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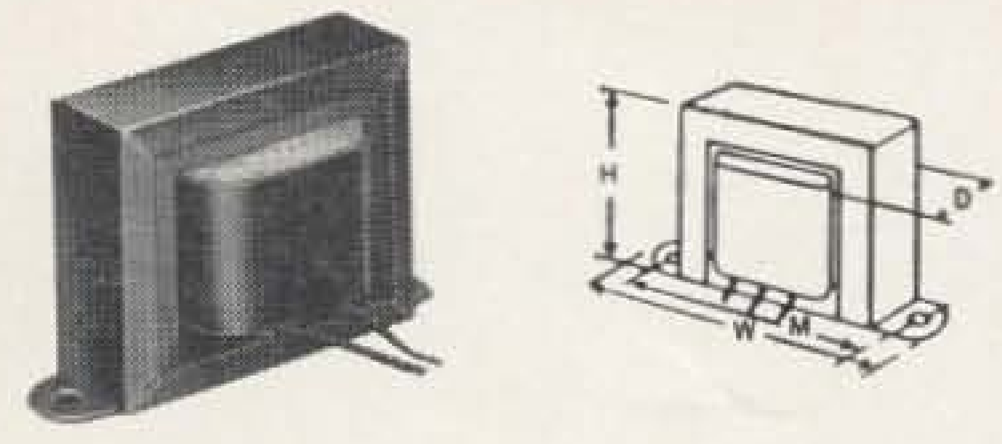
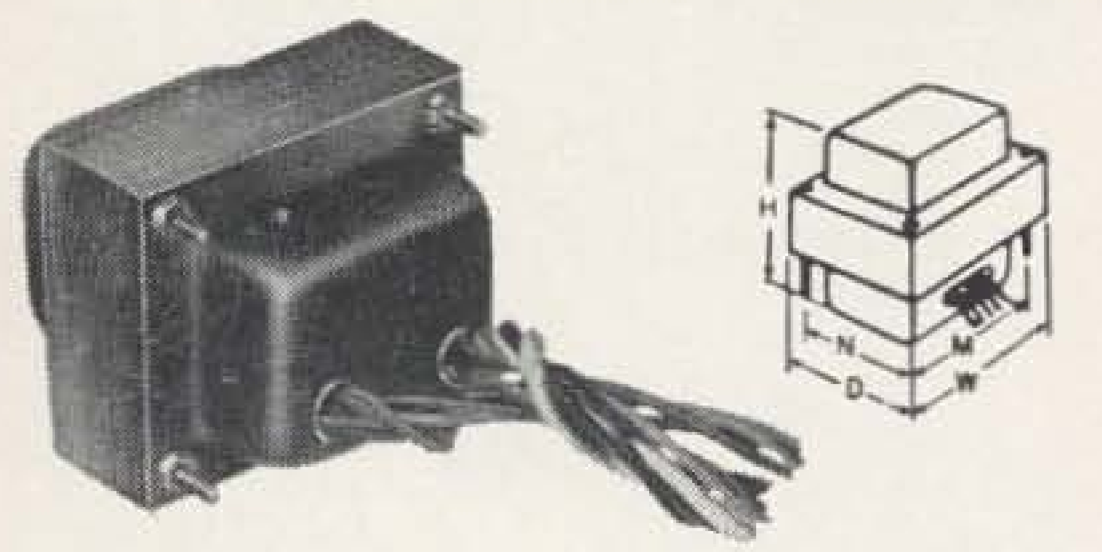
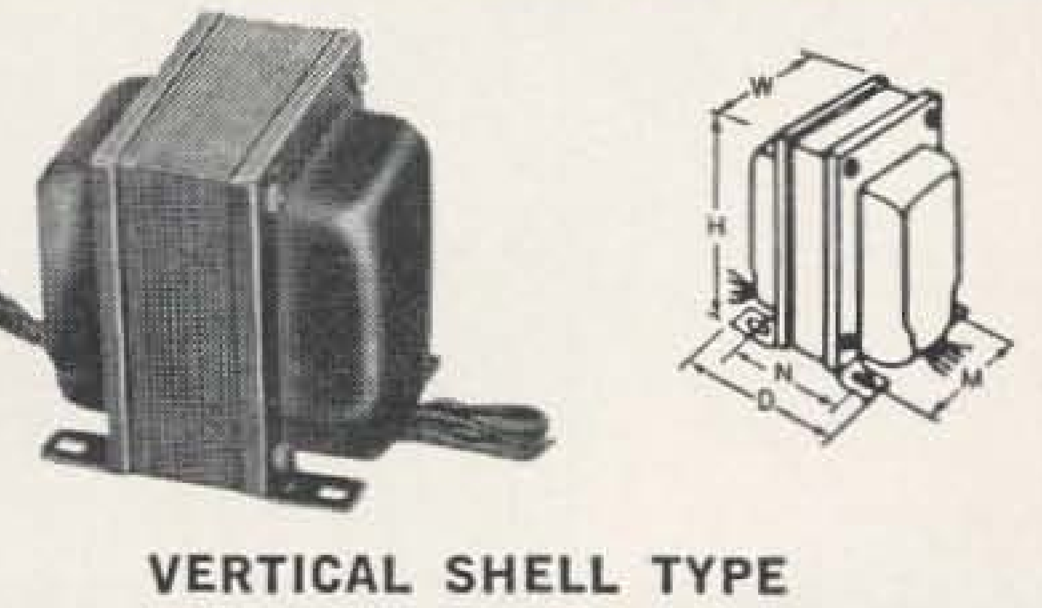


CHANNEL TYPE



DOUBLE SHELL TYPE



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FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

Type No.	Secondary	W	D	H	M	Lbs.
FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 5/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 5/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 15/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 1/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/8	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/16	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/16	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

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Type No.	Induct. Hys.	Current	Resistance Ohms	Dimensions, in. W	D	H	M	Wt. Lbs.
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
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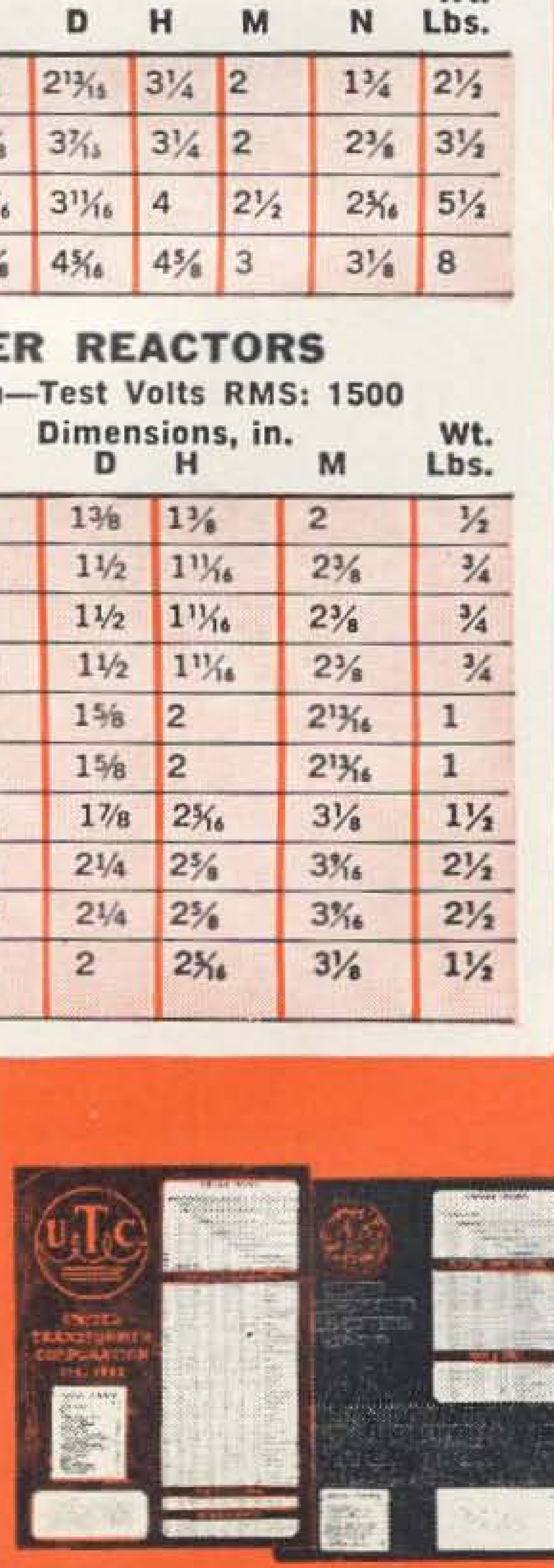

UNITED® TRANSFORMER CO.

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Kayla Bloom W1EMV
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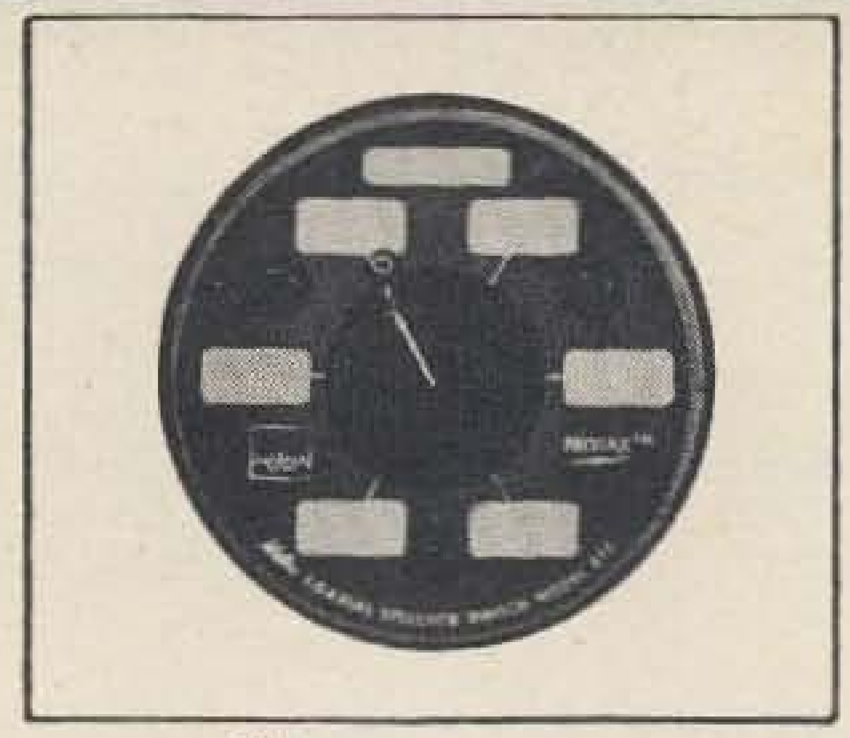

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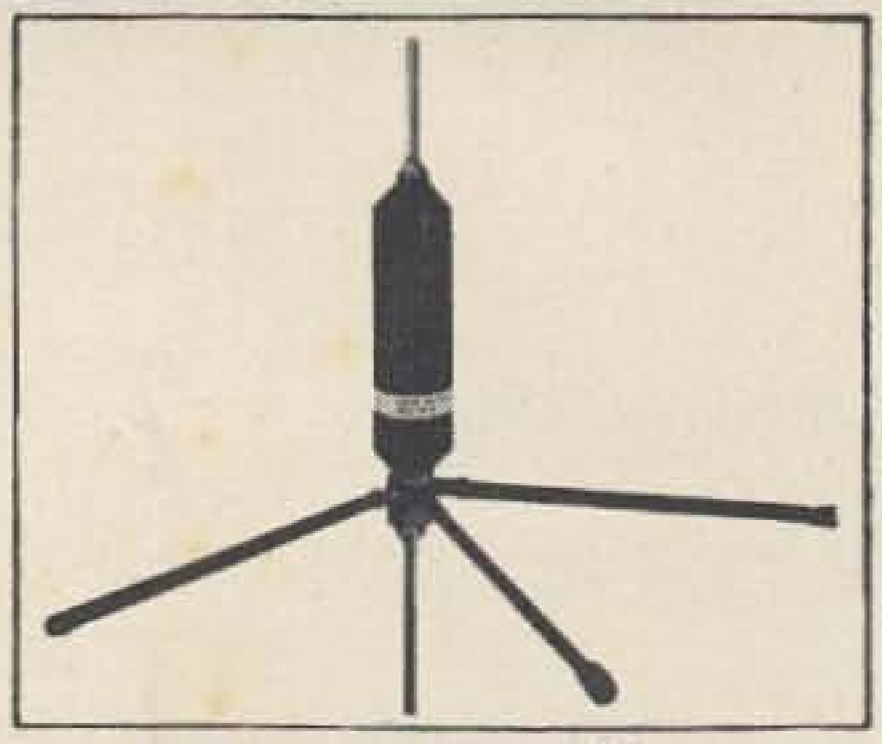

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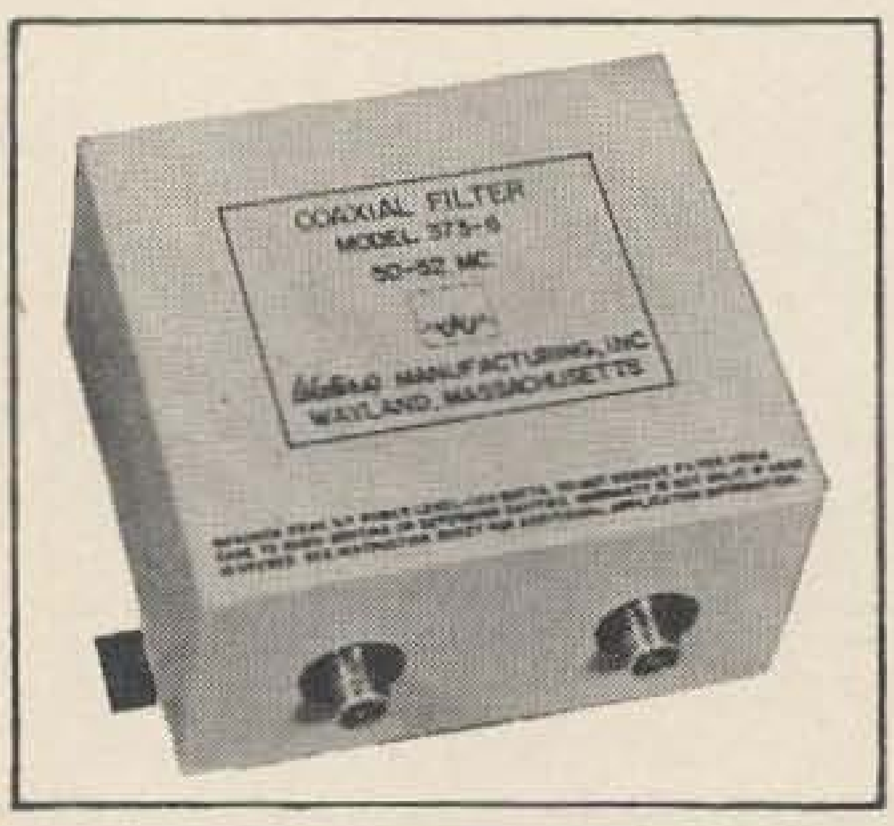

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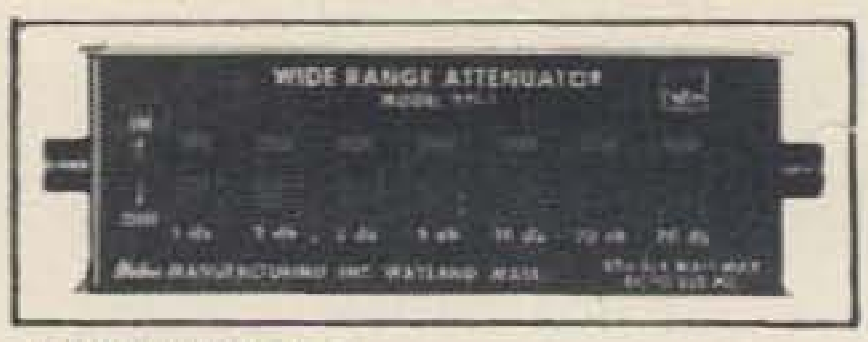

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Miller

My long editorial about Miller in November has brought quite a response. If Miller is not an international scoundrel and pirate, he certainly has gone to fantastic lengths to make it seem he is. I know he has me convinced now.

Hundreds upon hundreds of hams now feel that they have been hoodwinked by a fast-talking con man. They want to know if Don did, as he claimed, collect $12,000 from the DX clubs last summer. They want to know, if this is true, why he is now asking for more donations. His recent letter in October did not answer any of the questions, it just spent itself in a tirade against the ARRL, threatening suit, and requested more and more donations.

Twelve thou is a very big bundle and in the Indian Ocean it will carry you along for a long, long time. That area is famous for low prices. I think we all want to know that Miller isn't salting away the major portion of these donations for his retirement.

A letter from the Seychelles says, "Congratulations on the article 'Miller & Company'. It was about time that something like that appeared. We here knew all about the events which were going on in our area and we struggled to put a stop to it. The results were disheartening at first because although we *knew* about the Laccadives-Chagos hoaxes we could not get the government to take action. The local newspaper started things going and the Development Secretary has announced that Miller has been informed that he is 'personna non grata' here and that he would not at any time be allowed to land in VQ9 or in any of the islands of the British Indian Ocean Territories. His license for VQ9 has expired and will under no circumstances be renewed. The authorities in VQ8 have been alerted and it is possible that his rapid departure from VQ8 may have been the result of Telecommunications being after him to answer some embarrassing questions."

It looks as if less and less of the world is available to Don. With the generous financial aid of the DX'ers, Don has probably done more to hurt amateur radio and its future than any other one ham in history.

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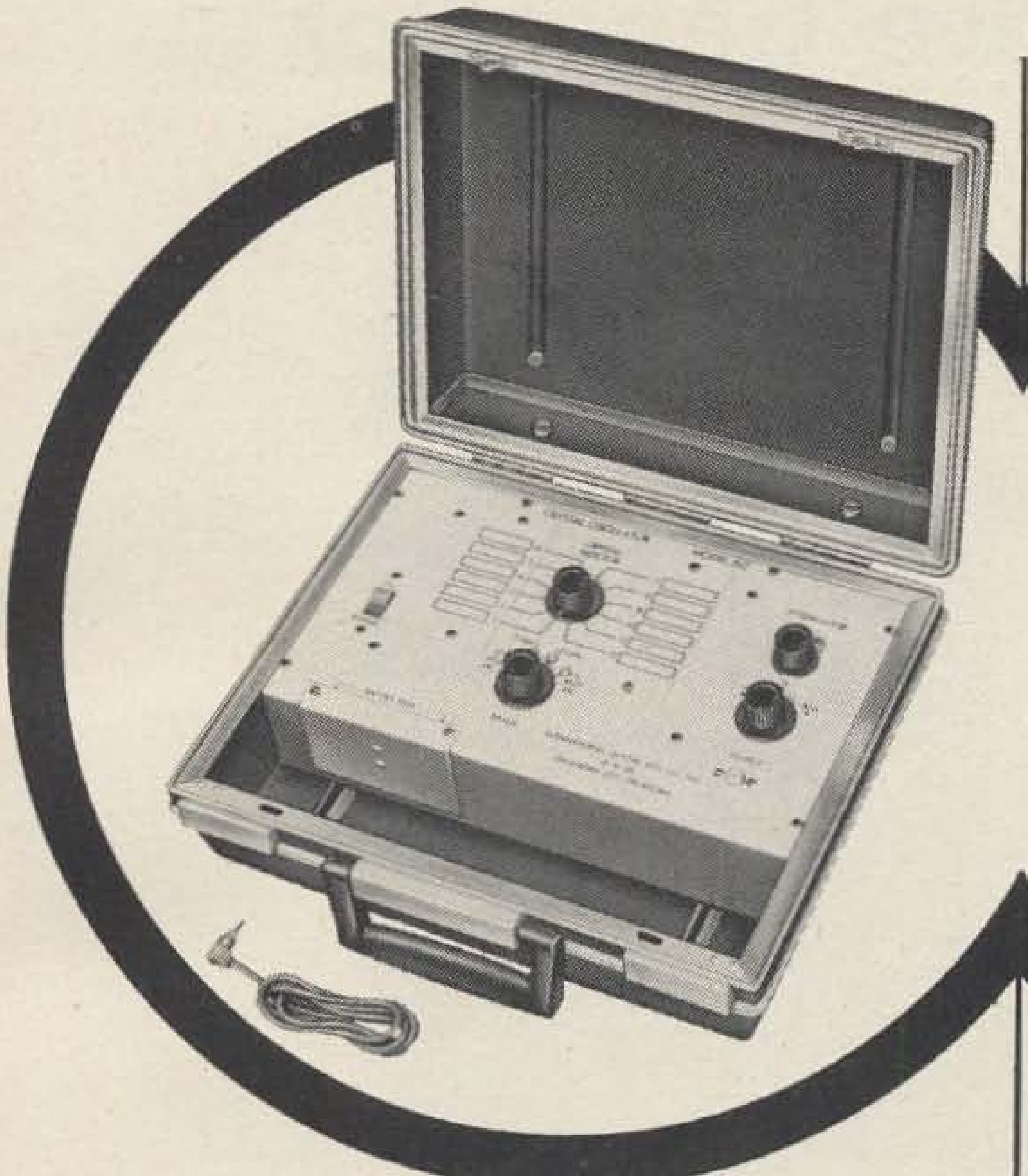

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IC Square-Wave Generator

The integrated-circuit square-wave generator.

This project was designed primarily for those who wish to acquaint themselves with, and gain experience using, integrated circuits. The square-wave generator described is a rather easy construction project. This is not to say, however, that it sacrifices performance for the sake of simplicity. In fact, several shortcomings of usual square wave generator circuits have been overcome in this design. The construction of this unit will result in a fine piece of test equipment which will be handy around any ham shack.

Circuit details

The circuit which generates the basic square wave form is shown in **Fig. 1**. This is called an astable multivibrator. The gates G_1 and G_2 are from a Fairchild μL 914 integrated circuit. It's a dual two-input gate and should be familiar to many 73 readers.

Each gate is cross-coupled to the other through a resistor-capacitor network which determines the operating frequency. Different capacitors are switched in for changing frequency bands. There are five bands: band A–10 Hz to 150 Hz; band B–100 Hz to 1.5 kHz; band C–1 kHz to 15 kHz; band D–10 kHz to 150 kHz; and band E–70 kHz to 1 MHz. In order to vary the frequency within these bands, normally you have to vary both R_1 and R_2 simultaneously. But by varying only R_1 we can obtain the same bandspread and save the cost of a ganged pot. Unfortunately this will destroy the symmetry or squareness of the output waveform. This can be remedied and, as you will see later, the remedy brings along a couple of extra advantages of its own.

The simple astable multivibrator of **Fig. 1** would work nicely if it were not for one big shortcoming. It may cease oscillating when switching frequency ranges or it may

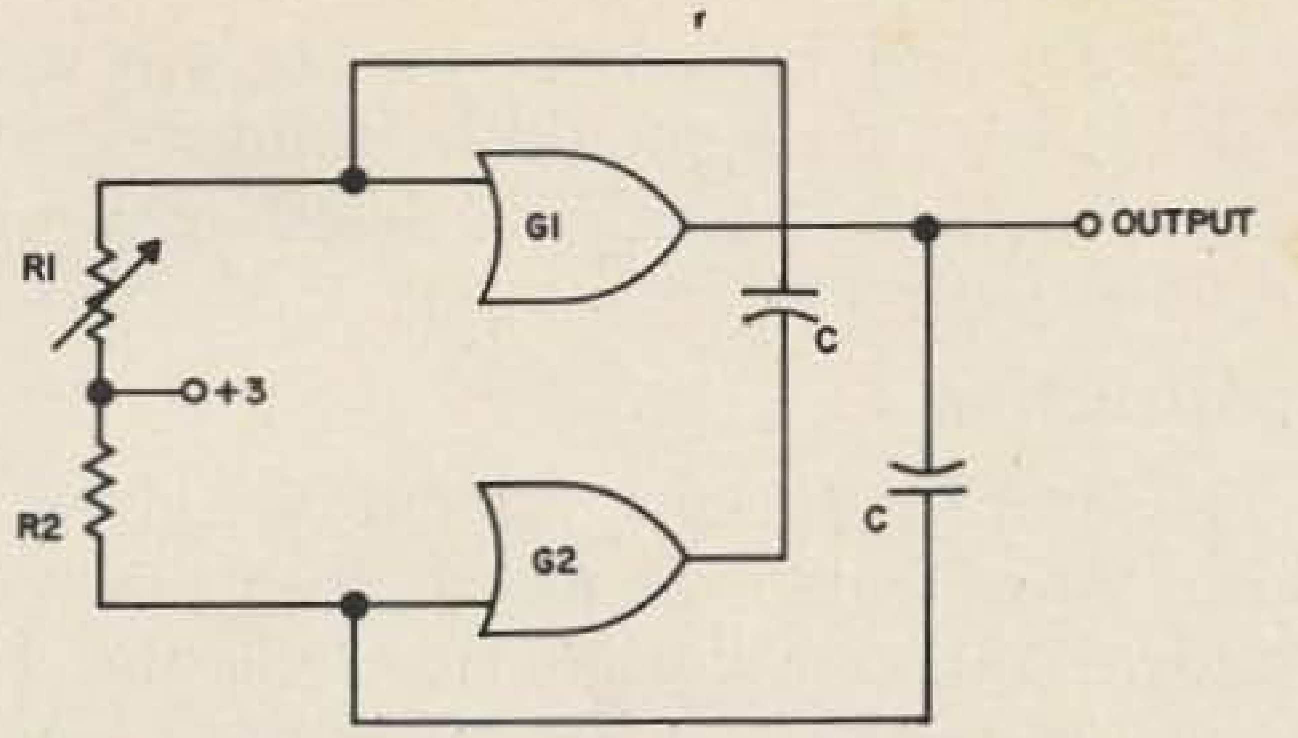

Fig. 1. Simple astable multivibrator circuits.

fail to start up when turned on. This happens when both gates saturate at the same time. In normal operation, G_1 and G_2 conduct on alternate cycles; that is when G1 conducts, G_2 is cut off. This process is insured by the capacitors which drive the gates by charging and discharging alternately.

However, suppose now that you are changing bands. As the arm of the bandswitch moves from one capacitor to the next there will be a time interval where there is no capacitor in the circuit at all. Both gates will now see a positive voltage at their inputs through R_1 and R_2 and will conduct heavily. The multivibrator will now be locked and cannot be started up again unless you first turn off the power. Obviously, it would be very frustrating to have to turn off the power whenever you wanted to change bands. I ought to know since it kept happening to me in my early stages of experimenting.

The seemingly insurmountable problem was easily overcome by using a couple of diodes. **Fig. 2** shows the circuit, known as a self-starting circuit. By referring to **Fig. 1** and **6** you'll be able to see how this circuit works. The two diodes are connected to each output and to the junction marked (X). The +3 V for R_1 and R_2 is now supplied through D_1 and D_2 from the collector of either gate. Remember that when a gate is cut off the collector goes positive and +3 V appears at junction (X). The circuit will operate properly as long as at least one gate is cut off. Now if both gates should happen to saturate at the same time when switching capacitors, the positive voltage at (X) will disappear, tending to cut off the gates immediately. In other words, the diodes, which form the OR gate, will not allow the multivibrator to lock in a saturated condition. Proper operation will begin when the next capacitor is switched in. We now have a reliable astable multivibrator circuit which produces rectangularly shaped waves.

As stated earlier, the method used for varying the frequency destroys the output wave's symmetry. When R_1 is varied, the output may change from a square wave to a rectangular wave or pulse, for instance. Of course, this change in wave shape has no effect upon the frequency as it is varied. In order to correct the wave shape, the output of the multivibrator is fed into a Fairchild μL 923 J-K flip-flop. The action of this flip-flop is shown in **Fig. 3.** The μL 923's output *changes* only when the input signal goes *negative*. Notice that the output is always a perfectly symmetrical square wave, regardless of the shape of the input waveform. The input can be spikes, pulses, rectangular waves or any other waveform which has a fast negative going portion. It can also be seen from the diagram that

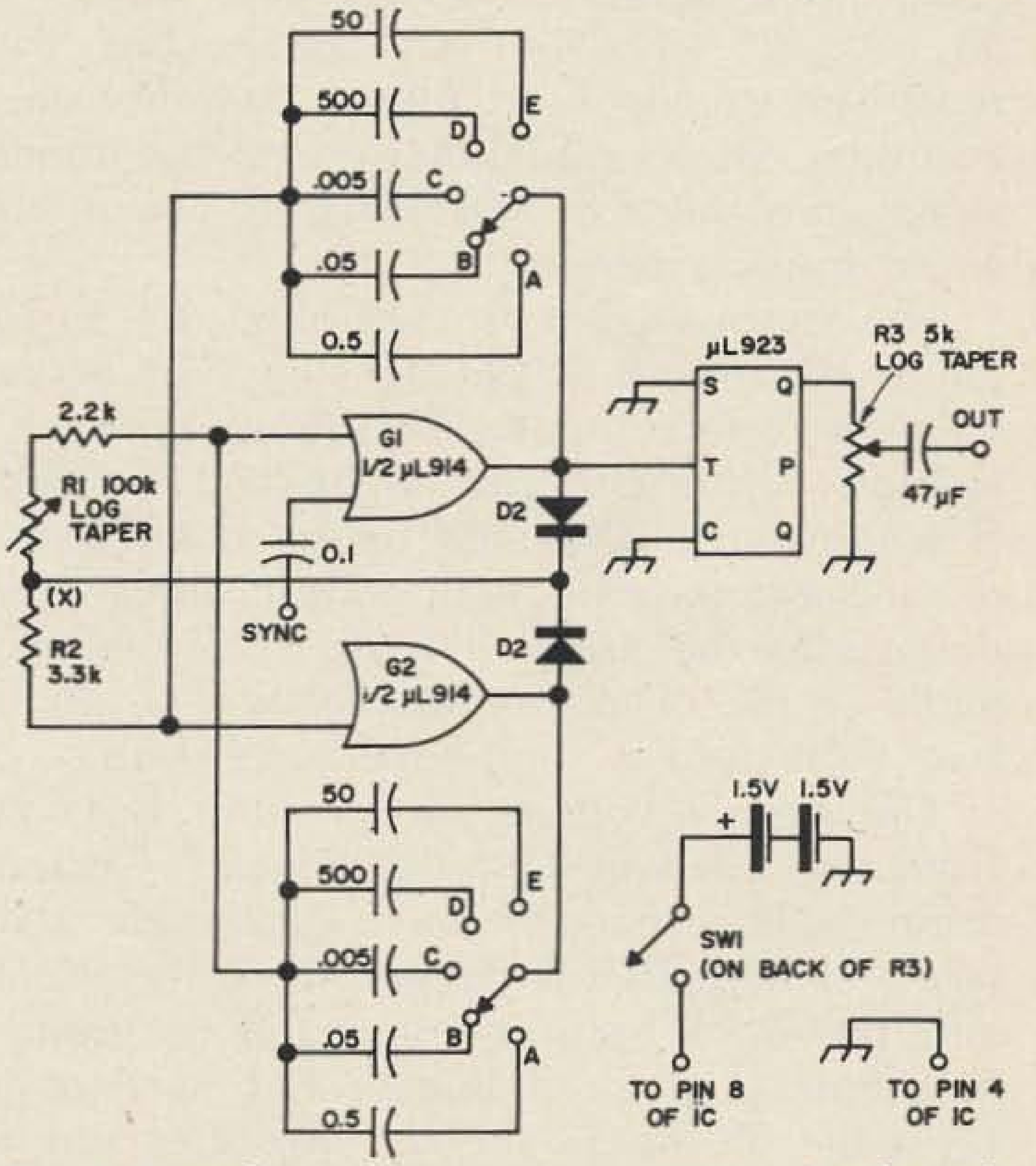

Fig. 2. Complete square wave generator. Bandswitching capacitors are 10% or better tolerance. Resistors are 1/4 watt.

the output frequency is one-half the input frequency. This means that the multivibrator is actually operating at twice the frequency indicated on the front panel dial. The generator puts out a beautiful square wave to 1 MHz and beyond. A slight amount of overshoot on the rising portion of the square wave is normal at high frequencies. The S (set) and C (clear) inputs are both grounded, and the P (preset) input and the $\overline{Q}$ output are disregarded.

