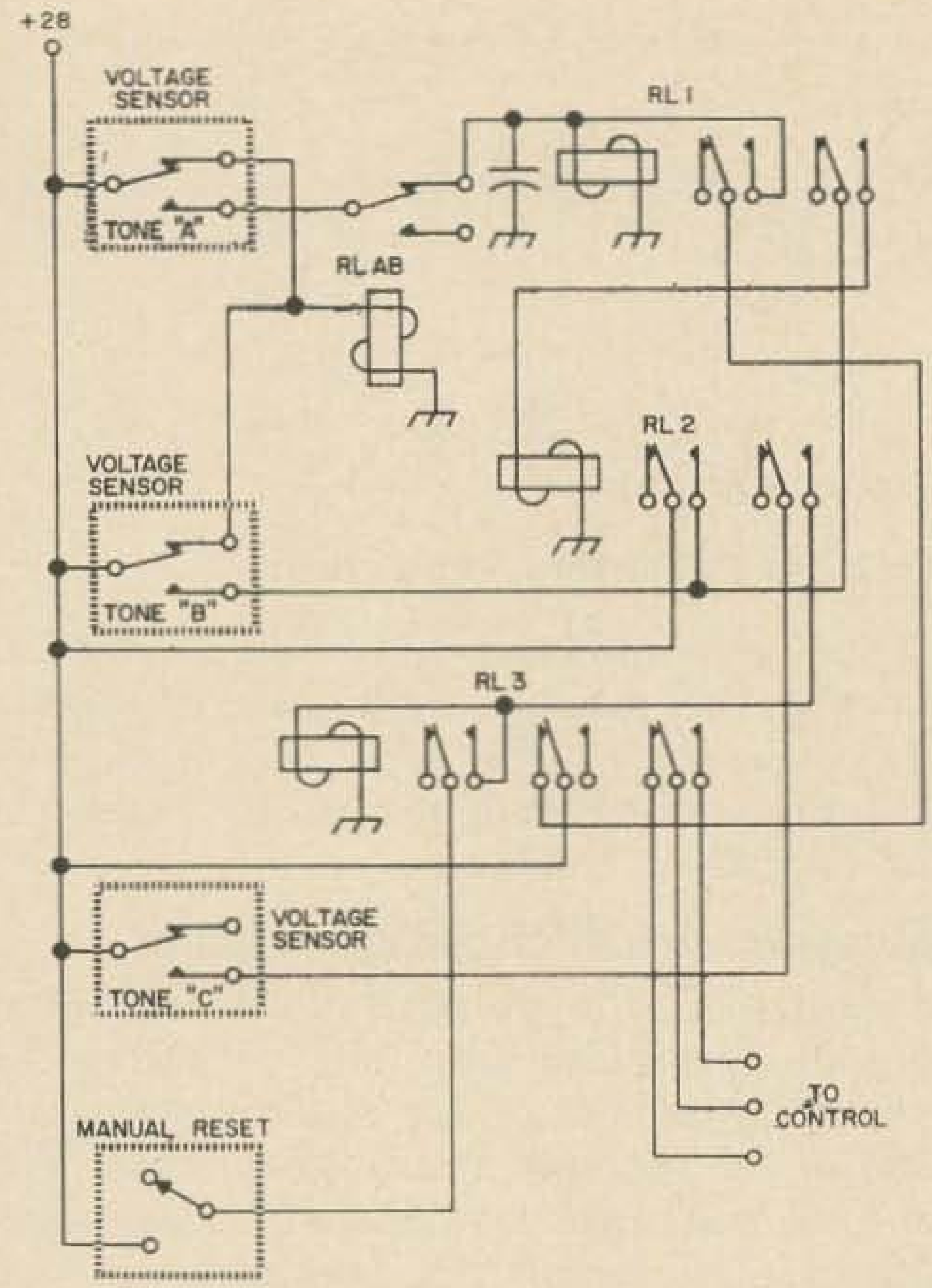

Fig. 5. Typical tone decoder. See text.

set mid-range between cutoff and saturation. This is because a large amplitude signal will cause the transistor to clip as well as the diodes, particularly at Q3 and Q4. Since a clearly symmetrical output is desired, the transistors must begin to "bottom out" and "top-out" evenly for increasing input signal.

Tone filters

The tone filters are used to select and pass the individual audio tone frequencies desired. The filter shown in **Fig. 3** is about the simplest that is useable. Normally the audio frequencies selected are about 1 kHz apart and thus this simple filter is more than adequate to reject adjacent tone "channels." Certainly a more complex multi-pole filter may be used and the separation between tone channels reduced accordingly. For this filter, L1-C1, and L2-C2 are resonated to the desired audio frequency. As can be seen, with reasonable (greater than 50) Q inductors a fairly high selectivity may be obtained. Ordinarily the output tap on L2 is about ¼ of the coil up from the ground end. For fanatics there are a number of active filters which will provide as little as 1 Hz 3 dB bandwidth at 100 Hz center frequency. However, anyone sufficiently versed in the literature to use such a circuit is probably bored with this article and has quit reading, hence no further discourse is given here.*

* For those who wish to pursue this phase of the project, a really excellent article entitled "Selective Audio Amplifiers" appeared in the July *Electronics World*.

Tone voltage sensors

This circuit is essentially a variable threshold relay driver with a variable feedback circuit to provide high sensitivity and a certain amount of latching action. Again the active devices aren't specified since so long as good hefty (perhaps 1 watt) transistors with Vce of at least 30 volts are used no trouble will be experienced. Progressive shorting out of the one megohm pot will increase the sensitivity of action, but will also provide increasing hysteresis on signal release such that in the extreme, several volts differential would be apparent between the threshold level and the release level. The threshold level is preset by the 50 kΩ resistor in the emitter of Q1. This preset level is above the noise output level of the tone filter but generally below the maximum tone output amplitude. Notice that the relay is the same as that depicted in **Fig. 5.**

Decoder

The decoder of **Fig. 5** is composed entirely of relays principally because relays are quite often available to the amateur in quantity. However it is obvious that a considerable reduction in size, weight, and generated transient noise could be obtained by use of equivalent solid state switches.

Obviously the simplest decoder would be a single switch which closed upon the presence of a given tone. However such a system would be vulnerable not only to accidental tripping and jamming, but also would be vulnerable to deliberate interference. The decoder shown here is fairly elaborate, but not so involved that construction is prohibitive. In many respects this decoder simulates the function of a "secure" system used by many governments to avoid unauthorized use of equipment and ensure secrecy.

For this particular decoder three tones of differing frequency are necessary (and hence three tone filters, etc.) for operation. The tone frequencies have been labelled A, B, and C for convenience; tone A might be selected as 1 kHz, tone B as 2.5 kHz and tone C as 5 kHz for instance. Due to the interconnection of relays and contacts a sequencing action must take place before the control is actuated. In this case, tone A must occur before tone B, and tone B occur before tone C, and A and B may not occur simultaneously. Hence, unless some random signal or person interested in actuating this system knew the exact tone frequencies and the proper sequence of these frequencies the control would not be actuated. Thus by using the latching properties of only four relays a very "secure" three tone system is available.

Conclusions

The four basic building blocks described here constitute the prime requirements in a secure tone signalling system. The uses have been briefly described for tone systems, and if nothing else, it is quite apparent that a very good amateur remote control system could be effected in a variety of ways. Each building block is quite uncomplicated, and easy to build and adjust. The authors have implemented this system in a variety of ways, for single tone signalling using one to eighty meter remote to home applications, all with great success. As was stated before, the applications are limited only by the ingenuity of experimenter.

. . . WB6MOC, K6YTY

A Low Cost AC Regulator

The detrimental effect that line voltage changes have on oscillator stability is well known by most hams.

A low cost voltage regulator suitable for use with VFO's, frequency standards, and other equipment having small a.c. power requirements (approximately 20-30 watts) is shown in **Fig. 1.** This circuit is almost identical to the one suggested by Lamkin Laboratories for use with their MFM frequency meter. (Switch and fuse added.)

This circuit will reduce voltage variations to about one third; the output will be approximately 100 volts RMS. In addition to the improvement due to the regulated line voltage, the reduced results in less heat being produced in the oscillator. By using this circuit, the filaments are operated at a reduced, regulated voltage.

The regulator should not be placed near the oscillator circuit as it produces considerable heat. A separate chassis is suggested, and the switch in the load should be shorted as operating the regulator without a load can ruin the OC3's.

We have used this regulator with a MFM for almost a year with great success. The cost is low and the construction very simple; give it a try.

. . . Deap Cupp W4JKL

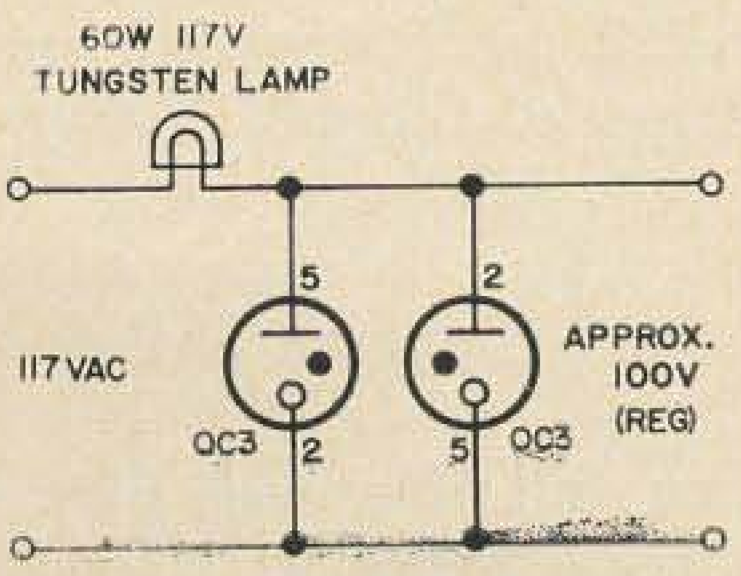

Fig. 1. A low cost AC regulator.

Paul Franson WA1CCH

The Vanguard 501 TV Camera

Talking to people over the radio is certainly one of the most intriguing hobbies that exists—as all 73 readers certainly know. But think how much more fascinating not only talking, but seeing, your contacts must be. Most hams have had at least some thoughts about ham television, but most have also never thought seriously about getting on TV because in the past, TV has been complex and costly, and TV signals have limited range and there have been few hams on amateur TV.

Well, TV signals still don't travel very far, but modern techniques of high power, high gain antennas and low noise converters have made reasonable distances possible. And more and more people are getting on TV. Transistors, varactors and modern transmitting tubes have made TV less complex than it once was, and the cost isn't unreasonable. It certainly can cost far less to put a TV station on the air than many hams spend on commercial sideband equipment. Obviously, TV isn't for all hams, but the experimenter can have plenty of fun with it. In large cities, for instance, licensing classes can be telecast to prospective hams, or technical sessions held for those wishing to increase their knowledge (or license class). The receiving converters for regular TV sets can be quite simple; see the article by PAØVDZ in this issue, for example. ATV'ers have telecast church and other events of interest to bed-ridden persons or others. I'm not sure where the FCC draws the line on broadcasting on ham TV, but there are obviously many possibilities for public service and good publicity for hamming with TV. Think of the fame you'd receive if you were to start the first (and only) TV station in a small town!

You can get on TV with a flying spot scanner, an obsolete converted surplus camera, or even a cast-off commercial camera, but there's no question that the most practical type of signal source is a modern, inexpensive vidicon camera designed for closed circuit TV such as the Vanguard model 501 camera. I've had the chance to play with one for some time now, and though I haven't put it on the air yet—at least on a ham band—I've come to the inescapeable conclusion that I should. Let's take a look at the Vanguard 501 and see what it has to offer:

In the first place, the 501 is tiny. Until you see it, it's hard to believe how small it is. It's almost the same size as five small pocket books in a pile. The small size is a result of the complete transistorization of the circuit (except for the vidicon and neon bulb HV regulators) and the compact, modern, plug-in etched circuit board construction. The camera weighs only 3½ lbs., yet seems to be very sturdy and well-made.

The 501 uses twenty transistors, including a low-noise VHF field effect transistor input amplifier. A clever part of the circuit is that the vidicon is used as a light sensor to set the camera for best conditions with lighting changes. The power supplies are regulated.

Output is either standard 1.5 volt video for use with a video monitor, modified TV set, or TV modulator for a transmitter, or rf for direct feed to the antenna terminals of a TV set tuned to a low band channel. The video output gives better quality, but the rf output is obviously more convenient. There's certainly plenty of output: I used the camera with 250 feet of coax with no problems (except that we did get into the neighbor's set on a blank channel. Good for remote baby sitting, I guess.) In either case, the quality was excellent. Everybody in the neighborhood, and all of their children, had to look at themselves on TV, and though all of them thought their likenesses horrible, they also agreed that everyone else looked very natural and that the camera did a magnificent job.

The camera worked well with only normal room illumination, or in the bright sunlight. Even with a small bulb at night, you could get a pretty good picture. The lens is inexpensive. It's 8 mm rather than the more expensive 16 mm variety, so telephoto and other extra lenses could be added to the 501 without spending a lot of money.

The only trouble I had with the camera was erratic noise in the picture at first. This was apparently due to a bad ground, and was easily cured by tightening a fairly-obvious loose mounting screw.

No schematic or instruction manual comes with the camera, though Vanguard has reported that one will be made available in the future. The camera is guaranteed for a year except for open filament or breakage of the vidicon.

As you can tell, I'm real pleased with the 501 I have been using. It is certainly an excellent buy at $279.95. . . . WA1CCH

C. R. MacCluer W8MQW
3080 Lakewood
Ann Arbor, Mich.

The Shackcom

A simple intercom that can be built from junk-box parts.

For all those who have felt the need of a communication link between the shack and the household I have a solution. The Shackcom shown in **Fig. 1** is a inexpensive, simple, and compact, two-way intercom. The circuit employs the three distinct types of transistor amplifiers and thus would serve as an excellent introduction to transistor circuits: T1 is in the common base configuration and thus transforms the 8 ohm speaker impedance to high impedance. T2 is in the common collector configuration and thus transforms the high Z output of T1 to about 400 ohms with a power gain. T3 is in the common emitter configuration and thus raises the 400 ohm output of T2 to a slightly higher impedance with a large gain in power. T4 and T5 are also in the common emitter configuration and develop the power needed to drive the second speaker.

Nothing about the circuit is critical. The output transformer T as well as the transistors T4 and T5 were taken from a discarded transistor pocket radio. The electrolytics can be of any value in the microfarads. The speakers used should be of the 8 ohm type, ½ watt, and with at most 5 inch cones. The volume control R is not necessary since the maximum output of the Shackcom is not excessive as long as the person speaking is at an arm's length from the speaker cone. The 2N404s are sold for ten per $1.00 by Poly Paks.

The prototype of the Shackcom was built on a 2" x 7" circuit board, and mounted in a 3" x 5" x 7" box with a 4" cone speaker. The circuit 1 is drawn in such a way to suggest how the Shackcom could be laid out on a printed circuit board.

. . . W8MQW

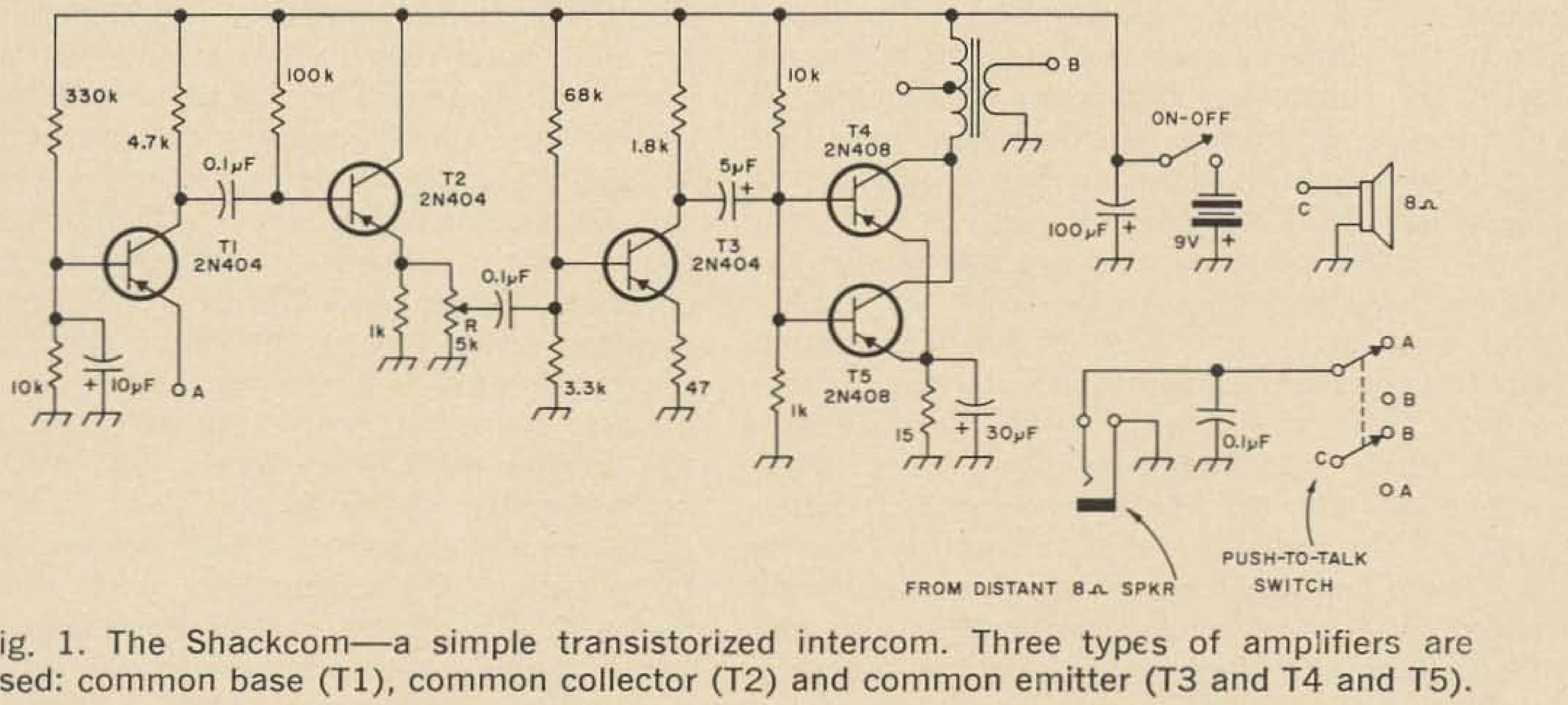

Fig. 1. The Shackcom—a simple transistorized intercom. Three types of amplifiers are used: common base (T1), common collector (T2) and common emitter (T3 and T4 and T5).

Butch Plugs

When you're working on a chassis or panel and make a butch by drilling or punching a hole in the wrong place, sometimes it can be a problem. For the larger size holes (about ¼ inch and above), you can buy a hole plug from one of several manufacturers. How about small drill holes? Very simple, mix up a batch of epoxy adhesive and fill the hole up. Make sure there is a little additional material above the surface of the panel. When the epoxy hardens, it tends to shrink slightly, and if sufficient material is not left on the surface, a small indentation will result. After the epoxy hardens, sand it smooth. A little paint and nobody will ever know that you drilled a hole in the wrong place.