Synchronization pulses are fed into gate G_1 for locking the generator's frequency to some external source or oscillator. For in-

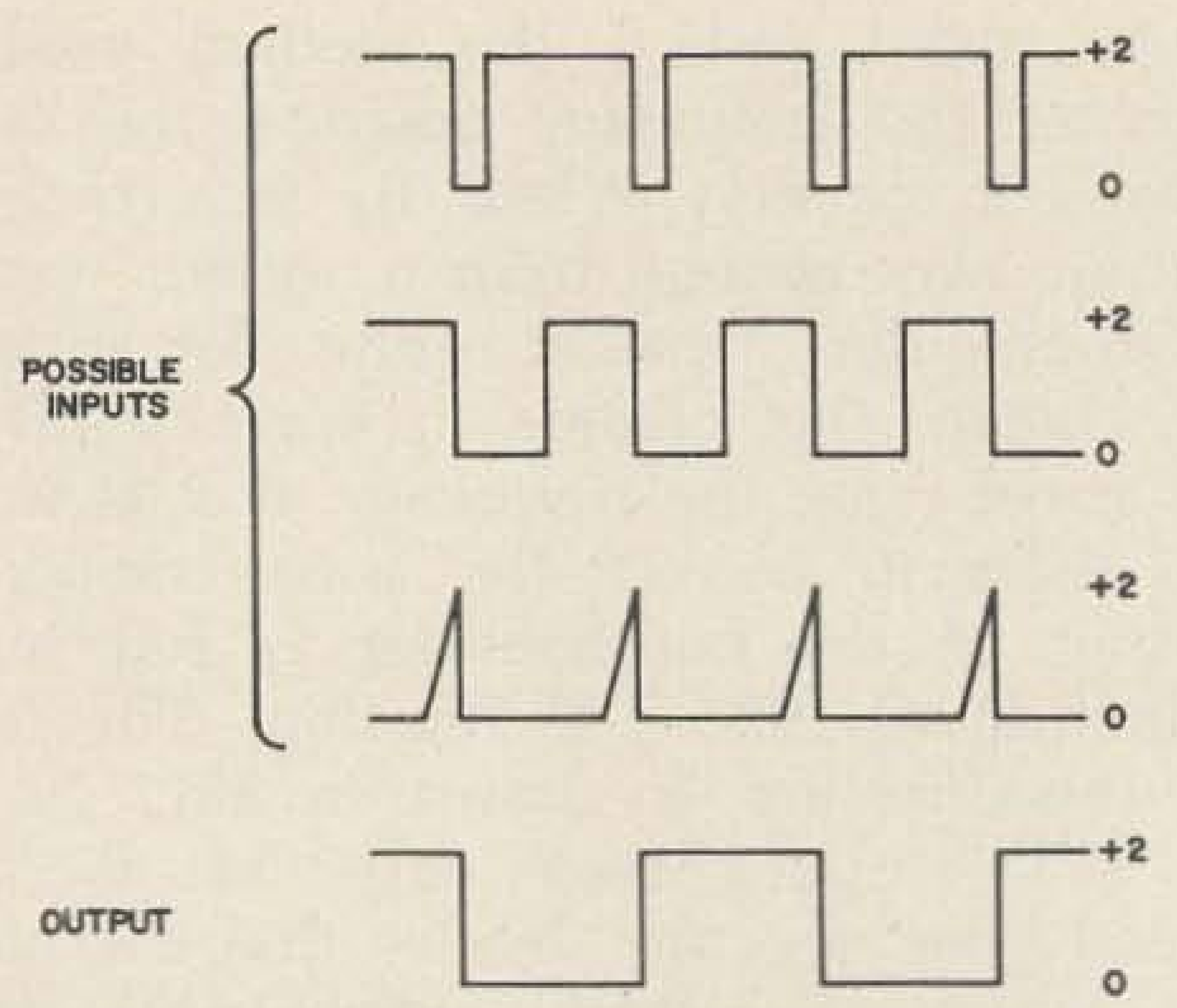

Fig. 3. Operation of the μL 923 flip-flop. Note that regardless of the shaps of the input waveform, the output is always a perfectly symmetrical square wave.

stance, by feeding a 100 kHz signal from your receiver's crystal calibrator, you can lock the generator at 100 kHz, 50 kHz, 33 kHz, 25 kHz, etc. Of course, this will result in excellent frequency stability and accuracy. Be careful not to feed too much signal into the sync terminals, as you might cause erratic operation.

The output level is controlled by a 5-k pot at the output of the flip-flop. The actual value isn't too important as long as it isn't too low. Otherwise you might load the flip-flop too much. Don't go below 1k. The use of a log-taper pot will permit adjustment down into the millivolt region for low-level audio work. The output voltage is about two volts into a high-impedance load.

The supply voltage for the unit is taken from two 1.5 volt D cells in series. Current drain is less than 40 mA. Remember that pin 8 of both IC's is connected to the +3 V and pin 4 of both is connected to ground or minus. A colored line or flat portion on the edge of the IC's body identifies pin 8.

Diodes D_1 and D_2 can be almost any signal diode. Parts values should be followed rather closely to insure adequate band coverage.

Construction

The printed circuit layout is given for those who want to make their own PC boards. You can get an idea of the front panel arrangement from the photo. Actually there is nothing critical about layout or construction so you can arrange things inside to your liking. I used a 4 x 5 x 6 minibox for my unit, which is just right if you use a Millen 10039 vernier dial as I did. This is a compact unit, and using a larger dial will mean using a larger cabinet. The Millen dial is rather expensive and maybe you'll want to use one of the imports and make your own scale. Since I'm on the subject of cost, I might as well say that the whole project will come to about $20.00 with all new parts, including the Millen dial. With an imported dial, you can probably knock $5.00 off that figure.

Calibration

You might have noticed by now that the scale on my dial is not linear. This is because I used a linear taper pot for R_1, since it was available. I'm not particular about such things but if you prefer a more linear scale, I would suggest trying a log- or semi-log taper pot. Keep in mind the fact that most vernier dials turn only 180° as opposed to the normal 270° turn of a pot. You might have to adjust the position of the pot in the dial to insure proper bandspread.

Calibration can be achieved only by the use of a scope or frequency counter. If you don't own one maybe you can gain

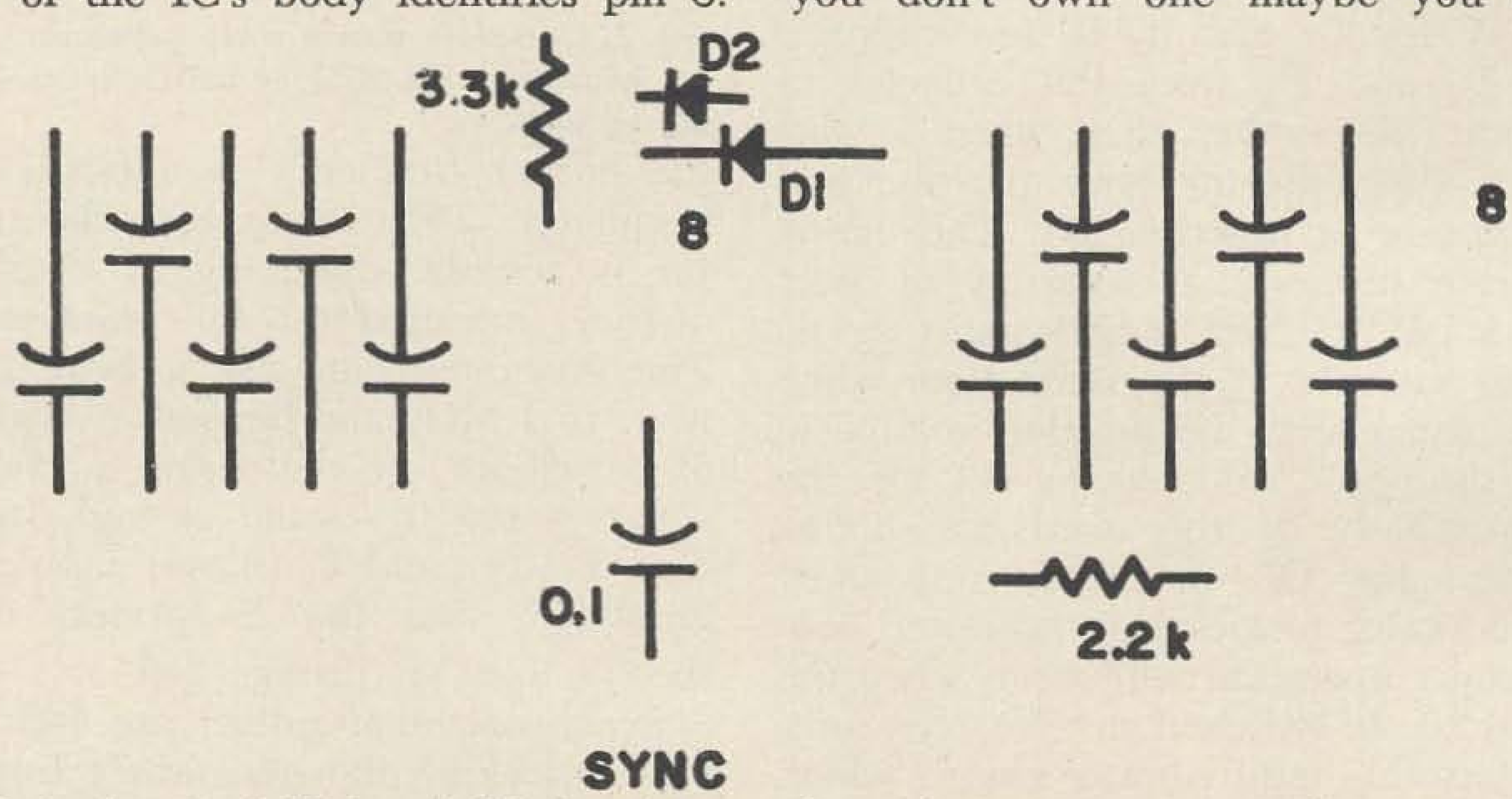

Fig. 4. Full size layout of PC board. This is a bottom view with components mounted on top.

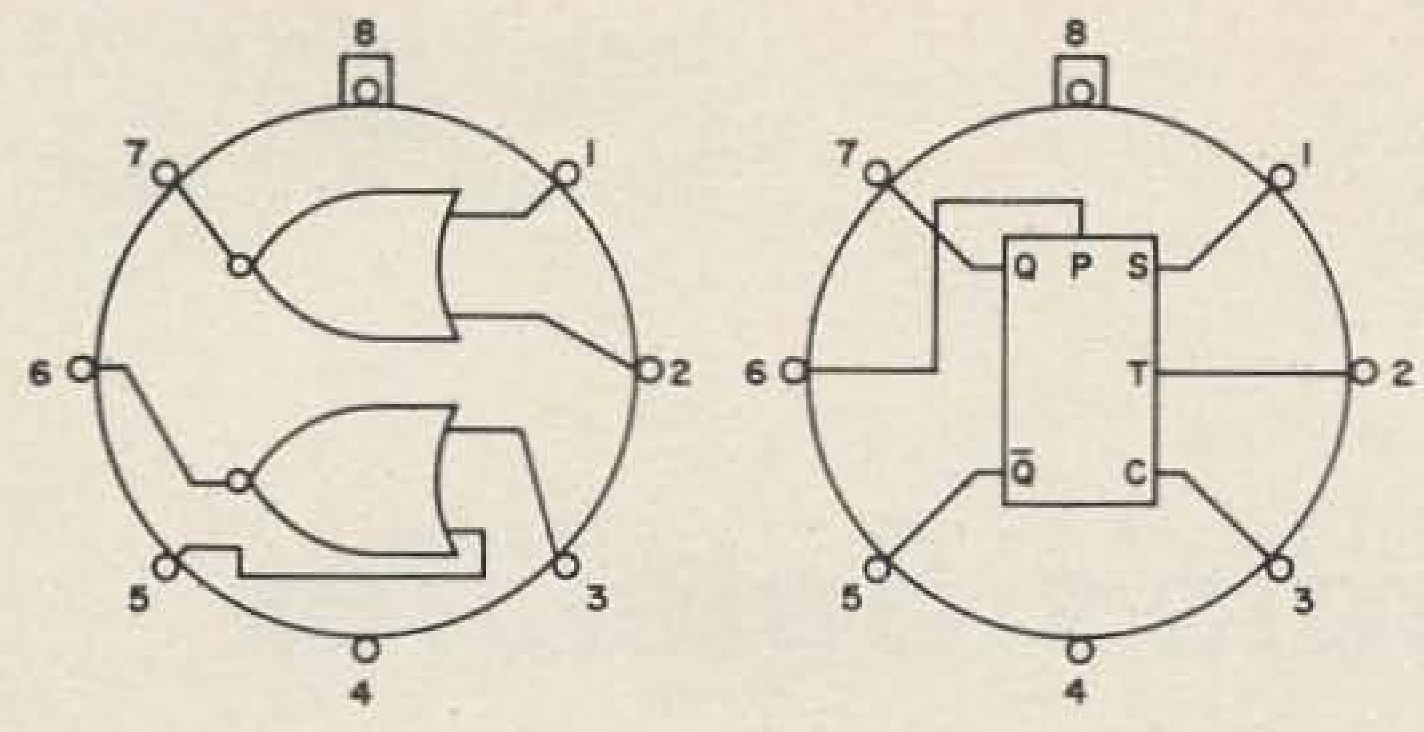

Fig. 5. Basic diagram for the IC's.

access to one for about fifteen minutes or so. By using 10%, or better, tolerance capacitors you'll only have to calibrate the lowest frequency band. On each succeeding band, the frequency is ten times the frequency at the same point on the previous band. The simplest method of calibration is with a 60-Hz sine wave, which can be supplied internally on most scopes.

To calibrate the lowest band (band A) the following procedure can be used. First, allow the scope to warm up for a few minutes until it becomes stable. Turn off the internal sync of the scope. Apply the 60-Hz sine wave to the vertical input of the scope and adjust the sweep frequency until you obtain six full cycles on the screen. Since you are not using the internal sync, you'll have to adjust it very carefully to stabilize the pattern. With six full cycles on the screen, the sweep frequency is now set at 10 Hz. Next, feed the square wave from the generator to the scope and tune the generator's frequency until you obtain one full cycle of a square wave. Be careful not to move the sweep frequency of the scope. The square wave generator is now set at 10 Hz and can be marked on the dial. Tune the generator again until two full cycles are visible on the screen. The scale can now be marked at 20 Hz. This process can be continued on up to 100 Hz. Afterwards, go back and repeat it all over again to make sure you have the proper calibration. Once you have made certain that there are no errors, you can mark the rest of the bands as outlined previously. On band E, you can listen to the signal on a broadcast receiver to see if it checks out. The bands on my unit did not exactly come out in multiples of ten because I used 20% tolerances capacitors from my junk box. Even so, they came out very close.

Operation

Square waves are very handy for testing amplifiers of all sorts in conjunction with an oscilloscope. In audio work they will reveal poor high or low frequency response, ringing and other ailments. Of course, you don't need a scope just for general testing of audio amplifires and such. A simple signal tracer will do.

Speaking of oscilloscopes, you can use 500-kHz square waves for adjusting compensating capacitors in scope probes and step, or decade, attenuators. Usually, the instruction manual of your scope will outline the proper procedure. Since this unit will supply a signal at up to 1 MHz in frequency, it can be used to fix or test amateur or broadcast receivers. However, a detailed discussion of testing with square waves is beyond the scope of this article.

I'm sure that if you build this square wave generator, you'll be very pleased with its performance and reliability.

. . . WA4ZQO

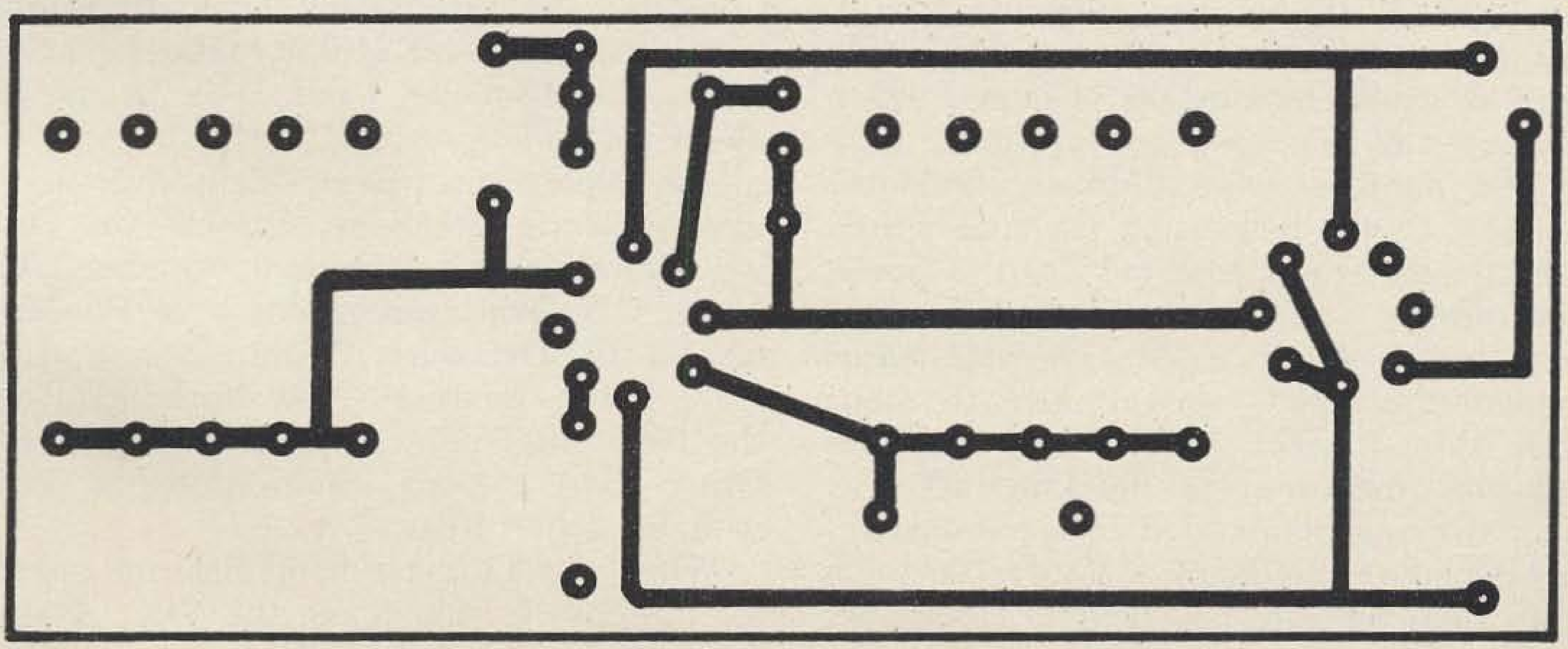

Fig. 5. Full size printed-circuit board used in the IC square-wave generator.

George Bonadio W2WLR
12 Public Square
Watertown, N. Y. 13601

Tuning in on Bonadio's Satellites

There are billions and billions of minute satellites or micro-meteorites *in-orbit* around the earth. You can tune in to a hundred of them a minute on 13 meters.

Eons ago, according to theory, there was a large planet between Mars and Jupiter. There are now thousands of asteroids in that area. If a planet had been there, it would have been chemically similar to the earth. This would include much sand in crystalline form. If such a planet broke up, there could easily be billions of tons of sand and similar particles scattered in space.

When these wandering crystals intercept the earth's path, they do so at speeds of ten to eighty kilometers per second. Their speed and mass combine to burn them up when they enter the atmosphere.

Burn-outs are nicely explained by the North American authority on meteors, Dr. D. W. R. McKinley, VE3AU, Ottawa, Ontario, Canada. His paperback book, *Meteor Science and Engineering* is published by the McGraw-Hill Book Company.

What happens to the particles which come close to the earth, but miss its atmosphere? For eons many have been captured by the earth's gravity and are orbiting around it.

I first detected these particles about three years ago. My theory was advanced June 4, 1965, in the Watertown (New York) Daily Times, a year before results of later Russian and American space probes were made public. The particles were dubbed "Bonadio's Satellites" by the newspaper's science writer.

My theory was borne out by the Soviet moon probe, *Luna 10,* and the *American Mars* probe, *Mariner IV*. *Circumlunation* (orbit of the moon) was attained by Luna 10 on April 3, 1966. According to *Scientific American*, "measurements by Luna 10 show that it is being bombarded by micro-meteorites (Bonadio's satellites) at a rate *100* times higher than the rate observed in interplanetary space."

Similar particles were detected in the gravitational field of Mars by Mariner IV. I postulated that these particles around the moon and Mars were the same as those I detected by radio around the earth.

The count

The recent probes to the moon, Mars, and around the earth found many more micrometeorites around the earth, moon and Mars than in space. The ratio is about 100 to 1. Such a ratio is impossible to ignore. Space data tells us nothing more about it.

It seems that space scientists have not yet been able to separate and identify an orbiting grain of sand, at modest speeds, from a *non*-orbiting bit, of less weight and higher speed. So, they report total counts.

I claim to have a means to prove that about 99% of these are in orbit; are real satellites; are countable apart from meteors, and that each has a great similarity to others. You can make your own count.

Piggy-back radar

There are huge signal beams from the Voice of America stations in Ohio and North Carolina. They frequently beam to Europe on 21.485 MHz and 21.650 MHz respectively, in the 13-meter band. The beams are about *ten million* watts E. R. P.

The Ohio beam passes ideally over northwestern New York State, Toronto and Ottawa, Ontario, and Montreal, Quebec. The North Carolina beam passes over Washington, D. C., Delaware, Eastern Pennsylvania, New Jersey, Southern New York State and the New England states.

Other VOA stations would probably do as well for other areas.

When the 15-meter band has not opened for the day, for amateurs, the VOA is often warming up on the air. The signal will be

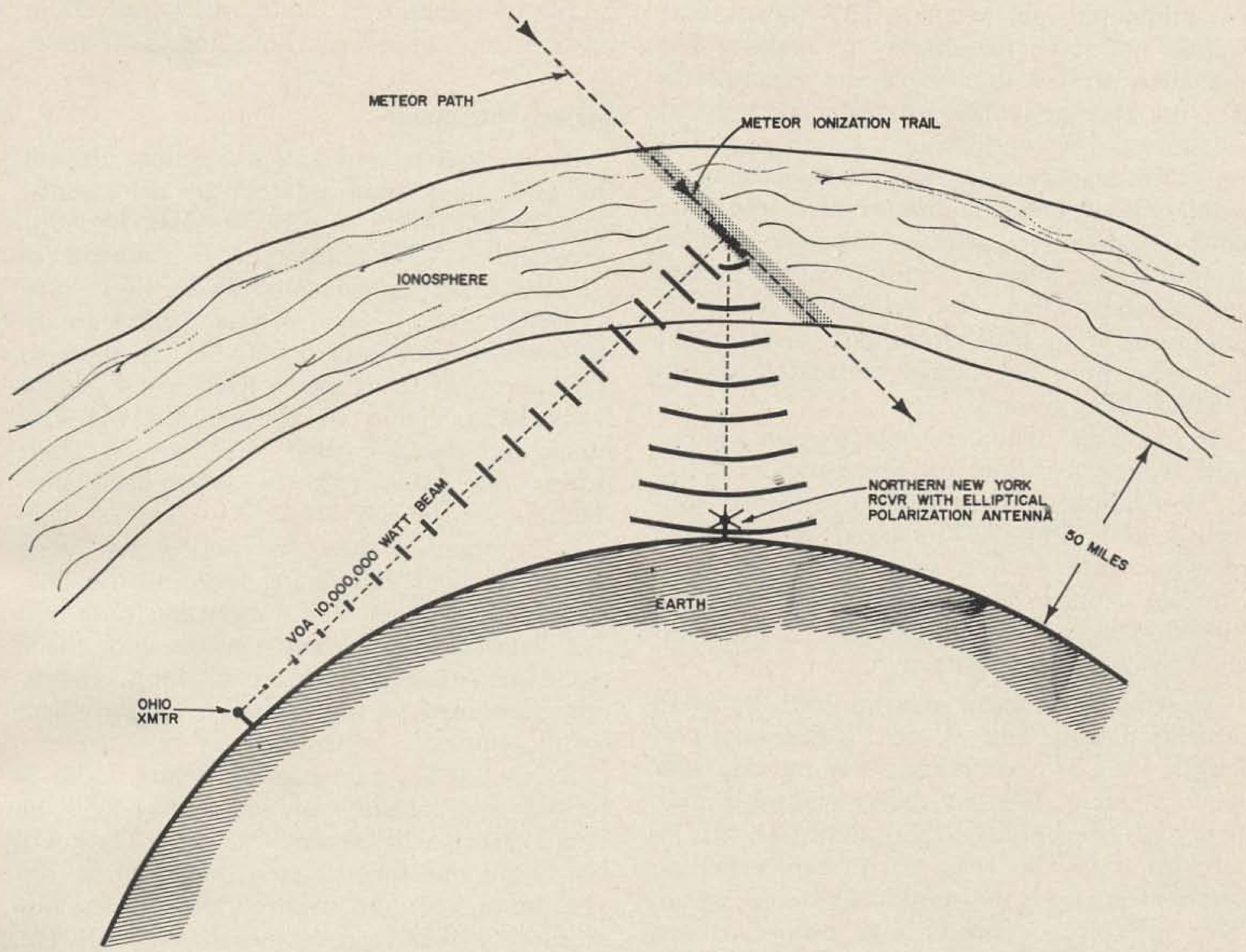

Fig. 1. Meteor count conditions—the meteor trail produced in the ionosphere increases the scatter signal strength up to a million times the residual level for a few seconds, roughly a few dozen times per hour.

fluttery with strengths from zero to S6 and usable for our purposes.

The beam has to be roughly 50 miles overhead, and only a few hundred miles away from the transmitter. Then the only signal heard from the VOA will be the random scatter.

If a meteor trail exists in the *10,000,000* watt beam area overhead, it will boost the VOA signal that is received. While the S-meter bounces up, the sound will resemble several rapid pats on a pillow. The meter may bounce over S-9, and drift down during the next five to fifteen seconds. These are real meteor trails, **Fig. 1.** They are caused by ionization from meteors having speeds in excess of *ten kilometers per second.*

Meteor counts, when 15 meters is unoccupied, can be made within 600 miles of Long Island by tuning into the continuously operated frequency-shift teletype station on 20.908 MHz. This station runs 16 KVA into a vertical antenna for the north Atlantic airplanes. Listening on its frequency, in the CW position, for ten minutes, will usually show several meteor bursts, of extra strength. In less than a second it builds up, and in several more seconds it fades down. This is "piggyback" radar. This is using a strong signal as a reflection means, while you are hiding away from it.

QRP

An S-1 signal from the VOA beam is down about *10 billion* to one. A beat note on that at about ten per cent modulation is *down* another 20 dB. This is, then, down about *one trillion* to one. One *trillionth* of *10 million* watts is *1/1000,000* of one watt, or one per cent of one milliwatt.

Satellite whistles

If a particle in space does not hit the earth's atmosphere, but orbits instead, something new is added. After an eon, the satellite's orbit will be small and nearly circular and its speed will have approached nearly five kilometers per second. This means that it does *not* have the energy to make a big ionization trail and will hit the atmosphere at a flat tangent, rather than driving into it.

Under such conditions, I found that the ionization trail made by the particle collapses within about seven meters or fifty feet. The sand or particle is orbiting over the surface of the atmosphere at roughly 5,000 meters per second. Thus, the reflection, from its brief ionization trail, from any given point in space, may be mostly dissipated within *1/700th* of a second.

In contrast, when an intersection meteor trail is able to bump up the S-meter, it has an ionization trail which is several kilometers long, **Fig. 1.** The tonal effect in the receiver from such a meteor is only deep rumbles, similar to distant thunder. It takes high fidelity, good through 2 Hz, to hear and show it on a scope pattern.

However, the grain of sand, with its small ionization trail, **Fig. 2,** at 13 meters wavelength, can be considered as a moving half wave reflector. If it can reflect enough signal, from its one-hundred-thousand-of-a-watt interception to the receiver, it can make an interference with the weakly scattered signal. This interference flutter rate cannot exceed the difference in the number of wavelengths changed per second.

On about 21.500 MHz an orbiting grain of sand burning-in will be flutterable up to approximately 777 Hz. The sand, at about 5,000 meters per second, can increase the length of the path of the signal to it, and then to the receiver, **Fig. 3,** by not more than 10,000 meters per second. By dividing 10,000 by the wavelength of 13, there is a maximum possible tone near 777 Hz, a good CW tone.

Taking the count

If the receiver and antenna system are not the best, take some amateur measurements. Spot 21.485 MHz or 21.650 MHz by your transmitter's VFO harmonics. Use a receiver selectivity which only slightly muffles voice signals on AM. Use any tone control to reduce tones well over 1,000 Hz. If there is a beam, turn it to get a very weak signal from VOA. Tune in during the morning hours and wait for their idle carriers. Their times vary daily with the ionospheric predictions for the day.

Some months they are not there. Once they have been found, log them on the dial. They are often on again between midnight and 1:30 A.M., as they set up and check out after the night's bandswitching. Conditions are best at night due to slightly less cosmic noises.

As the audio gain on the dead carrier is turned up, whistles of low tones will be heard. None will be over 800 Hz. They will last about one second each. As many as 100 per minute can be counted. As only a few of these will have tones much over 300 Hz, the modern communications receiver will not give a good count. The modern roll off of the audio is at about 300 Hz.

I use a 75A2 receiver, which now has corrected flat audio down to 20 Hz, and usable on the scope down to 2 Hz. Many of the tones of the flutters, so low they are inaudible, can be seen on the scope. As random distribution and satellite speed would

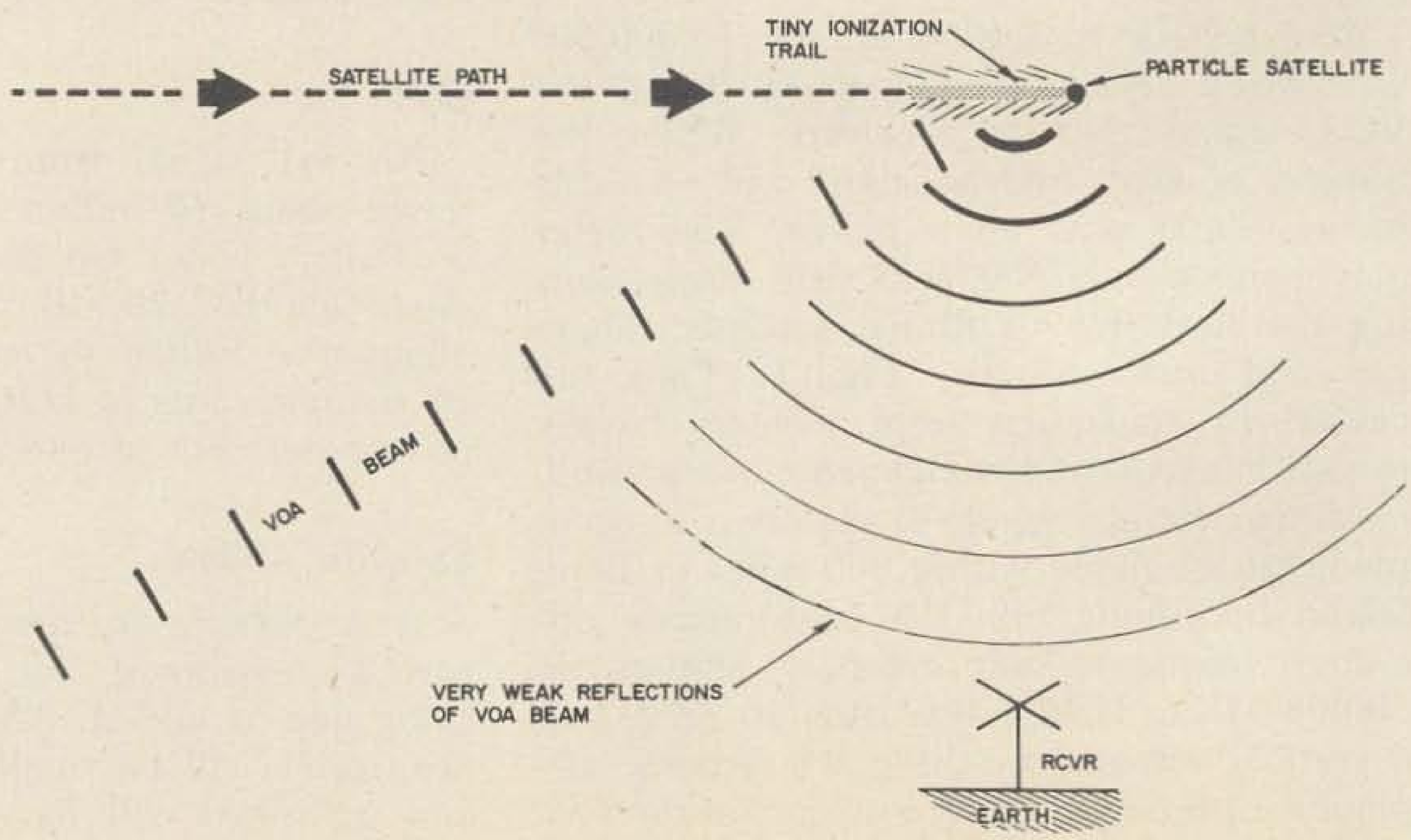

Fig. 2. Satellite count conditions—the small trail collapses so fast that it may be considered as a moving point in space. Often a hundred can be heard in a minute.