. . . Jim Fisk W1DTY

Gus Browning W4BPD
Cordova, S.C.

Gus: Part 19

After a very FB stay at Diego Garcia Island we all boarded the ship and took off for Salomon Island, another in the Chagos Archipelago. This island is some 50 to 75 miles away from Diego Garcia. We were met there by the manager of Salomon Island and invited to have supper at his house. He had his wife with him, a very charming person whose hobby is painting. She had a very large assortment of paintings of the islands, some of which would have won honors at any artists' showing. Believe it or not, they actually had a Coca Cola—they had had it for about ten years, I think. When it was opened it did not even go plop; it was completely flat. In South Carolina I would be afraid to give it to my dog for fear the dog would turn up his nose at it. But on Salomon Island that one Coke tasted like something direct from Heaven. We were served a very elegant meal, prepared undr the directions of the manager's French wife. Of course they had many different kinds of wine—what Frenchman does not? Late that night we went back to our ship. I did a little operating /MM for a few hours.

Early the next morning we loaded up the copra there and about noon we lifted anchor and were away for VQ9, Mahé. This return trip was a real dream ride: all the way "down wind." Hour after hour I would lie back in a deck chair watching the flying fish. They would all take off like a covey of partridges and sail through the air for a hundred feet or so. These Indian Ocean flying fish actually get about 20 feet above the water and sail with the breeze just like a bird. It's a beautiful sight to behold; they are a bright silver and actually shine in the sunlight. At night I used to like to watch all the apparent fireworks down around the propeller if the engine was running, or just at the point where the water passed the rear sides of the boat if it was under sail. They tell me it's some kind of algae in the water. How this stuff can look like fire when it's submerged I don't quite understand, but there it was every night. Looking south at night I could just see the Southern Cross on the horizon, not almost overhead as on Bouvet Island way down South, and not almost overhead as the North Star is when in the Faroes. There was always a nice cool breeze on the ship's decks and this trip back was about the nicest one I have ever had on any boat anywhere. We were out of the monsoon belt on this trip and this made the trip a real smooth one.

Upon arriving back at Mahé and paying for my trip to the Chagos, away I went again to my little "Hotel de Seychelles" where it was costing me $22.00 per week for room and board. When I was there they had no electricity at the hotel except their dc current which was no help to me at all. So it was connect up my little putt-putt again and buy some gasoline (they call it petrol) for something like 80¢ per gallon. The hotel there now has ac current from Port Victoria, I understand. That's the hotel that has thatched huts for each hotel room, all in a long row up and down the beach. They always gave me the one on the end so that my putt-putt would not keep everyone awake all night when I was on the air. Incidentallyy the food there is very FB: plenty of breadfruit, pineapples, oranges, coconuts, lemonade, fish cooked every way possible, turtle meat quite often, swell pastry, plenty of good home cooked cake, and even once or twice per week they have ice cream. All this for $22.00 per week. Not bad, eh? I again headed down to the dock area every time I had the chance. I had shipped there 3 forty meter AM phone rigs with the right model ARC receivers to tune 40. They wanted one installed at the owner's home on Mahé, one at his son's home on Mahé and the other down on Aldabra Island. Aldabra has no radio link with the outside world at all; all they have is a transistor radio to listen to the BBC and get the news.

Another boat was soon taking off for Aldabra Island, going via Cosmoledo and Assumption Islands. They decided to have the unit installed on Assumption Island instead of Aldabra since they were planning on cultivating guano on Assumption shortly. They told me to be ready to leave in two days.

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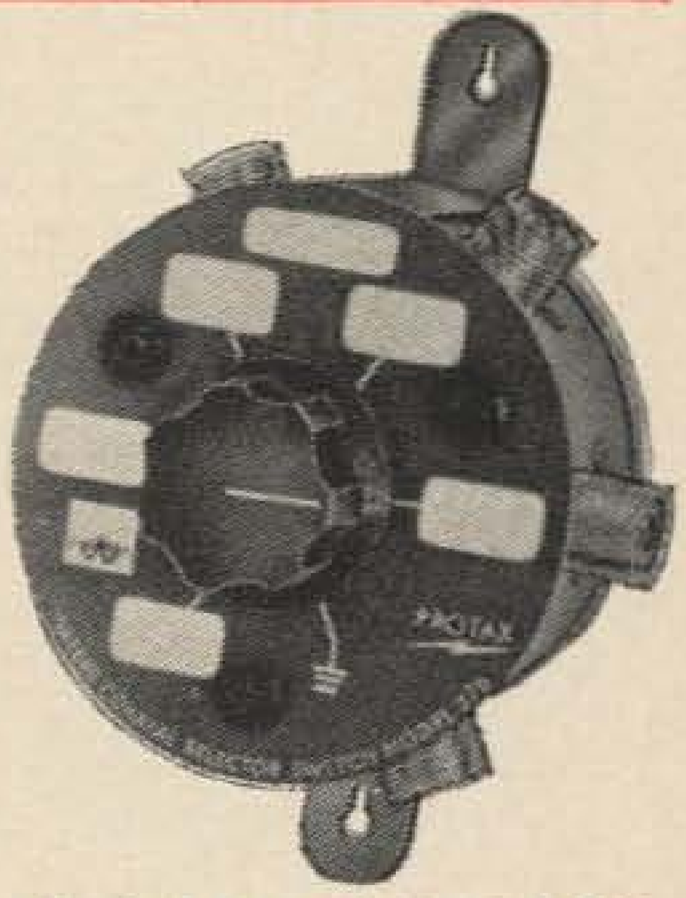

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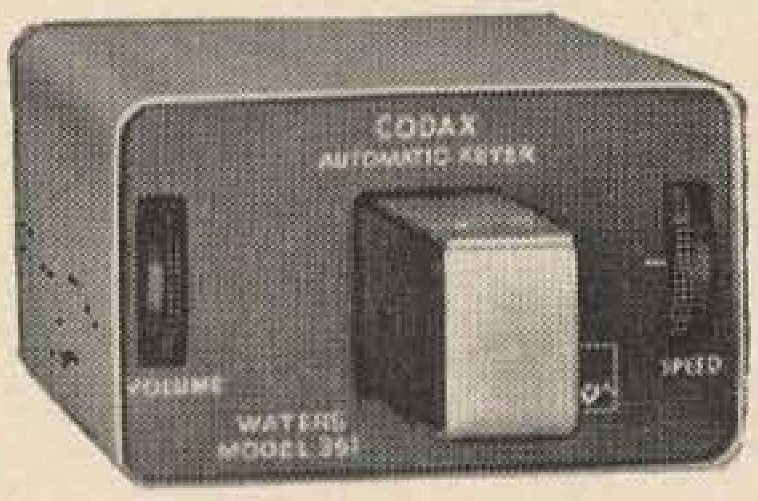

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If you want to see a new way to install a 70-foot bamboo pole get these Seychelles fellows to do the job. Here is how they put one up for me: they dug a nice hole (with their knives) right below the point where there were two big limbs on a tree that looked like an oak. One fellow got up in the tree with a piece of rope. They then put the small end of the bamboo at the edge of this hole they had dug and tied the rope to the small end of the bamboo. Then the other ten fellows started pushing the large end of the bamboo towards the hole while the fellow up the tree pulled up the small end. The large end was eventually dropped into the hole. I tried explaining that there were better ways to do this job, but none of them spoke English. I learned that there are many ways to do a simple job, many of them different from the way we have always done it back in the States. It makes you want to pull out your hair (and I ain't got much to pull!).

This ship that was going to Aldabra was going mostly to haul back a load of those very large turtles. The stop at Assumption was to bring back its manager, and to also install the 40 meter AM rig there. This was a fairly good sized ship (about 3 times as large as Harvey's—VQ9HB). The captain was a 100% full blooded Seychelles captain, tough as nails, with a good loud voice that his crew could hear even in the middle of the monsoon. He was the boss on that ship; when he spoke, they jumped. To me he was as kind as a father, so I have no complaints. Down to the ship I went and loaded everything on board, putting my /MM rig right up in the poop deck beside the big wheel. I mounted my putt-putt this time way up on top of the crew's sleeping quarters roof, because the S.E. monsoon was at its peak now and we all knew we were heading right into its teeth. I wanted to keep the water from getting into my putt-putt. Even up there it did get soaked by some of those monstrous waves. Those waves were killers down around the Aldabra area, and Aldabra is partly shielded by northern Madagascar.

As I said, we left VQ9 and headed for VQ9C (Cosmoledo group) making a very short 2-day stop there to pick up some copra and dried fish and deliver the usual mail and some much needed supplies. Then we were on our way to Assumption Island, right down in what Harvey calls the Cyclone Belt. We did really get a full dose of winds, rain and I don't know how high the waves were, but to me they looked like mountains falling down on the ship. We were tossed every which way and it was a battle staying in our bunks even with their side-boards up. Sea sick—don't make me laugh. Those fellows on that ship did not know what that word even meant. As for me—I had a long time ago found how to control those butterflies in my stomach. Just tell yourself that you are not going to get sea sick, make yourself believe it and you have it made. So there was no sea sickness even with the tossing ship all the way, every minute of every day. It never did come up for a breather as it does sometimes during the year. I had installed my rig up in the poop deck and we were up about 40 feet, where every roll and rock of the boat was multiplied by about 5. To sit fastened down at my operating position I soon learned to get in swing with the ship. I became a part of the boat; when it rocked, I rocked along with it. I told someone over the air I had the Aldabra Swing while I was on /MM, and I really meant it. This was exactly the opposite of the return trip from the Chagoes with that nice steady breeze blowing up back of us, pushing us along at a very steady rate.

After about 6 days we sighted Assumption Island. We anchored off shore about one-half mile down wind from the island. The island shielded us pretty well from the high seas. I loaded up everything and went ashore in the first landing boat. While they unloaded some lumber, doors, windows, etc. to build some small houses, I did some operating. I also mounted the wind-driven battery charger and two large 12-volt batteries, the ARC-5 being 24 volt operated. I got the wind-charger in operation and explained to the island manager that they should charge one battery one day and the next one the next day (the wind charger was only for 12 volts). He said he understood me (which I still have my doubts about). The modulation of this AM phone rig was way down and I was not satisfied with it at all but we had to leave the island the next day. A hint to anyone taking equipment to out-of-the-way places: test and test your equipment over and over and make sure that it's really on the ball before you ever leave the USA. You cannot ever be too careful, because out on some remote island there is no radio supply house around the corner. You cannot even find one bolt or nut on these islands. You bring along everything you need, or you do without and patch up the best you can.

We departed from Assumption Island for Aldabra Island, the distance between them being something like 50 miles. Incidentally, any of you who worked me while I was on Assumption Island don't have a new one; it counts the same as Aldabra since it's actually in the same group. The high seas were still pounding away when we left and the going was pretty rough until we anchored sort of behind and in the shadow of Aldabra. Ashore we all went, the usual mail was delivered, up went my antennas again and I was on from Aldabra for the second time. The pile up was not as big as before but it was still there. To me it was always interesting to tune across a band that's very quiet and practically no one is on. You think everyone is off the air and that you have wasted your time going to that spot. Then you call that first CQ; back comes maybe one station. You exchange reports with him and stand by. Then maybe 2 or 3 stations call and you come back to one of them. On about the third QSO there are maybe 25 stations calling you. From then on the pile-up pyramids. It's up to you to work that pile down faster than they pileup! You keep saying dwn 5 or up 5 every now and then; even doing this the "lids" still keep calling you on your frequency. I have heard a number of stations that insisted on calling on my frequency, hour after hour, and day after day. They never get a QSO because it has always been my policy to never work anyone on my frequency. You newcomers to this game of DXing, take a hint from someone who has been in on the pile up from both ends. Listen to what the DX station tells you to do and do it. Try and find a station he works, listen to this station's speed and style of operation and try your best to imitate this fellow. Observe the frequency of the fellows he is working, try to figure out how the DX station is tuning, try to outguess the other fellows in the pile. Maybe do what Frank, W5VA, does; watch for that peak signal condition and "nail the DX station" at that moment. That's the way to get that S-9. . . .

. . . Gus

Storing Test Leads

If your workshop is like most, your clip leads and test prods are always scattered all over the bench; and when you do pick them up, there is no convenient place to store them. A neat solution to this storage problem is to install two screw eyes in the wall about 30 inches apart; a piece of soft iron *mechanics' wire* is then strung horizontally between them and connected securely at the ends. To store leads with alligator clips, simply clip one end of the test lead to the storage wire and let the other end hang free. To store leads without alligator clips, just loop them over the wire. With this method of storage your test leads are always where you can find them.

. . . Jim Fisk W1DTY

Bob Nelson K6ZGQ
110 Morning Valley Drive
San Antonio, Texas

A Little About Noise

Perhaps more than a little; Bob's treatment of this important, but little understood subject is careful and complete.

Noise. This word describes the natural phenomenon which establishes the limiting range of all communication systems. To the DX man noise is the reason he can't work ZS1 at noon on 80 meters. Sure, a little of his signal reaches ZS land, but it is so far under the noise that it is useless and undetectable. To the VHF man noise is what stops him from working KL7 on 432 MHz. Again, some signal might get to Alaska by various means, but its very weakness, compared to the noise level at the receiving location, defies reception. Noise even affects the 75 meter ragchewer when a nearby electric shaver or ignition system tears up the signal he's listening to.

Now since noise has so much to do with establishing the limits of our ability to communicate, it seems wise to reach an understanding of what noise is, and how we might cope with it. And that brings us to the purpose of this article. If you stick with us from start to finish you will emerge with some basic knowledge of noise in radio systems. You will have an understanding of what noise is, what causes it, and how to eliminate a good part of it from your receiving system. Further, such vague subjects as "equivalent noise temperature," "noise figure," and "minimum discernible signal strength" will be explained. But enough of this introduction, let's get into the meat of the subject.

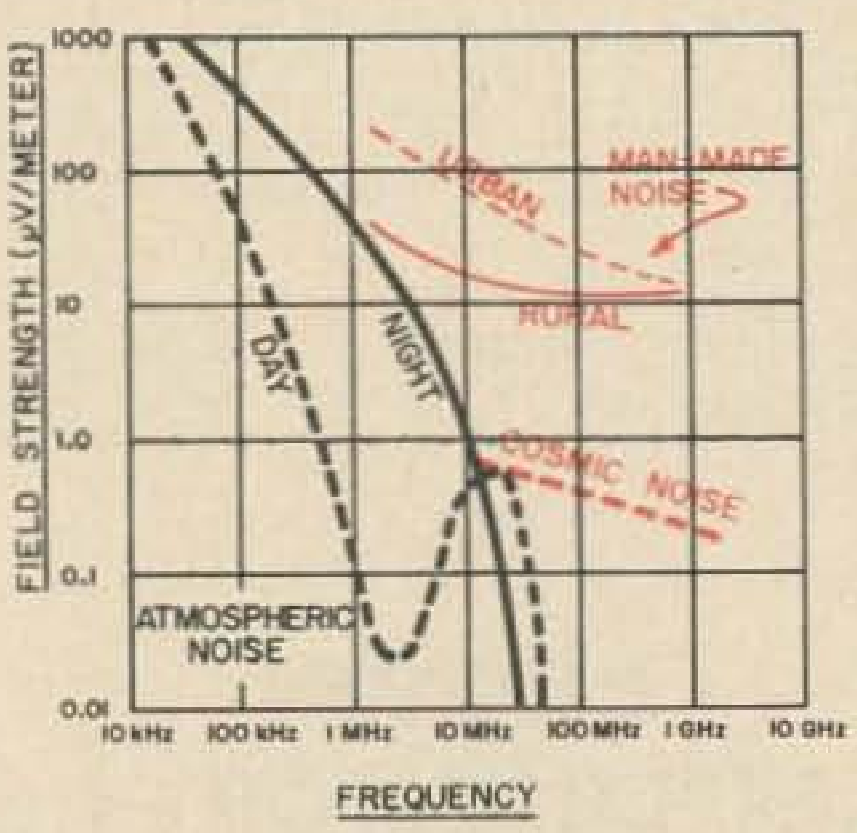

Fig. 1. Showing how the intensity of various types of noise sources varies with frequency. Source of graph: Reference 5.

What is noise?

Before discussing any technical subject it is always a good idea to define the terms to be used; then it is clear just what is being talked about. So, just what is noise, how can we define it?

In the most general sense, noise is any signal at the output of your receiver other than the one you want to hear. Therefore, noise is the hum and hiss, the static crashes, the ignition pulses, and the kilowatt tuning up 200 hertz from the signal you're tuning. The latter is more properly termed an "interfering signal", though, and we won't class it as noise. This article will treat all the others, as noise. Let's look at some specific noise types.

Cosmic noise. This is noise radiation that originates outside our atmosphere. It may come from the sun, our own galaxy (the Milky Way), from other galaxies or from some discrete "radio stars" which have been discovered. A great deal of it does indeed originate at the sun. The level of this "solar radiation" or "solar noise" varies from low "quiet sun" levels to magnitudes which are as much as 50 dB greater during "disturbed sun" periods. Sometimes solar radiation is even responsible for periods of radio blackout.

Most people have seen the band of stars in the sky known as the "Milky Way". These

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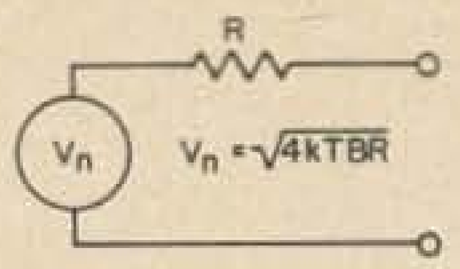

Fig. 2. Noise equivalent circuit for an electrical conductor or resistor.

are mainly the stars of the galaxy of which our own sun and planet are members. Our galaxy takes the general shape of a saucer and since we are on the saucer, the rest of the galaxy appears as a band of stars when we look in the right direction. If we point a high gain VHF antenna at this band we will observe that the receiver output noise level increases. In particular, if we point it at the center of the galaxy, where the concentration of stars is greatest, we will note a 10 to 20 dB noise increase over other directions on the "galactic plane". All these stars are generating noise in a manner similar to our own sun, which is itself a star. There are some particularly noisy stars which have been recently discovered and these are among the ones called radio stars".

Altogether cosmic noise is believed due to the "black body" or thermal noise (explained below) radiation of the interstellar bodies. It is not particularly strong except in the region 10 to 300 megahertz where it is sometimes the chief contributor of noise to the radio system, and thereby establishes the smallest signal that can be detected. The intensity of cosmic noise decreases as the frequency is raised.

It should be mentioned that cosmic noise does have one good side—it is providing the signals which radio astronomers are studying to help us learn more about the nature of our universe.

Atmospheric noise. As hard to believe as it may seem to be, there is an average of about 2000 thunderstorms going on all the time at various points on the earth. Each of the thunderstorms produces lightning discharges, and there is an average of about 100 of these occurring every second. A lightning stroke is very similar to an electric arc, or spark, and generates a considerable amount of radio noise over a wide frequency range. This is the chief generation mechanism for atmospheric noise.

Now the generated noise is propagated for long distances, particularly in our DX bands, just as are the signals from our transmitters. Consequently, noise that originally came from a lightning stroke over Moscow may interfere with your QSO with a VK2 on 20 meters. In fact the intensity of atmospheric noise is dependent on time of day, season of the year, frequency of operation, weather and geographical location of the receiver. As a general rule, atmospheric noise decreases with increasing frequency, although there is an exception to this rule, as seen in **Fig. 1**. Also, the intensity decreases with increasing latitude of the receiving location. The thunderstorm seasons of equatorial Africa, the Caribbean, northern India, and other areas along the equator, make these locations particularly noisy.

Another source of atmospheric noise is "black body" radiation by the atmosphere itself. This is usually not particularly important today, but within a few years as more amateurs use the UHF bands we will have to learn to combat its effects, since it increases at frequencies above 1000 MHz.

Fig. 1 shows that atmospheric noise ceases to be a prime noise source above 50 MHz. This is due to the loss of long-distance signal propagation at the higher frequencies. Below 30 MHz, however, we do have to concern ourselves with limiting the effects of this noise as much as possible. Some means of achieving this are the use of high transmitter power, receiver bandwidth no wider than the signal received, peak-limiting or noise-silencing devices for high amplitude, short duration pulses from nearby lightning flashes, and the use of high gain receiving and transmitting antennas. And of course these means are generally useful for combating the effects of other types of noise as well.

Man-made noise. In the frequency range from 1 to 500 MHz there is considerable noise radiated by the machines man creates to do his work for him. A classic example of this type of noise is the impulsive signal emanated by the ignition system of an automobile. As with lightning, the generation mechanism is an arc, this time at the spark plugs. Anyone who has had an unsuppressed automobile pull up next to his receiving antenna knows what this type of noise can do to even a strong signal. Noise-blanking devices are usually about the most effective in eliminating this type of noise. Also, since man-made noise is generally vertically polarized, maximum utilization of horizontal antennas should be employed in areas highly populated by automobiles and other noise-generating machinery.

Other sources of man-made noise are power-line leakage, electric motors, and industrial heating generators. Noise from these devices can be so severe as to interrupt even commercial communication and broadcasting. At least one space shot from Cape Kennedy is believed to have aborted due to an interfering signal from some man-made source. Since man-made noise is mainly due to machines, it is usually higher in intensity in the city than out in the country. See **Fig. 1.**

Thermal noise

We now come to the single most important source of noise. Thermal noise is important not only because it is present in radio systems, but also because it is useful in theoretical developments to represent other types of noise by an equivalent amount of thermal noise. Consequently, a good understanding of thermal noise is absolutely essential to anyone who wishes to understand noise theory as applied to radio.

Just as total darkness is the absence of all light, so absolute zero is the temperature when all heat is absent. There is a temperature scale with absolute zero as its zero point. This is the Kelvin system. Zero degrees Kelvin is absolute zero, 273 degrees Kelvin is the freezing point of water and 373 degrees Kelvin its boiling point. Kelvin system temperature can be found from Centigrade (Celsius) system temperature by:

(1) Degrees Kelvin = Degrees Centigrade + 273

Now let's look at a conductor of electricity. Since there is no perfect conductor, it will have some resistance, and therefore we can treat it as though it were a resistor. Now if the resistor is sitting in a room, its temperature is probably about 290 degrees K. Under this condition the electrons in the resistor will be moving about in a random fashion. This random motion of the electrons creates a random voltage across the terminals of the resistor. By random we mean that we cannot predict what the voltage will be at a certain time in the future. However, we can state what the mean voltage will be, thanks to a man named Nyquist. The formula that he developed is this:

$$v_n = \sqrt{4kTBR} \qquad (2)$$

v_n = Mean noise voltage, volts
R = resistance, ohms
k = Boltzman's constant,
= 1.37×10^{-23} joules/degree K
T = Temperature, degrees K
B = Bandwidth, cps

Here the word "mean" is similar to "average", but a strict definition can be found in the textbooks referenced. Notice that the mean voltage is dependent on the bandwidth across which it is measured. This implies that the noise is evenly distributed across all frequencies, and this is truly the case, at least in theory. Noise that is distributed in this fashion is termed "white noise". We can now draw the noise equivalent circuit for an electrical conductor, or resistor. See **Fig. 2.**

The next question that we might ask is, what is the noise voltage if I have two or more resistors in series or parallel? It can be shown mathematically that **Fig. 2.** can still used. First you find the effective resistance of the combination, this is then R. Then v_n is found from this R, by using Equation (2). Consequently, it is pretty simple to find the noise equivalent circuit for most resistive networks.

There is one more thing to be looked into about this noise voltage. Since its magnitude is random with respect to time, we cannot add two such voltages together directly (when they are in series) as we can with ordinary voltages. Voltage sources that cannot be added directly are termed "incoherent", and must be added by this formula:

$$v_{nT} = \sqrt{v_{n1}^2 + v_{n2}^2} \qquad (3)$$

v_{nT} = total effective mean noise voltage.
v_{n1}, v_{n2} = individual mean noise voltages to be added.

This equation is illustrated in **Fig. 3.** Note that we will get the same v_{nT} whether we first combine the R_1 and R_2 and find v_{nT} directly from Equation (2), as in the last paragraph, or if we go to the trouble of using Equation (3). We are merely taking either of two routes to get the same result. However, both methods should be understood. Also, Equation (3) is not limited to the addition of just two incoherent sources. It can be extended to include as many voltages as must be combined. Thus for 5 incoherent sources:

$$v_{nT} = \sqrt{v_{n1}^2 + v_{n2}^2 + v_{n3}^2 + v_{n4} + v_{n5}^2}, \qquad (4)$$

where the notation is the same as in Equation (3).

Now we must find how much noise *power* is *available* from the circuit of **Fig. 2.** Most amateurs will tell you that you will draw the most power from a circuit like **Fig. 2.** when you load it with another resistance equal to R, and this is true. The new circuit is **Fig. 4.**

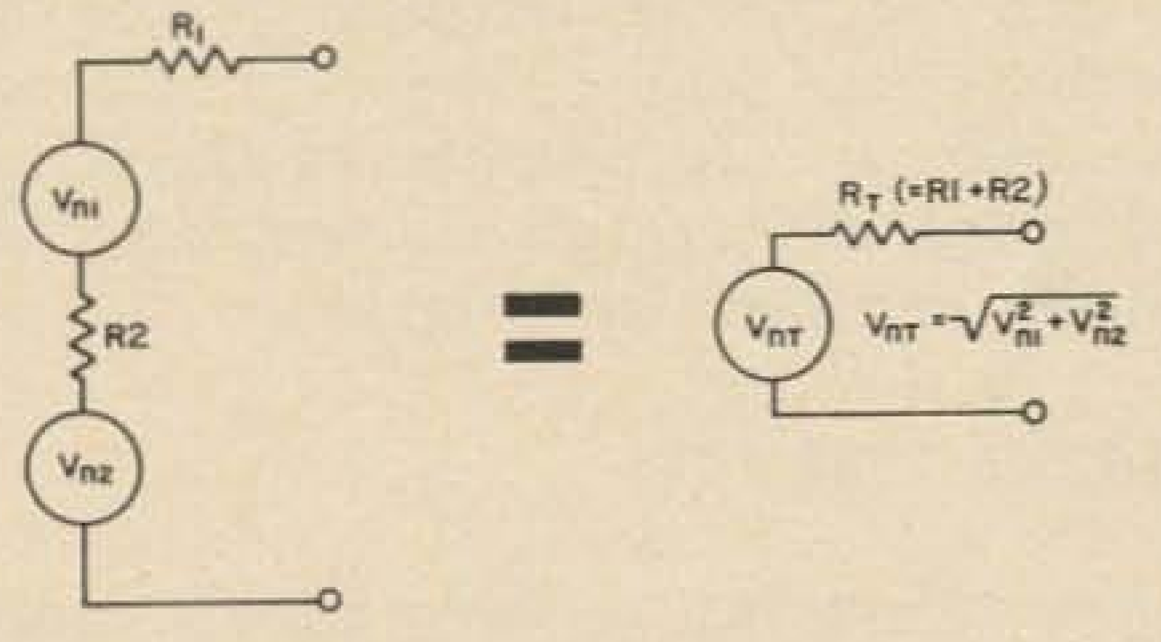

Fig. 3. Combining two resistors into their total equivalent noise circuit.

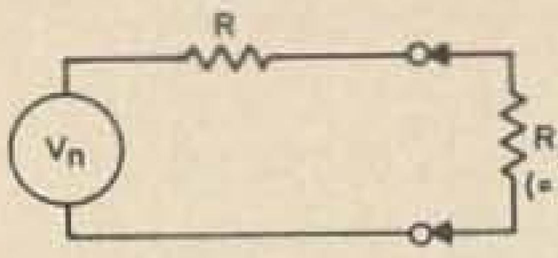

Fig. 4. Loading the circuit of Fig. 2 to obtain maximum available output noise power.

The voltage across R_L is $\frac{1}{2}v_n$, thus the power dissipated in R_L is (from Ohm's law):

$$(5) \qquad P = \frac{E^2}{R} = (\tfrac{1}{2}v_n)^2/R_L = \frac{v_n^2}{4R_L}.$$

But since $R_L = R$:

$$(6) \qquad P = \frac{v_n^2}{4R},$$

and from Equation (2) ,$v_n^2 = 4kTBR$. Thus,

$$(7) \qquad P = \frac{4kTBR}{4R} = kTB.$$

Thus the *maximum available output noise power is kTB*. Note that it doesn't depend on what value R has. Therefore any conductor or resistor has the same available noise power at its terminals. This is a very significant fact and helps to simplify noise theory, as we shall see.

As noted above thermal noise is often used to represent other types of noise. This is because thermal noise is easily represented and worked with mathematically, while other types of noise often are not. Consequently, if we have a certain amount of noise power available from some source we can, by using Equation (7), represent that source by a resistor at the temperature T which gives the same available noise power output. (The bandwidth, B, over which we measure the available noise power must be the same for the source and our representation, of course.) Thus *any noise source has an equivalent thermal noise temperature, or just "noise temperature"*. This is a very important fact to understand. For example, as noted above, the noise temperature of a star is roughly its actual temperature, because its output is mainly thermal noise.

We can now leave thermal noise for awhile and turn to another subject. If you feel a little hazy on some of the points covered above, refer to one or more of the references listed in the bibliography for extra instruction, or to get another viewpoint.

Noise in receivers

Up to this point we have mainly concerned ourselves with noise generated outside the receiver-antenna system. The only exception to this has been thermal noise, which is generated both within and without the receiving system. We now must concern ourselves with noise generated within the receiver itself.

Noise is generated in a receiver in several different ways. There is thermal noise due to the resistive elements in the receiver circuitry, and there is noise somewhat like thermal noise that is caused by the vacuum tubes and semiconductors in the receiver. These foregoing types of noise can be minimized by designing the receiver for low noise figure. Unfortunately, there are three other noise generation mechanisms within the receiver that cannot be minimized by design for low noise figure.

Cross-modulation. There are two ways in which two or more signals can mix together within a receiver to produce a third signal, which interferes with the desired signal. One of these ways is through cross-modulation. Cross-modulation requires the presence of only the desired carrier and another undesired carrier which is modulated. In cross-modulation the modulation on the undesired carrier appears on the desired carrier, that is, the modulation "crosses" over from the undesired to the desired carrier. The effect is due to limited dynamic range in the receiver. The undesired carrier does not necessarily have to be within the *if* passband of the receiver, and more often is not. The cross-modulation effect usually takes place in the stages of the receiver close to the antenna. The stronger the undesired signal, the more likely the effect is to be noticed. Low cross-modulation requires special design effort and designing a receiver for lowest possible noise figure will usually make the cross-modulation characteristic worse.

Intermodulation distortion. This is the other way in which signals may mix in a receiver to produce a third, interfering, signal. Again it is due to limited linear dynamic range in the receiver. Intermodulation does not require the presence of the desired signal. It is the mixing of two undesired signals, or their harmonics (which are themselves generated within the receiver), to produce a third signal at or near the desired signal frequency. Again, this type of noise generation requires special design effort for its minimization, and a low noise

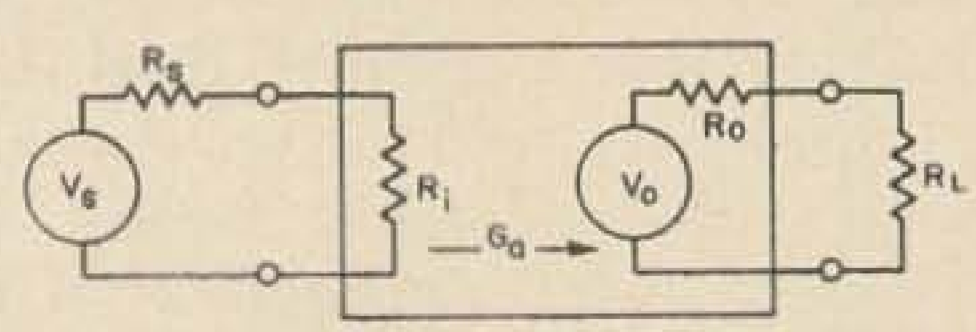

Fig. 5. Representation of an amplifier circuit. G_v is voltage gain, v_o/v_s. G_a is available power gain.

figure design scheme will make it worse.

Noise modulation. This effect is merely a combination of cross-modulation and intermodulation distortion. Once again it is due to receiver non-linearity. Since noise is always present in the receiver, there is always a source of "signals" to produce the cross- and intermodulation effects. As a consequence there is always modulation of the desired and undersired signals by the noise in the receiver. If it were not for noise modulation, you would not notice any difference in output when tuning across an unmodulated carrier with an AM receiver. This is because the detector only responds to the modulation on the carrier, not the carrier itself. But since the noise modulation effect modulates the carrier with noise, you get the characteristic hissy noise output. Reduction of cross- and intermodulation effects will reduce noise modulation also.

Now we have an idea of some receiver noise problems. We will discuss them some more, but now it is time to turn to another topic.

What is power gain?

If you ask a typical amateur what the power gain of an amplifier is, he will probably tell you it is the output power divided by the input power. In a sense he is right, but there is a bit more to it than that. An understanding of that "bit more" is necessary to those who would understand noise theory.

Have a look at **Fig. 5.** (We will consider all impedances to be purely resistive.) Here we have a source of input power, made up of V_s and R_s, which we will amplify with the amplifier in the box. The amplifier has an input impedance R_j, and an output impedance R_o. The load is R_l. Now we can define several different power gains. The first we shall call just plain "power gain". It is defined thusly

(8) power gain = G_p

$$= \frac{\text{power going into } R_l}{\text{power going into amplifier from source}} .$$

Of course "power going into R_j" is the same as amplifier output power.

Now the real purpose of a power amplifier is to increase the power available from a source. But "power gain", as defined above, doesn't tell you whether the amplifier is actually achieving this or not. For example, if R_s and R_j are widely different very little power will get into the amplifier to be amplified and even with a large power gain the output power that is available from the amplifier may be very small, maybe even less than the source

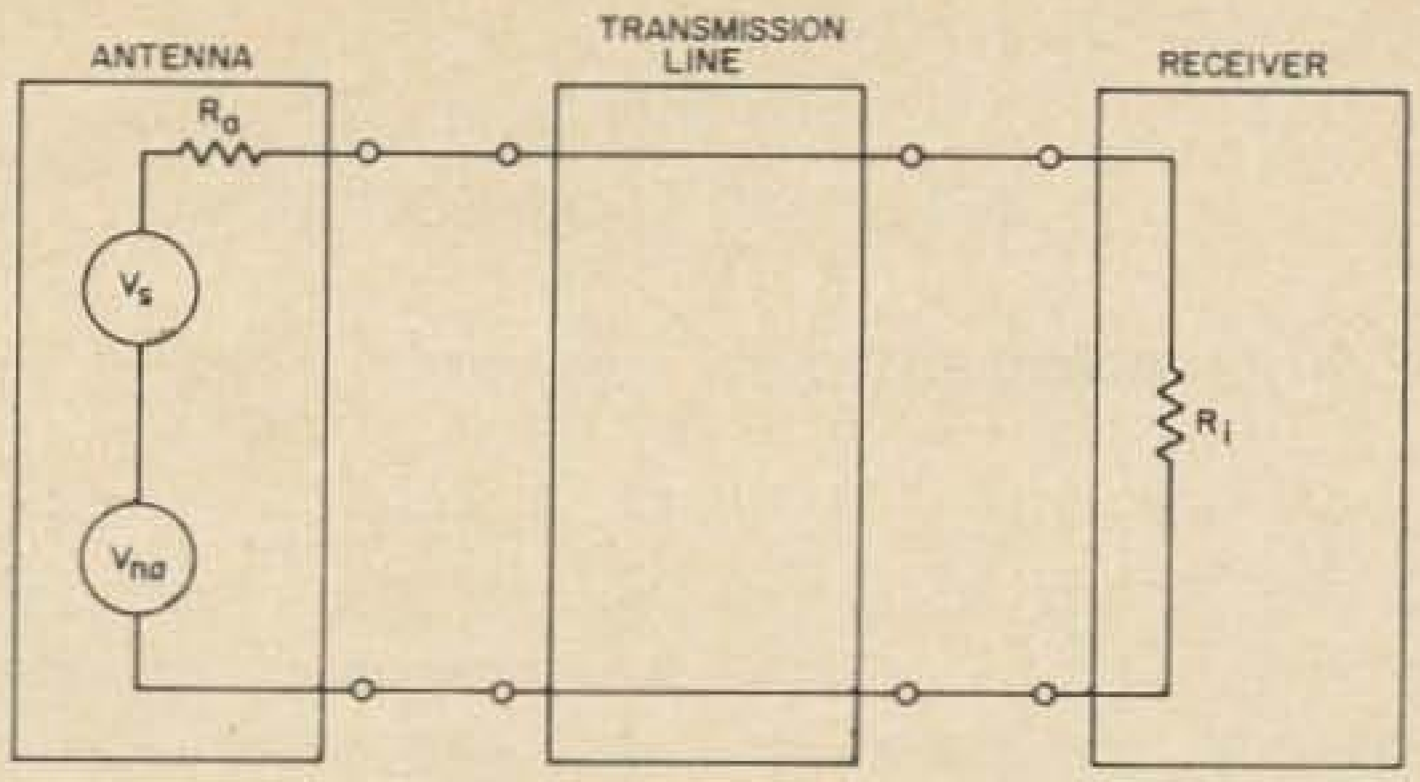

Fig. 6. The receiving system.

had available to begin with without the amplifier. In this case the amplifier would be doing more harm than good, for it is adding noise to the system, without increasing the available signal power. Consequently a better measure of amplifier gain is needed. This is called "available power gain":

(9) available power gain = G_a

$$= \frac{\text{power available at output of amplifier}}{\text{power available from source}} .$$

The power available from the source is (remember how we got Equation (7)?): $v^2_s/4R_s$. And the power available at the output of the amplifier is: $v^2_o/4R_o$. Therefore:

$$(10) \qquad G_a = \frac{V_o^2/4R_o}{V_s^2/4R_s} = G_v{}^2 \frac{R_s}{R_o} .$$

G_a will be maximized when the input is matched, that is $R_j = R_s$, but is unaffected by the match between R_o and R_j.