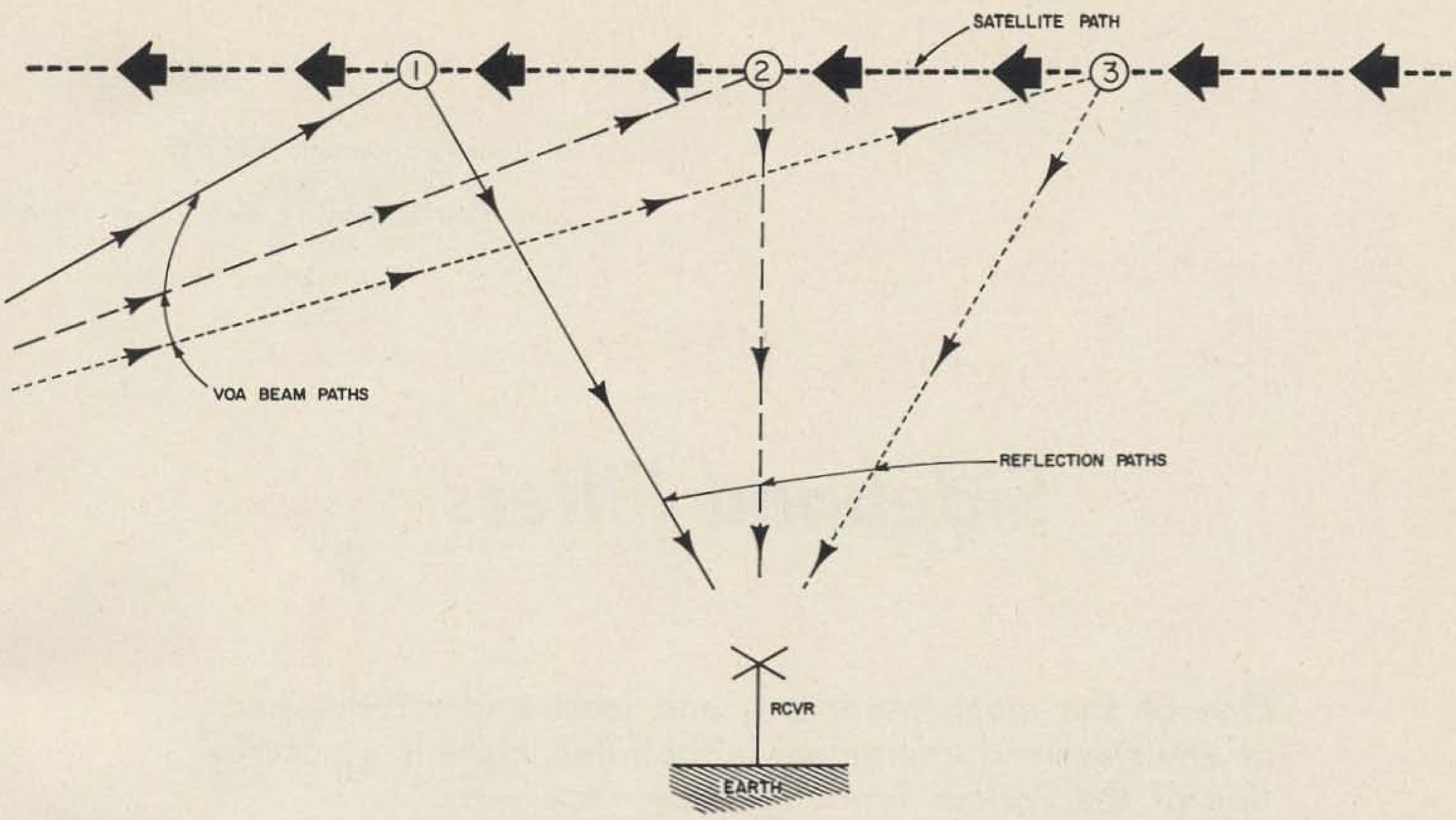

Fig. 3. Doppler shift triangulation—a satellite may produce a lower sideband tone by going from 1 to 3 or a higher sideband tone by going from 3 to 1. In many paths the tone can be sub-audible. Maximum pitches of tones are calculable.

suggest, most tones fall in pitch, although a few low pitched ones should and do rise slightly.

My claims

I believe that I am the first to detect, count, describe and separate these satellites from meteors. I estimate the count in space at 10^{19} around the Earth, with the moon and Mars having almost as many, perhaps more than 10^{18}, with less around moonless Venus and Mercury and many more around Jupiter, Saturn and Uranus which have many moons.

This reception is not a fading 'fluke' of elliptical polarization (having proved this with a special antenna for elliptical polarization), nor a manifestation of the sun on the layers, nor from cosmic rays, nor from meteors.

There is no other practical radar system in use today that can detect these satellite burn-ins on a continuous basis on these wavelengths.

While these whistles have been heard and noted by others before, none of them have indicated that they were caused by natural satellites burning-in rather than by the commonly believed meteor theory.

In another newspaper story I recently predicted that these particles would be found largely around high peaks of the moon. The peaks would first intercept the orbit paths of the particles. However, I expect much of the moon is covered with a "sea-salt-crystalline-flower" crust. This was deduced since the earth has enough sea-salt to spread over its surface 200 feet thick. I expect that there is much "salt" in with the "sand" on the moon.

From my estimations, a moonwalker, standing on its highest peak, would be hit about once a day, or less, by slow orbiting moon satellite particles. In the lowlands, he would get about one hit a year, from a much higher speed meteor.

. . . W2WLR

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Sideband Filters

One of the most important, and least understood, parts of any sideband equipment is the filter. Here is a description of the various types and how they work.

In light of present day developments in single sideband (SSB) transmission and reception, it is felt that the following information relative to crystal-lattice SSB filters and mechanical SSB filters will be of interest to amateur radio operators.

Both SSB transmitters and SSB receivers require extremely selective band pass filters. Most SSB transmitters and receivers incorporate filter networks which act in the frequency range of 100 to 500 kHz or higher dependent upon the carrier-generator frequency.

In an SSB receiver, the sideband filter rejects adjacent channel interference and undesirable mixer products. In SSB transmitters, the signal bandwidth must be limited sharply in order to pass the desired sideband and reject the unwanted sideband residual carrier frequency and spurious frequencies generated in the modulator. The filter used, therefore, must have a very steep skirt characteristic (fast cutoff) and a flat bandpass characteristic. These requirements are met by crystal filters, inductive-capacitive (LC) filters, and mechanical filters.

Crystal filters

Crystal filters have the high Q and excellent stability characteristics necessary for use in SSB receivers and transmitters.

When crystals are employed, they are used in crystal-lattice filter circuits (**Fig. 1**). The filter consists of two pairs of identical transformers, T1 and T2. Crystals Y1 and Y2 are series-connected and Y3 and Y4 are shunt-connected. Each pair of crystals is matched in frequency, within 10 to 20 Hz of each other.

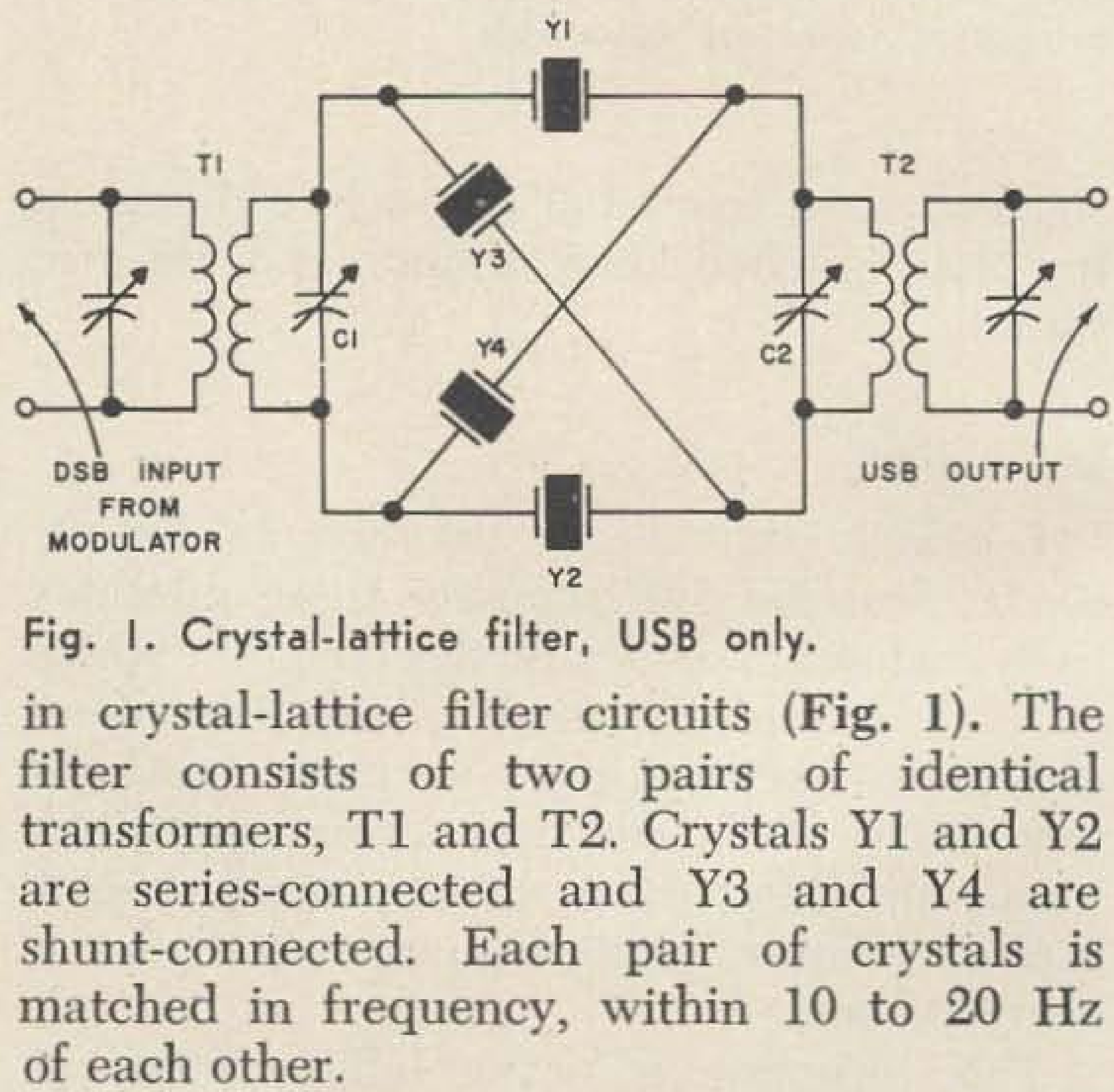


Fig. 1. Crystal-lattice filter, USB only.

With an intermediate frequency of 100 kHz and upper sideband frequencies of 100.1 kHz to 103 kHz, series connected crystals Y1 and Y2 are 100.1 kHz crystals and the shunt-connected crystals Y3 and Y4 are 103 kHz crystals. Input and output transformers T1 and T2 are tuned to the center frequency of the pass band (101.5 kHz) and act to spread the difference between the series-resonant and parallel-resonant frequencies of the crystals. Capacitors C1 and C2 are used to correct any overspreading of frequency difference under matched crystal conditions. The operation of the crystal-

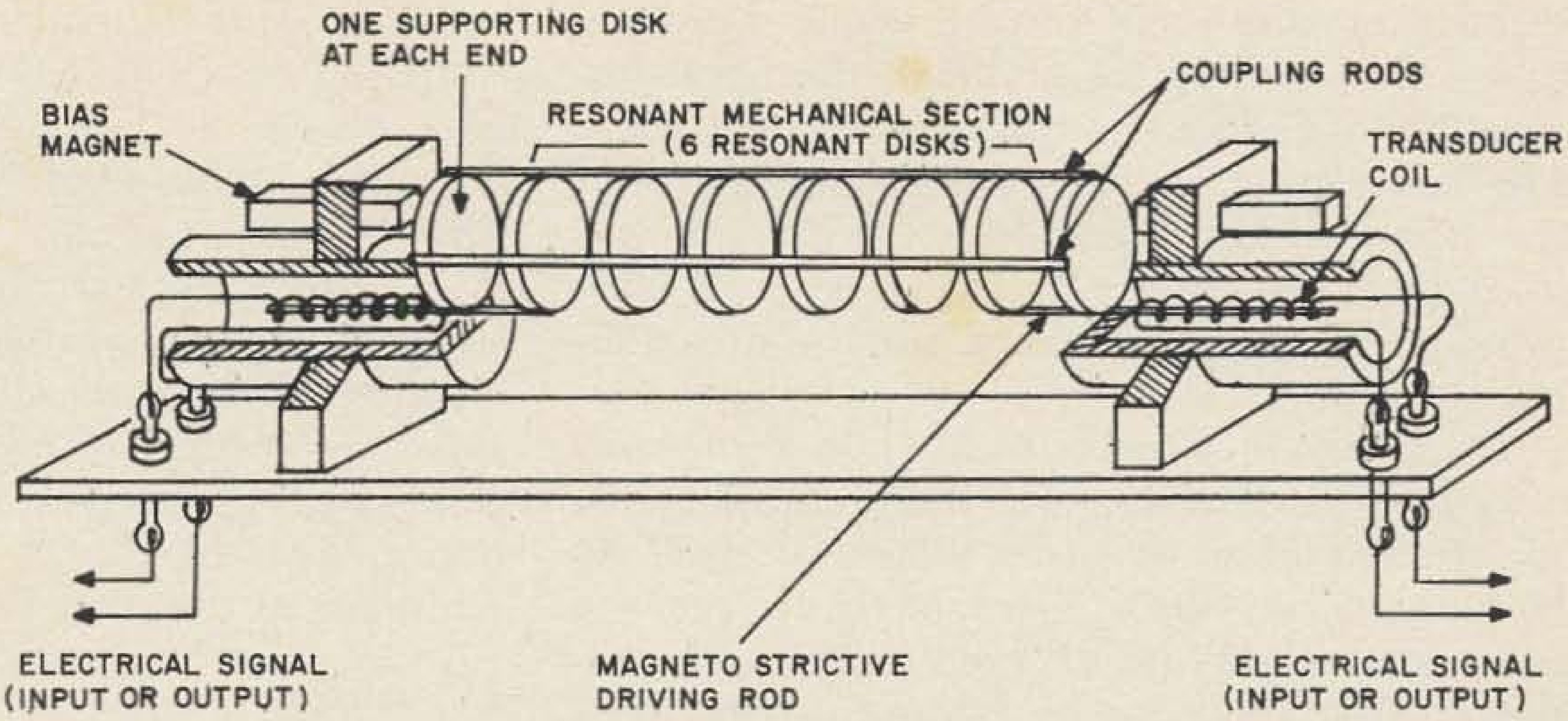


Fig. 2. Elements of a mechanical filter.

lattice filter is similar to that of a bridge circuit. When the reactances of the bridge arms are equal and have the same sign (inductive or capacitive), the signals through the two possible paths of the bridge will cancel out. When the reactances are of opposite sign, there will be a partial transmission through the network. The maximum is transmitted in the pass band at the points where reactances are equal in amplitude and opposite in sign. The insertion loss of a crystal-lattice filter varies from 1.5 dB to 3 dB.

Mechanical filters

The mechanical filter is a mechanically-resonant device (**Fig. 2**) which receives electrical energy at its input, converts it into a mechanical vibration, and then converts the mechanical vibration back into electrical energy at its output. The mechanical filter consists of four basic elements. The four elements are described in order along the signal flow path.

1. The input transducer coil, bias magnet, and magnetostrictive driving rod, which convert electrical energy input into mechanical oscillations (vibrations).
2. The mechanically resonant metal disks.
3. The coupling rods which couple the metal disks.
4. The output transducer coil, bais magnet, and magnetostrictive rod, which convert the mechanical oscillations back to electrical energy.

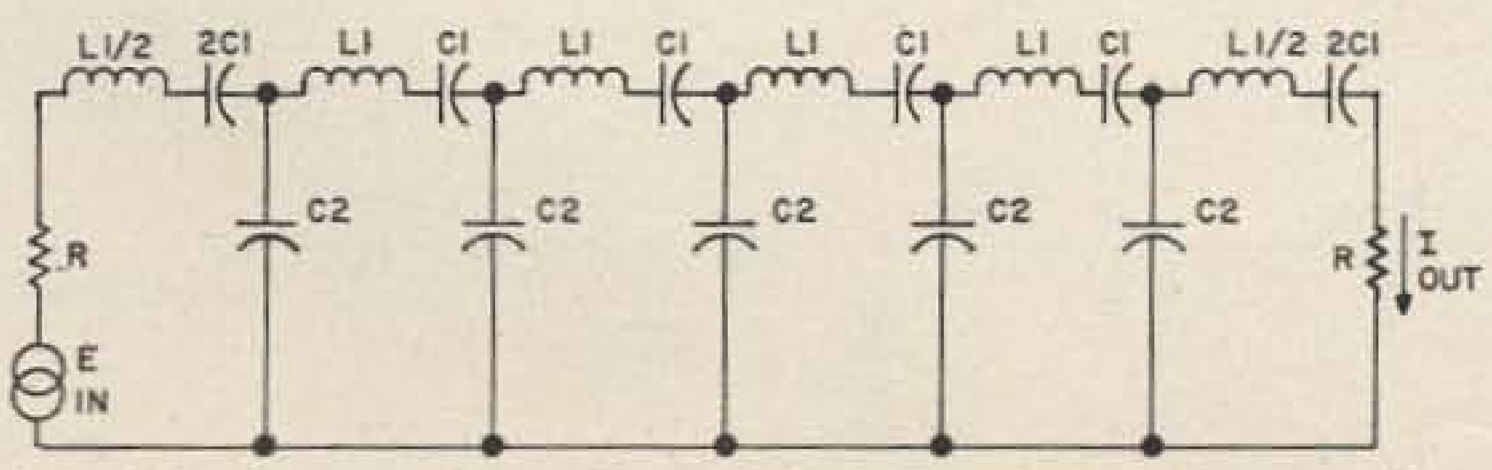


Fig. 3. Electrical analogy of a mechanical filter.

Series-resonant circuits L1-C1 represent the metal disks (**Fig. 3**). The coupling capacitors C2 represent the coupling rods, and the input and output resistances R represent the matching mechanical loads. From this equivalent circuit, it can be seen that the center frequency of the mechanical filter is determined by the series-resonant circuit

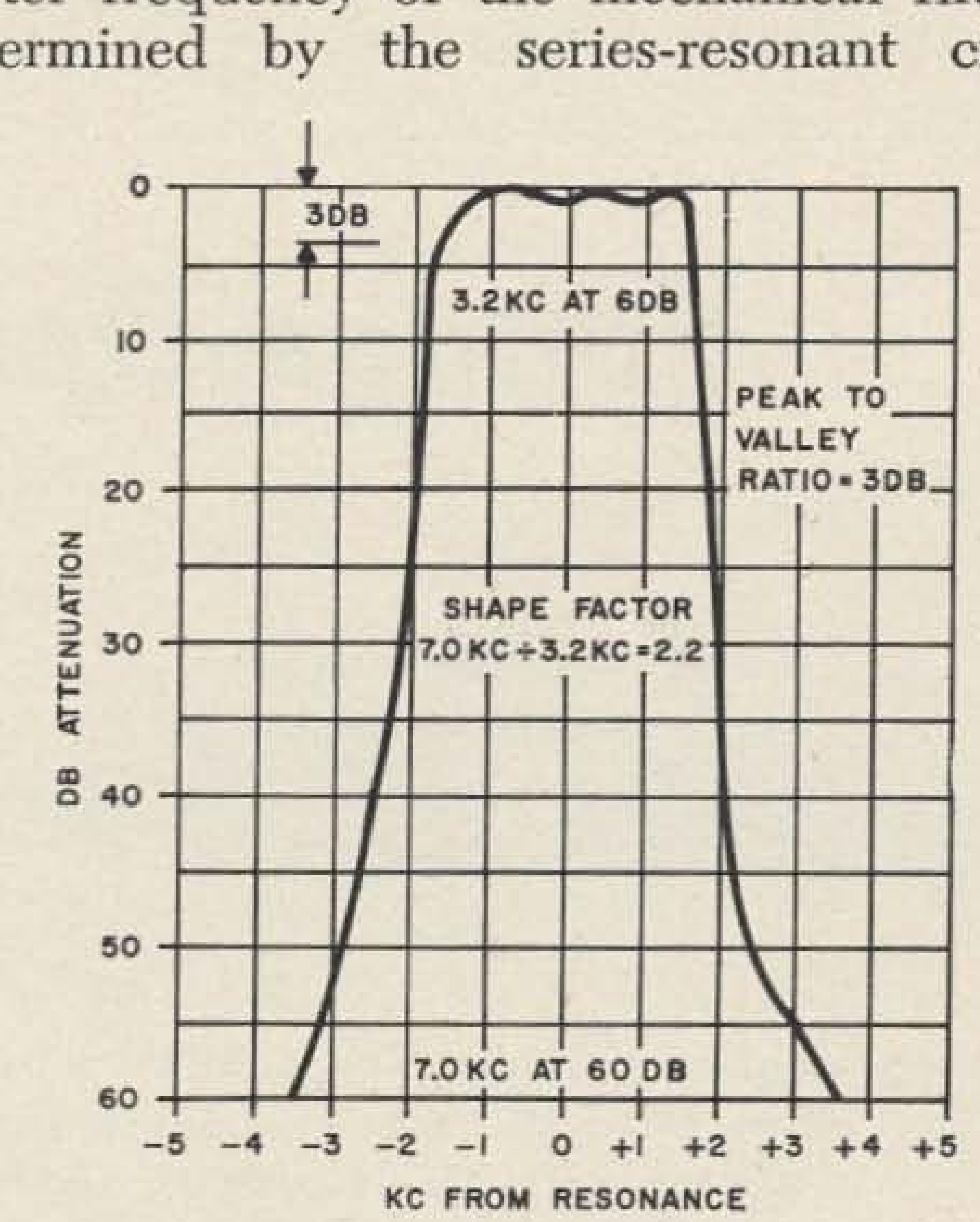


Fig. 4. Mechanical filter, characteristic curve.

formed by L1-C1, which represents the metal disks.

The transducers may be either magnetostrictive devices or electrostrictive devices. The magnetostrictive transducer is based on the principle that certain materials elongate or shorten when in the presence of a magnet field. Therefore, if an electrical signal is sent through the transducer coil containing the magneto-strictive material as the core, the electrical oscillation will be converted into mechanical vibrations of the core material. The mechanical vibration then drives the mechanical elements of the filter. The electrostrictive transducer is based on the principle that certain materials, such as piezo-electric crystals, will distort when subjected to an electric field. In practice, the magnetostrictive transducer is more commonly used. The transducer converts electrical energy at the input to the mechanical filter and acts in the reverse order at the output. It also provides proper termination for the mechanical network.

Each disk in a mechanical filter represents a series resonant circuit; therefore, increasing the number of disks increases skirt selectivity of a filter. The shape factor, the ratio of bandpass 60 dB below peak to bandpass 6 dB below peak, determines the skirt selectivity (**Fig. 4**). Present filters have a limit of eight or nine disks. A six-disk filter has a shape factor of approximately 1.85; a nine-disk filter has a shape factor of approximately 1.5.

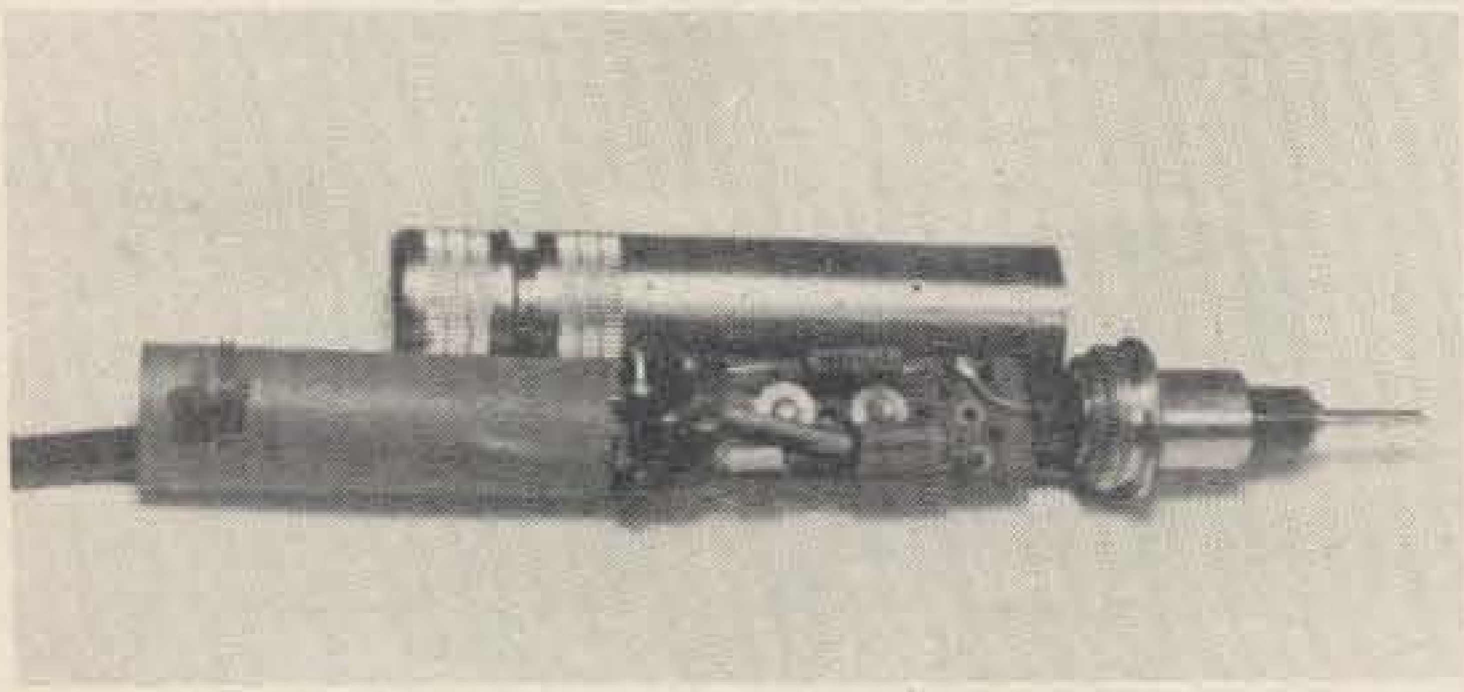
Coupling capacitors C2 (**Fig. 3**) are the equivalents of the coupling rods which couple the disks. By varying C2, the bandwidth of the equivalent circuit is changed. Variation in thickness of the coupling rods also effects the bandwidths of the mechanical filter. The characteristics of an ideal filter would include flat bandpass. However, for practical application, this ideal situation is not attainable. The bandpass characteristic of the filter is termed "peak-to-valley ratio". The peak-to-valley ratio is defined as the ratio of maximum-to-minimum level of the ripple across the useful bandpass of the filter (**Fig. 4**).

LC filters

LC filters have been used at *if* frequencies in the region of 20 kHz. However, generation of the SSB signal in this low frequency range requires an additional mixing stage to obtain a transmitting frequency in the high-frequency range. For this reason LC filters have had relatively little application.

. . . WB2GYS

Voltage-Doubler RF Probe



The voltage-doubler rf probe. This unit is built into a Mallory 100-A extension jack. The probe end is made from a Klipzon #33-402 BU with an earphone tip jack cemented into the test prod.

The following is a description of an rf test probe which can be used to detect very small rf signals in a receiver *if* strip. It will detect signals which do not give any indication on a regular one-diode test probe.

The probe can be made with parts obtained in any radio store. It is built into a Mallory 100-A, two-way extension jack used for earphones. The container is a two-piece nickle assembly with built-in clamps and an insulated paper tube which will slide over the parts to prevent shorts to the shell. It costs $1.50.

The hole where an earphone plug is normally inserted is reamed out with a number "J" drill so that a black bakelight Klipzon test probe fits tightly (Klipzon #33-402 BU). The self-holding point was removed because the series capacitor could not be soldered to it, and was replaced with an earphone tip. If the exact drill is not available, any error in assembly can be corrected by cementing the parts.

The diodes, capacitors and resistor were mounted on perforated board using small rivets. The whole assembly was attached inside the jack housing after removing the insides. The rugged construction of the probe is highly satisfactory for bench work because it can be dropped without damage.

Signals from the probe can be fed into a VTVM on the low volt scale for sensitive measurements. The reading of the VTVM will be a peak-to-peak voltage reading of the rf signal being detected. It is very valuable when tuning up a single-sideband transmitter signal coming through the filter; in fact, it is hard to get along without one.

. . . W6BLZ

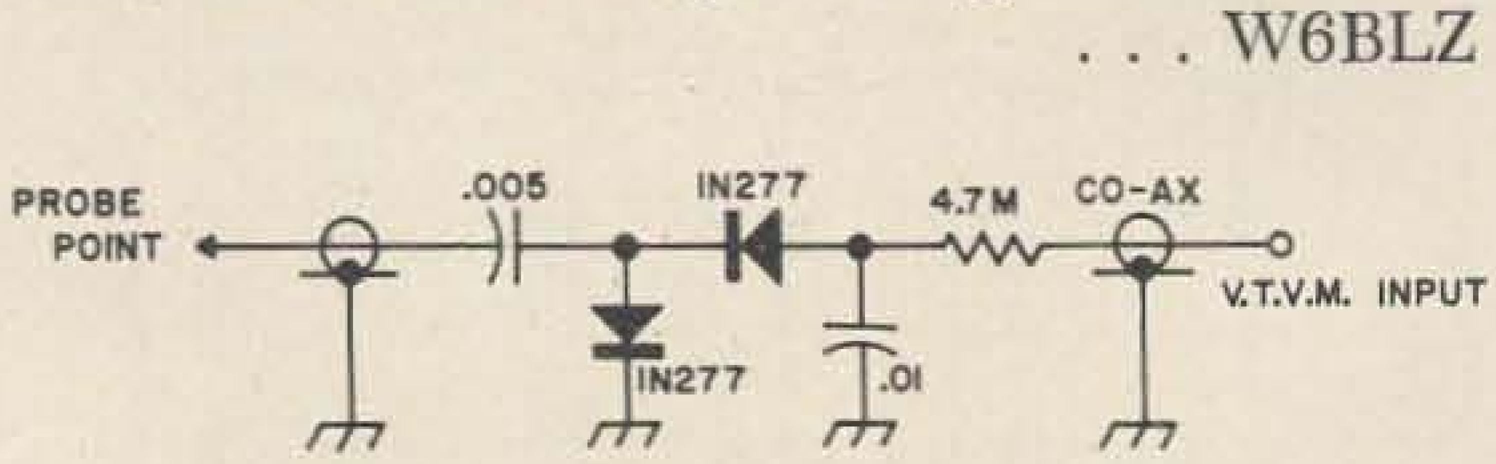


Fig. 1. Schematic of the voltage-doubler rf probe.

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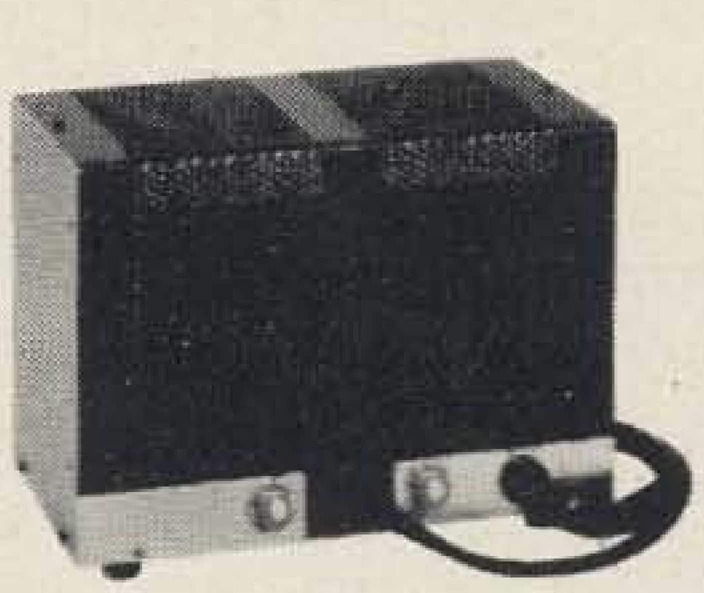

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The Two-Meter Groundplane as a Gain Antenna

A groundplane is a unity-gain, omnidirectional antenna.

So much for Lesson 1. The meat of this article, Lesson 2, will shoot down what you learned in Lesson 1. Because virtually any vertically polarized omnidirectional antenna can be used to provide gain and directivity *selectively*—without modification of the antenna itself.

To many, a true omnidirectional antenna represents the optimum approach. For the amateur who operates in the center of a metropolitan area, or the hilltop ham, or the centrally located net control—what could be better? But—what about the guy who lives between two cities and wants good, broad coverage in only two directions? Or the fellow at the foot of the hill who wastes all that rf by dumping half his output into it?

An omnidirectional antenna can still be the answer, but employed to provide gain where the action is.

The secret is not in the antenna itself, but rather in the mounting of the antenna. *Don't mount it atop a mast.* Place it near the top of a mast or tower, and adjacent to it so that the tower or mast itself becomes a part of your antenna system. Learn two simple rules and you can design your omnidirectional antenna to give gain in practically any direction or directions you choose: The first rule is that for each quarter wavelength you space the vertical radiator of the antenna from the tower or mast, you get one major lobe. And the second rule: The bigger the mass of the supporting structure, the wider the frontal and side lobes. Consider the radiation pattern of **Fig. 1.** The solid round dot at the center represents an antenna supporting structure. If an omnidirectional antenna were mounted at the top of the structure, the pattern would be roughly circular. The broken line represents this pattern at a relative field strength of 1.0. If the same antenna were to be moved from the top to the front of the tower and spaced a quarter wavelength from it, the pattern becomes more or less like that of the heavy asymmetrical line. (This is assuming the tower is between eight inches and a foot in diameter adjacent to where the antenna is mounted.) In the sketch, the antenna is represented by the small circle above the center dot.

As shown, the result is an excellent 180-degree signal with no wasted rf off the back. And the bonus is a 30-percent increase in signal strength over 150 degrees of that half-circle. Naturally, this city-side amateur isn't getting something for nothing; whatever he gains in one place, he loses in another. This can be demonstrated by thinking of the broken line in the sketch as a closed loop of string. You can manipulate the string and change the configuration of

λ/4

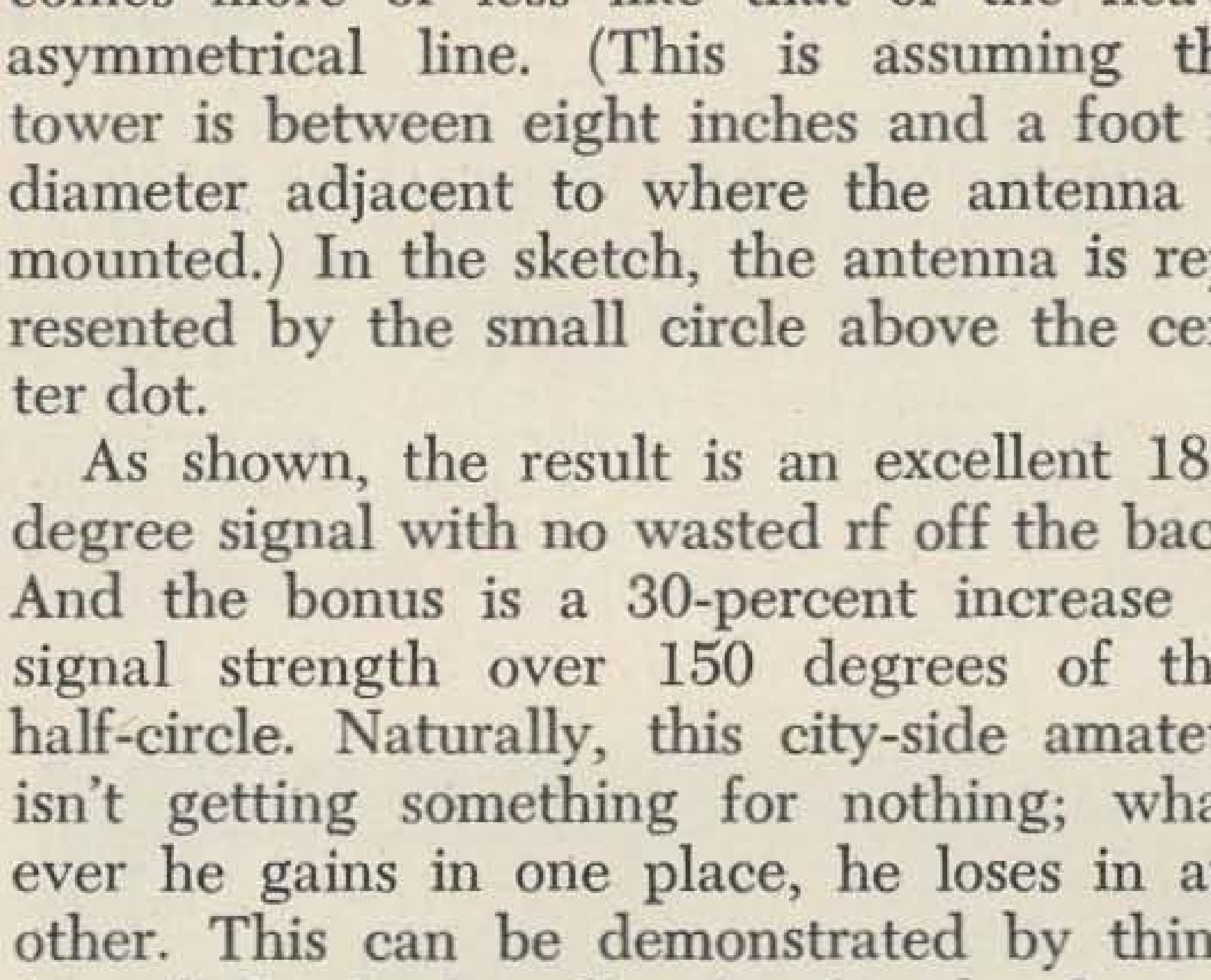

Fig. 1.

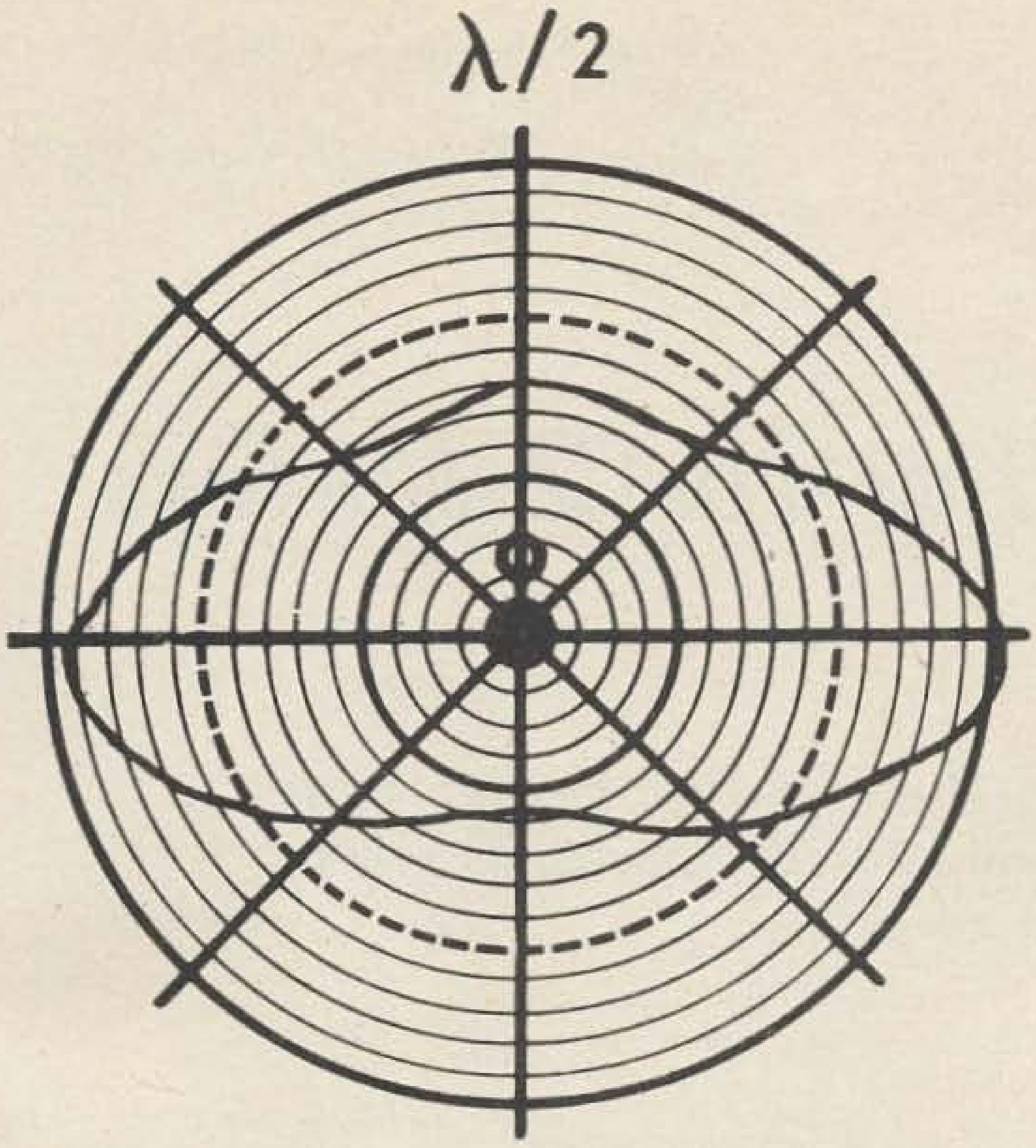

Fig. 2.

it, but for all practical purposes, the size remains the same.

For the amateur who wants good coverage in two general areas spaced roughly 180 degrees apart, the best approach would be to mount the antenna a full half-wavelength from the support structure. A typical radiation pattern from this mounting method is shown in **Fig. 2.** It should be borne in mind that the mass of the tower affects the pattern substantially. A mast would yield a pattern with sharper, thinner lobes—more gain at the expense of horizontal angle of radiation. The half-wave pattern shows that the signal is reduced by 20 percent (from a top-mounted vertical) in a 90-degree area off the front of the antenna, and by about 35 percent in a 60-degree area off the back. But it is increased by as much as 150 percent laterally.

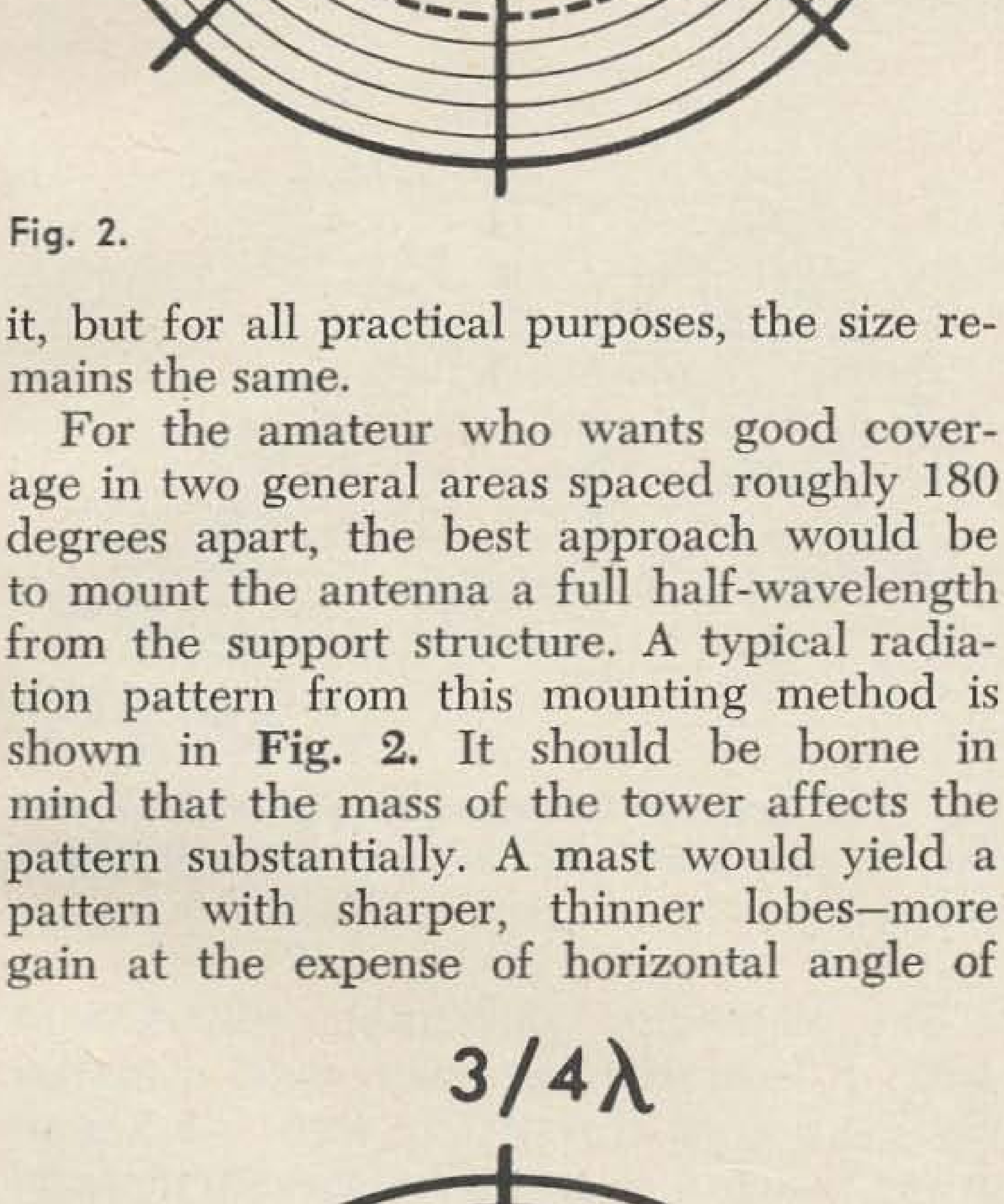

Fig. 3.

A sort of cloverleaf effect can be obtained by spacing the antenna three quarter-wavelengths from the tower. As shown in **Fig. 3,** it results in a very broad frontal lobe with uniform gain over about 80 degrees. The two nulls slightly forward of both sides is compensated for by the gain just rearward of both sides.

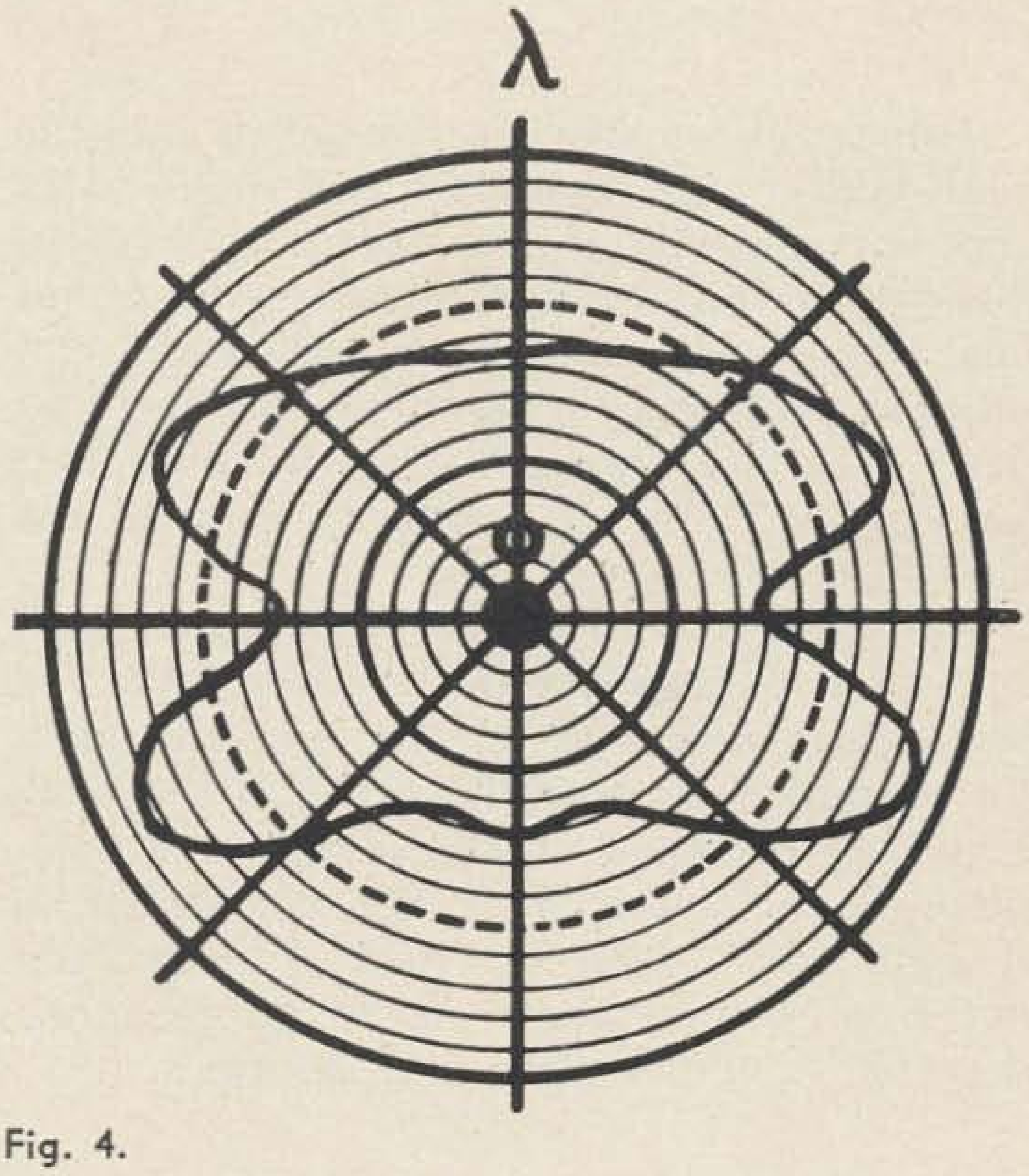

Fig. 4.

It is probably impractical to consider mounting the antenna more than three quarter-waves from the tower. On two meters, a full wavelength would be in the neighborhood of six feet. But the sketch of **Fig. 4** gives a pretty good idea of what the pattern would look like.

The important thing is that the theory is not restricted to any frequency. The patterns remain the same regardless of whether the operation is on six meters or 420 MHz. And the radiation patterns gradually shift from one to the other, so by experimenting with varying spacings, practically any desired effect can be achieved.

. . . K6MVH

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R.F.D.
Peterborough, New Hampshire 03458

RF Insertion Amplifier for 2 Meters

If you're having trouble driving that final on two meters, try this insertion amplifier. It will provide up to 20 watts output with a minimum amount of drive.

Things get tough when you get up into the VHF-UHF range. You often get to 144 MHz and find everything running nicely, except that you haven't enough power to drive that final. You even thought about using two tubes in push-pull for the final, but now you don't even have enough drive for one. This has happened to me plenty of times in the last thirty years.

An insertion amplifier can be a good answer. It works just like the name says. You insert it between the exciter and the final, for example, to boost the drive to the final. You can also use it in the design of a complete rig, of course. This one will accept an rf input from ⅛ watt to a watt or so, and put out from several watts up to 20 or more, depending on the drive and dc input.

The 8156 as an insertion amplifier

The 8156 is the baby brother of the 7984. Both are G. E. tubes and my favorite tubes for 2 meters. They are both rated for use up to 175 MHz. My only complaint is that while the 7984 costs $5 and puts out 50 watts, the 8156 costs $4 and puts out only 20. The 8156 is hard to beat at this price.

If you are interested in an amplifier with lots of gain which will put out 20 watts on 2 meters and has a lively plate dip, this is it. See **Fig. 1.** Another attraction is the socket. It uses the same connections as the 7984. It is also very sensitive to small signals (transmitted) and can be made part of an exciter if you wish. It should, perhaps, be attached to the final, though, as it has a 12-volt filament.

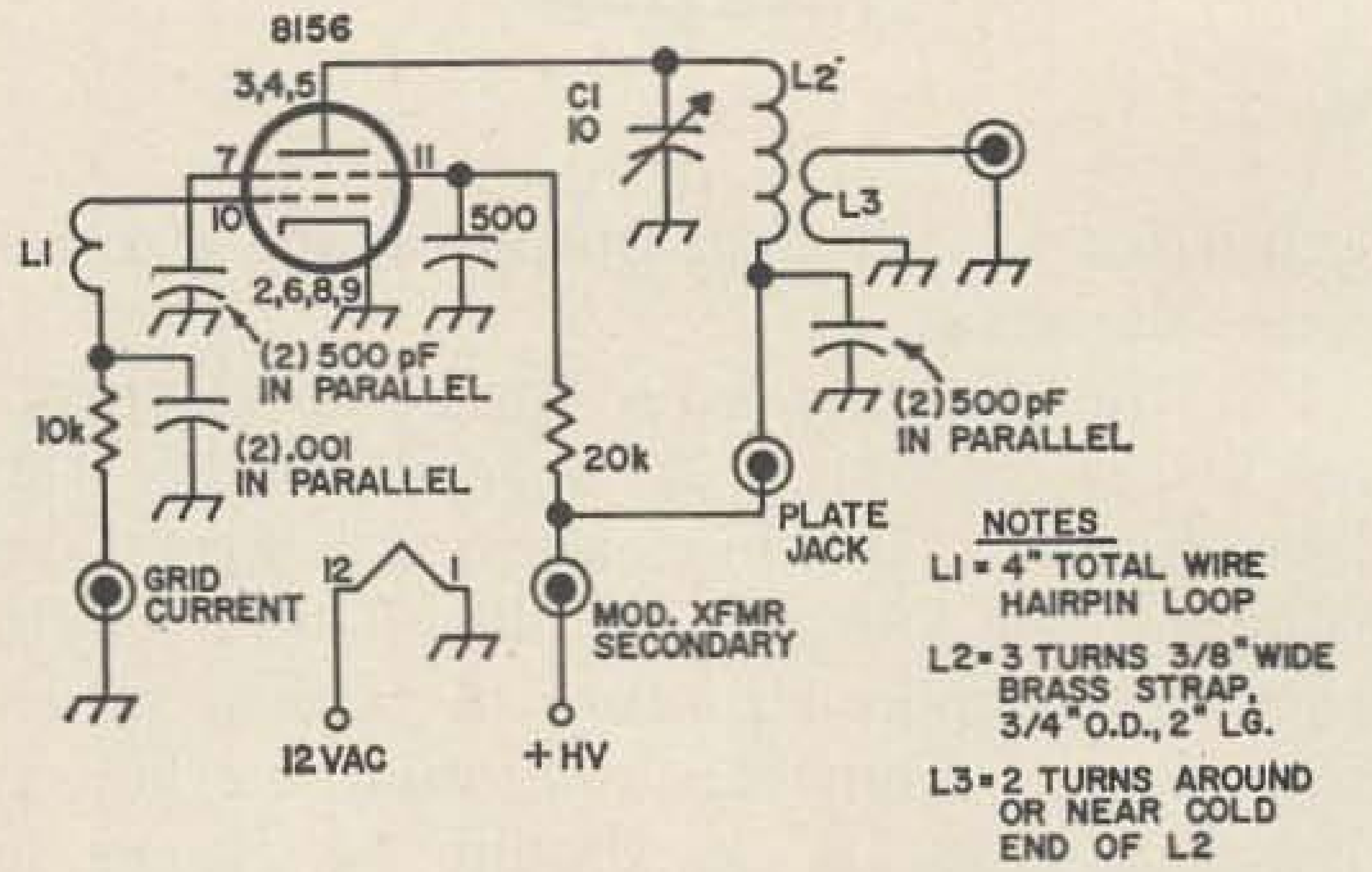

Fig. 1. If you are interested in an amplifier with lots of gain which will put out 20 watts on 2 meters, this is it.

The plate dip, when using only ¼ watt drive, is from 100 mA down to 35 mA. You can get a good 6 watts out from the ¼ watt drive; which is a gain of some 24 times in power. If you push it, the gain and efficiency will both go up. At 20 watts dc input, the output is almost 10 watts. This is not maximum efficiency, but we are only concerned with an insertion amplifier for step-up purposes from a low-power exciter.

For most applications in driving a final amplifier in the 50 to 100 watt range, the rf power output from the 8156 will be plenty. You can go from a watt or so up to 20, which is very useful. You can also modulate it for use as a low power transmitter, using it for 5 or 10 watts output until you can get that 25-watt modulation transformer and the 50-watt final.

You can put a 7984 directly into the socket of the 8156, but you will have to shorten the grid loop a little. That's about the only change needed. The plate has a little higher capacitance also, but should stay in the 10 pF range of C1.

One note: *do not use one of those black molded-mud sockets on 2 meters.* I keep talking about these things, and yet time and again, I get stuck with one. Low-loss 12-pin sockets just aren't available in the stores. So, I put in a "black" socket, and what trouble *that* gave me; I spent more than 2 days trying to get a decent plate dip. You understand that when I talk about a plate dip, I am using this as a reference for a high Q plate circuit. If you leave the drive and tube voltages alone, the dip will be a direct indication of the Q of the circuit. There is a lot more to this, of course, but this will give you over 95% of the desired test results.

Almost desperate, I finally had the luck to hear a little crackling noise and see a thin line of blue smoke rising up from the vicinity of the plate side of the socket. Pushing the plate and screen voltage up, and leaving the plate dipped so that a maximum of rf voltage developed between pins 3, 4, and 5 (all plate pins), and the grounded socket rim, an arc soon developed and that was that. You should see that socket. It looks as if you had held a match under it.

Taking one of the more low-loss 12-pin sockets out of a perfectly good piece of low frequency equipment in the shack, I replaced the black one. Without any other changes, the plate dip went from 70 mA (out of 200) down to 50 mA. Some difference!

Now things began to move. I could get a 50% plate dip with only 150 volts on the plate. And, about 50% efficiency with about 10 watts out. Note that is with only ¼ watt of drive. No self oscillation occurred at any time using the low-impedance type L1 on the grid.

I was now able to find out exactly how much drive the big final needed for absolute maximum rf out, by controlling the plate voltage of the 8156, and also could run my crystal vfo exciter at very low, stable power.

As a final check; there is now a nice plate dip of from 100 mA down to 35 mA. This is good.

The 5763 as an insertion amplifier for 2 meters

If you have some 5763 tubes on hand, they will do the job for you; though not as well as the 8156. The 5763 is indicated for maximum ratings to 50 MHz. But, let's see what it can do in spite of that. A number of days on the bench were the result of that decision. I could get a power gain of between 10 and 15 under certain conditions, but it seemed reluctant to "go" on 2 meters. Working carefully with the grid and plate circuits, the best plate dip I could get on 2 meters with about ½ watt drive, was from

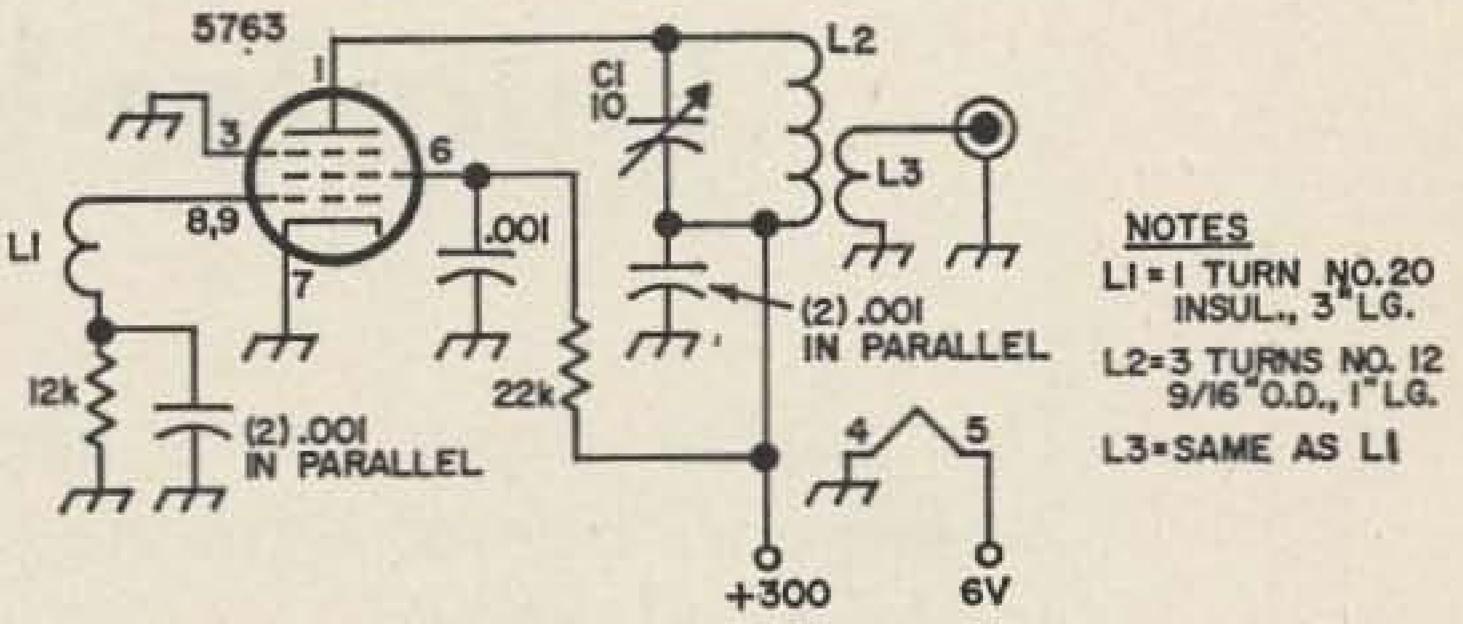

Fig. 2. Using the 5763 as an rf insertion amplifier for 2 meters. You may have to boost your power to get sufficient drive.

40 mA down to 34 mA, and about 1.5 watts out.

The poor plate dip on resonance seems the best indication of its sluggishness on 2 meters. If you have some 5763 tubes available and don't feel like getting an 8156 just yet, you can use the 5763 and perhaps boost your power enough for the drive you need. **Fig. 2** shows the circuit; which is not complicated.

Pay attention to the grid circuit, though. I spent lots of time on this one, and another like it for the 8156. I was able to set up a 2-meter tuned-grid circuit in spite of the large input capacitance and lower frequency ratings, but when using a tunable-grid circuit, more grid current was lost on applying dc screen and plate power than with a fixed tuned 11, and, even worse, self-oscillation showed up. So, I went back to the grid loop. The entire "grid coil" is a single piece of wire 3 inches long and bent into a U.

This does not allow for a cable link from the exciter, but I have not been able to get a cable link to equal the efficiency of the close-coupled low-impedance loop feeding directly into the grid.

This unit, with 250 volts on the plate and 40 mA of current, will put out a watt and a half, if everything is tuned up properly. It is a useful piece of equipment, but I'm afraid that today the 5763 is a little out of date for VHF.