We shall make considerable use of this available power gain in the development of noise figure theory. But while we're about it we may as well define two other types of power gain, which you will see more and more frequently nowadays and may not otherwise understand. The first of these is "transducer power gain". It is defined thusly:

(11) transducer power gain = G_t

$$= \frac{\text{power going into } R_l}{\text{power available from source}} .$$

Maximizing G_t requires matching both R_j to R_s, and R_l to R_o. A little thought will show that G_t is always less than or equal to G_a. In other words, G_t for a particular amplifier will never exceed its G_a.

The other frequently used gain figure is "insertion power gain". It presupposes that source and load impedances have been specified, and is a measure of the effectiveness of "inserting" a particular amplifier between the given source and load.

(12) insertion power gain

$$= \frac{\text{load power with amplifier}}{\text{load power without amplifier}}.$$

The receiver-antenna system

We now have enough preparation behind us to begin a discussion of the receiving system. This system is composed of the antenna, the receiver, and the transmission line connecting the two. **Fig. 6** is a representation of the system.

The transmission line will have a certain amount of loss, of course. We can look at this another way, though. Since part of the signal is lost due to the attenuation of the transmission line, there is less signal power available at its output than at its input. Therefore, the line has an available power gain of less than one. It turns out that the available power gain of the transmission line is equal to the inverse of its loss:

$$G_{aTL} = \frac{1}{L_{TL}}. \tag{13}$$

(Subscript TL means transmission line)

For example, if the loss is 2 (that is, 3 dB), the available power gain is ½ (or —3 dB).

Note that the antenna is represented by a resistance (we are assuming the antenna to be lossless and resonant) and 2 voltage sources connected in series. Let's look at each of these components one by one.

R_a is merely the radiation resistance of the antenna. This is the resistance that would be measured by an ohmmeter looking into the antenna terminals. Don't try it with your VOM, though, because the ohmmeter must operate at the resonant frequency of the antenna.

v_s represents the signal voltage. The antenna is immersed in an electromagnetic field generated by the transmitter we want to listen to, and the result has been the conversion of the field strength into the voltage, v_s.

v_{na} represents the noise voltage. Part of this noise voltage is due to the thermal noise generated in R_a. The rest of the noise voltage is due to atmospheric, cosmic, man-made and other types of noise. This we term "excess noise", because it is excess to the inherent thermal noise in the antenna.

The antenna's actual temperature we shall call T_{ao}. Therefore the thermal part of the noise voltage is

$$\sqrt{4kT_{ao}BR_a}.$$

But remember we said awhile back we can represent *any* noise by an equivalent amount of thermal noise, merely by raising the temperature of the representative resistor to the proper value. This is what we are going to do in the antenna. The total effective antenna noise temperature we shall call T_{aeff}. Therefore:

$$v_{na} = \sqrt{4kT_{a,eff}BR_a}. \tag{14}$$

$T_{a,eff}$ is the sum of the actual antenna temperature, T_{ao}, and an excess temperature, $T_{a,ex}$, which represents all the noise except thermal noise:

$$T_{a,eff} = T_{ao} + T_{a,ex}. \tag{15}$$

If there were no noise except thermal noise in R_a, then $T_{a,eff} = T_{ao}$, of course.

Fig. 7. shows how the excess noise varies with respect to frequency. Note that above about 700 MHz the excess noise has about disappeared, so that $T_{a,eff} = T_{ao}$, or in other words, $(T_{a,eff}/T_{ao}) = 1$. But below 700 MHz the excess noise gets larger and by the time we reach the 10 meter band (28 MHz) the excess noise is at least 100 times greater than the thermal noise. This great variation of the excess noise makes it necessary for us to divide our approach into two different parts. First we shall neglect the excess noise and look at the receiving system without it. Then we will put it back in to the system and see what changes we have to make to our thinking.

Noise figure

From **Fig. 6** we can see that the antenna output contains noise as well as signal. With a given antenna there is little that can be done about this antenna noise, we just have to live with it. It would be nice though, if we could avoid having any additional noise added into the receiving system by the receiver. Unfortunately this is impossible, and the receiver does add some more noise. The receiver's noise figure is a measure of the additional noise contributed by the receiver.

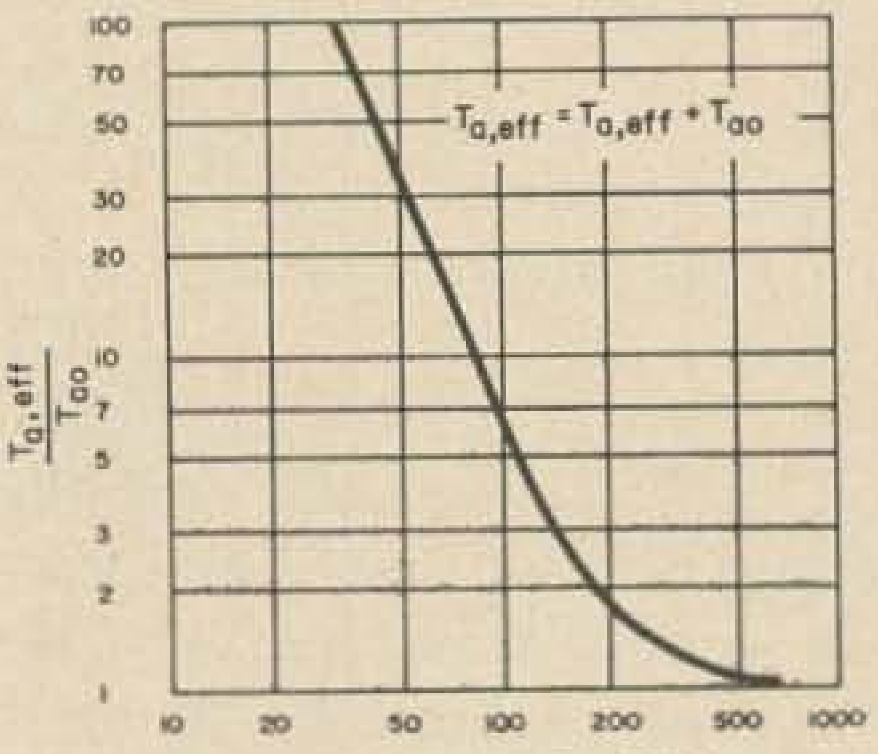

Fig. 7. Showing how $T_{a,eff}$ typically varies with respect to T_{ao}.

(This neglects any cross- or intermodulation effects in the receiver.)

The noise figure of a well designed receiver will be determined primarily by the "front end", that is, the stage or two closest to the antenna. Noise figure for an amplifier is defined thusly:

$$\text{(16)} \qquad \text{noise figure} = NF = \frac{S_i/N_i}{S_o/N_o}.$$

where: S_i = available signal input power
S_o = available signal output power
N_i = available noise input power
N_o = available noise output power

This is merely the ratio of the input signal-to-noise ratio to the output signal-to-noise ratio. A perfect receiver would have a NF of 1 (or O dB).

Now we have the definition out of the way, let's see what we can do with it to find the receiver noise figure. First, if the transmission line is matched to the antenna and receiver input then the resistance seen by the receiver looking at the antenna is R_a. In this case S_i is the available power from the antenna multiplied by the available power gain of the transmission line:

$$S_i = \frac{v_s^2}{4R_a} G_{TL}.$$

The amplifier (receiver) available output is S_i multiplied by the available power gain of the amplifier (receiver): $S_o = S_i G_{aR}$. (G_{aR} is the amplifier, or receiver, available power gain.) The available input noise power is (neglecting antenna excess noise for now): $N_i = kT_{ao}B$. And the available output noise power is: $kT_{ao}BG_{aR} + \Delta N$. ΔN is the available output noise power due solely to noise generated within the amplifier (receiver).

Now if we put all these quantities into Equation (16) we come up with:

$$\text{(17)} \quad NF = \frac{kT_{ao}BG_{aR} + \Delta N}{kT_{ao}BG_{aR}} = 1 + \frac{\Delta N}{kT_{ao}BG_{aR}}.$$

Notice that we would only have a noise figure of 1 if ΔN were O, which require a perfectly noise-free receiver.

Now take another look at Equation (17). Note that the receiver noise figure is dependent on the source temperature, T_{ao}. In order to avoid confusion, the radio and communications industry has decided that noise figure will be measured at T_{ao} = 290 degrees K. If it were not for this standardization noise figures published by one manufacturer would be difficult to compare with those published by another. Remember, *noise figure depends on source temperature.*

Receiver noise temperature

Often nowadays you will see the noise performance of a receiver (particularly the very low noise variety in the VHF and UHF range) specified in "receiver noise temperature." You may have asked yourself, what does this mean? How can I relate this noise temperature to noise figure which I understand better? Well, let's see.

Once again remember that noise is often represented by an equivalent amount of thermal noise. What we are doing with our receiver is pretending that the additional noise, ΔN, comes from a source at the receiver input terminals. This source must be at a temperature, $T_{R,eff}$, to account in a thermal way for the additional receiver noise. Therefore, $\Delta N = kT_{R,eff}BG_{aR}$. Now putting this into Equation (17):

$$\text{(18)} \quad NF = 1 + \frac{kT_{R,eff}BG_{aR}}{kT_{ao}BG_{aR}} = 1 + \frac{T_{R,eff}}{T_{ao}}.$$

Or,

$$\text{(19)} \quad T_{R,eff} = T_{ao}\,(NF - 1),$$

where: $T_{R,eff}$ = effective receiver noise temperature.

Note that $T_{R,eff}$ is a bit more arbitrary measure of receiver noise performance than NF, because it requires no reference temperature. Also, if you want to convert from NF to $T_{R,eff}$ (or reverse) be sure you measure the NF at the same T_{ao} as you use on the right-hand side of Equation (19). So now we can convert back and forth from NF to $T_{R,eff}$. By now you should have a fair understanding of what noise figure and temperature are.

Cascaded stages

Sometimes it becomes of interest to find the total noise figure for two or more stages in cascade. An example of this problem would occur if you had a new preamp in mind for your VHF receiver and wondered if it would really improve performance appreciably. We won't go into the derivation of the formula, but here it is for two stages:

$$\text{(20)} \qquad NF_T = NF_1 + \frac{NF_2 - 1}{G_{a1}}$$

NF_T = total effective NF
NF_1 = NF of first stage
NF_2 = NF of second stage
G_{a1} = G_a of first stage

If you have more than two stages, the formula can be extended thusly:

$$(21) \quad NF_T = NF_1 + \frac{NF_2 - 1}{G_{a1}} + \frac{NF_3 - 1}{G_{a1}G_{a2}} + \frac{NF_4 - 1}{G_{a1}G_{a2}G_{a3}} + \ldots\ldots$$

[notation same as for Equation (20)].

If it is necessary to find the total noise temperature for two stages:

$$(22) \quad T_T = T_1 + \frac{T_2}{G_{a1}}$$

T_T = total noise temperature
T_1 = noise temp for first stage
T_2 = noise temp for second stage

And for more than two stages, the formula is simply extended:

$$(23) \quad T_T = T_1 + \frac{T_2}{G_{a1}} + \frac{T_3}{G_{a1}G_{a2}} + \frac{T_4}{G_{a1}G_{a2}G_{a3}} + \ldots\ldots.$$

Excess noise again

In the development of Equation (17) we decided to assume the effective source (antenna) noise temperature to be T_{ao}, the actual temperature (which we further assumed to be 290 degrees K). But we know in the general case, below 700 megacycles, this is not the case, for the actual antenna noise temperature is $T_{a,eff}$. This would suggest that we should measure the receiver noise figure with a reference temperature equal to $T_{a,eff}$. We can see from Equation (17) that if we did this the noise figure calculated in this manner would get smaller and smaller as we decreased frequency, because $T_{a,eff}$ gets larger and larger. This seems to imply that receiver noise figure becomes less significant at low frequencies.

Let's look at this another way. From Equation (18), we can define an antenna noise figure:

$$(24) \quad ANF = 1 + \frac{T_{a,eff}}{T_{ao}}.$$

ANF = antenna noise figure

But since $T_{a,eff}$ increases as frequency decreases, the antenna noise figure would also increase. This would seem to imply that at low frequencies, the antenna noise figure would be so much larger than receiver noise figure, that the latter would become insignificant in the system.

What we have been hinting at in the two preceding paragraphs is that below some certain frequency, receiver noise figure is no longer an important design consideration. This is an important fact to understand. Due to the variation of $T_{a,eff}$, it has been determined that (using modern tubes or transistors in the front end) noise figure should not be considered in the design of a receiver for operation below about 100 MHz. This 100 MHz figure is purely arbitrary, and some present day authorities might tell you 200 MHz is a better figure.

What then are design considerations for a low-noise receiver below 100 MHz? The answer to this is primarily the cross-modulation characteristic.

Our crowded DX bands today demand as little interference between signals as possible. One thing we can do to establish this condition is design our receivers for low cross- and intermodulation, so that the signals cannot mix together in the receiver and thereby create even more interfering signals. It is an unfortunate fact that a receiver cannot be designed for optimum noise figure and optimum cross- and intermodulation simultaneously. In fact the two types of considerations are in direct conflict. Consequently, we must decide between the two lines of design. Below 100 MHz we would decide in favor of low cross-modulation. Above 100 MHz we must begin to think in favor of low noise figure.

Minimum discernible signal

Our last topic will concern the minimum signal that can be detected by a receiving system. The development will be useful in that the final result will be an equation, examination of which will show how the weak signal performance of a receiving system can be improved.

Minimum discernible signal strength is defined here as the power density (at the receiving antenna) in the field of the desired signal which produces a receiver output signal power equal to receiver output noise power. We assume the antenna thermal noise is the dominant noise input component.

The input signal power under minimum discernible signal (MDS) conditions is:

$$(25) \quad S_i = A \times MDS \Big|_{S_o = N_o}$$

S_i = receiver input power
A = antenna capture area
MDS = as defined above

(The vertical bar with $S_o = N_o$ means the equation applies when output noise power is equal to output signal power.) Now rearranging Equation (25):

$$\text{(26)} \qquad \text{MDS} = \left.\frac{S_i}{A}\right|_{S_o = N_o}$$

But $S_o = G_aS_i$; and $N_o = G_akT_{ao}B + \Delta N$, as above when we developed Equation (17). Therefore:

$$\text{(27)} \qquad \text{MDS} = \frac{S_o}{AG_a}, \text{ and since } S_o = N_o\text{:}$$

$$\text{(28)} \qquad \text{MDS} = \frac{kT_{ao}B + \Delta N/G_a}{A}$$

Now substituting Equation (17) into Equation (28):

$$\text{(29)} \qquad \text{MDS} = (kT_{ao}B/A)\ \text{NF}.$$

Equation (29) is the end result we wanted. It shows that the MDS of a receiving system increases as the bandwidth and noise figure of the receiver increase, and decreases as the antenna capture area increases. The derivation of Equation (29) did not consider transmission line losses, but it is obvious that to keep the MDS down we must use transmission lines with small losses. Also, it should be noted that decreasing bandwidth will decrease MDS, but we can only do this until receiver bandwidth is about equal to signal bandwidth, for further reduction would make it impossible to recover the intelligence in the signal.

Conclusion

The intent of this article has been to provide a general overview of the receiving noise problem. It was particularly desired to point out when noise figure is and is not important in receiver design, and to show the relationship between noise figure, noise temperature, and minimum discernible signal strength. The author hopes that the reader has found it helpful to his understanding of noise.

. . . K6ZGQ

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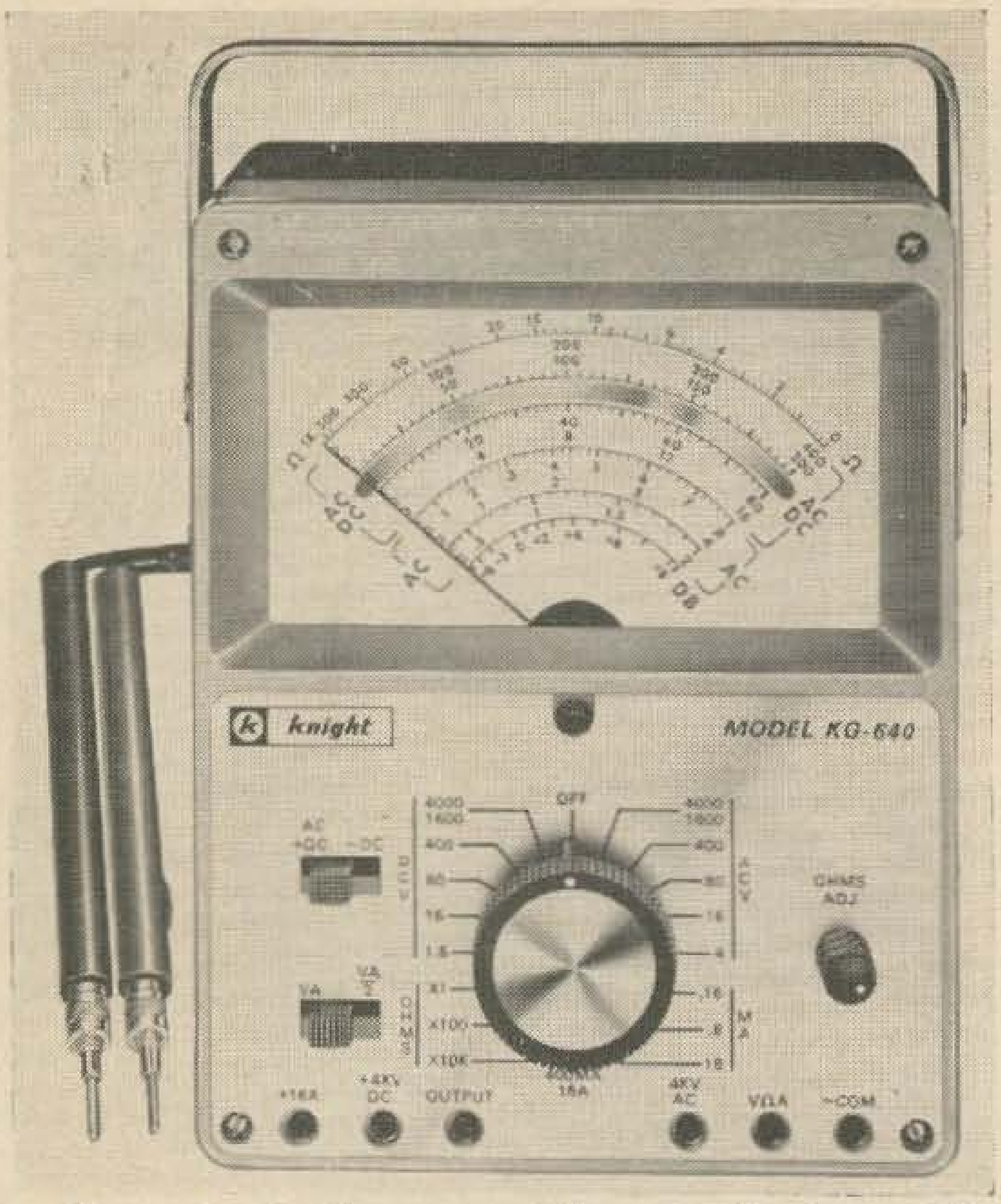
The Knight-kit KG-640 VOM



If you're in the market for a volt-ohm-milliameter, the new Knight-Kit KG-640 seems to be an excellent choice. This 20,000 ohms per volt instrument has many plus features that you don't usually find in inexpensive test meters. First of all, the meter is a taut-band unit; that is, the needle is suspended on a thin taut metal band instead of conventional bearings. Bearings, no matter how well designed, introduce a certain amount of friction. On the other hand, with the taut band movement, the friction is nil. This assures repeatability of reading plus dependable reliability. In addition, a mirrored scale on the meter face eliminates any errors that might be caused by parallax.