The 8156 unit is far superior.

. . . K1CLL

John Schultz W2EEY
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Mystic, Connecticut 06355

2 Elements Spaced a Quarter-Wavelength

The author describes a simple coaxial feed system for a 2-element beam antenna which allows simple electrical pattern selection.

The author desired a simple beam antenna for 15 meters which could be made from wire elements strung between some trees and still provide various directional patterns.

These requirements were satisfied quite easily by a driven, two-element array with quarter-wavelength spacing. Quarter-wavelength spacing of two driven elements represents a very interesting case because of the variety of directional patterns which can be obtained without any complicated impedance-matching problems. This is due to the fact that at quarter-wavelength spacing the impedance of each element is almost the same as its free-space impedance, while at closer spacings the presence of each element severely affects the impedance of the other element.

The three directional patterns which can be obtained from such an antenna are shown in **Fig. 1.** The cardioid patterns will provide gain of 4-5 dB while the bi-directional pattern in (c) of **Fig. 1** will provide about 3-dB gain.

The antenna which the author constructed for 15 meters is shown in **Fig. 2.** RG-59/U is used to feed each antenna as well as for the quarter-wavelength phasing section. RG-59/U was chosen because when the two feedlines are effectively paralleled by the pattern selector switch, an impedance of 36 ohms will result. When RG-58/U is used to the transmitter an SWR of about 1.5 to 1 should result.

Actually, the author measured an SWR of closer than 2.0 to 1, probably because of some slight mismatch between the RG-59/U and the dipoles. The 2.0 to 1 SWR should cause no difficulty as far as transmitter loading is concerned and the actual power loss in the short length of RG-58/U used between the pattern selector switch and transmitter is insignificant.

An alternative connection between pattern

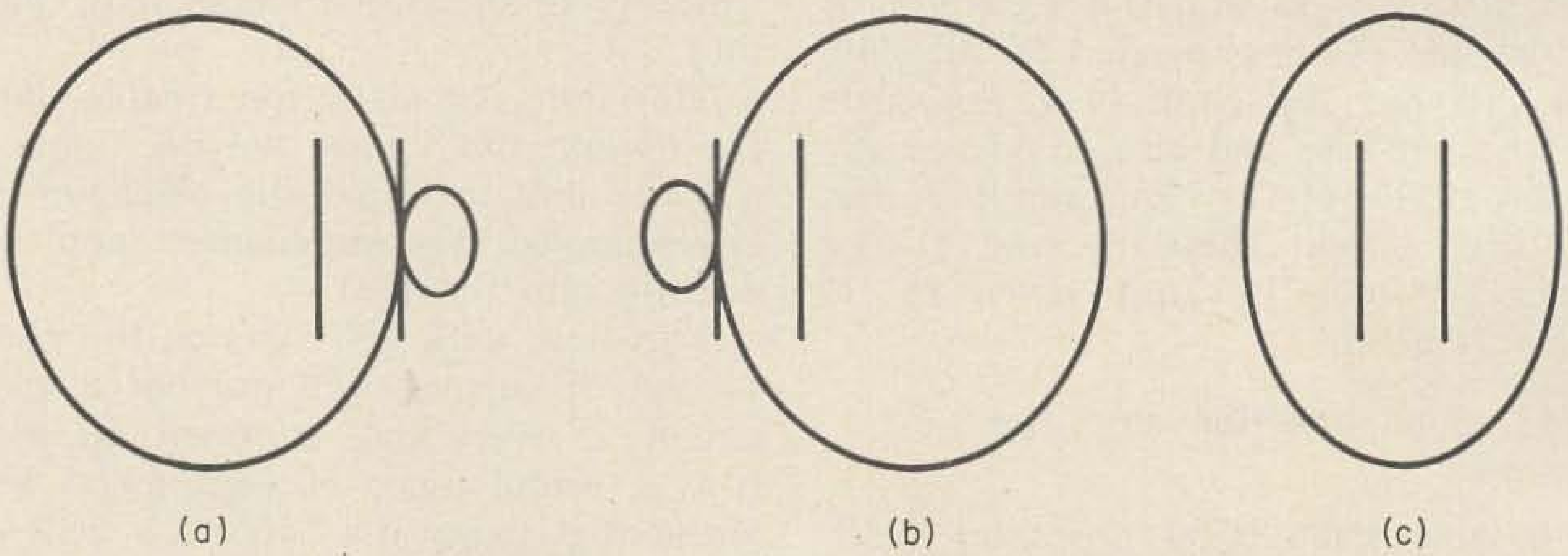

Fig. 1. A representation of the three directional patterns possible. (a) is the cardioid pattern obtained with a 90-degree phase difference between elements, (b) is the same pattern switched in the opposite direction, and (c) is the pattern of zero-degree difference between elements.

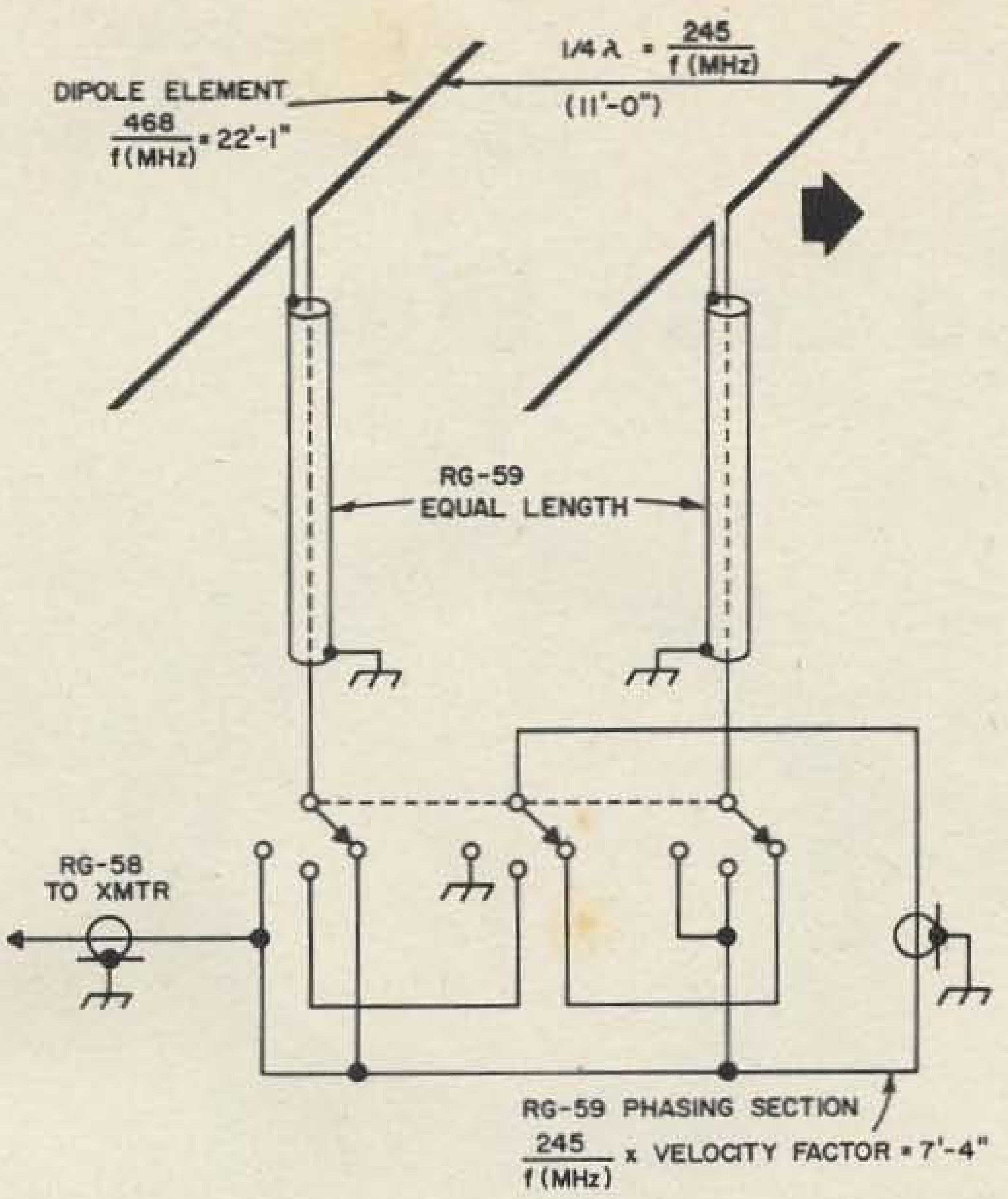

Fig. 2. The pattern selector switch. Maximum radiation is in the direction shown by the arrow for the switch position show. When the switch is in the bi-directional position, the antenna is also grounded through the quarter-wave phasing section as a lightning protection feature. The dimensions shown are for 15 meters.

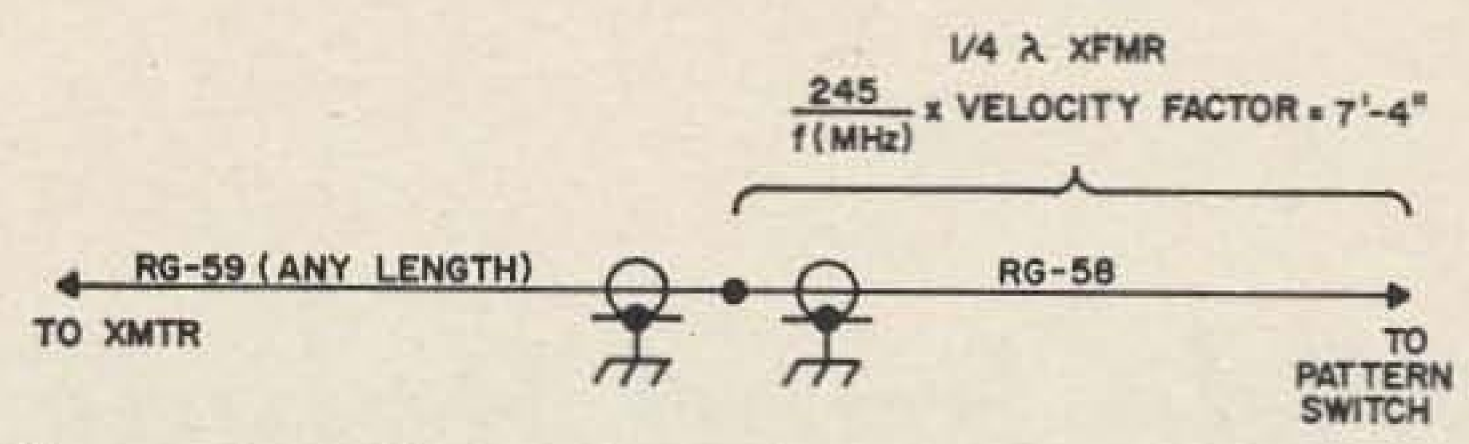

Fig. 3. An additional matching circuit which can be placed between the pattern switch and transmitter to improve the SWR. It replaces the RG-58/U phasing line shown in Fig. 2.

selector switch and transmitter is shown in **Fig. 3** for those who insist upon the lowest possible SWR.

The same scheme of feeding and phasing the antennas could be used with an antenna dimensioned for another band or with vertically oriented dipoles. For horizontal antennas, they should be elevated at least a quarter-wavelength to insure that the impedance of the dipoles is 60-70 ohms.

For someone who is just interested in a beam pattern in one direction, the simple feed system shown in **Fig. 4** can be used. The RG-58/U feedline should be limited to about 100 feet, however, because it may operate at an SWR of up to 2:1.

This type of antenna is certainly not new but the type of feed system devised by the author considerably simplifies construction. The directivity is not as sharp as a two-element parasitic-type beam but it provides almost the same gain in several directions at a minimum installation cost.

. . . W2EEY

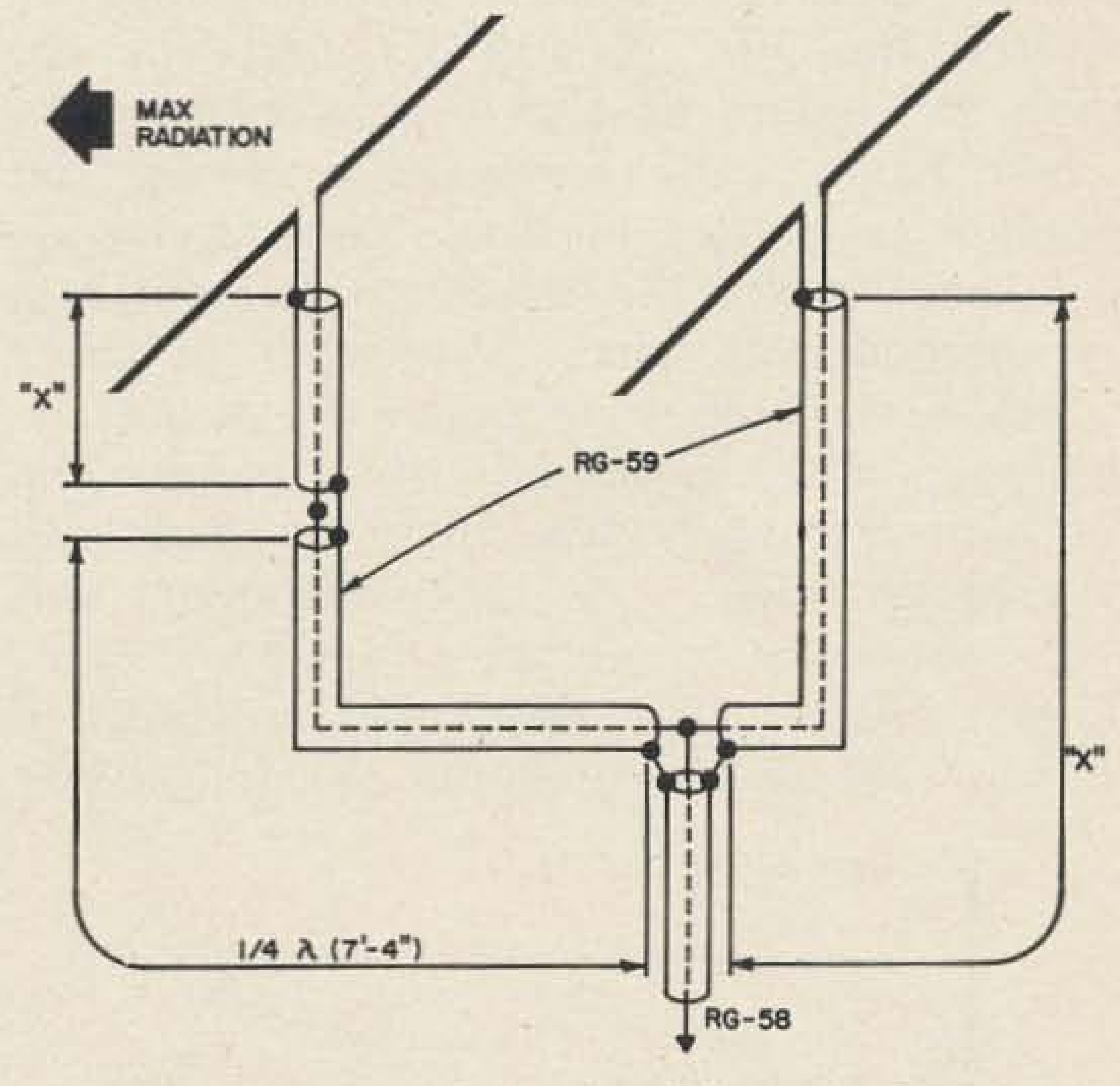

Fig. 4. Feed system for a fixed-direction beam pattern. The sections marked with an "X" are made up from RG-59/U and may be any convenient, but equal, lengths.

Hewlett-Packard Application Note

The new application from *H-P* entitled, "Step Recovery Diode Frequency Multiplier Design" (Hewlett-Packard AN913) should be very interesting to the VHF/UHF set. This note gives step-by-step procedures for designing UHF and microwave frequency multipliers. Examples describe design procedures for a X10 multiplier with an output of 2 watts at 2000 MHz, and a X5 multiplier with a 2000 MHz output of 5 watts (2304 MHz enthusiasts take note). Another example describes a X5 multiplier that achieves 10,000 MHz output at 180 mW.

This Application Note includes design aids in the form of full-page graphs that can be used to find the optimum circuit components. Methods of matching the multiplier input and output impedances to source and load are described and techniques for compensating the circuit for temperature changes are also discussed. For your copy, write on your company letterhead to Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304.

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Wide-Band Baluns the Easy Way

The desirability of using a network or transformer to feed a balanced coaxial line is well known and has been widely discussed. Single-band baluns have been well covered with this in mind. A variety of broad-banded, ferrite-cored baluns have recently come on the market. I had a need for such a 1:1 wide-band balun to go with a three-band antenna and none was immediately available; a little research produced a simple, cheap and easily constructed balun which met all of the requirements, electrically and mechanically. It covered the 40, 20, and 15 meter bands, using 20 meters as the design center.

Not having any formulas to cover the resonant frequency of scramble-wound coils of coaxial cable, the time honored cut and try method was used. A number of turns of RG-8/U cable were coiled up using the diameter of the desired finished balun. The resonant frequency was then checked with a grid-dip meter. A little trimming was then necessary to obtain resonance in the 20-meter band. The resultant coil consisted of ten feet of cable wound in five turns.

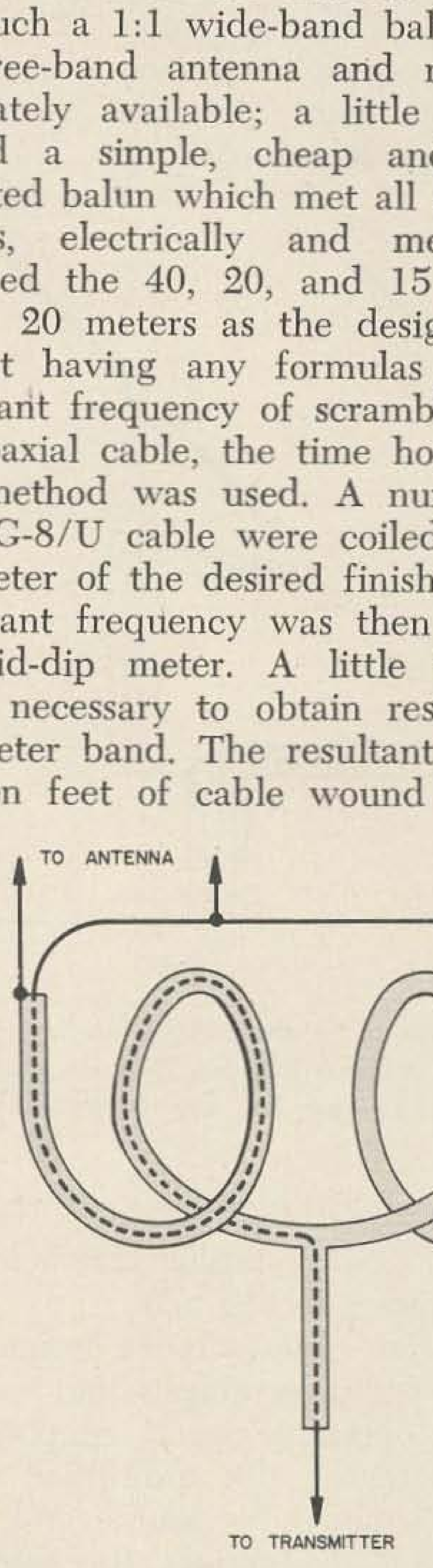
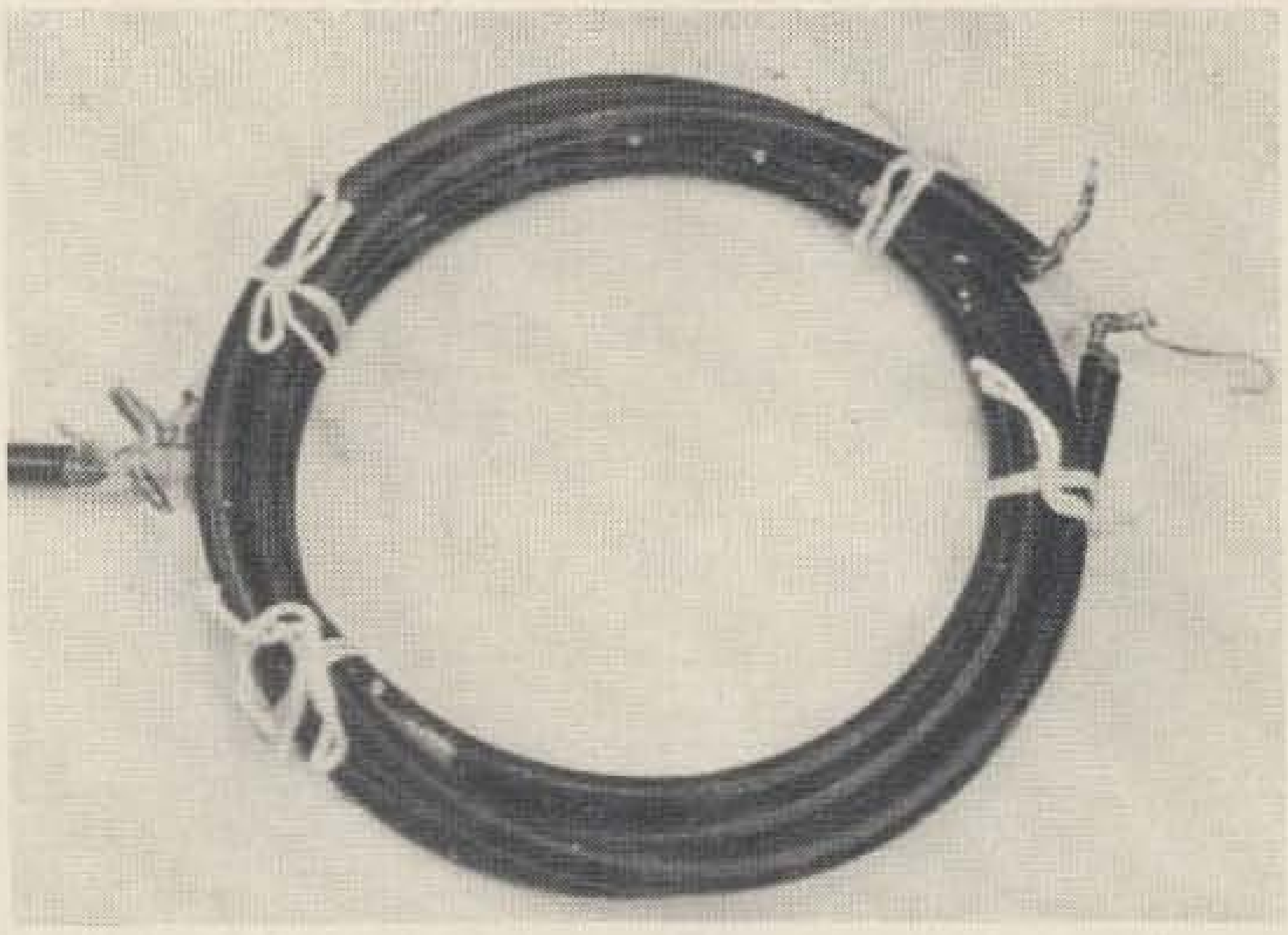


Fig. 1. The 1:1 balun constructed from a length of coaxial cable. When designed for the center of the desired frequency range, it will cover a 3:1 frequency operating range. The unit described here for 40, 20 and 15 meters consisted of two 66-inch lengths of RG-8/U.



The completed coaxial-cable balun used by K4ZZV on 40, 20 and 15 meters.

The odd number of turns were purposely worked out so that the center-tap feed point would come on the opposite side of the coil from the load point for mechanical reasons. The five-turn coil was then cut in half, and the inner conductor and the shield were connected according to the diagram and then recoiled. In actual practice, the original coil was scrapped and two new 66-inch lengths of cable were cut. This allowed for three inches to be skinned back on each end to make the connections and still maintain the original length. The joints were carefully soldered and taped to keep out the moisture. The coil was then bound with lacing cord, and it was ready for installation using the shortest possible leads to the antenna.

Measurements on the experimental 1:1 balun shown in the photo using a 50-ohm dummy load gave SWR readings of 1.34:1 on 40, 1.15:1 on 20, and 1.43:1 on 15 meters. This was considered reasonable so the finished product was installed at the antenna. It is still necessary to tune the antenna when using a balun transformer as it works much better looking into a non-reactive load. Its purpose is to take the rf off the shield of the coaxial feed line when feeding balanced antennas and make the antenna the only radiating device in the system.

. . . K4ZZV

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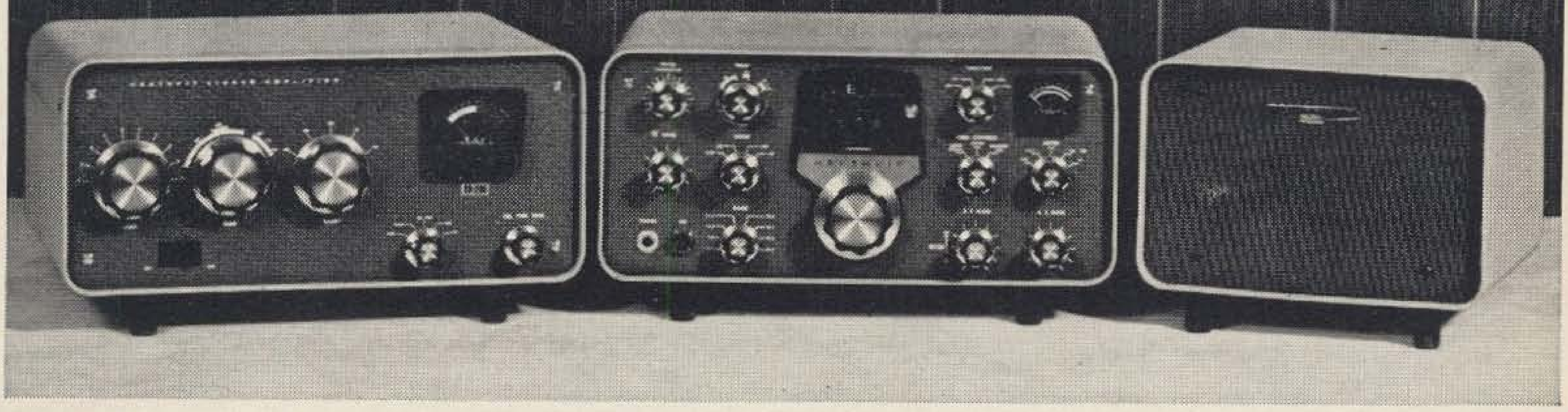

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Assembled SBW-101, 23 lbs., write for terms...... **$540.00**
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R. Steinberg, K6GKX,
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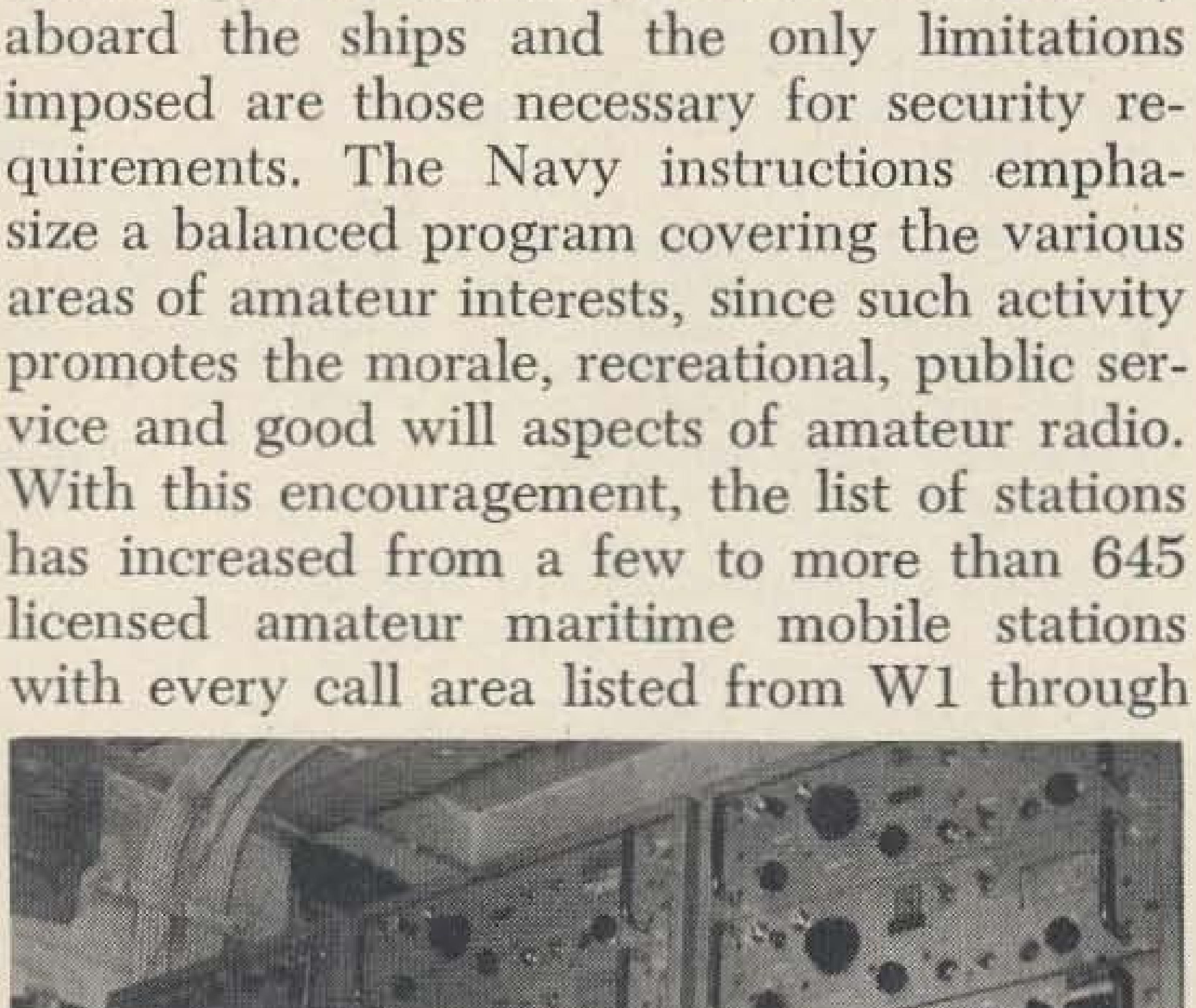
Hamming—The Navy Way

Radio amateurs are the same the world over but what does an amateur radio station mean to the men aboard our fighting ships of the U.S. Navy? The answer is told by the men who operate these stations and at the same time you will see some of the "shacks" and the ships they are on.

Back in the early 60's, amateur radio was only used by a few ships in the Navy, but today this has changed. Radio amateurs are encouraged to have amateur radio activity aboard the ships and the only limitations imposed are those necessary for security requirements. The Navy instructions emphasize a balanced program covering the various areas of amateur interests, since such activity promotes the morale, recreational, public service and good will aspects of amateur radio. With this encouragement, the list of stations has increased from a few to more than 645 licensed amateur maritime mobile stations with every call area listed from W1 through WØ; with some KC, KH, KL, KM and KZ prefixes included.



Official U.S. Navy photograph.

Ensign E. S. Gregg KIIJG setting up a phone patch in the communications center of the aircraft carrier *USS Princeton*.

With Long Beach being the home port of many Pacific Fleet ships, we were fortunate to see some of these maritime mobile stations; so let us take you on a tour to meet these amateurs and see their "shacks" and the equipment they use. Some "shacks" are large, some are small. The size of the "shack" and the limitations of space available depend upon the size of the ship. Some ships use commercial amateur radio equipment while others use the Naval radio equipment aboard ship; providing the equipment is operated within the F.C.C. rules regarding amateur operations. The commercial amateur radio equipment is purchased by the crews of the ships from the Recreation Fund; a fund derived from the profits of the Ship's Store and Soda Fountain.

As your guide on this tour we will go aboard several of the ships now in Long Beach and our first visit will be to the Amphibious Assault Carriers *USS Princeton* (her nickname is "The Sweet Pea"). The *Princeton* recently completed a deployment operation; and with her mission completed, the crew looked forward to homecoming. It was at this point that amateur radio entered the picture. The executive officer, Commander T. N. Thompson, a former commander of Little America in the Antarctica, well remembered the tremendous value of KC4USA in keeping morale high for lonely, isolated navymen. Commander T. N. Thompson asked for and received permission to commence amateur operations after leaving Hawaii. Ensign E. S. Gregg, the Education and Training officer, started operations on the amateur bands using his call, K1IJG/MM, with Navy communication equipment. Assisted by Air-man Apprentice N. D. Crouch, WA4BTO and Petty Officer D. Palmer, the results were so successful that over 150 phone patches were completed in a three-day period with calls going from Los Angeles to New York City. Some problems created by rapid changing skip were encountered, but so many landlocked hams offered to help out with the traffic that some offers had to be turned down. The entire crew was so gratified with the results that the Captain is now considering a request to purchase commercial amateur radio equipment in anticipated formation of a radio club and the building of a new ham station. This will increase the interest of radio amateur activities with more emphasis on phone patching.

The *USS Topeka,* a guided missile cruiser, is berthed close by, so let us go aboard and meet the two licensed radio amateurs: Chief Radioman Bob Middleton WA4RDE, and Lt. Pat Roth K3EUE. The present amateur radio station K3EUE/MM, was activated in March, 1967 and has worked three continents, twelve countries and 25 states. Many phone patches have been run for members of the crew from the ship to the Long Beach Naval Base Station, WB6GUI and the Westcar Amateur Radio Net, which specializes in phone patching. The Westcar Amateur Radio Net has stations from San Diego, California to Seattle, Washington always on standby to pick up traffic from Navy ships. The *Topeka* has had amateur radio activity since 1961 when it was attached to the Atlantic Fleet. When the ship was transferred to the Pacific Fleet, late in 1961, the amateur radio interest was so amazing that it served as the most effective single training aid for radiomen and electronic technicians. At this time, Chief Middleton now has a code and theory class of 25 prospective radio amateurs from the ship's crew, who will soon receive their F.C.C. amateur radio licenses.

Our next ship on the tour is the repair ship *USS Hector,* named after the famous Trojan Warrior. The *Hector* is a floating shipyard which is able to move with the fleet to any part of the world and is capable of repairing almost any equipment or part of any ship in the Pacific Fleet. Even though a busy ship, the "ham" actvities are not neglected. The radio amateur station WB6SUV, is under the supervision of Chief Petty Officer, Vic Jeter WB6SUV assisted by Chief Petty Officer Dave Wood WØJOB, and Petty Officer

Official U.S. Navy photograph.
Chief Radioman Bob Middleton WA4DRE, working some DX in the ham shack on the cruiser *USS Topeka.*

Paul Himmelberger K3THZ. The station started operations in April 1966 and has since been very active on all amateur bands. On a recent return cruise to the states the *Hector* amateur radio station made some 1200 contacts and handled over 500 pieces of traffic; many of emergency nature, for the ship's crew. The international goodwill aspects of amateur radio was not neglected with the station logging some 50 countries on all continents, and some mighty choice DX. The welfare and morale traffic was paramount and the *Hector* claims a first in that the station maintained schedules with her home port, Long Beach, from the start to the finish of the cruise. This was due in a large part to the efforts of the operators at the Long Beach Naval Base Radio Club Station, WB6GUI, who handled the traffic through that station. Radio amateurs are cordially invited to visit the *Hector* and the ham station at various ports-of-call along the west coast of California to Washington. It is possible to arrange for hams to come aboard for short cruises of a few days to see how the *Hector* operates at sea, and to observe maritime mobile operations.

Before continuing with the tour of the ships, let us look in on the Long Beach Naval Base Radio Club Station WB6GUI, which is the key station of communications for many ham stations aboard the ships. This station, under the supervision of the Special Services Department, started operations in 1963 and,

A busy night at WB6GUI, the Long Beach Naval Base Amateur Radio Station. Chief Vic Jeter WB6SUV of the *Hector* is at the Model 19 Teletype machine, while Seaman Gene Brockman WA9LRO, of the aircraft carrier *Yorktown* passes traffic.

since then, has handled thousands of phone patches and traffic for the Pacific Fleet. This station is for the licensed radio amateurs of the Naval Base and the fleet. When ships are in port, the radio amateurs of these ships operate the station when on liberty. Several hundred Navy men of all ranks have operated WB6GUI since the station was opened in 1963. Many nights they have spent hours upon hours of their own time to complete phone patches so that men at sea could talk to their loved ones at home. This is a rewarding experience for these men as they know someday they may be out to sea and wish to talk to their families. Phone patching is a prominent part of the operations of WB6GUI and the navy way is to say, "a job well done."

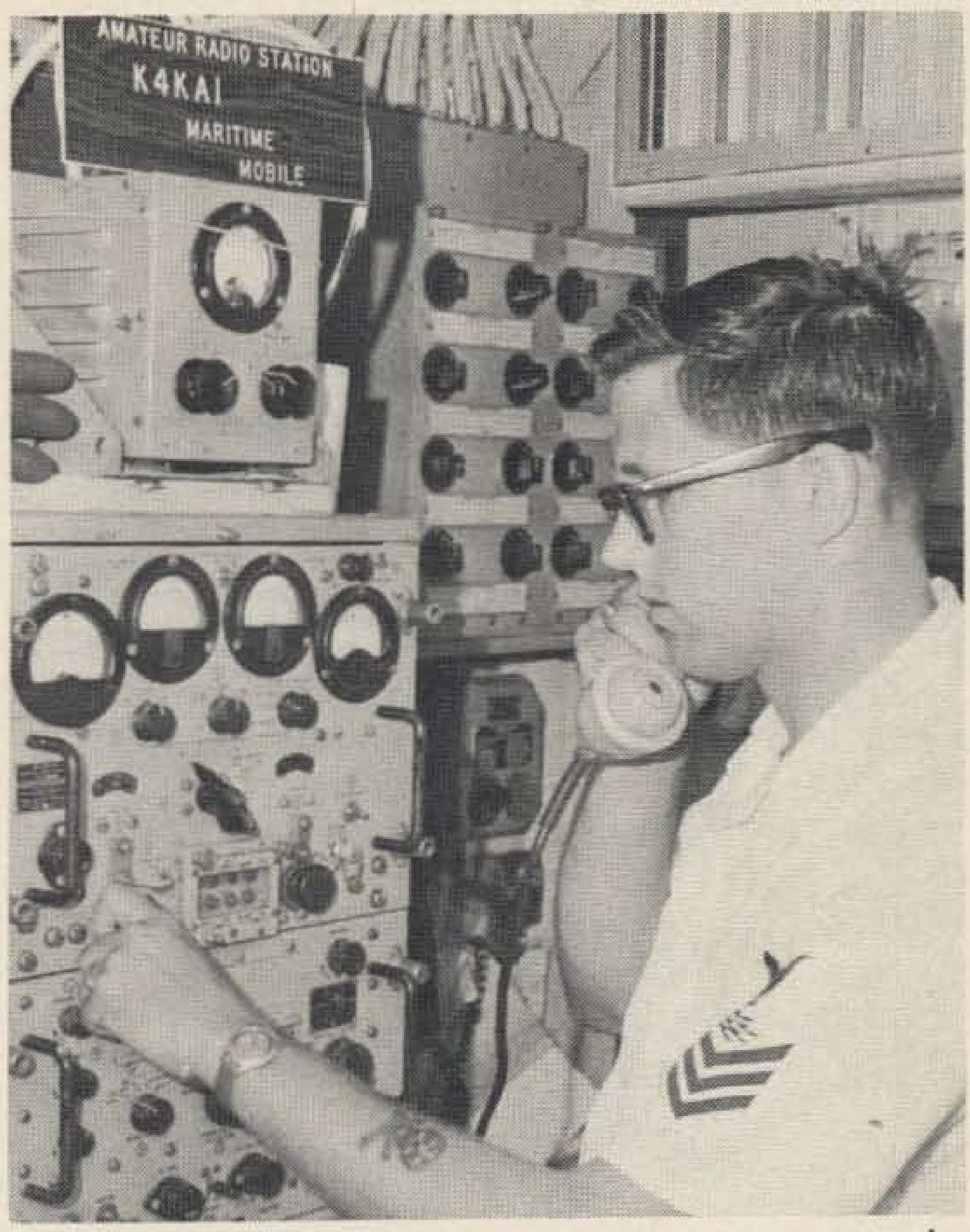
Now that our visit is completed at the Long Beach Naval Base Radio Club Station, WB6GUI, let us continue with the tour to the worlds first Nuclear Powered Guided Missile Frigate, the *USS Bainbridge*. The ham shack uses the ships navy communications equipment. There are three radio amateurs aboard, Radioman Charles L. Davis WA8BPY; Radioman Donald E. Atkins K5KLE; and Lt. Paul Johnson KØJWX. The *Bainbridge* has been a very busy ship in the western Pacific area and radio amateur activity has been very little. On their next cruise the station will be operating and looking for contacts to all parts of the world with phone patching included.

Docked close by is the destroyer *USS Edson*, so let us go aboard and see one of those "fighting greyhounds" and look in on the ham shack. Our visit was to see how radio amateurs operate on the smaller ships such as the *Edson*. To our amazement we found that even with limited space, the shack was as businesslike and efficient as in your own home. The *Edson* amateur radio station has been operating since January 1967, and it was thru the efforts and foresight of Lt. Commander C. J. Stuart K6AXY that amateur radio operations paid off when the ship returned from the western Pacific recently, and 120 phone patches were completed in four days. Chief Radioman Bob Sinclair KH6FLY, and Electronics Technician W. R. Waugaman ran the phone patches through the support of 28 land-based radio amateurs without any problems. This was the first time phone patches were made on the *Edson* and at first the reaction was indifference. During the earlier period of the phone patching, the operators had to look around in the crew to make a phone patch but two days later the crew were waiting in line to talk to relatives and friends back home. When KH6-FLY/MM was first opened earlier this year, the dx was from all parts of the world and in returning from the western Pacific recently, the station worked the North Pole, (weather station), Australia, South America and Alaska on both CW and phone. Nine states were also worked and four, Texas, Kentucky, Oregon and Washington, were worked on teletype. This is the first time, as far as we know, that teletype has been used from an amateur station aboard a navy ship at sea. The *Edson* is presently using Navy communications equipment for amateur radio on 10, 20, 40, 75 and 80 meters.

On this tour we have tried to pick out all size navy ships, from the big aircraft carrier down to the small minesweeper, so you could see and read about the ham operations on these ships. Our last visit on the tour is the ocean going minesweeper, the *USS Persistent*. Though small in size (170 feet long and approximately 20 feet across the beam), the

Persistent has an amateur radio station K4KAI/MM which can be heard frequently in any part of the world. It was activated in the latter part of 1965 and the communications equipment is both navy and commercial amateur radio. Very little activity was done on the amateur bands during most of 1966 as the *Persistent* was in western Pacific deployment. Upon completion of that assignment, radio amateur activities got under way when the ship was returning to her home port in Long Beach. K4KAI/MM, with Radioman Sam Yates, began phone patching for the crew. Many phone patches were completed with the help of the hams in the Los Angeles area. Some DX contacts were made on this trip but phone patching was priority.

We have reached the end of our tour of these several ships but the stories from the radio amateurs aboard the ships could be multiplied several hundred times by those amateurs on the ships we did not reach. It is a most significant factor that amateur radio plays an important part in the lives of our navymen at sea. The morale, recreational and international good will part of amateur radio is considered a necessary way of life for the men who roam the seas. The mention of phone patching in each of the ship's stories told here shows the importance to morale and the happiness loved ones get by these phone patch calls. Much credit should be given to the land-locked radio amateurs who night after night assist the ships with the phone patch traffic.



The ham shack and communications center on the minesweeper, *USS Persistent*. Radioman Sam Yates K4KAI at the controls.

Thanks to the Naval officers and navymen for their assistance in presenting this story.

. . . K6GKX

Maritime Mobile Ships

For those of you who are interested in handling traffic and phone patches for the many maritime mobile stations, here is a list of active stations in both the Atlantic and Pacific Fleets along with their call sign(s).

USS

ACME (MSO-5Ø8)	WØQQG
ADVANCE (MSO151Ø)	K3RYG
AFFRAY (MSO-511)	KØFZD
ALACRITY (MSO-52Ø)	K3AEP
ALBANY (CG-1Ø)	K3MDT, K9MWA, K4WOV
ETHAN ALLEN (SSBN-6Ø8)	WB6DCI
ALUDRA (AF-55)	K3YDB
AMERICA (CVA-66)	K3WUD, K3NLC, WA2SGC, K3PUP, K2LQQ, K6GEM
AMPHION (AR-13)	WA4UEJ
RICHARD B ANDERSON (DD-786)	WB6EXI, K4SVW, KØPAQ, K7OEG, K8ITC
ANGLER (AGSS-24Ø)	K1SDY
ANNAPOLIS (AGMR-1)	WA2FLB
ARCADIA (AD-23)	K1LZN, WB2FVX
ARGONAUT (SS-475)	W8CWE
ARNEB (AKA-56)	K3OYB
ASHLAND (LSD-1)	W8FZE
ASSURANCE (MSO-521)	WA4FIJ
ATAKAPA (ATF-149)	K3DTM
ATKA (AGB-3)	WAØHOT
AUSTIN (LPD-4)	W9AFH
AVENGE (MSO-423)	KØLBZ, W9AXX
BAINBRIDGE (DLGN-25)	W5SLG
BARRY (DD-933)	K1RUZ
BASILONE (DD-824)	W2B2TTS
BAYFIELD (APA-33)	K8LDO
BEATTY (DD-756)	K3QMF
BELKNAP (DLG-26)	WB6JTC, K5QFX, WA4SNB
BELLATRIX (AF-62)	WB6BRT, WA4BEW
BENNER (DD-8Ø7)	K5KWC, K1MEY
BENNINGTON (CVS-2Ø)	W5SKG
FRED T BERRY (DD-858)	K4OND
BIGELOW (DD-942)	WA2CEC
J DOUGLAS BLACKWOOD (DE-219)	K3SUC, W3GKQ, W3ELD

BLANDY (DD-943) WB2QCP
BLENNY (SS-324) W3YYZ
BON HOMME RICHARD (CVA-31) KØRWW, K6AYK, WA6BAU, WA8ICM
BOSTON (CAG-1) WA2BQO, KM6CI
BOXER (LPH-4) W4PJT
BRADLEY (DE-1Ø41) K6ZIC, K5UOD, K6AAG
CHARLES E BRANNON (DD-446) K7YMO
BRIDGET (DE-1Ø24) K9JII
BRINKLEY BASS (DD-887) K7BIK
BRISTER (DER-327) K8DJE
BRUMBY (DE-1Ø44) WA4OIV
BRUSH (DD-745) W9EPX, WB6FJY
BRYCE CANYON (AD-36) K5SLO, WA3BDP, WB6NJB
BUCHANAN (DDG-14) WØNHZ
BURTON ISLAND (AGB-1) WA4ZSU, WA8SEJ, KC4USI
BUSHNELL (AS-15) WA4YWF, W4PSZ, K4VWI, K3PCE
BUTTERNUT (AN-9) K9BFK
RICHARD E BYRD (DDG-23) K9KLO
CABILDO (LSD-16) WA6MVV
CADMUS (AR-14) W4WZN
CALCATERRA (DER-39Ø) K1ZBR, WA4JVL
JOHN C CALHOUN (SSB(N)-63Ø) WA4SOL, WA4SPW, WA4KTZ, K4VUF
CALIENTE (AO-53) K7LRX
CALVERT (APA-32) WA6LHK
CAMBRIA (APA-36) W2SLC
CANBERRA (CAG-2) W3UFM
CANISTEO (AO-99) K9KBI
CAPRICORNUS (AKA-57) WB2RAF
CARP (SS-338) K1UIH
CARPENTER (DD-825) K4PCF
CARTER HALL (LSD-3) WB6EHP
CASA GRANDE (LSD-13) K4JGR
CASCADE (AD-16) W9OVD, KØTNJ
CATAMOUNT (LSD-17) K8DEY
CAVALLA (AG(SS)-244) KØZMQ
CHARLES P CECIL (DD-835) K8ZHA
CHEMUNG (AO-3Ø) WA5IXB
CHESTERFIELD COUNTY (LST-551) K6RGO
CHICAGO (CG-11) WA4GMF, K1YCD, K7GBN, WA8CMW
CHIKASKIA (AO-54) W3IAM
CHIPOLA (AO-63) K5DIO, KH6EJR, K5FMD, KØOAQ
CHIVO (SS-341) W4VID
CHURCHILL COUNTY (LST-583) KZ5LB
GEORGE CLYMER (APA-27) WA7CZV, K8CRM
COATES (DE-685) W1IFO
COCHRANE (DDG-21) K6GIW
COCOPA (ATF-1Ø1) W6AAG
COGSWELL (DD-651) KL7EUQ, K7WYC
COLONIAL (LSD-18) WA6UJV, W4ZEH
COLUMBUS (CG-12) K5BWV
COMPAS ISLAND (EAG-153) WB2BTN
CONE (DD-866) K5HWH, WA2VCQ
CONSTELLATION (CVA-64) WB6BVQ, WA6SXV, W6CKO, WB4CJJ, K7LWY, W4NNC
CONYNGHAM (DDG-64) WB2OCK
COONTZ (DLG-9) KH6EEL
CORAL SEA (CVA-43) W9FGD, WA6ONO
CORRY (DD-817) K3GLX
COURTNEY (DE-1Ø21) WA2IQX
CROMWELL (DE-1Ø14) K6HAS
ALFRED A CUNNINGHAM (DD-752) WA2HZT, K5ECA
CUTLAS (SS-478) W2BAG
DAHLGREN (DLG-12) K8DMS, WA4LIG, KØOID, WA5CXH
JOSEPHUS DANIELS (DLG-27) WB6HWZ
DARBY (DE-218) W3BIV, K3BVE
DASH (MSO-428) WA2ELV
DAVIS (DD-937) WA1DAJ
DENEBOLA (AF-56) K9ZLE
DEWEY (DLG-14) W8CVJ, WA2TPQ, WA4VAI, K8EVS, K3CJG
HARLAN R DICKSON (DD-7Ø8) W1HHB
DIRECT (MSO-43Ø) WA4KJB
DULUTH (LPH-6) K7VSA, WA6NJS, WB6RTT, WAØBDI
DUPONT (DD-941) K2LUU, K4PSE
DUXBURY BAY (AVP-38) K3TUV
DYESS (DD-88Ø) WA1FKI
GEORGE EASTMAN (YAG-39) K4SBF

The first nuclear-powered guided-missile frigate, the *U.S. Bainbridge.* The ham shack on board uses navy communications equipment—Radioman Charles Davis WA8BPY, Radioman Donald Atkins K5KLE and Lt. Paul Johnson KØJWX are operators.

Official U.S. Navy photograph.

EATON (DD-51Ø) K4IOV
EDISTO (AGB-2) K1UFU
ELDORADO (AGC-11) K4AFS
ELOKOMIN (AO-55) WA3BXQ
EMBATTLE (MSO-434) KØKKW
ENDURANCE (MSO-435) K6ZQB
ENGAGE (MSO-433) WA6IQW
ENGLAND (DLG-22) WB6QPY
ENHANCE (MSO-437) WA4RKM
ENTERPRISE (CVA(N)-65) W7WFJ
EPPERSON (DD-719) K9WZL, KØFJX
ESSEX (CVS-9) W2IRI
ESTES (AGC-12) K2GIG
EVERGLADES (AD-34) K4TFE
EVERSOLE (DD-789) K9TQE
EXPLOIT (MSO-44Ø) K1YPG
FARRAGUT (DLG-6) K1KK
FORRESTALL (CVA-59) WA4UVR
FORSTER (DER-334) K6QWZ
FORT MANDAN (LSD-21) KØRYJ
FORT SNELLING (LSD-3Ø) WA1BSH
DOUGLAS H FOX (DD-779) W4ATT
MYLES C FOX (DDR-829) K1CTD
FREMONT (APA-44) W9PJK
FRIGATE BIRD (MSC-191) WA4OQB
FRONTIER (AD-25) WB6QLG, WB6ONN
FULTON (AS-11) K9HAI, WA1CME
GAINARD (DD-7Ø6) K1WHO
GALVESTON (CLG-3) WB6DCG
GARCIA (DE-1Ø4Ø) WA2DLT, W7HUO, W5BMS
THOMAS J GARY (DER-326) WA1FETN, WA1FRG, WA5OSR
GEARING (DD-71Ø) WA1BJH
GENESEE (AOG-8) K5HKK, K6LHC
HOWARD W GILMORE (AS-16) W4CSE
GLACIER (AGB-4) WA6QFT
GRAMPUS (SS-523) WA4UMA
GRAND CANYON (AD-28) K8ZPS
EUGENE A GREENE (DD-711) WA4HIX
GREENWICH BAY (AVP-41) WA4DRR
GREENWOOD (DE-679) W4KLB
GRIDLEY (DLG-21) WA7MEC
GUAM (LPH-9) WØGVH, K3KMS
GUNSTON-HALL (LSD-5) W7IIZ
GURKE (DD-783) K4UOM
GYATT (DD-712) K4BJM
HALFBEAK (SS-352) K1OKZ
HAMMER (DD-718) KØDNP, WB6NZF
HANSON (DD-832) W9BJT
HARTLEY (DE-1Ø29) WA1DAI
HARWOOD (DD-861) W1AFG
HASSAYAMPA (AO-145) K8WOW
HAWKINS (DD-873) KP4BPG
HAYNSWORTH (DD-7ØØ) WA5AXW
HAZELWOOD (DD-531) K8PXG
HENRICO (APA-45) WB6GMC
HERMITAGE (LSD-34) WB2HTG
HISSEM (DER-4ØØ) K60BM
HOEL (DDG-13) WB6RHO, WØRDP
HOPEWELL (DD-681) WA5BDR
HORNET (CVS-12) WA4EXJ, K4OCG, K6UPL, W4OUO, WB6RKM, WB6RCV, WA8NMT, WA5NRT, WA9QOJ
HULL (DD-945) K6HXV
HUNLEY (AS-31) W6HOM
ROBERT K HUNTINGTON (DD-781) K9WQK
HUSE (DE-145) W5LSD
HYMAN (DD-732) K8JIO
INDEPENDENCE (CVA-62) WØFPA, K4RSH
INGRAHAM (DD-694) W8VRR
INTERPRETER (AGR-14) K3YDV
INTREPID (CVS-11) K9JXV, K4YXK, WA4TTN, WA5ENI, K5GXR, K4MFL, K7PPW, K1YYJ
ISLE ROYALE (AD-29) K1FFC
IWO JIMA (LPH-2) W6BQM, K4PWE
JACK (SS(N)-6Ø5) W9FMO, K3SHA, W5DBC
JEROME COUNTY (LST-848) KH6EPA
DANIEL A JOY (DE-585) K8BBT, WØTZK
KANKAKEE (AO-39) WA1CRY, WA5BNH
KASKASKIA (AO-27) K3MTP, K4CCK
KEARSARGE (CVS-22) WA6KGG, W5ARZ, W6AJY, WAØNPY, WA6RIH, WB6CIK, K7ROP
WILLARD KEITH (DD-775) K4QDL
KENNEBEC (AO-36) WA4LWB
JOHN KING (DDG-3) K3UKE, WA8QBN, WA4GTA
KITTY HAWK (CVA-63) WA4OIV
KOINER (DER-331) WØLHG, K3ZZM
KRETCHMER DER-329) W4ZBF
JAMES E KYES (DD-787) K9BMH
LAFFEY (DD-724) WA8CND
LAKE CHAMPLAIN (CVS-39) KØDUG
EVERETT F LARSON (DD-83Ø) K6PKD
LASALLE (LPD-3) WA5HUR, K3OZD, KØBPH
LAWRENCE (DDG-4) K9ZMZ
LEAHY (DLG-16) W1UNV, WA4YAE
WILLIS A LEE (DL-4) K9JWV
LEXINGTON (CVS-16) K9IOD, K1GKM
WALLACE L LIND (DD-7Ø3) WA4SZI
LINDENWALD (LSD-6) W5HNE
LITTLE ROCK (CLG-4) K4JOH
LOESER (DE-68Ø) K8QMJ
LONG BEACH (DG(N)-9) WB6AKN
LOWRY (DD-77Ø) K9PAE
LOYALTY (MSO-457) K4KOI
ROBERT H MC CARD (DD-822) WA4MQZ
MC CLOY (DE-1Ø39) K1UGW, W1RHO
LYNDE MC CORMICK (DDG-8) K9TMH, WA6DDM
EDWARD MC CONNEL (DE-1Ø43) WA4UFD
MC MORRIS (DE-1Ø36) K6MUX
MAC CONOUGH (DLG-8) KØMOC
MAHAN (DLG-11) KØVVR, WA4DWD, W5DJQ
MANLEY (DD-94Ø) WAØFUU, WA5AXW
MARIAS (AO-57) WA9JSF
MARYVILLE (EPCER-857) WA3BIM, W6DLJ
MASSEY (DD-778) K2PQV
MAZAMA (AE-9) W4IKS, K4NTC
MEREDITH (DD-89Ø) K4HID
MIDDLESEX COUNTY (LST-983) WA9PWI
MIDWAY (CVA-41) K8NJU, WB6GGD, K5TLM, KØPHX, K1OTI
MILLS (DER-383) WQ2WAI
GENERAL WILLIAM MITCHELL (T-AP-114) WA5JLU, WA5CHJ
MITSCHER (DL-2) W9MI

MOALE (DD-693) WB2NFW
MOCTOBI (ATF-1Ø5) W4UAF
MONTROVIA (APA-31) KØHRE
MONTICELLO (LSD-35) W1CUS, K6MAV
MOUNT MC KINLEY (AGC-7) W6DDT, WB6DJW
MOUNTRAIL (APA-213) W8EOP
MUNSEE (ATF-1Ø7) KH6EEL
NAVARRO (APA-215) W5GKV, W7RIL, WA8KAB
NEW (DD-818) K3UKZ
NEWPORT NEWS (CA-148) W1UNC, WA4MBE, K4VIV
NICHOLAS (DD-449) K5WFQ
NIBLE (MSO-459) WA5CXH
NITRO (AR-23) WA8APC
NOA (DD-841) K2QNG
NORFOLK (DL-1) WA4EQD
NORRIS (DD-859) K1DRB
OAK HILL (LSD-7) K7TXZ
O'BANNON (DD-45Ø) KH6FQL
OBSERVATION ISLAND (EAG-154) K1TTN, W4JLE
O'HARE (DD-889) W4UAJ
OKANOGAN (APA-22Ø) K4NEL, K1YUK
ORION (AS-18) K5BZZ
ORLECK (DD-886) K9BFK
ROBERT A OWENS (DD-827) K8UML
PAGE COUNTY (LST-1Ø76) WA4YBN
THADDEUS PARKER (DE-369) WA5HBF
FLOYD B PARKS (DD-884) W9UQP, K6ZIC, WØQDJ
PARROT (MSC-197) WA5CXH
PARSONS (DD-949) WB6ASO
PEREGRINE (AG-176) K9LMG
NEWMAN K PERRY (DDR-883) WA2FVT, WA8NLL
PICKET (AGR-7) K7VGW
PINE ISLAND (AV-12) K7YSU
PIPER (SS-4Ø9) K1BHV, K1TFX
PLUCK (MSO-464) WA6WLJ
PLYMOUTH ROCK (LSD-29) K2PIQ
POCONO (AGC-16) WA4SPF
POINT DEFIANCE (LSD-31) WA6LMK
POWER (DD-839) WA8GHQ
WILLIAM V PRATT (DLG-13) K9ZQH, WA2SYV
PREBLE (DLG-15) W3VYW
PRINCETON (LPH-5) K3UPN, KA6SRC, K2GIG
PROVIDENCE (CLG-6) W6ACH
CASIMIR PULASKI (SSB(N)-633) K9CJL, WA5DLS
PURDY (DD-734) K1WTI, W6EYI, K1NQH, K1NWD, WA3DMA
PRYO (AE-24) K5BSG
QUILLBACK (SS-424) W4FTL
RALEIGH (LPD-1) K1VJC, WN4UOT
RANDOLPH (CVS-15) K2JSR
RANGER (CVA-61) W4IAN, K1RNL
SAM RAYBURN (SSBN-635) WA1BSE, K1PDL, K8QLW
RECLAIMER (ARS-42) W5GOG
REDFIN (AS(SS)-272) K3IPX
RENVILLE (APA-227) WN8CKR
REPOSE (AH-16) WA6YHD, KH6EJR
PAUL REVERE (APA-248) WA6KGZ
REXBURG (SPCER-855) K5HKO
RIVAL (SMO-468) W4VFV
CHARLES H ROAN (DD-853) WA6VRR
ROBERTS (DE-749) W3ZNK
SAMUEL B ROBERTS (DD-823) K9MLK
ROCKBRIDGE (APA-228) WB2UWV
ROCKVILLE (EPCER-851) W7FNP
FRANKLIN D ROOSEVELT (CVA-42) WA9AJW, W6GTJ, K8NYP
ROWAN (DD-782) K7BBI
FORREST B ROYAL (DD-872) WA9OXU, K7DTS
WILLIAM R RUSH (DD-714) K1JUV
SAILFISH (SS-572) K1FPP
SAINT PAUL (CA-73) K7IEY
SALAMONIE (AO-26) W3YVJ
SALINAN (ATF-161) WAØKZL
SAMPSON (DDG-1Ø) W3KUA
SAN MARCOS (LSD-25) W4LNQ, W1NHK
SAN PABLO (AGS-3Ø) K4FUJ
SARATOGA (CVA-6Ø) K2UVG
SARSFIELD (DD-837) K3JLN
SAVAGE (DER-386) WA4PCA
SEA LEOPARD (SS-483) K3OVE
SEAN LION (AP(SS)-315) WA4BDO, WA4OZG
SEA POACHER (SS-4Ø6) K4YRE
SEARCHER (AGR-4) W1LWD, WA1BQH, WA4SSC
SEA ROBIN (SS-497) K3QBP
SELLERS (DDG-11) WA8JZN, K8SXB
SEMINOLE (AKA-1Ø4) W4PIO
SEMMES (DDG-18) WA4VAK, WA5OSA, WA4TOV
SENECA (ATF-91) K9CDQ
SEVERN (AO-61) WA6NKQ
SHAKORI (ATF-162) W2ABZ
SHELTON (DD-79Ø) WB6QYF
FORREST SHERMAN (DD-931) K8NSR, W8VRR
SHRIKE (MSC-2Ø1) K3SWB
SIERRA (AD-18) K4NOO, W4YJC, K5PDQ
SIRAGO (SS-485) WA4QOZ
SKYLARK (ASR-2Ø) K9HAI, KH6EYC
SOUTHERLAND (DD-743) WB6BQE, K6VMV
SPRINGFIELD (CLG-7) WA5BXF
STARK COUNTY (LST-1134) KH6FCB, WA5NNO
STATEN ISLAND (AGB-5) WB6NEO, WA4FJI, KL7EAL
STEINAKER (DD-863) WA7BOD, K3FXT, K1LQA
HENRY L STIMSON (SSBN-655) W1IOW, WA1BMT, W7RPK, W1VRT
STODDARD (DD-566) K7LNQ
BENJAMIN STODDERT (DDG-22) WA6NWZ
STORMES (DD-78Ø) K4HBT
STRIBLING (DD-867) K5VBO
STRONG (DD-758) WA2NVD, K8KXT
SUFFOLK COUNTY (LST-1173) WAØADO
SUMMIT COUNTY (LST-1146) WA9NLC
ALLEN M SUMNER (DD-692) W5CPQ
SUMNER COUNTY (LST-1148) WA6QVW
SWERVE (MSO-495) WA4FZP
TALBOT COUNTY (LST-1153) W4JZN
TALLAHATCHIE COUNTY (AVB-2) K3YVJ
TALUGA (AO-62) K8QJF
TANNER (AGS-15) W2MNK, W2HLI, W1FKA
JOSEPH K TAUSSIG (DE-1Ø3Ø) K9QBC
TAWAKONI (ATF-114) KH6FJE
TELFAIR (APA-21Ø) K4UGT