The KG-640 has a total of 57 different measuring ranges; many more than almost any other VOM on the market. On the DC scale, for example, the readings go from 0.8 VDC full scale (very handy for transistor work) up to 4000 volts. This range is sufficient for almost any DC voltage measurements that a ham is ever likely to make. The other ranges of AC voltage, resistance, current and dB are equally extensive. A complete list is given in the specifications below.

Although this VOM is available completely assembled, there are considerable savings if it is purchased as a kit. It is relatively easy to assemble with the very complete and easy to follow directions which are furnished. Plenty of illustrations are used throughout the text, and with the clear and concise instructions, it is difficult to make an error in construction. Total construction time is reasonable too—it took me about seven hours to complete the VOM.

After the VOM was completed, I was very interested to find out what kind of repeatability and meter linearity I could expect. Using W2DXH's voltage calibrator (see his article in this issue), I was able to accurately measure the linearity of the meter movement. It was remarkable, in fact, almost unbelievable! At

Knight-Kit KG-640 Specifications

DC Sensitivity:	20,000 ohms per volt or 10,-000 ohms per volt (function of scale multiplier switch).
Accuracy:	Within 3% of full scale reading on DC to 1600 volts; within 5% of full scale reading on AC to 1600 volts.
Frequency Response:	20 Hz to beyond 200 kHz.
DC Volts:	0 - 0.8 - 1.6 - 8 - 16 - 40 - 80 - 200 - 400 - 800 - 1600 - 2000 - 4000 volts.
AC Volts:	0 - 2 - 4 - 8 - 16 - 40 - 80 - 200 - 400 - 800 - 1600 - 2000 - 4000 volts. Sensitivity 5000 or 2500 ohms per volt.
Output Volts:	0 - 2 - 4 - 8 - 16 - 40 - 80 - 200 - 400 volts.
Resistance:	0 - 1K, 100K and 10 megohms. Center scale values of 12, 1200 and 120K ohms.
Decibels:	−12 to +74 dB. Based upon 1 milliwatt into a 600 ohm line as 0 dB.
DC Current:	0 - 80 μA, - 160 μA, - 400 μA - 800 μA - 8 mA - 16 mA - 200 mA - 400 mA - 8 A - 16 A.
Batteries:	1 flashlight, type C and 4 penlight, type AA.
Size:	6¾" x 5¼" x 3¾".

only one point from one end of the scale to the other did the meter deviate from a linear reading. At the five volt point on the 15 volt range, the meter indication was about 100 millivolts off. And 100 millivolts out of five volts is a pretty small deviation—so small it wouldn't even be noticed in the normal run of measurements.

Next the accuracy and repeatability tests. These were made using the same voltage calibrator. The accuracy of the meter proved to be extremely good. The DC voltage scales, as far as I could tell with my naked eye, were right on the money. Same with the AC ranges. The resistance ranges were checked out with precision 1% resistors; in every case they were very, very close to the known resistor value. Repeatability: I couldn't detect any difference in readings when making the same voltage measurement several times. A 10 volt source showed up as exactly ten volts on the meter each time I put the probes across it.

If you're in the market for a VOM, you should definitely take a close look at the Knight-Kit KG-640. For accuracy, reliability, and dependability, it would be difficult to find a better instrument value for $39.95.

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73 Looks at the Motorola HEP Line

Motorola's new experimenter transistors have many ham uses.

If you've been in a radio store recently, you've probably noticed a large display full of mouth-watering Motorola semiconductors. The display (and the items in it) are part of the new Motorola HEP program. The *H*, *E* and *P* stand for Hobbyist, Experimenter and Professional, and that's who the program is aimed at. The HEP semiconductors are designed for radio-TV servicemen, experimenters, schools—and hams. Naturally, we're most concerned about their ham uses, and they have plenty.

The HEP program means that now many common and exotic semiconductors with excellent performance are finally available at local radio and hobby stores—and at reasonable prices. The HEP line is very extensive; it even includes some digital integrated circuits and a field effect transistor. Most of the items are lower in price or about the same as competing experimenter-hobbyist transistors, but the HEP line is much more extensive. You can buy cheaper versions of many of the devices from industrial distributors under other names and in different cases, but the HEP line is widely available. That's a great boon to most hams even if it means that the transistors cost a few cents extra.

I've had a chance to try some of the HEP devices, and I've found them excellent. All the ones I've been able to check beat the specs Motorola publishes. Here's a quick look:

The HEP-1 is a "standard" PNP germanium mesa transistor. It costs 89¢ and is useful in most low power experimenter circuits: af amplifiers, *if* amplifiers, regenerative and super-regen detectors, oscillators, etc. It easily oscillates to 250 MHz in a simple dipper I have.

The HEP-2 and HEP-3 are low power, high frequency germanium transistors. They have cutoff frequencies of 750 and 250 MHz and betas of 60 and 80.

The HEP-50 through 53 are 300 and 600 mW silicon PNP and NPN transistors for the HF and low VHF range. They are useful for everything from CPO's and meter amplifiers to low power transmitters. V_{CB} is listed from 10-20 V, so they're not suitable for most modulated amplifiers or other circuits with inductors unless you use very low voltage. Cost is 79¢ to $1.29.

A group of recently announced transistors seems to have been added with the ham in mind. They're four tiny silicon plastic transistors for VHF use. The numbers are HEP-54 to 57 and three are NPN, one PNP. Dissipation without heat sinks is 310 mW. Cutoff frequencies range from 30 to 750 MHz and beta from 70 to 180. Prices are $1.08 to $1.44. All four show very low input and output capacitance.

HEP-101 is a 10-V, 400-mW 95¢ zener, and HEP-102 through 105 are 1 W zeners for 3.6, 6.2, 9.1 and 12 V. They cost $1.20 each.

HEP-151 through 162 are various silicon rectifiers rated from 1 A to 15 A and 50 to 1000 PIV. The 15-A ones are stud mounted, and come with mounting kits, the 3-A ones are top hats, and the 1-A ones are tiny (smaller than ½-W resistors) epoxy-cased units. As examples of prices, the 15-A, 50-V HEP-151 is 79¢; the 1-A, 400-V HEP-157 is 56¢; and the 1-A, 1000-V HEP-160 is $1.45.

Especially interesting are the miniature (¼"×¼"×⅜") HEP-175 through 177 bridge rectifiers rated at 1 A from 50 to 400 PIV. They cost $1.49 to $2.25.

HEP-200, 230 and 231 are germanium power transistors. 200 and 230 are 3-A TO-3 cased units (about 85¢). The HEP-231 is a 15-A, TO-36 high power transistor. It comes with mounting kit and costs only $1.69.

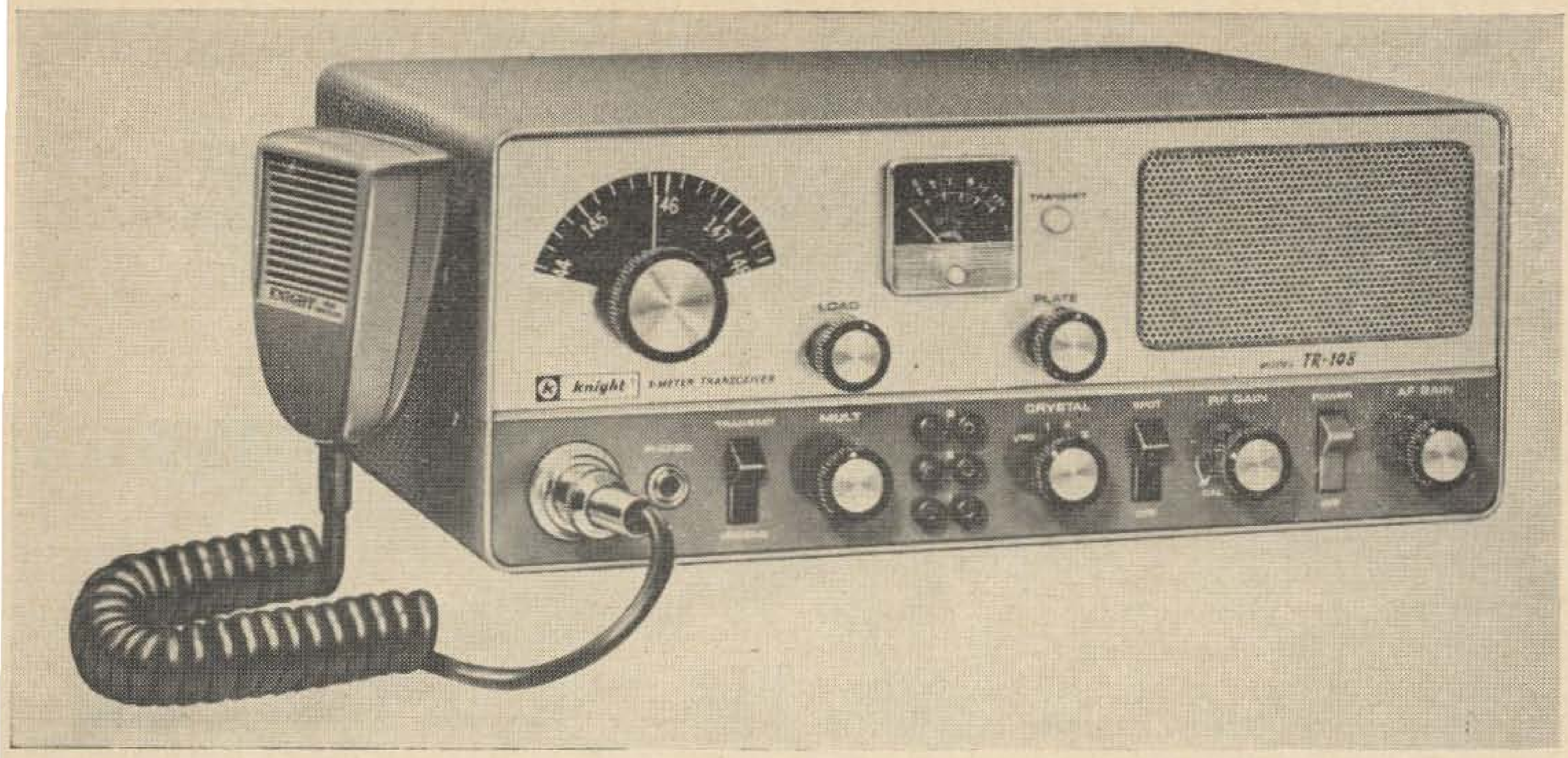
The HEP-232 and 233 are high power, high voltage units: 70 V, 7 A, 90 W and 65 V, 15 A, 150 W respectively.

HEP-250 through 254 are germanium PNP audio transistors, including a low leakage one.

HEP-300 through 307 are silicon controlled rectifiers (SCR's). These incredibly useful devices haven't been used much by hams yet, but we should see more and more of them. They make excellent switches and relays for vibrator replacement, speed controls, etc. The HEP units are rated at 5 and 15 A and 50 and 200 V. They come in both normal and reversed polarity with mounting kits for $2.29 to $6.20.

HEP-309 and 311 are triggers for use with SCR's. HEP-310 is a unijunction silicon transistor; its price is $1.49.

HEP-553 through 558 are digital integrated circuits. See the article by W6GXN in the December 73 for some uses for them. They cost $1.69 (for a bias driver, a fancy regulated power supply) to $5.99 (J-K flip-flop).



Jack Morgan K1RA
Greenfield, N.H.

Knight-Kit TR-102

Two-meter equipment has come a long way in the past 25 years. A look at the gear we used in the W.E.R.S. activity during WWII would make you shudder: modulated oscillators that drifted all around the band, and super-regen receivers that could radiate almost as much as the transmitters.

At a meeting of the Old Timers in Trenton, N.J., in 1946, the late John Reinartz, W1QP, showed us a five-tube, crystal controlled two-meter rf source, built on a 3 x 8 inch chassis. He plugged in a 4.5 MHz crystal at one end, and a small flashlight bulb lit up at the other. We were amazed that those receiving tubes could put out anything at all on two, especially with the final tube doubling. But we were progressing.

Things are very different today on two, and kits have little resemblance to those of the early days. One of the most interesting recent kits is Allied's Knight-Kit Model TA-102. Similar basically to the Model TR-106 that was discussed by WA1CCH in the August issue, this one has an additional multiplier, and coils that are well designed for two. Output is a good 10 watts over the entire band with either VFO or crystal control. The Model V-107 VFO unit is an accessory that plugs into the rear deck and gives a very neat appearance along side the TR-102.

The instruction book gives you two chances to do everything right the first time: clearly worded text, with a picture to show exactly what is intended. You would almost have to make an error on purpose to get into trouble. The kit we assembled gave no problems and produced the expected output.

Here is a very inexpensive way to get on two meters with a good modern transceiver, ready for either mobile or fixed operation simply by using the appropriate power cable. We expect to hear TR-102's in ever-increasing numbers in round tables, emergency and mobile work. See you on two with a TR-102.

The HEP-801 is an N-channel field effect transistor for low frequency and dc uses. It costs $3.39.

Also included in the HEP displays are heat sinks, IC sockets, TO-3 mounting kits and a number of books and pamphlets. A couple of the books are discussed briefly on page 87 in the October 73.

The prices quoted above may vary a bit from different stores. You can get a complete list of HEP distributors and a catalog from Motorola HEP, Box 955, Phoenix, Arizona 85001. Incidentally, the new Allied consumer catalog lists the HEP-devices with their prices. Whether you order them by mail or buy them locally, try some of the HEP semiconductors. You'll like them.

. . . WA1CCH

A Junkbox Ten Minute Timer

Here is a ten minute timer which will serve as a reminder when its time to identify in those SSB contacts. If you have one of these you can give the kitchen timer back to the XYL and perhaps avoid a citation at the same time.

The circuit uses a 12BY7 to control a sensitive relay in the plate circuit, which in turn controls a warning light to tell you when the time is up. The tube is normally in a conducting state and the light is on. When the normally open momentary contact pushbutton is depressed, a negative voltage, rectified by CR1 is applied to the grid of the tube, biasing it beyond cut off and extinguishing the light. At the same time the 8 μF capacitor charges to about 175 volts negative. As long as this capacitor remains charged sufficiently the tube can not draw enough current to energize the relay and turn on the light.

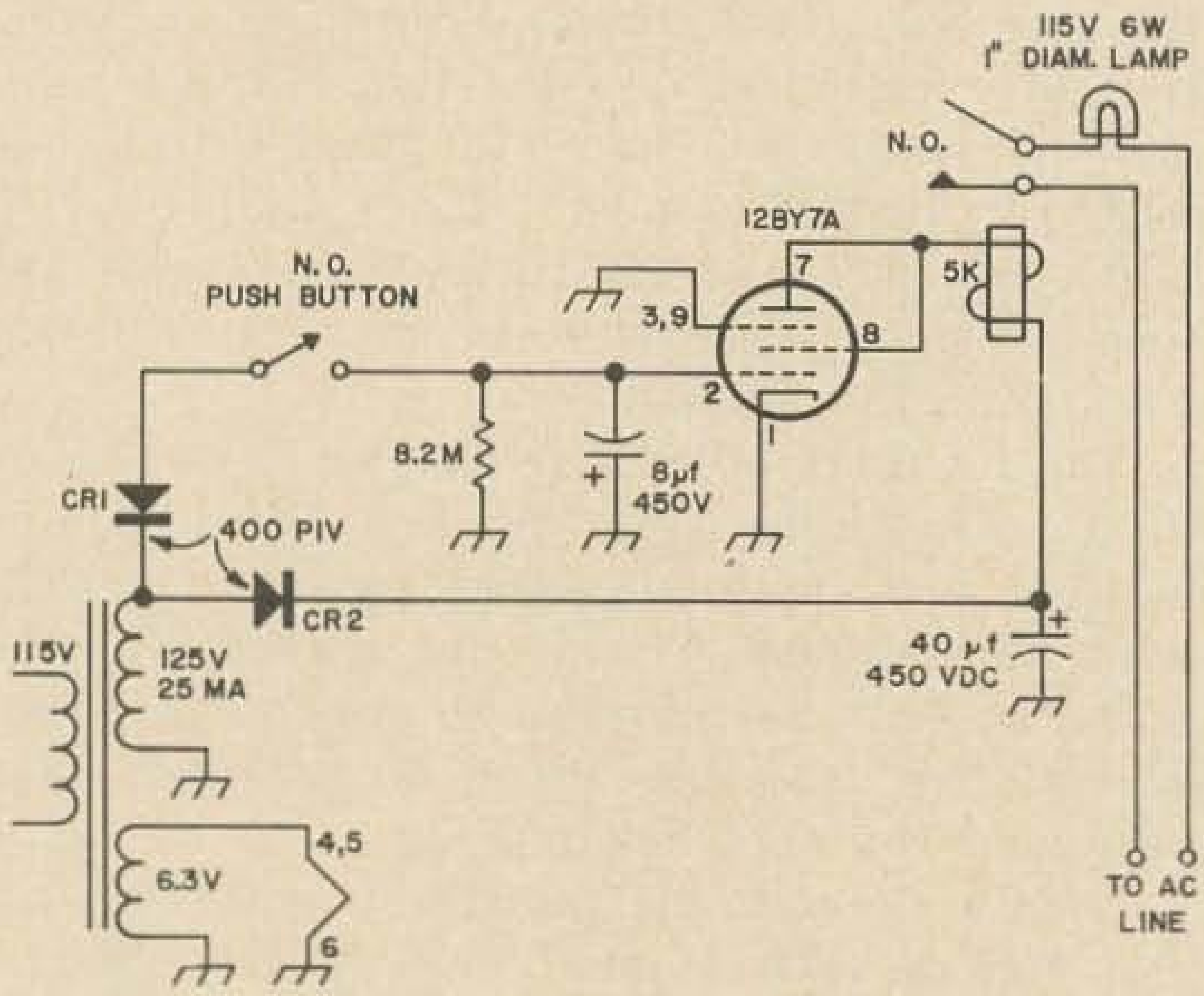


Fig. 1. Junkbox ten minute timer.

The capacitor slowly discharges through the 8.2 M resistor until after about 9.5 minutes the relay pulls in and the warning light lights. A push of the button starts the cycle over.

The discharge time of the 8 μF capacitor is controlled by the value of resistance across it. The 8.2 M resistor shown gave a time of 9.5 minutes which was considered close enough. If the resistance is increased the time will be longer, if it is decreased, shorter. A change of one megohm will change the time by about a minute and 10 seconds.