TERREBONNE PARISH (LST-1156) WA5LWJ
LLOYD THOMAS (DD-764) W1LWD
JOHN W THOMASON (DD-76Ø) WB6OKO
THOR (ARC-4) K4JOH
TICONDEROGA (CVA-14) W4PAE
TIDEWATER (AD-31) K5BZF
TILLS (DE-748) W1GPY
TIOGA COUNTRY (LST-1158) K5ARW
TOPEKA (CLG-8) K6QXX, K9EPT, W4MCH
TORSK (SS-423) KØGWG
TORTUGA (LSD-26) K7ZWU
TOWHEE (AGS-28) K4ZED
TRIGGER (SS-564) W2CIR
TRUTTA (SS-421) K4CJP
TULLIBEE (SS(N)-597) W1VRT
TUTUILA (AGR-4) K3QNP
UHLMANN (DD-687) W6VOQ, K8MBN
UNION (AKA-1Ø6) WA6SZS
UTINA (ATF-163) K9JLX
VALLEY FORGE (LPH-8) K1GUD
VANCE (DER-387) WA4HTF
VAN VOORHIS (DE-1Ø28) KØVRF
VEGA (AG-59) WØQMY
VERMILLION (AKA-1Ø7) K2QJR, K8TJZ
VERSOLE (DD-878) W1CHQ, WA4SSC
VERSUVIUS (AE-15) WA6RDH
VIGIL (AGR-12) W8ZRY, W9PDW
VIGOR (MSO-473) WA5IAG
VOGELGESANG (DD-862) K5UCE, W4UAJ
WAHKIAKUM COUNTY (LST-1162) K3KFE
WALDO COUNTY (LST-1163) K4HCD
WALDRON (DD-699) K8UHX, K1TLQ
WALTON (DE-361) W6SAW
CHARLES R WARE (DD-865) K5MCM
WARRINGTON (DD-843) WA4VEL
WASP (CVS-18) K3QEQ, K2VVO, WA4MYJ, K2CBF
WHETSTONE (LSD-27) W4FLF
WHITEHURST (DE-634) W7WWIN, K6QXR
WILKINSON (DL-5) K1JQM
JOHN WILLIS (DE-1Ø27) WA1CNC, WA3EAI
WINSTON (AKA-94) W5CAT
WILLIAM M WOOD (DD-715) K1RNA
WOOD COUNTY (LST-1178) W4RRO
WRANGELL (AE-12) WA2ASM
YANCEY (AKA-93) WA4RRO
HARRY E YARNELL (DLG-17) WB2DXR, WA2PTQ
YELLOWSTONE (AD-27) K1WGO
YORK COUNTY (LST-1175) WA4QZG
YORKTOWN (CVS-1Ø) W8NBO, WA4OKF, WA6PPX
YOSEMITE (AD-19) K1HVJ
ZELLARS (DD-777) K4FPH

MISCELLANEOUS

CAMCARDIV 16 W4HME
COMCRUDESFLOT 6 W4IJQ
COMDESDIV 42 K5CXR
COMDESDIV 112 WØDRO
COMDESDIV 222 W4TGB
COMDESDIV 322 W4UAJ
COMCRUDESLANT K4CEC
COMDESRON 4 WA4JIZ
COMDESRON 6 WA4OMK
COMDESRON 17 K9PUI
COMDESRON 32 WA4RRO, W1UNC
COMIDEASTFOR K3TUV
COMINDIV 73 WN6OIU
COMPHIBGRU 4 K4BLS, W4BNT

USNS

GENERAL H H ARNOLD (T-AGM-9) KA4EBR, K4CQD, W5CCA, W2ISJ, WA4PQD, W3WBM, K4TXE
BALD EAGLE (T-AF-5Ø) WB4AOT
BARRETT (T-AP-196) W6WCM
GENERAL R M BLATCHFORD (T-AP-163) WA6IEV
COASTAL CRUSADER (T-AGM-16) W3HSW
COASTAL SENTRY (T-AGM-15) WA4OUE, WA4EGJ, W1BZO
CORPUS CHRISTI BAY (T-ARVH-1) WA9ENW, K4IEG, WØEBN, WA5DNO
CROATAN (T-AKV-43) W1JSX
ELTANIN (T-AK-27Ø) W1YMG
FURMAN (T-AK-28Ø) K7SEW
GENERAL HUGH J GAFFEY (T-AP-121) KB6BU, K6PJF
JOSIAH W GIBBS (T-AGOR-1) W4DAY
GENERAL W H GORDON (T-AP-117) WB6PKN, W6GIB
GREENVILLE VICTORY (T-AK-237) W2HMW
HARRIS COUNTY (T-LST-822) WA6KNA
HUNTSVILLE (T-AGM-7) WB6BFE, WB6BJF
SGT TRUMAN KIMBRO (T-AK-254) K6QMS
KINGSPORT (T-AG-164) K9OLL
KULA GULF (T-AKV-8) W2YCF
LONGVIEW (T-AGM-3) KH6CB
MAUMEE (T-PO-149) K6BPE
MICHELSON (T-AGS-23) K9PCS
MISSION BUENAVENTURA (T-AO-111) W3HXE
MISSION SANTA YNEZ (T-AO-134) WA5FJN
NORWALK (T-AK-279) W3JAK
PIONEER VALLEY (T-AG-14Ø) W4CPL
RANGE TRACKER (T-AGM-1) WA6MAI, WA6WFL, W6YHR
SAMPAN HITCH (T-AGM-18) WB6NEP, KH6FOS, WB6HTP
TWIN FALLS (T-AGM-11) W2IEV
GENERAL HOYT S VANDENBURG (T-AGM-1Ø) W3HSW, WA4SUM, W4JIV, WA2BTB, K2JMI
WHEELING (T-AGM-8) WA6MCP, K5COU, KØDNM
WYANDOT (T-AKA-92) K2SFE
YUKON (T-AO-152) W6JJY

AERONAUTICAL MOBILE

AIRDEVRON 1 WB6MBU
ALUSNA, ATHENS WA6HSH
NAS MINNEAPOLIS KØNAG
NAS OCEANA W3ZOT
PATRON NINE WB6NXN, WØLHN

Fire in the Hamshack-Are You Ready?

Are you prepared in case of a fire in your hamshack? Have you made any plans for the event? How much protection do you have? Does your insurance cover your equipment in case of fire? These are some questions which should be considered by any serious amateur.

Fire prevention costs very little except for time, planning and workmanship. Everyone knows about fuses, circuit breakers, ash trays, chassis and cabinet-ground straps and a good ground system. How many of us ignore or abuse the limits of this protection? There should be a master switch which will kill all of the power in the shack, except for the lights. This is good protection. A good type of fire extinguisher should be on hand in a prominent place, preferably near the door. Having it under the workbench, or over there behind something when you need it is as bad as not having one at all. There are several types of fire extinguishers on the market and most of them are quite inexpensive when compared to the cost of a receiver or a transmitter.

The CO_2 type are best for electrical fires. They smother the fire as well as cool things off. They are fitted with a trigger so they can be used in spurts and can be controlled easily. The CO_2 can be forced into the ventilation holes in cabinets to smother the fire inside, saving time and equipment. The CO_2 type will not damage equipment by corrosion or residue, and is non-conductive so it can be used with safety in high voltage areas. The charge can be checked with a scale, as the full and empty weight are marked on the cylinder. They can be recharged at the central fire station in most large cities.

Another type of fire extinguisher which is very good is the dry-chemical type. It uses a finely powdered dry chemical under pressure to smother the fire. The powder is also nonconductive and non-corrosive. The action is very similar to the CO_2 type. Some of the dry-chemical extinguishers have a gauge which shows the charge, and some can be recharged easily at home. The cost of this type ranges from four to fifteen dollars. For those who feel that this is expensive, a bucket of dry sand will work well in most cases, but it cannot be forced into the cabinets to get at the base of the fire as well as the pressure and nozzle of the extinguisher.

The types of extinguishers which should be avoided are the sodawater-acid and the carbon tetrachloride types. These are very dangerous to use on electrical fires. The soda-water-acid type is conductive, as well as being corrosive to skin, paint, and metal. Picture in your mind spraying a fire in a high-voltage plate supply with a conductive stream which leads to a metal can that you are holding! Now ground your feet in a conductive puddle of the drip and splash! This is worse than shaving in the bathtub with a razor that is plugged into 220 V. Even with the power off, the filters can hold a lethal dose for quite awhile.

The carbon-tetrachloride unit is not as conductive as the soda-acid type, but the carbon tet will break down with heat and the fumes are toxic. Also, the cold stream of carbon tet can break the glass envelopes on any hot tubes which might have been saved by using other types of extinguishers. Current flow through carbon tet will make a very toxic gas. The carbon tet can cause a reaction with some types of plastic, and may cause further damage.

No hamshack should be without a fire extinguisher. Your local fire department will be glad to help you with your choice and location, and will also assist you with its use and storage. The firemen will be only too happy to come to a club meeting and give a demonstration of the various types of fire extinguishers and their uses.

Fire extinguishers are like spare tires; something you hope you will not have to use but a real life saver when you really need them.

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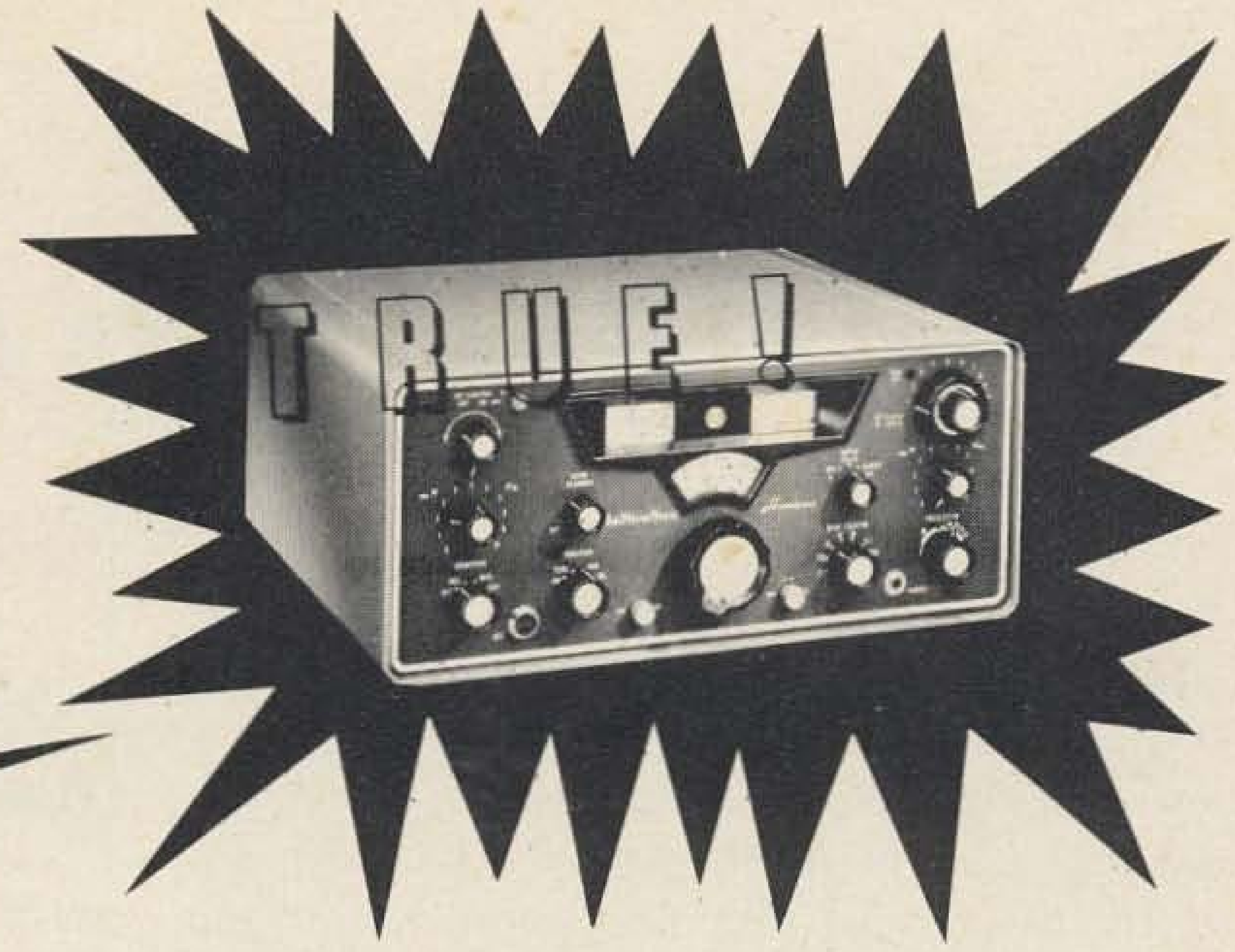

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Diode Circuits Handbook

Back in the days, long ago, when diodes were plugged into sockets and required lots of space and heater power, they weren't very common. I guess that they seemed too expensive and wasteful of space to be popular. Rectifiers and detectors were about the only diodes you saw—and the detectors were usually combined with other tubes in common envelopes.

Things are different now. Even those who still build receivers with tubes use lots of diodes. But they're different diodes. Now they're usually tiny glass or plastic-cased silicon or germanium diodes which are soldered into equipment. And they're all over the place. The tube-type "Junior Miser's Dream" in the 1966 *ARRL Handbook* uses ten semiconductor diodes. The Davco DR-30 contains 15 and its power supply uses a few more. There's a good reason these receivers use so many diodes; diodes are very useful. One diode can often take the place of many other components, including such large, expensive, and cantankerous parts as relays, voltage-regulator tubes and switches.

I've often searched through dozens of references for a particular diode circuit and I suspect that many of you have done the same. I finally decided to try to get together all the practical ham diode circuits I could find and put them in a reference article for me—and all 73 readers. Most of the circuits I found seem to be fairly well known and have appeared in many places, so I haven't tried to give credit.

Take a look at these diode circuits. Chances are that some of them are unfamiliar to you and could be useful in some of your projects. Some of the circuits are complete in themselves; many others are used with other devices.

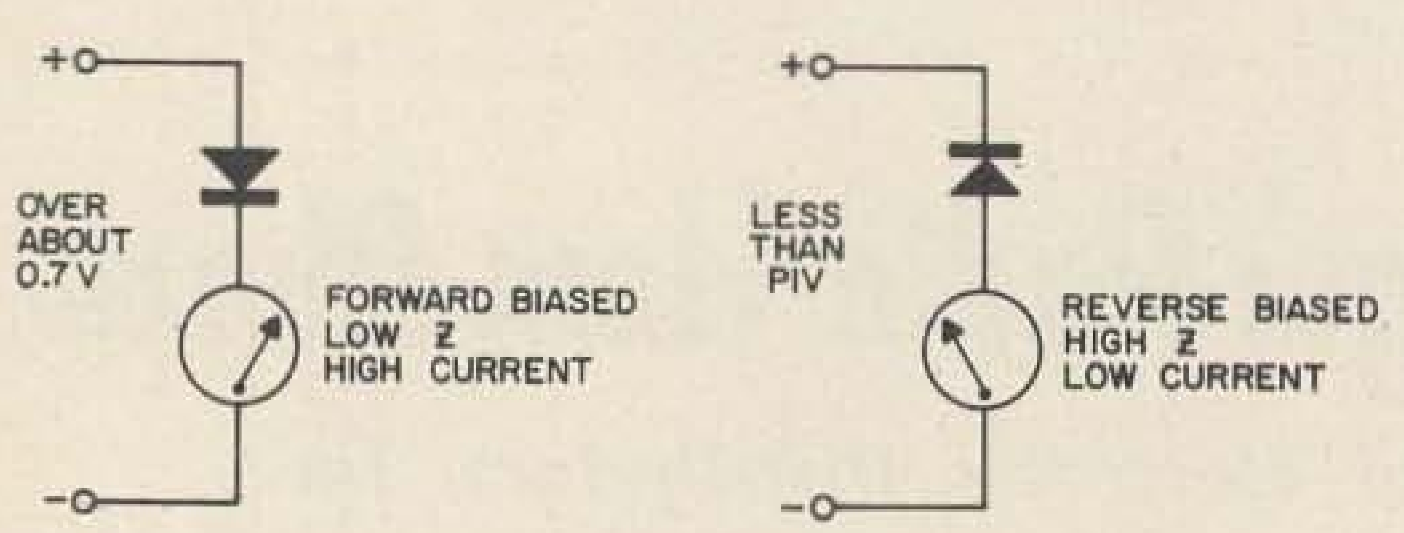


Fig. 1. The properties of a diode depend on whether it is forward biased or reverse biased.

Basic Diode Facts

Uses of readily available, well-known silicon and germanium diodes are the subject of this article. None of the applications are for tunnel diodes, four-layer diodes, or other specialized devices. The varactor circuits I've given will work with at least some common diodes, but work better with varactors, of course. Unless stated otherwise, the diodes shown are not critical.

To use this article, you should keep a few basic characteristics of diodes in mind. What makes a diode a diode is that for a given voltage, it will conduct more current when the voltage is connected across the diode in one way than in the other way. See **Fig. 1.** High current flows (the diode has low resistance) when the positive side of the power supply is connected to the anode of the diode. This is called forward biasing. When a diode is forward-biased, with adequate current flowing through it, it will have a fairly-constant voltage of about 0.7 V across it if it's a silicon diode, or about 0.3 V across it if it's germanium. This voltage is called the forward voltage drop. It will increase slowly with increasing current to a maximum of about 1.5 V for most diodes.

The reverse of forward bias is reverse bias. If you connect a voltage source across a diode so that the positive side of the supply is connected to the cathode of the diode, the diode is said to be reverse biased. A reverse-biased diode acts like a very high resistance so that almost no current flows through it. However, if you increase the voltage to a high enough value, the diode will "break down" and conduct current heavily. If there isn't enough resistance in the circuit to limit the current to a safe value, the diode will be destroyed. If there is enough limiting resistance, the circuit will settle down with part of the total voltage across the diode and part of the voltage across the limiting resistance. As the voltage is increased further, the voltage across the diode remains fairly constant unless too much current flows and cooks the diode. The break-down point is called the avalanche voltage, for high-voltage diodes, and the zener voltage for low-voltage diodes. The maximum voltage that should be applied to a diode is called its peak inverse voltage (PIV). The PIV, as rated by the manufacturer, is always less than the avalanche or zener voltage.

As you can see from the above discussion, a high breakdown voltage—at least higher than any peak voltages in the circuit—is desirable for diodes used as rectifiers. However, diodes can be used as regulators, too; for this use, a low, and known breakdown voltage is needed. Thus, you can use a zener diode as a rectifier, or a rectifier as a zener, if you are able to pick the right diode.

Silicon diodes resist high temperature better than germanium ones, so are most useful for high power. On the other hand, germanium diodes have lower forward voltage drops (about ¼ V as against about ¾ V for silicon). Silicon diodes usually have lower leakage and higher reverse-biased resistances than germanium diodes.

Diodes have capacitance as well as resistance. This capacitance varies with the voltage applied. A reverse-biased diode is often used as a voltage-variable capacitor (varicap or varactor). Most silicon diodes can be used in this way, but diodes made and tested for this purpose are generally more predictable and satisfactory.

Power Supplies

Rectifiers

Say diode to the average ham, and he thinks of power-supply rectifiers. Diodes, and particularly silicon diodes, have so many overwhelming advantages over thermionic rectifiers that only the most conservative ham, or the ham with a junk box full of 5U4's, still uses tubes. Silicon diodes are cheaper, smaller, more versatile, etc., than tubes. However, semiconductor diodes are far more sensitive to voltage and current

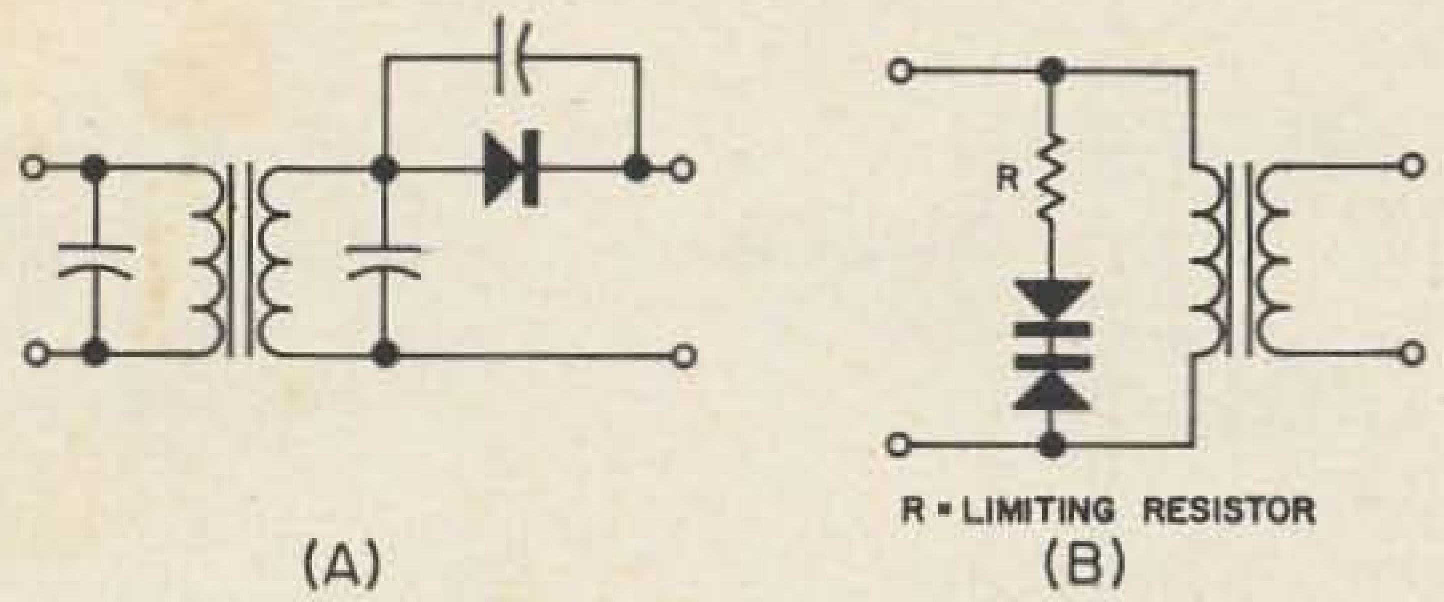
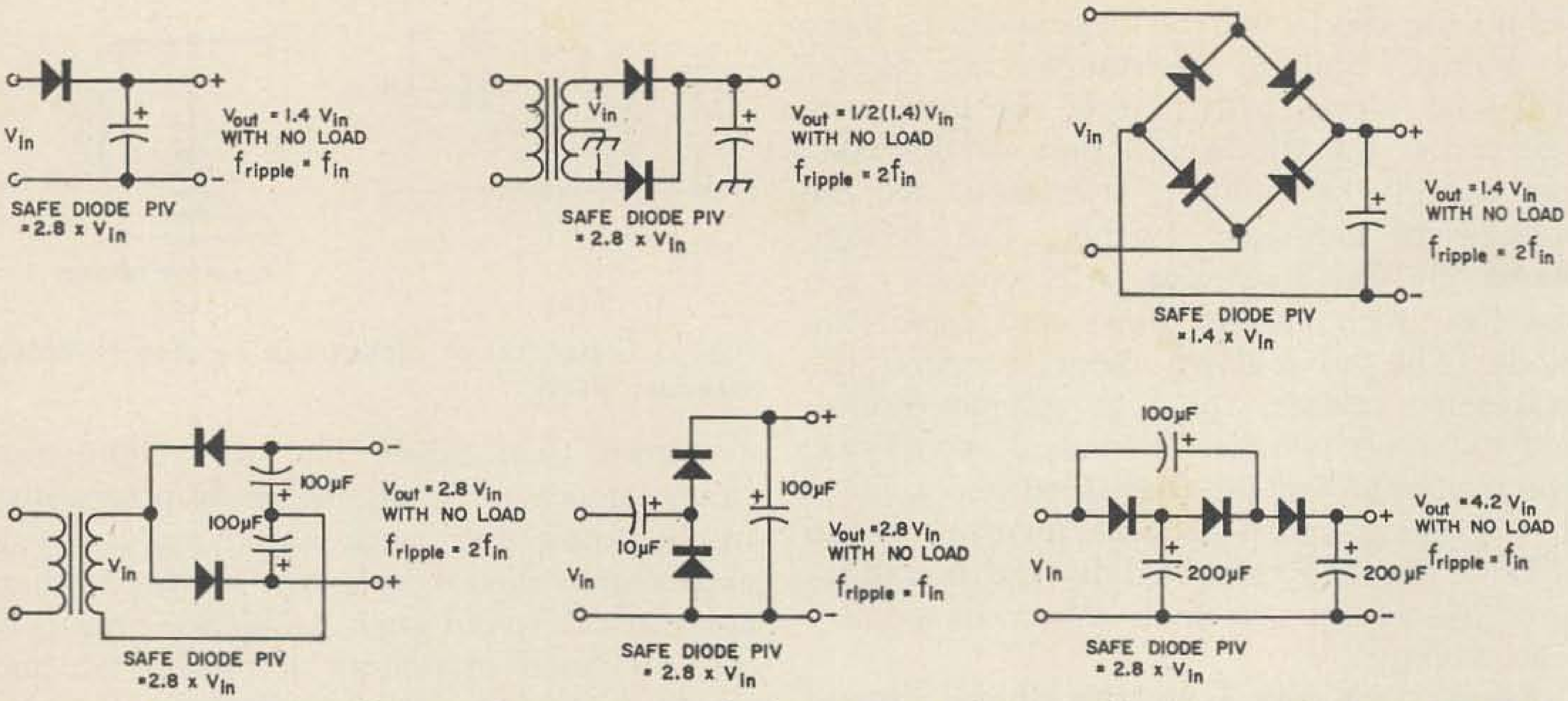


Fig. 2. Capacitors or diodes can be used to reduce transient peaks.

overloads than tubes. The very short transients generated on almost all ac power lines by lightning and large inductors, can ruin unprotected diodes instantly. However, there are ways to avoid such problems. One is to connect small capacitors across the ac line, across transformer secondaries, or across the diodes themselves. These capacitors tend to stretch the length of the voltage pulses while reducing their height. Special semiconductors can be connected across transformer primaries to clip off high peaks, or you can even connect two diodes, cathode-to-cathode, across the primary for the same effect. It's best to choose two diodes with roughly matched avalanche points a little higher than the peak value of the line. The peak value of the 117 V ac line is 170 V, so use 200-300 PIV diodes. See Fig. 2.

Another way to avoid blowing out diodes through accidental voltage transients (which may reach 4-5 kV), is to use special diodes designed to withstand such peaks. They're called controlled-avalanche diodes and in most cases cost more than regular diodes.

Of course, these suggestions can help take care of random voltage transients. But most hams who blow diodes, do it because they haven't been following good "engineering" practice. There's a lot of confusion about the ratings of diodes. The peak inverse voltage, or peak reverse voltage, of a diode, as rated by the manufacturer, is below the minimum peak voltage; which will cause the diode to conduct in the reverse direction. This is equivalent to the "zener" break of high voltage diodes. For instance, a diode with a 200-V PIV rating will not conduct current (over a few micro-amperes) for any dc voltage under 200 V applied across it in the *reverse*-biased direction (with the cathode connected to the positive voltage). But, if you increase the voltage over 200 V, at some voltage (its avalanche voltage) the diode suddenly starts conducting like mad, and quickly shorts (for diodes usually



Figs. 3-8. The most popular rectifier circuits with their output voltages and minimum safe diode PIV rating.

short, not open) unless there is enough resistance in the circuit to prevent excessive current flow.

For example, suppose the diode under discussion had an avalanche point of exactly 200 V. If it's a common epoxy-case diode, it can probably dissipate about ½ W. That is 2.5 mA, so if more than 2.5 mA is flowing through that diode in the reverse direction, it's not going to stay healthy long. Note that this discussion is about direct current, as it's a little easier to follow than ac. If alternating current is applied across the diode, things are more complicated, but the same basic considerations apply.

If the diode is *forward* biased (positive voltage to the anode), about 0.7 volts will be dropped across the diode. If the diode can dissipate ½ watt, that means (by P=EI) about 700 mA can flow through it.

Manufacturers rate their diodes by minimum PIV's, not actual avalanche voltages (except for regulators). You might do this same thing if you get $10 worth of unmarked diodes from a surplus dealer. You could put out a series of cans labeled 0-100, 100-200, 200-300 and so forth. Then you could check the diodes and throw them in the proper can. Any in the 100-200 PIV can could be used for applications calling for a PIV under 200 V. The ratings on diodes are often conservative. A 1N2069 diode is listed at 200 PIV, so it will have an avalanche voltage of over 200 V, but could be quite a bit higher—I've found 1N2069's with avalanche voltages of over 1500 V.

The other diode problem is current overload. There should be enough resistance in the circuit to limit current to the specified peak value, typically 25 A.

Enough theory. **Figs. 3-8** show the most common types of rectifier circuits with the minimum PIV's that should be used for the diodes and the voltage outputs. The voltage "multipliers" (more correctly, "adders") can be carried on to ridiculous limits, but aren't very practical over about four diodes since you start needing so many big charging-filtering capacitors.

When you use discreet diodes in series to get a higher PIV than a single diode has, you should remember that the diodes you use are unlikely to be well matched. They probably have widely different avalanche voltages and back resistances, so that voltages applied across the series string will divide unequally across the diodes. This will likely blow out one of them, which will tend to blow out the others. A simple solution is to connect a 100-kΩ to 1 = MΩ resistor across each diode in the series, as shown in **Fig. 9.** Use the same value across each diode, though the value isn't critical. These equalizing diodes have saved a lot of diodes which otherwise would have blown. Incidentally, very high voltage rectifiers in one can are generally made from a number

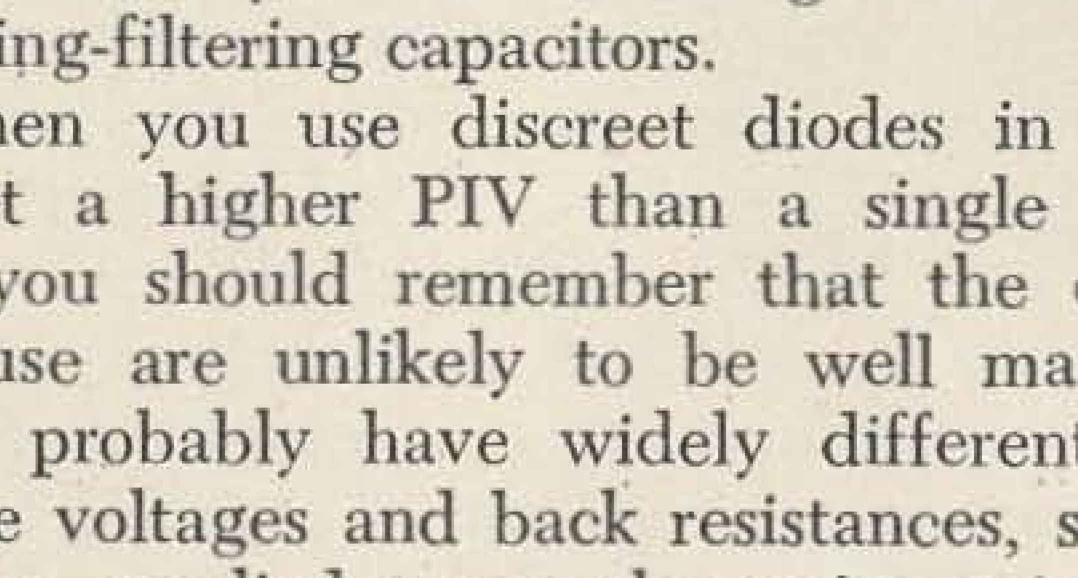
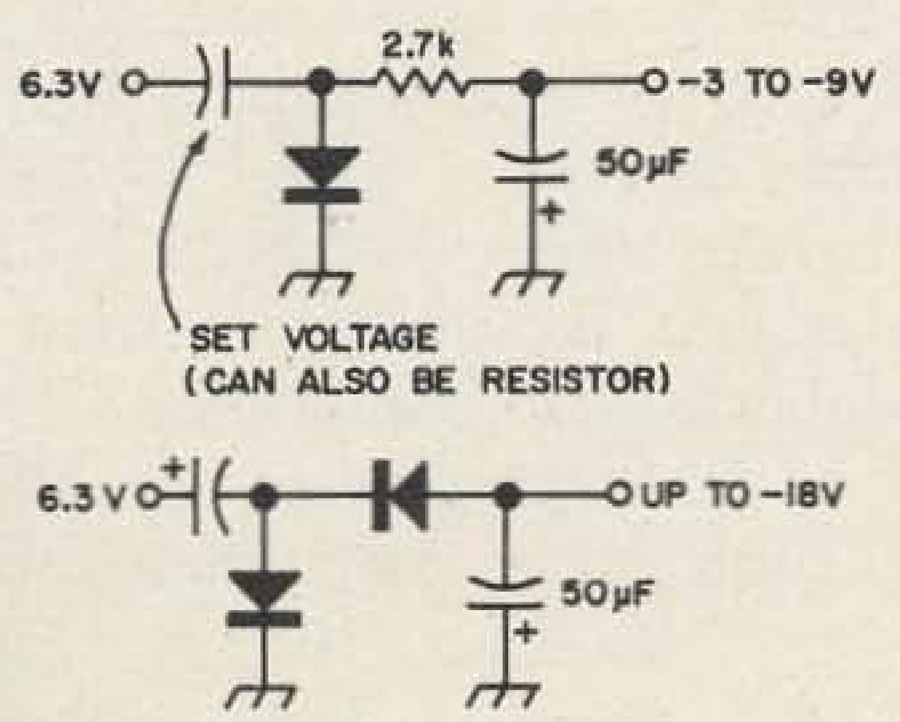


Fig. 9. Resistors are used across series diodes to equalize reverse voltage drop.

of individual junctions in series, but they don't require equalizing resistors since they're made from the same slice of silicon and are well matched.