. . . Fred Davis K8DOC

Propagation Chart

JANUARY 1967

Issued November 12, 1966

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7*	14	21	21	21
ARGENTINA	14	14	.14	7	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7*	7*	7*	7*	7*	14*	14	14	21	21
CANAL ZONE	14	7#	7	7	7	7	14	21#	21*	21	21	21
ENGLAND	7	7	7	7	7	7	14	21#	21#	14	14	7
HAWAII	21	14	7*	7	7	7	7	7*	14	21#	21	21
INDIA	7	7	7*	7*	7*	7*	14#	14	14	7*	7*	7
JAPAN	14	7*	7*	7*	7	7	7	7	7*	7*	7*	14
MEXICO	14	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	14	14	7*	7*	7*	7*	7	7	7*	7*	7*	7*
PUERTO RICO	14	7	7	7	7	7	14	21	21#	21	21	14
SOUTH AFRICA	14	7	7	7	7*	14	21	21#	21#	21#	21	14
U. S. S. R.	7	7	7	7	7	7*	14	21	14	7*	7*	7
WEST COAST	21	14	7	7	7	7	7	14	21	21#	21#	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	7*	14	21	21
ARGENTINA	14	14	14	7	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7*	7*	7*	7*	7*	7*	14	14	21	21
CANAL ZONE	21	14	7 #	7	7	7	7#	21	21#	21	21	21
ENGLAND	7	7	7	7	7	7	14	21	21#	14	14	7*
HAWAII	21	14	14	7	7	7	7	7*	14	21	21#	21
INDIA	7	7	7*	7*	7*	7*	7*	14	14	7*	7*	14
JAPAN	21	14	7*	7*	7	7	7	7	7	7*	7*	14#
MEXICO	14	7	7	7	7	7	7	14	14	21	21	14
PHILIPPINES	21	14	7*	7*	7*	7	7	7	7	7*	7*	14
PUERTO RICO	14	14	7	7	7	7	14	21	21#	21#	21	21
SOUTH AFRICA	14	7	7	7	7*	7*	14	21#	21#	21#	21	14
U. S. S. R.	7	7	7	7	7	7*	7*	14	14	7*	7*	7*

WESTERN UNITED STATES TO:

ALASKA	21	14	7	7	7	7	7	7	7	14	21	21
ARGENTINA	21	14	14	14	7	7	7	14	21	21	21#	21
AUSTRALIA	21	21#	14	14	14	7*	7*	7*	14	14	21	21
CANAL ZONE	21	14	14	7 #	7	7	7	14	21#	21#	21	21
ENGLAND	7*	7	7	7	7	7	7*	7*	14#	14	7*	7*
HAWAII	21	21	14	14	7	7	7	7	14	21	28	21
INDIA	7*	14	14	7*	7*	7*	7*	7	7 #	7*	7*	7*
JAPAN	21	21	14	7*	7	7	7	7	7	7*	14	21
MEXICO	14	7#	7	7	7	7	7	7	14	14	21	14
PHILIPPINES	21	21	14	7*	7*	7	7	7	7	7*	7*	14
PUERTO RICO	14	14	14	7	7	7	7	14	21#	21#	21#	21
SOUTH AFRICA	14	7	7	7	7*	7*	7*	14	21	21#	21#	14
U. S. S. R.	7*	7	7	7	7	7	7*	7*	14	7*	7*	7*
EAST COAST	21	14	7	7	7	7	7	14	21	21#	21#	21

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

Good: 1, 2, 9-13, 16-22, 28-31
Fair: 3, 4, 5, 14, 15, 23, 24, 27
Poor: 6, 7, 8, 25, 26
VHF DX likely: 12, 13, 21, 27

Letters

More Non-Technical Articles?

Dear 73:

How about running a few not-so-technical articles in each issue of 73. You see, not every amateur is a Marconi or a De Forest; therefore, I suggest that you divide your magazine into three sections: one for the advanced amateur, one for the average amateur and, lastly, one for the so called "button pusher" type amateur. This way, I believe, all hams will be able to enjoy your publication, not only the experts.

Robert Mauro WB2UHY
Whitestone, New York

Modern Hamming

Dear 73:

Just finished reading "Remove the Drudgery from Ham Radio." It is a great idea, but why bother with all that expensive equipment anyway? There is a very cheap way to do our hamming today—by telephone! S-9 signals, no QRM (except on party lines), no QSB, no TVI, no license tests, no unsightly antennas on the roof. . . . The telephone company will even keep a log for you (of out-of-town calls, at least).

Jerry Blakeslee WB2VUC
Pitman, N.J.

Dissatisfied Reader

Dear 73:

Please enter my subscription to 73 for two years. I enjoy the construction articles and also the editorials. I would much prefer to see more articles, though, and less space devoted to letters from dissatisfied readers.

J. H. Shoemate WA6LTJ
San Jose, California

Chess Cover

Dear 73:

My husband, WØYEG, is an ardent subscriber to 73 Magazine, and consequently, you can find one or more issues in almost every room of our house. I'm not particularly interested in ham radio, but I am interested in magazine covers and advertisements. Your covers are always attractively done but the November issue wins the prize! Hats off to the bright fellow who's responsible for this exceptionally clever cover! It ranks number one on my list and I have a feeling that it'll be a long, long time before any cover tops this one.

Lorrie Dodge
Omaha, Nebraska

Microwave Propagation

Dear 73:

Received my copy of the November issue of 73 with the article "Amateur Microwave Propagation" and I'd like to offer the following comments.

On page 100, second column, 7th and 8th lines, I recommend against using two antennas to serve one transmitter since this will surely result in a "multipath" condition with fading and distortion being the result. The method is okay for receiving though.

On page 103, in the descriptive note for Figure 7, the formula for computing gain got a little gnarled in the composing room. It should read: Gain (in dB) = 20 log f + 20 log D—(52.6).

On page 104, in the notes for Figure 9, 3rd line from bottom of page, sine conventions, should read ". . . negative when the angle slopes up.")

Ray Thrower WA6PZR
San Carlos, California

Horseflies

Dear 73:

Keep up the good work. You have a wonderful magazine. As an older man, and an advocate of "Law and Order", I am for the ARRL 100% but we certainly need 73! We need for Wayne to keep the ARRL from becoming too stodgy. You have already had an influence on QST—their journal has noticeably improved in the past few months, so please keep sniping.

Bob Bergner, M.D., K4JBK
Louisville, Kentucky

Dear Wayne,

It looks like the ARRL is trying to put themselves out of business. All this carping about home-made equipment and technical proficiency is beginning to get me down. After all, if the hams wanted to be professionals they would do so. Another thing that irks me is this retesting business. At least a dozen of my friends have pointed out that they got their licenses in good faith and now the implication is that they are a bum or a crook or something. I suspect that a good percentage of the old timers wouldn't even try to pass a new test. Ham radio can only service with numbers and we won't have them with a sword hanging over our neck. I've been in radio for over 36 years and I've never heard as much hate and discontent as these ARRL proposals have caused. QST wonders how come new licenses have fallen off . . . I feel for them.

Bob Wilson K1GVA
Portland, Maine

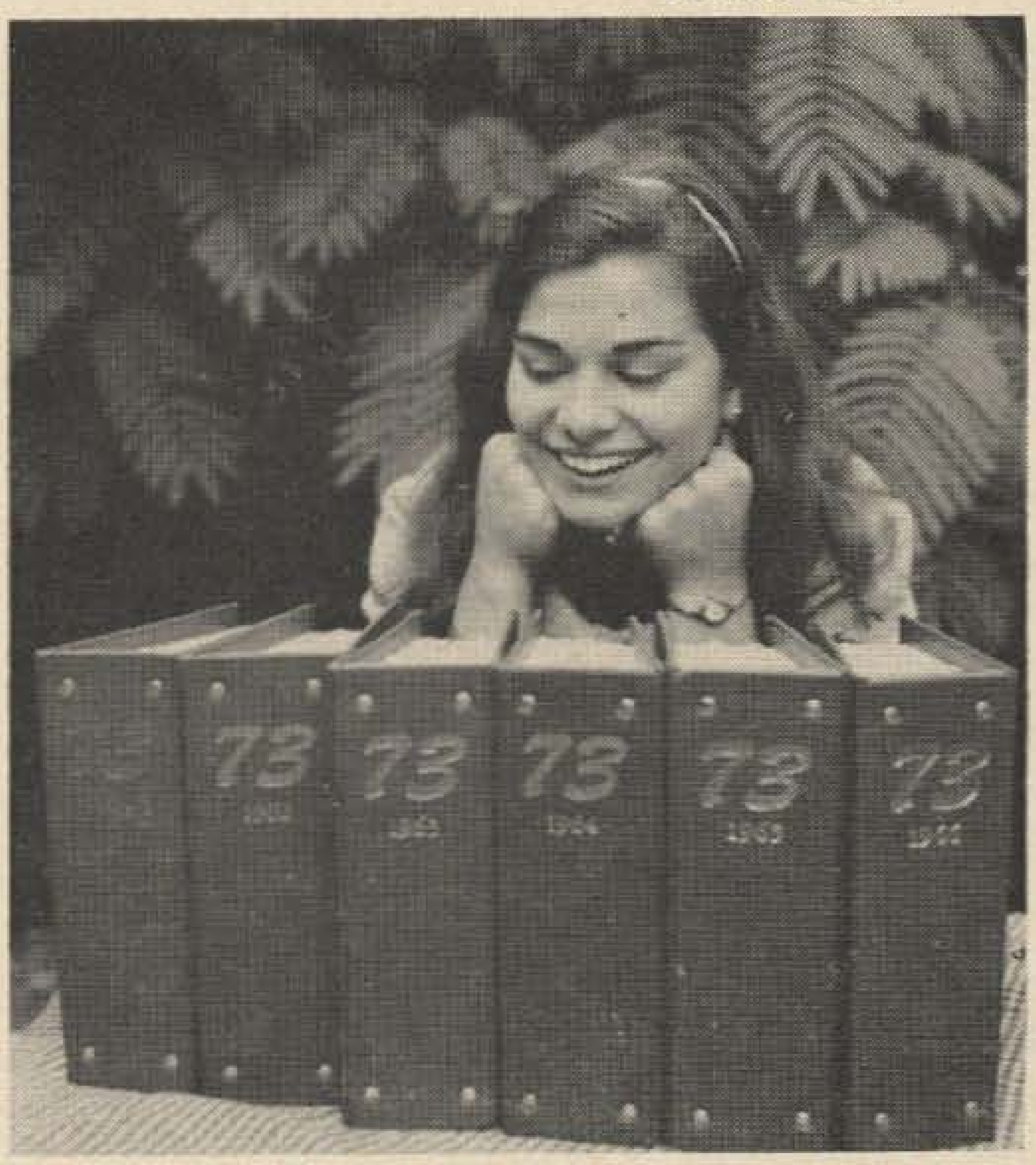
New Reader's Comments

Dear 73:

Just a day ago I wrote to raise the devil because I had been waiting over two months to get your rag after sending you my good dough. One day after it is in the mail box the rag arrives. I don't write letters and never did but after a glance at this I just had to drop a line for what it is worth. Sure I been hearing all the propaganda about you—what ham hasn't the past few years—well I got that 73 (finally) and doggone, I sat down with it and didn't get up till I went over it from cover to cover (cost me some sleep). Well contrary to what I had heard, I like the thing. The articles are really good. I enjoyed the rambling style—I like the construction articles—I like the Editor's Ramblings—I like Wayne's column "de W2NSD"—In fact I like the whole d--- thing so much I'm gonna try to gather up enough loot to try to get all the back issues in the near future. By the way, I do a lot of building (not the novice stuff), as I been in the game a couple of years myself, and I like the saddle-stitching because I do use magazines on the work-bench to build stuff from articles. You got a new one on the string and I even would like a copy of you booklet "Writing for 73". A self-addressed envelope is enclosed and I am even putting a stamp on it. You might be hearing from me again and if the mags are all as interesting to me as this first one has been, you will have me around for a long time.

Keep up the good work. Some of us can appreciate it.

C. G. Stuart W8TZO
Toledo, Ohio



That's W7IDF's pretty daughter Thea admiring the 73 binders. Have you ordered the binders you wanted?

Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general information.

Roger Taylor K6ALD, BSEE, 2811 W. William, Champaign, Ill. 61820. Antennas, semiconductors, product data, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

(Editor's Ramblings from page 4)

high gain antennas, and low noise stable transistor converters) have reduced the early problems of UHF quite a bit. After some flustering and discussion, Congress passed the All Channel TV Law, which requires all TV sets now sold in the US to be able to receive all 82 channels. The hope was that the public would buy enough new sets to insure that most people could receive all channels in a few years, though some claimed that the increased cost of the sets (UHF tuners add about $20 or less to the cost of most sets) would ruin the TV manufacturers since no one would buy the more expensive sets.

These critics were wrong. Tax reductions and prosperity, plus the recent color TV set boom and the increasing number of two (or three) set families have caused such a turnover in TV receivers that it won't be long befoer most US families can receive all stations, VHF and UHF.

Then the time will come for the inevitable change that VHF broadcasters have been fearing: All TV must move to UHF. This will certainly not help their competitive position, but it will give them a few advantages: UHF TV is generally less bothered by ghosts and cochannel interference than VHF, and the wider flat bandpass available at UHF often gives better reception of color TV than VHF. Also, UHF suffers no skip interference.

Vacating the VHF band will release 72 MHz for other services. Perhaps a few megahertz more should be added to the FM broadcast band, and legitimate users of CB deserve some VHF frequencies where they won't be bothered by skip. But a great deal of those frequencies should go to businesses. Perhaps 25 to 50 MHz wouldn't be excessive in view of the number of present and prospective users. With 10 kHz channels, that would be 2500 to 5000 channels.

This change would save the still-little-used VHF ham bands for the future when they'll undoubtedly become more and more important. It also would provide the vital frequencies needed for two-way radio without adopting such suggested stop-gap measures as using unused TV channels permanently.

Writing for 73

Would you like to try your hand at writing some articles for 73? If you would, we've got a small booklet, "Writing for 73," which you can have for a self-addressed business envelope. I've also made up a list of articles I'm looking for if you'd like that.

. . . Paul

What's New for You?

This is the first in our new monthly series devoted to short, timely items of interest to technical hams. We're going to concentrate on practical developments that are of use to hams now—or will be very shortly. Among the topics we'll cover are new semiconductors and circuits, other new components, newly available surplus, technical nets, technical meetings, and so forth. All items will give credit to the sender. Please get them in to us as soon as possible so all interested hams will be able to take advantage of them quickly. The deadline for an issue is the 15th of the second month preceding the date on the cover. For instance, items to be in the March issue should be here by January 15. Please keep your contributions short for this column. Long items should be submitted as articles.

Paul Franson WA1CCH

Motorola $1 FET

If you have been neglecting to use field effect transistors because of their high cost, the new Motorola MPF103, 104 and 105 may be just what you're looking for. These new transistors cost $1.00 in quantities up to 100 and are available through Motorola dealers. All of these devices have a maximum drain-source voltage rating of 25 volts, gate-source voltage rating of −25 volts and 200 mW dissipation. The only difference between the units is in the forward transfer admittance (y_{fs}) and zero-gate-voltage drain current (I_{DSS}). Typical values for the MPF103 are I_{DSS} — 3 mA, y_{fs} — 3000 μmhos; MPF104, I_{DSS} — 6 mA, y_{fs} — 4000 μmhos; and MPF105, I_{DSS} — 9 mA, y_{fs} — 4500 μmhos. The low value of input capacitance, typically on the order of 4.5 pF and the reverse transfer capacitance of 1.5 pF result in excellent operating characteristics well into the VHF bands. As a test, a 200 MHz Colpitts oscillator was constructed using these FET's. All of them worked well in the circuit; in fact, two of the devices out-performed a common five dollar variety. Excellent results were also obtained in a 3.5 to 4 MHz VFO using the Clapp circuit and in several rf amplifier circuits up to 50 MHz. Although I have not tried it, I suspect that these transistors might work well in a two meter converter.

Jim Fisk W1DTY

95¢ Fairchild FET

Fairchild's new 2N4360 silicon P-channel field effect transistor costs only 95¢ in small quantities. The low price is partly a result of its epoxy case. Maximum voltage for it is 20 V, dissipation is 200 mW, input capacitance is a maximum of 20 pF, and feedback capacitance is only 3 pF. Typical forward transconductance is 3000 μS (microsiemens or micromhos). This FET is designed for low frequency use, but shows some promise in the HF range.

WA1CCH

$1 TI FET

There's been a lot of talk about the new Texas Instruments TIXM12 P-channel germanium field effect transistor. It's designed for VHF use—typical noise figure is 2 dB at 100 MHz. It sounds perfect for six and two meter converters as well as HF uses. The only problem is that it's not available. This seems to be the TIXM05 story all over again. When and if these very promising-sounding FET's become available, we'll let you know.

WA1CCH

15¢ GI Transistors

General Instruments has recently introduced a number of very cheap epoxy-cased silicon transistors. They're made in Taiwan and cost as little as 15¢ if you buy a lot of them. Individual prices run a little more, but not much —about 40 to 50¢. These transistors are useful for many ham applications as amplifiers and switches. F_T is 200 to 250 MHz minimum, and they come in PNP and NPN pairs. Among them are the 2N4140-2N4143, and 2N4227 and 2N4228. They work well in general purpose applications.

WA1CCH

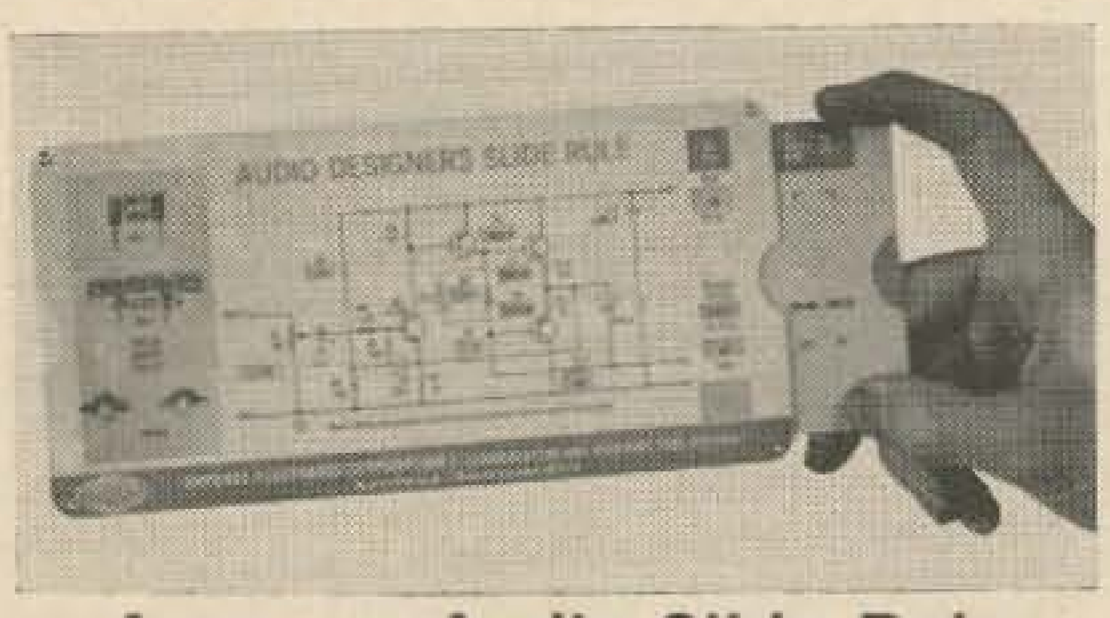
NEW PRODUCTS

New ATV Catalog

If you're interested in ham TV—or think you'd like to get interested in ham TV—you'll certainly want the new 1967 catalog from ATV Research. It's 20 pages thick and contains all sorts of gear of interest to TV'ers. Best of all, it's free! Send your name, address and zip code to ATV Research, P.O. Box 396, South Sioux City, Nebraska 68776.

TI Audio and AM/FM Handbook

Texas Instruments has just published a new book in their useful handbook series. This one is about the design of audio amplifiers and AM/FM tuners. While it's devoted to consumer applications, it's obviously also very useful to the ham who designs. The book is thoroughly practical; it even gives photos and printed circuit board layouts for some receivers. The name is Audio and AM/FM Circuit Design Handbook and it costs $3. You can buy a copy from any TI distributor or from TI Technical Publications, MS75, P.O. Box 5012, Dallas, Texas.



Amperex Audio Slide Rule

Here's one of the cleverest and most useful gadgets we've seen in some time. It's a handy slide rule for audio circuits. One side (shown in the photo), shows a basic audio system with a slide that gives the proper parts values for different transistors, power levels and voltages. The amplifiers range from a one watt, 9 volt amplifier to a 12 watt, 28 volt one. All use the excellent complementary symmetry circuit which provides excellent results with no transformers. The back of the rule is a more conventional slide rule for designing audio circuits. Any audio designer should have this rule. It costs only 50¢, and is available from Amperex Semiconductor Division, 230 Duffy Avenue, Hicksville, N.Y. 11802.

Aladin Breadboarding Kit

Aladin Kits has introduced a new breadboarding kit that should fill the needs of just about all electronic experimenters and hams. This kit contains a punched phenolic deck, an aluminum mounting base, several brackets for mounting switches, pots and transistor sockets, silver plated solderless connectors and an assortment of assembly hardware. The terminals contained in this kit are designed so that circuit connections may be made easily and efficiently without soldering. This is extremely helpful when designing and building circuits. For more information, write to Aladin Kits Company, 21011 Dequindre Road, Hazel Park, Michigan 48030.

New Meshna Catalog

John Meshna's just published a new catalog. You'll eat your heart out looking at his goodies contained in this fat 72 page book. Meshna's catalogs certainly must be the best surplus catalogs around; he doesn't just list the gear with prices, but tells you what it's good for. He writes with much wit, too. You've got to get this catalog; send John the 25¢ today. You'll hate yourself otherwise. Meshna, 19 Allerton St., Lynn, Mass.

Building Your Amateur Radio Novice Station

Most beginners will tell you that the hardest thing about ham radio is getting started. In addition, many of them say that most articles and books describe equipment which is either too complicated or do not furnish sufficient construction details. Howard S. Pyle, W7OE, has put together a construction manual for building an amateur novice station with the complete details that many people have been looking for. *YB* Pyle describes a professional-looking transmitter and receiver which cost very little to build. They have been thoroughly tested for ease of construction and for on the air performance. Nothing is overlooked in the construction phase; full size drilling and cutout templates for chassis and panels are included within the pages of this book. They may be fastened directly to the chassis and panels and used as a guide for drilling all the necessary holes. While the completed equipment has been specifically designed for the novice operator, it will serve the General-Class amateur as well. The price of this new book is $3.50, and it is available at your local distributor or from the publisher, Howard W. Sams & Company, 4300 West 62nd Street, Indianapolis, Indiana 46206.

Heath's New Single-Banders

When Heath announced their single-band SSB transceivers a few years ago, no one could believe their low price of $120. Now they've improved the already-excellent transceivers and reduced the price! In addition to all of the features we already know about—low cost, small size, high performance, easy construction—they've now added front panel selection of sidebands, improved audio and AGC, mike and gain control, more convenient front panel arrangement, a mode switch position for the optional 100 kHz calibrator, ALC input for use with linears, and power connectors and up-dated styling to match the SB-line. And the prices: $99.95 for the HW-12A (75 meters), $104.95 for the HW-22A (40 meters) and HW-32A (20 meters). Write to Heath, Benton Harbor, Michigan for more information.

Transistor Circuits

K. W. Cattermole's *Transistor Circuits* is a very good circuits reference book which would be an excellent addition to any serious amateur's library. The circuit descriptions in this new edition of a well known volume (in engineering circles) are clearly written and not *highly* mathematical, although a working knowledge of algebra is helpful. It gives a clear insight to circuit operation and provides the reader with much practical, useful, and worthwhile design data. The 70 page chapter on high frequency amplifiers should be particularly interesting to hams. This chapter is very well done and covers internal feedback and neutralization, gain limiting and multistage amplifiers, coupling networks and wideband amplifiers. Other chapters cover bias supplies and stabilization, power amplifiers, oscillators, modulation, detection and mixers, and binary and computer circuits. In addition, six appendices contain data, although quite mathematical, of use in detail circuit design. This book is highly recommended for the amateur with a strong technical background. $14.50 at your bookstore or write to the published, Gordon and Breach, 150 Fifth Avenue, New York, New York 10011.

(W2NSD from page 2)

the U.S.

Fellows listening to some of the ridiculous pile-ups on 20M may think I am off my beam, but I've done enough working from the rare end now to speak with some authority on the problem. The DX operator, I feel, is entirely responsible for any mess that builds up. It is his show and he can run it as he wants. Through a lack of experience or stupidity he can allow fellows to break in on him, tail end, or call endlessly. The sharp op can size up the crowd for him easily, as I pointed out last month. If he is operating transceive. . . . I'm speaking primarily of sideband now . . . he can work fast break-in, allowing no more than five or six seconds for callers. If he wants to see how many are waiting he can ask for one call from all waiting and see how finely he has to break down the group to get individual call letters through. Usually the band is open to certain call areas or countries and these can be broken down into prefixes on fast breaks . . . WB2, WA2, etc. If the fifth area is weak a simple request for fives is enough. Ditto calls from other countries, which can be handled exactly the same.

The major problem is how to get the DX stations to operate efficiently. I've tried to explain to them over the air and almost without exception they continue on doing exactly as they were before, grumbling about the QRM and making one contact every few minutes.

More Safari

OK, sports fans, I'll try to carry on my narrative from the October editorial. Mind you, ham radio plays a small part of the following so buzz off if you read True or Sports Afield and get your thrills there.

During the first two weeks of our hunting Larry and I had taken turns shooting, with one of us waiting in the Land Rover while the other went out and stalked the game. This had gotten to be quite boring and we decided to try going out on alternate days and see how that would work. Larry (WA6TCI) went out the first day with Jim (W5PYI) along to take pictures while I sat back at the "hotel" writing my October editorial. This kept me pretty busy for the day with just enough time to hike the half mile into Nanyuki and look the town over carefully and buy a couple of Ruark books (Something of Value and Uhuru, both of which I recommend most highly).

On Sunday it was my turn. I was worried . . . Larry had been out shooting zebra all day Saturday. He'd gone out at 6:30 in the morning and come back at 8:30 with two nice zebras. He'd gotten up to about 60 yards from a herd for the first one and 100 yards on the second. In the afternoon Larry came back for lunch and reported that the herds were now quite alert and he wasn't able to get in close for another shot. Just before dinner he and Freddy, our White Hunter, closed in on a good sized herd and Larry shot at a good specimen . . . then Freddy shot . . . no results . . . they both shot several more rounds into the rapidly disappearing herd and brought down one little foal as the only casualty. Very embarrassing.

Sure enough, when I went out on Sunday the zebra were very spooky and we just couldn't get close to them at all no matter how we tried to sneak around. In desperation I tried a very long shot after an hour and a half of tracking a herd . . . I missed. We followed them for another hour and a half and then gave up and went back to the hotel for breakfast.

Hiking through the brush at a crouch for three hours at 6000 feet elevation is particularly tiring. After breakfast I snoozed for a half hour to recoup. At 10:30 we were off again driving through the thousand acre paddocks looking for zebra herds. It is amazing how difficult those brightly striped animals are to see at a distance. Nothing in sight. We took off on foot again and by 11:30 we had a small herd in sight. Ten minutes later I was within shooting range and carefully drew a bead on a large stallion . . . wham! I missed. Rats!

Kerede, my gun bearer, followed the herd with me racing along behind him. I don't know how he knows which way they've gone, but we veered this way and that with nothing whatever in sight and in ten minutes had them back in range. I wasn't going to miss again, you can be sure. I steadied the gun against a thorn tree and settled down for a very careful shot . . . about 150 yards . . . nothing to it. Blam! Off they went, another miss. I must have a subconscious wish to spare zebras. This is ridiculous . . . and very humiliating.

We went back to the car and started looking again . . . aha, a good sized herd of zebra over across that large open plain. Kerede and I got out and stalked through the bush on the edge of the plain while the car continued on as a decoy in the other direction. As we got in closer we could see they were still grazing calmly . . . then suddenly a raucous cry from two "get away" birds rang out above us . . . get away . . . get away . . . get away. The zebras did.

After a late lunch and an afternoon siesta we went out for one more try. By 5:30 Kerede and I were trailing a herd of zebra mixed with impala . . . this was a spooky group and we just couldn't get in close. I fired one shot at 130 yards as they started off again for my third miss of the day. So much for Sunday.

My marksmanship just wasn't that bad, I knew, so I began to suspect that something was amiss with the gun. Larry, back at the hotel, agreed. His shots the previous night had been easy ones too and he still had missed. Obviously something was wrong with the sighting scope.

Monday at mid-morning Larry returned with another zebra, this being his day for shooting. That's four for him, counting the foal they'd bumped off by accident . . . and I haven't gotten a one. Say, what about the sighting on the rifle? Oh, they'd checked that and it was perfect. So much for our excuse for missing. Larry went back out after zebra again, but they were wise by now and he never got another shot at them the rest of the day.

Secret Valley

Most of us have heard about the Tree Tops Lodge in Kenya, a hotel built among the tops of the trees where visitors can watch the wild game coming to feed. Shamsu Din has built his own version of Tree Tops up on the side of Mount Kenya at about 8000 feet and calls the little glen and pond it overlooks Secret Valley. We all drove up there for a night to have a look at the leopards which come there every night to feed . . . Larry's zebras being the meal for this evening.

To get to the lodge you drive by Land Rover up the side of the mountain and park in a small clearing and then hike a couple hundred yards along a small trail through impenetrable forest. The bamboo and vines grow around 200 foot high trees with not enough room for even a person to get through. It was dark and alarming going down the trail, but the hotel guests were reassured by Shamsu standing guard with his big rifle and full cartridge belt. Larry and I weren't so happy because we knew that those bullets were the wrong size for the rifle and the whole thing was for show. Shamsu wouldn't let us bring our rifle . . . we'd been teasing him too much about popping off one of the leopards that come in to feed.

On some nights they have as many as eight or nine leopards turning out to feed on the platform just about twenty feet from the porch of the lodge. They have lights rigged up so visitors can take pictures right up close. I was all set with my super telephoto, but only one leopard slunk around this night and he never got up in the light. I did get some pictures of bushbuck and water buffalo though.

Secret Valley Lodge is rustic. The rooms are very simple: rickety bed, table, lamp and a couple of hooks on the wall for your clothes. The rates are $14 a night, but you can strike a bargain with Shamsu if he isn't filled up. I have yet to meet an Indian that you can't bargain with . . . it seems to be part of their heritage. I've met few that I didn't *have* to bargain with.

Our separate day arrangement for hunting didn't work out very well for Larry, I had no problem keeping myself amused on my day off with writing, horseback riding and things. But Larry had nothing to do and while I was out hunting on Sunday he sat around the hotel with his teeth in his mouth and got bored silly. He and Jim walked down town Nanyuki, but there was nothing to do there but watch haircuts. They tried taking pictures of the town, but every African that happened to be within camera range came over and demanded a shilling. By Sunday night Larry and Jim were ready to go back to Nairobi rather than face another day like that.

Ignoring my carefully laid plans and hotel reservations for the rest of the trip they took off Tuesday morning for Nairobi, leaving me to hunt for two more days by myself. Well, OK, I've still got special licenses for an oryx and an eland, perhaps I'll get one or both. I can meet then in Nairobi at the end of the week and get back on schedule. And I still want that zebra.

Piga Punda

Up at 6 . . . dress in my bush pants and shoes . . . shirt and bush jacket to ward off the cold, 50° this morning. Pour the tea in the sink . . . no way to prevent the boy from bringing it in the morning and I don't want to make them unhappy by not having it appear to be drunk. Freddy arrives with Kerede and Labun . . . we're ready to get a punda (zebra).

After an hour or so of bumping along through bush country without nary a speck of zebra hide showing we pulled up at a native hut and, after a lot of fast Swahili discussion, one of the Africans led Kerede and me into the bush on foot. Inside of ten minutes we've spotted a herd. Kerede isn't taking any chances on my marksmanship this morning, he guides me in close. The zebra are uneasy . . . they move off a bit . . . we follow, freezing when they look our way. They move off some more, we sneak along, hiding behind one inch thick trees. I take very careful aim and get off a shot at about 90 yards. The zebras take off immediately at top speed, but Kerede says piga (hit) . . . and off we go after them. Within five minutes we have them in sight again and the one I hit is limping badly. I aim carefully again and drop him. He is a big fellow with a beautiful skin.

We tried to follow the herd for another shot, but they weren't about to let us get within 200 yards. The afternoon was just as non-productive. Freddy had to get on to another safari, so he and his bearers were replaced by Prince Sam Sapieha (from Poland) and his bearer for my last two days of hunting.

How to Shoot an Oryx

Sam and his bearer Katimba joined me at 6:30 the next morning and, after checking my rifle out on the rifle range to make sure that it and I were shooting OK, we headed into the zebra territory for one more zebra try. Sure enough, there they were, a half mile away. We got out of the Rover and stalked them carefully. Just as we got to about 150 yards from them they melted away. We couldn't figure how they had spotted us so quickly when an African walked by . . . he had scared them off, not us. We tracked them for an hour and a half more, but they were with some impala and we just couldn't fool both groups at once.

After a fast breakfast at the hotel we packed a lunch and headed for the Napier ranch about 35 miles from town to look for my oryx. Frankly, I wasn't too sure what an oryx looked like. I think that I bought the license for one because Shamsu was dinning in my ear that he could guarantee me one. The license was only $3, so I said what the hell and bought the extra license. Same for the $11 eland.

I'd worked my way down the list of animals my license permitted me to shoot. I passed up the cute little dik dik and steinbok because they are so tiny and both live in mated pairs rather than in herds. I'd gotten one tommy, two impala, a waterbuck and one zebra. The license did permit me another tommy, two grants, another waterbuck, a bushbuck, a reedbuck, a couple more zebras, crocodile, wildebeeste and warthog . . . some other time perhaps . . . let's get on to the oryx.

Just after 11 we picked up one of Napier's boys and headed out into the paddocks looking for oryx. He knew right where they were and we soon spotted them off in a nearby 1000 acre paddock. We had to drive about three miles to find a gate into that area. The oryx caught on right away to us and we could see them off in the far far distance through our glasses. As we drove they kept moving and we didn't get any closer to them. OK, we're not going to be able to approach them in the car.

Plan two was for Sam, Kibruto (the skinner) and I to hide behind a bush and wait for the oryx while Katimba drove the Rover around the edge of the paddock to keep the oryx moving. This plan broke down right away. We had no sooner gotten settled for our wait when the Rover was in deep mud and just barely able to work its way out. The roads around the paddock were impassable.

OK, plan three. Sam, Kibruto and I set up a blind made out of a couple of dead thorn trees and lay down behind it to watch while Katimba and the Napier boy tried to herd the oryx toward us. We waited about 45 minutes, whispering softly and flicking adventurous ants off our clothes, but no oryx. Katimba returned to tell us that the oryx refused to be herded . . . they just wouldn't pay any attention to them at all. They are probably used to the Africans herding cows and bulls through the paddock.

Plan four next. In this one I was to follow Katimba closely so the oryx wouldn't see me until it was too late. After a mile or two of sneaking along behind Katimba it became obvious to all of us that the oryx had no trouble at all telling the difference between an African and a European at 500 yards. They weren't fooled one bit and they hauled out as soon as I slouched up.

It was after 2 and I was quite ready for lunch. This hiking through thorn bushes is rough. You have to watch every tree closely so you don't get one of those 2" thorns jabbed into you, and they stick out all over. The ground is spread with the thorns too, many of them carefully pointed up to be stepped on. They will go right through most shoe soles and give a nasty infection. In the bogs I had to jump from one grass tuft to the next with memories of all those African movies where fellows disappear in quicksand going through my mind.

A few impala sandwiches washed down by some Schwepps fruit punch called Schwop got me ready for plan five. Africans, by the way, don't each lunch . . . they just squat and talk while the white bwanas eat. Two more Napier boys had joined us by this time so Sam decided that he and I would hide behind a bush in the middle of the paddock and everyone else would try to get the herd moving toward us.

We picked a nice bush, removed as many of the thorns lying around under it as we could, and settled down to wait, finding a few missed thorns the hard way. There is no position that is comfortable for long and I found myself shifting around every few minutes trying to distribute the ache. We could, after a half hour, hear the boys whistling at the oryx, but nothing came in sight. Aha, some horns began to show above the thorn trees not far away . . . here they come. I got all ready and aimed carefully where I expected them to come out. A huge animal came out . . . that isn't an oryx, that's a Brahman bull. I wasn't sure what an oryx looked like, but I knew this wasn't it. The oryx went off in another direction while a herd of bulls went past us. We got up, brushed off the ants and made our way to another bush over toward the oryx. Suddenly about twenty of them ran across a clear spot about 150 yards from me. I figured I had about a 50% chance of getting one so I waited, hoping we could get closer. I knew that one shot would be all I would have.

Katimba motioned for me to follow him and we headed off at an angle to the herd and I got set for another try about 500 yards farther on. Just as I was settled down they poured out in the open and I got my first good look at them. I picked out a big one and aimed at his heart . . . wham! The herd took off instantly and mine was down, struggling to get up. I walked in carefully, knowing that these animals can be very dangerous when wounded. They have very long, very sharp horns and know how to use them. A second shot in the neck ended the struggle. I'd gotten my oryx.

Note

I wanted to find out what the reaction was to the first part of this hunting trip in the October issue before I inflicted more on you. The reaction was enthusiastic, hence my continuation this month. There'll be just one more day of hunting to cover next month and then I'll tell you about my visit to the 5Z4 boys and up into Uganda and Tanzania. I also want to give you some thoughts on the prospects for this section of Africa and how this may affect amateur radio.

If you don't get bored, I'd like to tell you about my interesting visits to the other countries in Asia and the South Pacific. I stopped in 26 this trip all told.

. . . Wayne

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14TH ANNUAL BANQUET of the Lake County Amateur Radio Club, Inc., to be held at Yeibel's Restaurant, U.S. 30 and 41 (Schererville, Ind., near Gary) at 6:30 p.m., CST, February 11, 1967. Entertainment, Speakers, prizes. Tickets $4.00 each from Herb Brier, W9EGQ, 385 Johnson St., Gary, Indiana 46402.

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BC 610E complete with instruction books. Open to any type offer. All letters answered. East Coast Electronics, 123 St. Boniface Rd., Cheektowaga, N.Y. 14225.

WANTED Plug in units for Tektronix oscilloscope model 531. Quote type, price and condition. Paul Ignatow K6KRS, 246-41st Ave., San Mateo, Calif., 94403.

SBE-33 with 12 volt power supply in excellent condition. $250 or best offer over $200. William A. Dickson W1AOL, Box 172, Milton, Mass. 02187.

FREE SIGNAL SLICER with HRO-60 receiver—$250. Model B Central Electronics Slicer, coils A, B, C, D with receiver. You pick up. W2SVV, 1942 Pennington Ave., Trenton, N.J. 08618. 609-882-1812.

DRAKE 2-B RECEIVER. Cannot be told from brand new—perfect condition inside and out. Will ship prepaid in U.S.A. $160. J. Demler, 305 Weyer, Hastings College, Hastings, Nebraska 68901.

FREE CATALOG—loads of electronic bargains. R. W. Electronics, Inc., 2244 So. Michigan Avenue, Chicago, Illinois 60616.

TRANSISTORS—Final clearance—100 asst. for $1.50—new, full-length leads—U-Test-Em—postage paid in USA. No COD. Star Sales Co., 404 W. 38, Wilmington, Delaware 19802.

LINEAR with two 4-250's, $100; Gonset G-50 $200. Philip S. Will W8HPB, 30 West Street, Canal Winchester, Ohio.

STOLEN: LK-2000 Linear Amplifier from trailer at Newporter Inn, Newport Beach, California, Prototype, carried trade logo BTI; serial #1743. $200 reward for information leading to its return. Brad Thompson Industries, P.O. Box CCCC, Indio, Calif. 92201. Tel. 714 347-0637.

TELREX-TRI-BAND Model TB74—excellent condition complete with spec sheets—priced to sell. 100 feet CPH Amphenal RG 8/U $8.00. Jack R. Hildreth, 1 Stonehill Dr., Stoneham, Mass. Tel. 438-0755.

SX-117, $235; GSB-100 like new, $160. Shipped prepaid express to you with certified check. WA4NYJ, 147 South Bay Drive, Ft. Walton Bch, Fla. 32548.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military & commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Station, New York, N.Y. 10013.

HEATH SB10 and TX1—$185.00; Drake 2A and 2AQ multiplier speaker—$185.00 F.O.B. Bill Wheeler, K8NWH, Route 5, Owosso, Michigan 48867.

TRANSCEIVER SB100 Heath, New (used 10 hours). Built by expert, guaranteed 90 days. AC & DC power supply. Mobil 75-40 Hustler antenna. Call 207 622-6119 days, 207 622-1949 nites. Peter Williamson, J. B. Farrell Co., Augusta, Maine.

PLASTIC HOLDERS—each display 20 QSL cards. 3 for $1.00 or 10 for $3.00 prepaid and guaranteed. Free brochure of other ham goodies included. Tepabco, Box 198N, Gallatin, Tennessee 37066.

QSL CARDS, Free samples. Send stamped envelope to George WA4QKD, Box 282, Valparaiso, Florida 32580.

HEATH 0-10 oscilloscope $35.00; Ballantine VTVM Model 300 $60.00; Ballantine VTVM Model 310A $90.00 Joe Barsoomian, 31 Porter Street, Watertown, Mass. 02172.

VACUUM VARIABLE CAPACITORS, Jennings UCS, 10-300 mmfd, 7.5 KV, complete with gear drive train, mounting bracket brand new, $27.50 postpaid. Satisfaction guaranteed, limited supply. Bill Slep Company, Drawer 178, Ellenton, Florida 33532. Phone (813) 722-1843.

CANNOT REACH MARS. Must sell Mint Invader 2000 with PL-175's. Less than 10 hours operating time. Manual and original cartons. $750 or best offer. Also Drake 2B, 2BQ, xtal calibrator. $200. WANT mint or factory sealed **T4X, R4A** and power supply. CDR Rotator. Schedule possible. WA2TAR 261-01 69th Ave., Floral Park, New York 11004. 212 F17-8466.

TOOOBES: 811A—$4.25; 7094—$26.90; 6146A—$2.55; 6CW4—$1.40; 5894—$15.50; Extra power 6146B—$4.00; 6360—$3.45; 8236—$9.50. All new, boxed, guaranteed. Free catalog. Vanbar Distributors, Box 444Y, Stirling, N.J. 07980.

CENTRAL ELECTRONICS 10A, $50; Hallicrafters SX 101 MKIII, $150; WB6LGQ, 19011 James Road, Bakersfield, California. You pay shipping charges.

JOHNSON 6N2 Thunderbolt linear amplifier, factory wired, clean, carefully maintained, factory new condition, $395. J. W. Gregory K4OSK, 6495 Killian Drive, Miami, Fla. 33156. Telephone MO 1-7576.

WANTED: Heathkit Models XC-2 and XC-6 2m and 6m converters for Mohawk receiver. H. S. Waites, VE7FL Box 39, Marysville, B. C., Canada.

HEATH GRID DIPPER $15, Heath TV alignment generator $15, BC 603 on 6m $15, ARC 1 $20, Motorola 80D hi band 30 watt, BC 221, BC 348, BC 1306, SCR 522. Prices or make offer—must sell. Much more—tubes, tfmrs, etc.—stamp for list. Al Hansel KØIQF, Rt. 4, Waseca, Minnesota 56093.

COLLINS 32S-3, 516F-2. Immaculate, $600.00. Eldico SSB-100F, 80-10M xmtr with Dow antenna relay, filter type rig with 1 inch monitor scope built in, 100W output on SSB, perfect, $250.00. Dow double co-ax relay for hi-lo power switch, $10.00. Lee Richmond, WB2OSF, 166 Floral Avenue, Plainview, L.I., N.Y. 11803. 516-G-E3ETA SHR cmfw shrd taoin bgqkj mfw 11803. 516-GE3-8663.

HALLICRAFTERS SR-150 Transceiver, AC Supply w/ Speaker, DC Supply, Station Mike & Sand, Mobile Mount, Mobile Mike & Speaker, Hustler Mast & Bumper Mount w/75,40,20 Resonators: $550.00. R. W. Fanus, WB4CPR; 411 Hibiscus St., West Palm Beach, Fla.

EXCELLENT CONDITION, ART-13 including low-frequency broadcast band tuning unit. Complete all tubes and crystals. Famous Collins rig, First $35.00, exp. collect. W4FPQ, Box 467, Greenville, N.C. 27834.

SWAN 175 with WRL AC Supply, $125.00. Will trade for 50-60 ft. crank-up or tilt-over tower. Bob Stevens, K9ING, 101 Vera, Carterville, Ill. 62918.

NCX-5 Mark 22 and NCL-2000 in factory sealed Cartons NEW $1000.00 AC Supply $95.00. K7HYZ N. 308 Locust Spokane, Washington 99206.

FOR SALE! Collins 75A-4 receiver, Collins KW-S1 transmitter and power supply, all for $1200 or best offer. Heath 6 meter transceiver HW 12, with Hustler antenna, $140. Heath TC-2 tube checker, $25; Heath Visual Aural Signal Tracer Model T3, $10; Heath RF Signal Generator SG8, $15; Heath fm test oscillator FMO-1, $25; Eico oscilloscope #460, $50; Eico Battery Eliminator #1050, $30. Make offer to Dr. Roger Simmons, WA4UDG, 621 Seattle Drive, Lexington, Kentucky.

QSL CARDS???? "America's Finest" Samples 25¢. Sakkers Printery, W8DED, Holland, Michigan.

FOR SALE: Have complete set of unused, repeat unused, equipment as follows: Hallicrafter SR150, 12VDC power pack, Mosley D4-BC-A antenna, V-4-6 80 meter coil, Hallicrafter speaker, Shure mike and other accessories. Contact Don Mosley, Box 1552, Waco, Texas. Telephone Swift 9-2491.

Index to Articles Appearing in 73 Magazine in 1966

For articles appearing **before** January 1966, consult the individual indices we've published each January. A cumulative index to all issues of 73 will be available on January 15, 1967 from us for 25¢.

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High Frequency Antennas

VHF Antennas

Transmission Lines

ATV

Commercial Equipment

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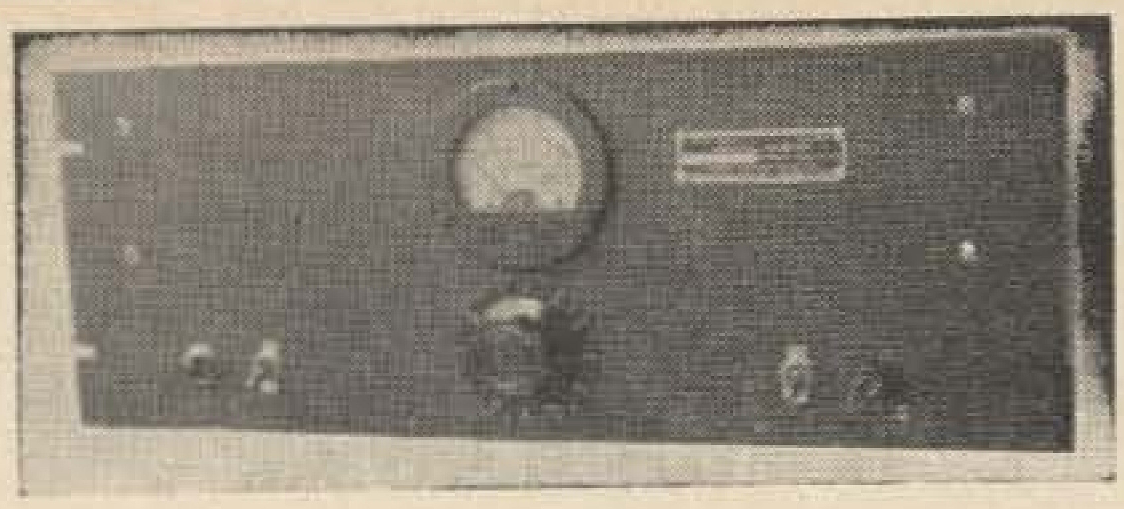
Receivers

High Frequency

VHF Converters



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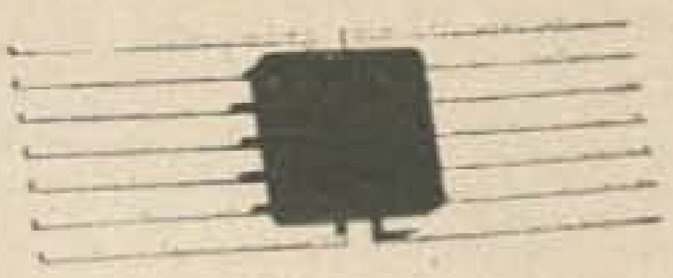
Gates $1.50



TO-85 flat pack case. They come complete with schematic electrical characteristic sheet and some typical applications. $9.00-$15.00 values from original manufacturer.

Completely enclosed transistorized ignition heat sinks. Heavy gauge anodized aluminum	$2.00 each
6"x9" speakers, 20 ohms, 1.5 oz magnet	$2.50 each
4" speaker, 3.2 ohms, 1 oz magnet	1.25 each
2.5" speakers, 10 ohms	2/$1.00
24 volt, 60 cycle, 6 pole (3 open, 3 closed) 2 throw 15 amp contactors	$4.00 each
Dual 1 megohm potentiometers with 6 and 12 volt off-on switches	4/$1.00
455 KC IF transformers	3/$1.00
262 KC IF transformers	3/$1.00
Dual 20 MFD at 350 volt electrolytic condensers	40¢ each
28-101 MMF ceramic trimmer condensers	6/$1.00
GaAs Varactors, similar to AP-1, AP-6, etc. 70 KMC at 150 mw.	$4.00 each

SILICON CONTROLLED RECTIFIERS

PRV	7A	PRV	TO-5 1 AMP	TO-18 350 MA
50	.35	15	.25	.15
100	.60	30		.30
200	.90	60	.70	.50
300	1.35	100	.90	.70
400	1.75	200	1.10	.90
500	2.25	300	1.25	1.00

TRANSISTORS

PNP silicon epitaxial low leakage transistor in TO-18 package. Similar to 2N2185 30 volts at 150 mw. 3/$1.00

Similar to 2N329A general purpose PNP epitaxial transistor in TO-5 pack. Low leakage 30 volt unit with a 400 mw dissipation rating and B 30-80. Comp. with a $9 value. 4/$1.00

Similar to 2N3060, a 60 volt silicon PNP in TO-46 pack has a B of 30 with 4 W dissipation. Used in DC amplifiers, high voltage work and audio systems. 4/$1.00

Similar to 2N1640 bidirectional transistor, a TO-5 silicon unit. in which the emitter and collector are interchangeable. 40¢ each

Similar to 2N339-2N341, etc. High voltage medium power units. NPN silicon. 7/$1.00

Similar to 2N728. A high frequency NPN TO-18 unit extending to the UHF range. 5/$1.00

Similar to 2N545, a 5 watt NPN TO-5 high voltage unit used for fast switching. 5/$1.00

Similar to 2N1648 NPN high voltage 20 watt silicon unit used in power output stages and power transistor drivers. 2/$1.00

Similar to 2N2875 PNP silicon 20 watt power transistor with cut off frequency to 30 mc. 2/$1.00

Similar to 2N2885 NPN and TMT8035 PNP microtransistors. 75 mw power at high frequencies. Both units $1.00

Similar to 2N247 PNP germanium. Good for rf work. 10/$1.00

TOP HAT & EPOXIES

PRV	750MA
100	.07
200	.09
400	.12
600	.20
800	.25
1000	.50
1200	.65
1400	.85
1600	1.00
1800	1.15
2000	1.35

Silicon Power Rectifiers

PRV	3A	20A
100	.10	.40
200	.20	.60
400	.25	.80
600	.35	1.20
800	.45	1.50
1000	.65	—

5A Insul Base

PRV	
100	.20
200	.40
400	.60
600	1.00
800	1.25

Similar to 2N255 20 watt PNP germanium power transistor in TO-3 case. 4/$1.00

Similar to 2N327A PNP silicon TO-5 unit used in audio. 6/$1.00

Similar to 2N519 silicon PNP unit used in rf circuits. 10/$1.00

Similar to 2N389, 424, etc. 85 watt high voltage NPN silicon unit in TO-53 case. 75¢ each

Similar to 2N1209, 2N1212, etc., with similar electrical characteristics in 11/16" stud package. 75¢ each

FET'S N channel type similar to C610 used as amp, switch, chopper—very high input Z. $1.25 each

DIODES

10 watt zeners. 5-60 volts. state voltages desired. 75¢ each

1N429 6 volt double anode regulator. 2 watts. 5/$1.00

SV176 7 volt reference diode 5/$1.00

Silicon bilateral switch. Replaces two SCR's by firing in either direction when breakdown voltage exceeded. Used in light dimmers, etc. 2/$1.00

Silicon voltage references. These are a series of precision regulators designed to operate from 2 volts up, similar to SV140, SV3207, etc. 50¢

1N251 a high frequency silicon diode used to 1000 mc. May be used as discriminator or detectors. PIV of 20 volts. 10/$1.00

S284 similar to 1N251 but with PIV of 30 volts. 10/$1.00

Glass diodes. Color coded. Si 20/$1.00 Ge 30/$1.00

Microdiodes similar to MD27, etc., up to 200 PIV at 30 μa. These are switching diodes with a short recovery time (.3 μsec). 6/$1.00

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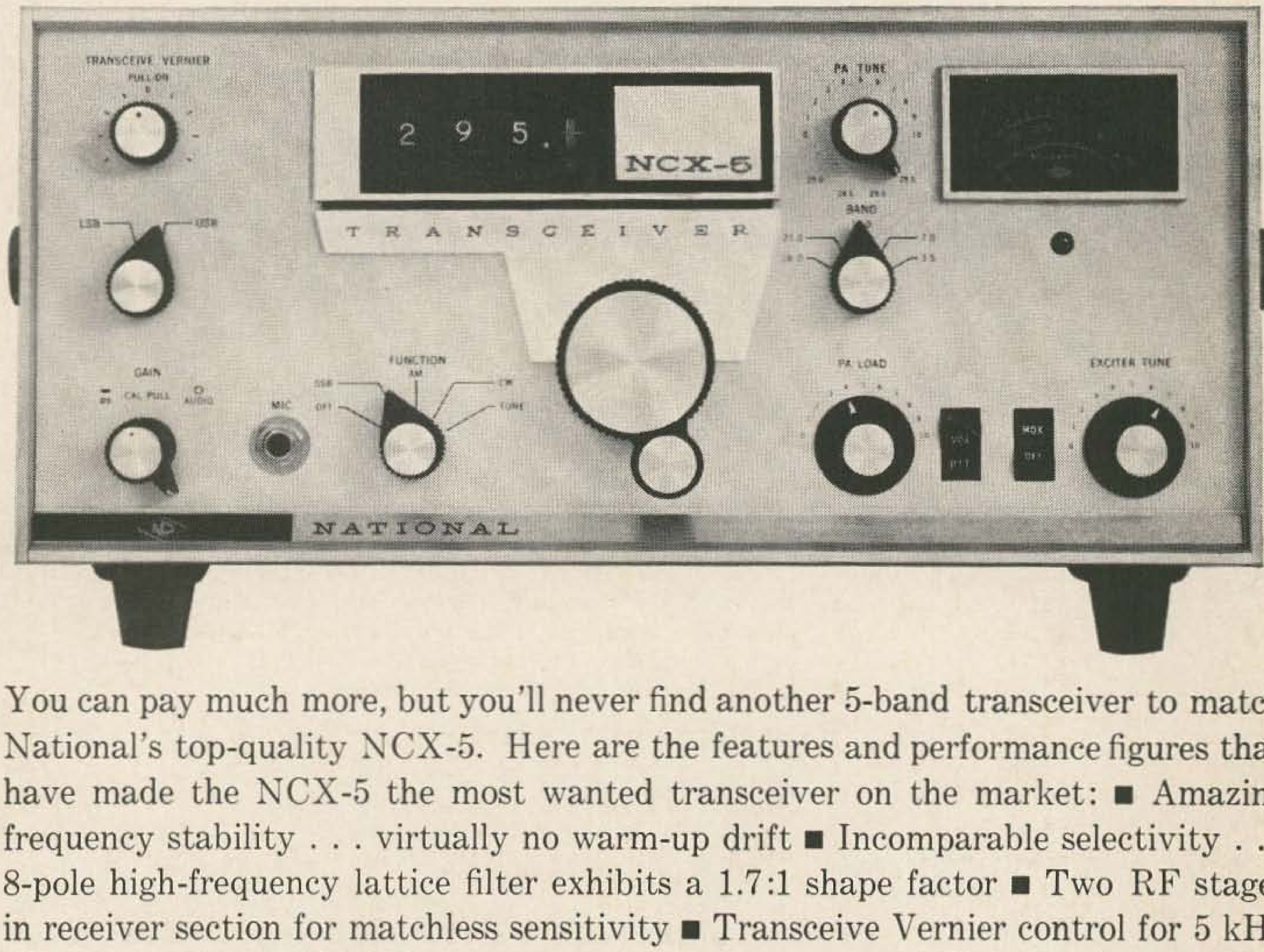

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