Most modern transmitters and tube-type receivers require some negative voltage at low current for bias. Probably the easiest way to get this is by rectifying (with multiplying, if necessary) the filament line (See **Figs. 10** and **11**, or by tapping down resistively, or by a capacitor from the high voltage winding of the power supply. For low voltages, common germanium diodes, such as the 1N34, can be used for rectifiers. Shunt rectifiers work as well as series when they're being driven by a high-impedance source, such as a high-value resistor or low-value capacitor. A single diode can put out up to 9 V from a 6 V supply when it's loaded lightly.



Figs. 10 and 11. Simple shunt rectifiers can provide low bias voltages.

Fig. 12 is a simple bridge high voltage supply which can provide two high voltages at once. One voltage is about twice the other. This type of rectifier is often used with a junked TV power transformer for transmitters in the 100-200 watt range.

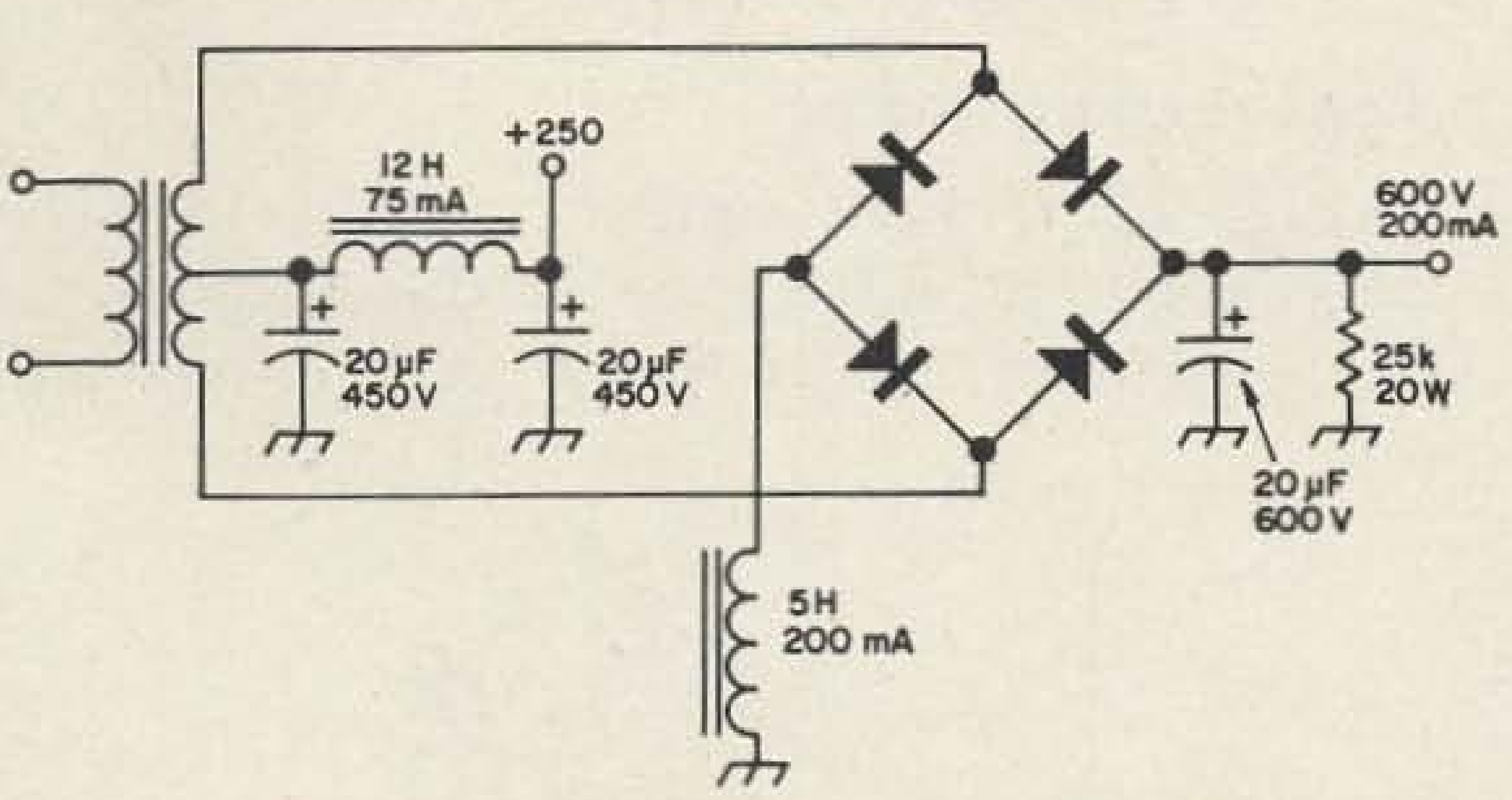


Fig. 12. This circuit gives two outputs, 600 V and 250 V.

Regulators

A zener diode regulator is shown in **Fig. 13.** It doesn't look very impressive, and the values of everything in it are dependent on everything else. W2DXH's 12-page article on zenors in the October 1966 issue of 73, covers the subject thoroughly and succinctly, and there's little reason to go over it again.

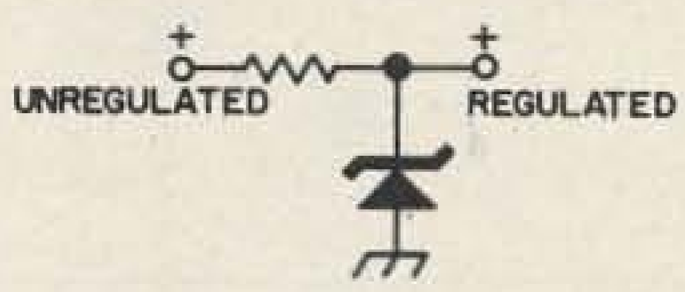


Fig. 13. A basic zener regulator. The values depend on input and output voltage, current, etc.

It's interesting that low-voltage zeners (under about 6 V) and forward-biased silicon diodes (equivalent to 0.7-V regulators) have thermal drifts opposite in direction from the drifts of avalanche diodes (zeners over about 6 V). So we can put one or more forward-biased diodes in series with a regular zener (as in **Fig. 14**) to decrease the total temperature-voltage drift. These diodes are also useful to boost a zener up a little amount. Remember that forward-biased silicon diodes act like 0.7-V regulators, and forward-biased germanium ones act like 0.2-0.3 V regulators.

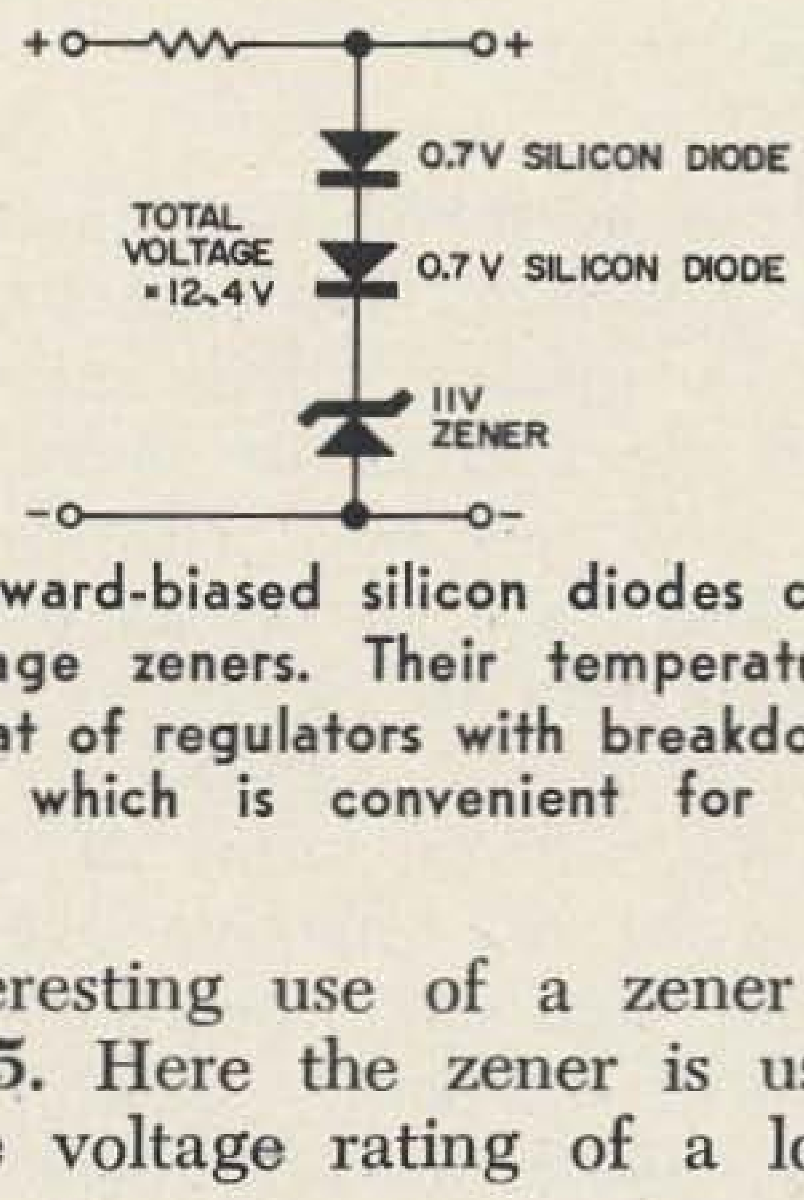


Fig. 14. Forward-biased silicon diodes can be used as low-voltage zeners. Their temperature drift is opposite that of regulators with breakdown voltages over 6 V, which is convenient for temperature stabilization.

An interesting use of a zener is shown in **Fig. 15.** Here the zener is used to increase the voltage rating of a low-voltage capacitor.

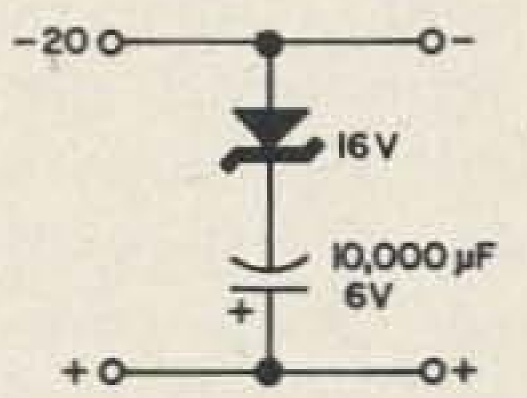


Fig. 15. A zener can be used as a ripple filter and to "increase" the voltage rating of a capacitor.

Fig. 16 shows the use of two different zeners to get a regulated low voltage. You can use a forward-biased diode in a similar manner to get a regulated voltage slightly lower than a given zener will provide. For instance, suppose you have a 10 V zener, but want a slightly lower voltage. A forward-biased silicon diode (the reverse of the one shown) connected in place of the 8 V zener would give about 9.3 V.

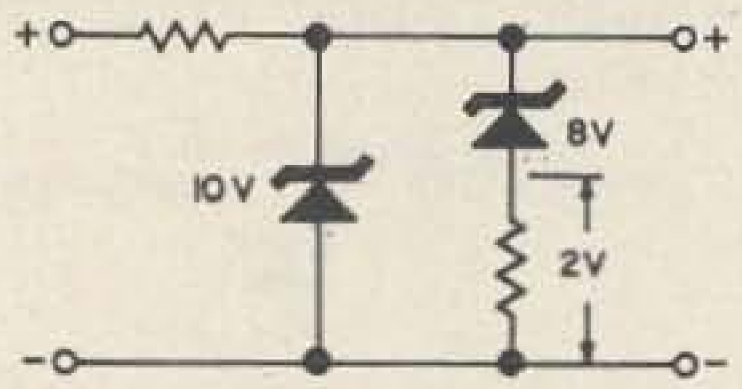


Fig. 16. Two zeners can furnish a regulated low voltage.

Zeners can also be used on ac. **Fig. 17** shows this use to regulate at slightly less than 110 V.

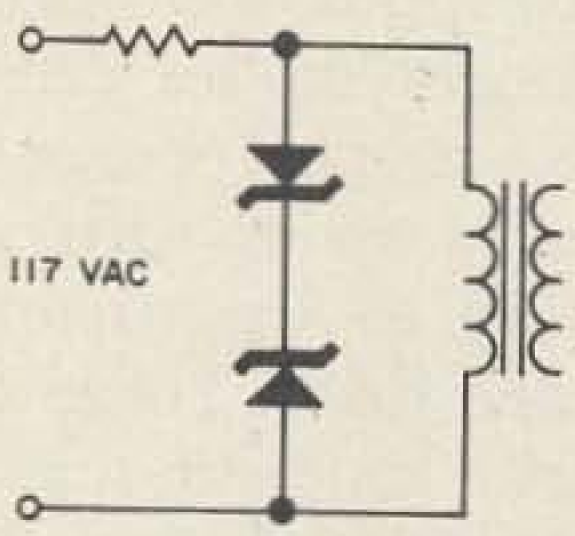


Fig. 17. Zener regulators can be used on ac, too.

Meters

AC meters

Since true ac meter movements are very frequency sensitive, most meters used by hams are dc meters. Diode circuits can be used with dc meters to make ac meters for many different uses. However, this can be tricky and it's a good idea to understand what's happening in the circuits. The most common and useful method for describing an ac voltage is in terms of RMS (root-mean-square), or effective, voltage. This voltage has the same heating effect as a dc voltage of the same value. The 117 we call the ac line is an RMS value. However, most ac meters made from a dc meter and a rectifier, read either peak or average value rather than RMS since these circuits are far simpler. The peak value is the difference between the 0 point of a wave and its highest peak, as measured on an oscilloscope. The average value, which should be called the average rectified value, is of very little use in radio and chances are you've never even seen an average value mentioned except in discussions of ac voltmeters. If you're curious, it's the area under the curve, divided by the time measured. There is a very simple relationship between these values—for perfect sine waves: peak is about 1.4 (or exactly $\sqrt{2}$) times RMS; RMS is about 0.7 (exactly $1/\sqrt{2}$) times peak; average is about 0.6 (exactly $2/\pi$) times peak and so forth. However, for wave shapes other than perfect sine waves, the relations are not the same, and we must give some thought to the measurements we make under these conditions.

Average-reading meter

The most common type of ac voltmeter—the type used in virtually all VOM's, for example, is shown in **Fig. 18**. This circuit usually uses a copper-oxide bridge rectifier since this type of rectifier is linear at much lower levels than silicon or germanium diodes. Notice that there is no capacitor in this circuit. The reading on the meter will be the average value of the ac waveform. However, the scale is almost always calibrated in terms of RMS. As mentioned before, this is accurate only for true sine waves, but is generally satisfactory for other waveforms as even 10% second-harmonic energy causes only 3% error. This type of rectifier circuit is useful up to a few hundred kilohertz. It cannot be used higher because of the properties of the rectifier and the high stray capacitance of the circuit.

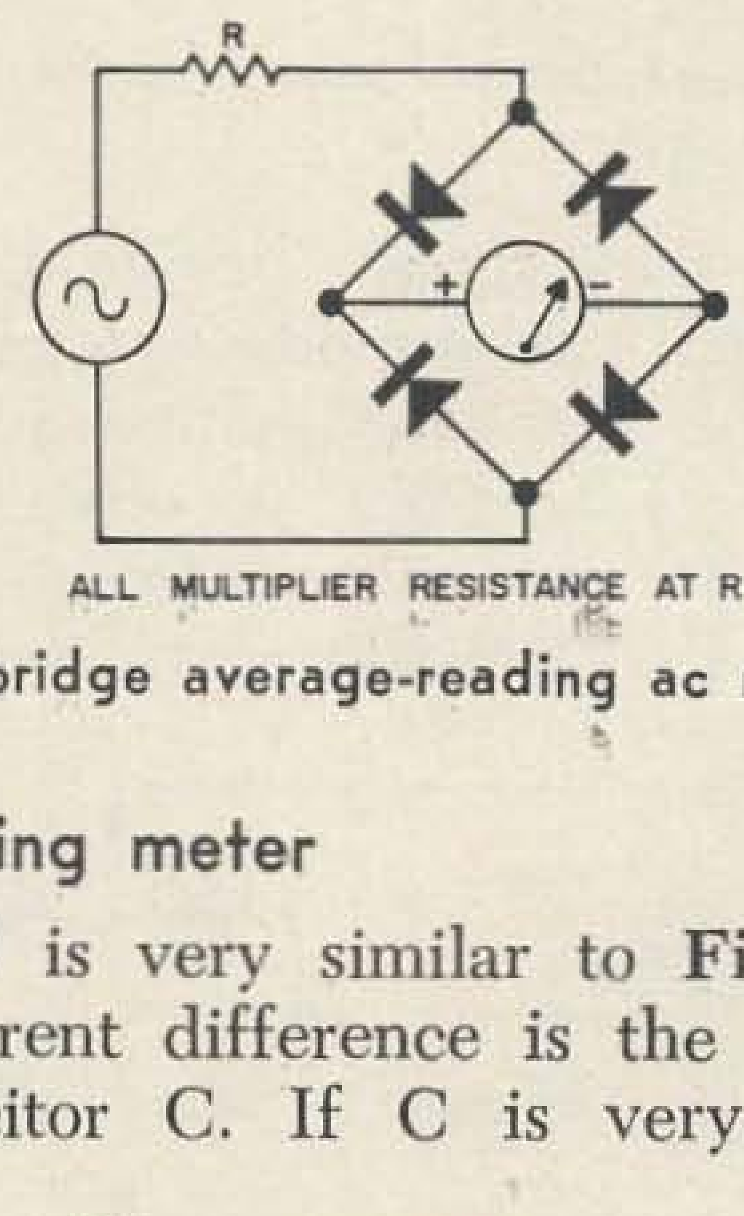


Fig. 18. A bridge average-reading ac meter.

Peak-reading meter

Fig. 19 is very similar to **Fig. 18**. The only apparent difference is the addition of the capacitor C. If C is very large and

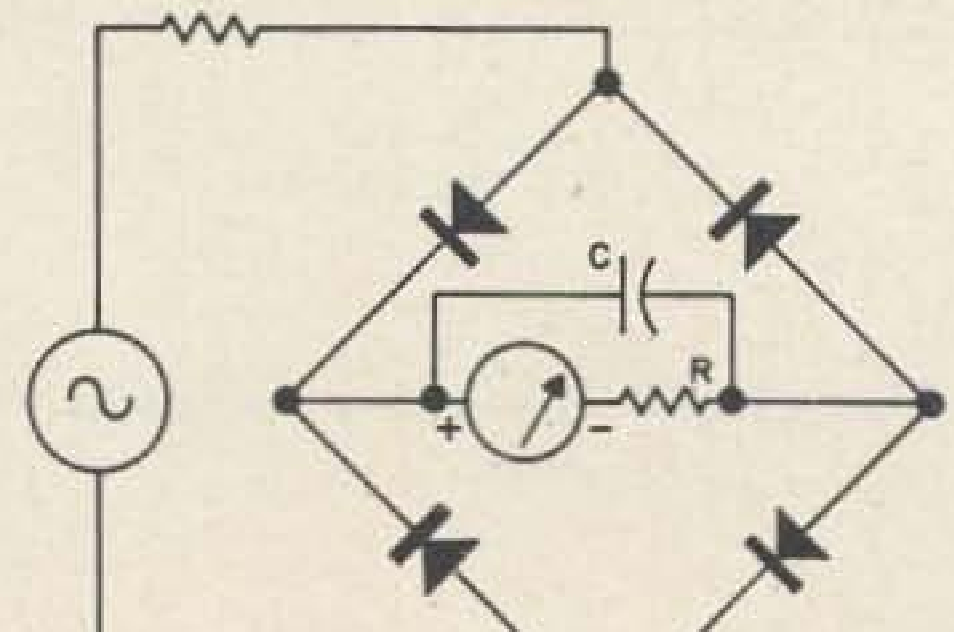


Fig. 19. A bridge peak-(or semi-RMS) reading ac meter.

the meter has a high resistance, the capacitor will stay charged up to a high level and the meter will read approximately the peak value of the waveform. For instance, with a 1-mA meter and 50-μF capacitor, this makes an excellent peak meter for the value of fairly constant audio voltages. The time constant is too long to follow fast changes. This meter is excellent for aligning receivers with a modulated signal generator.

RMS-reading meter

If capacitor C in **Fig. 19** is made small with regard to the period of the ac frequency being measured, the meter will read approximate RMS. Unfortunately, the optimum value for the capacitor will vary with frequency, so this type of meter has limited use. A combination of peak- and average-reading meters can provide a meter which reads closer to RMS.

Peak-to-peak-reading meter

Sometimes we need the peak-to-peak value of an ac voltage. This will be twice the peak value on a symmetrical wave, and it can be measured with the circuit of **Fig. 20** This, of course, is a voltage "doubler." The capacitors must be large, and the meter resistance high, to keep the capacitors charged.

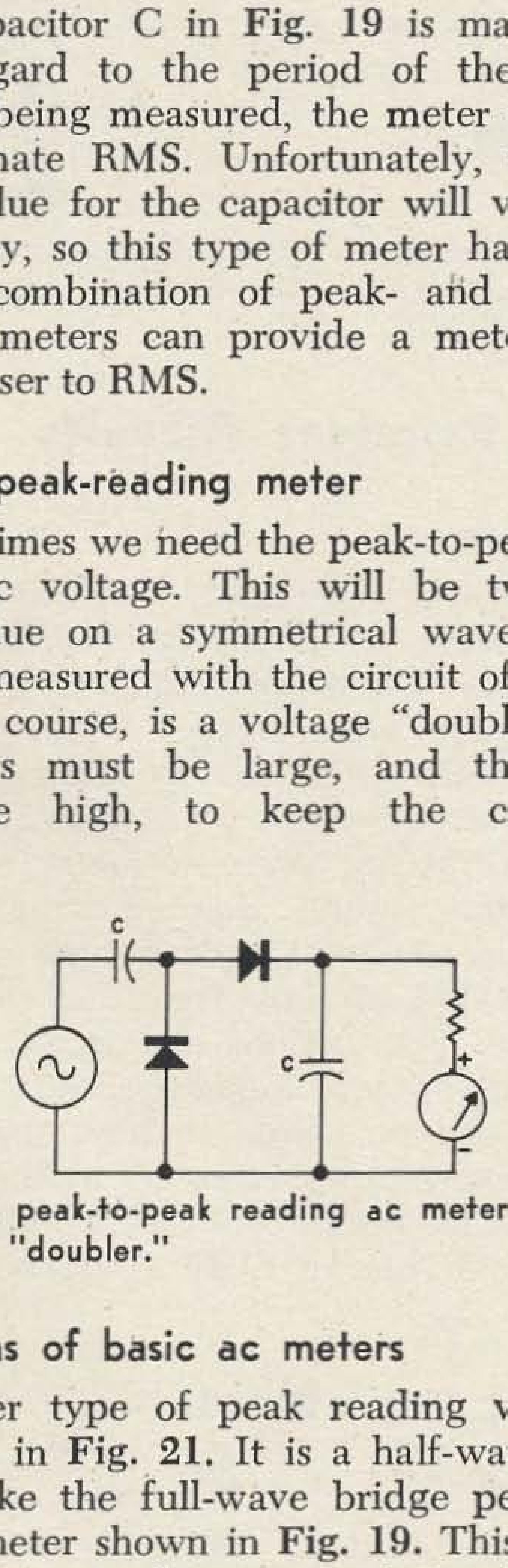


Fig. 20. A peak-to-peak reading ac meter is simply a voltage "doubler."

Variations of basic ac meters

Another type of peak reading voltmeter is shown in **Fig. 21.** It is a half-wave rectifier, unlike the full-wave bridge peak-reading voltmeter shown in **Fig. 19.** This circuit, or a variation of it, is used in rf probes

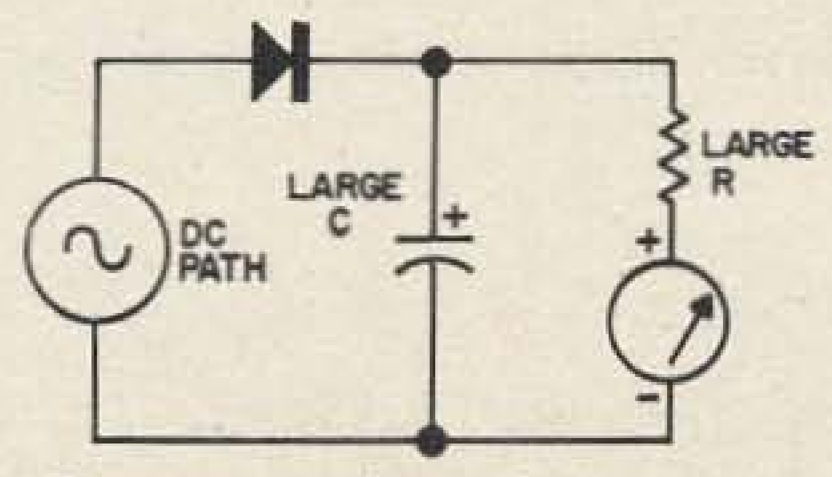


Fig. 21. A half-wave peak-reading ac meter.

where the rectifier must be close to the circuit being measured.

A similar peak reading circuit that requires no dc path is shown in **Fig. 22.** Another type of RMS-reading meter is shown in **Fig. 23.** This one is useful only over a limited frequency range.

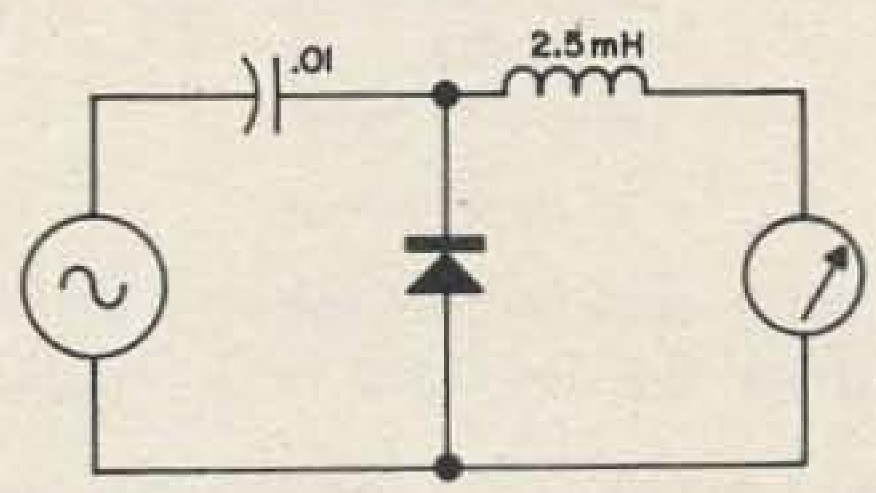


Fig. 22. A half-wave peak-reading ac meter that requires no dc path.

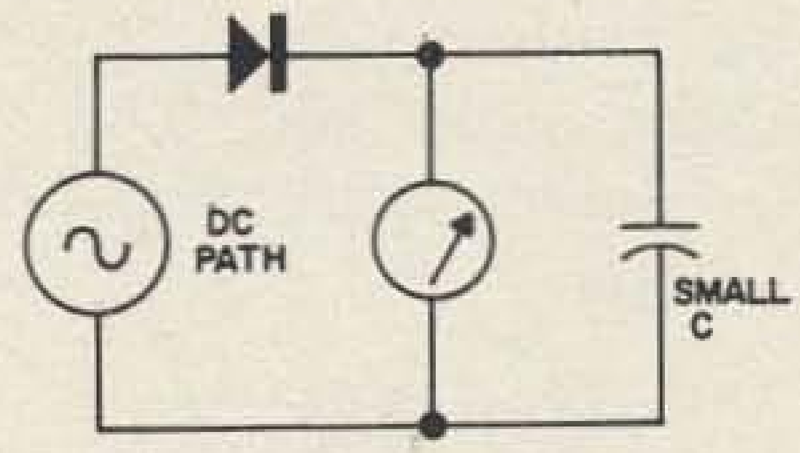


Fig. 23. A semi-RMS-reading ac meter.

Reversable-polarity meter

Fig. 24 looks like an ac voltmeter, but it can also be used for something else. Remember the last time you made a small transmitter and wanted to measure both the grid and plate currents? They are opposite in polarity, so it took a DPDT switch. This circuit gets around that. Voltages of either polarity may be applied to it and will always read upscale.

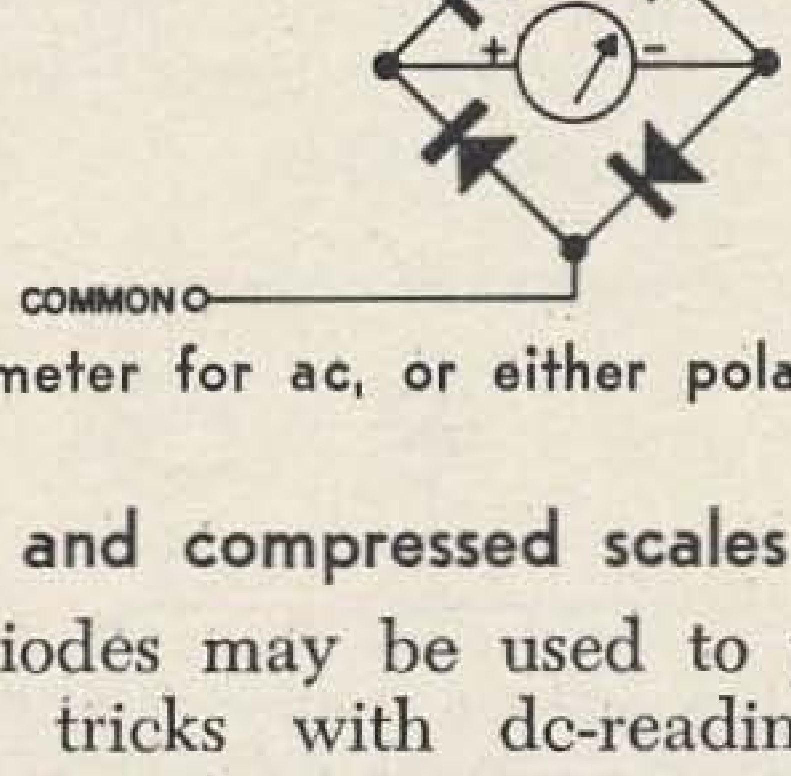


Fig. 24. A meter for ac, or either polarity dc.

Expanded and compressed scales

Zener diodes may be used to play some interesting tricks with dc-reading meters. For instance, suppose you want to meter the voltage in your car. It never goes below 12 V or above 15 V. If you use a 15-V meter, the variation will be a small part of the scale and hard to read. But if we expanded the 12 to 15 V range to fill the face of the meter, the variations would be very noticeable. A way to do this is shown in **Fig. 25.** A 12-V zener diode is placed in series with a 0 to 3 V meter.

The meter reads nothing until the voltage reaches 12 V, then reads normally from 13 to 15 V. This is called supressing the low end of the scale.

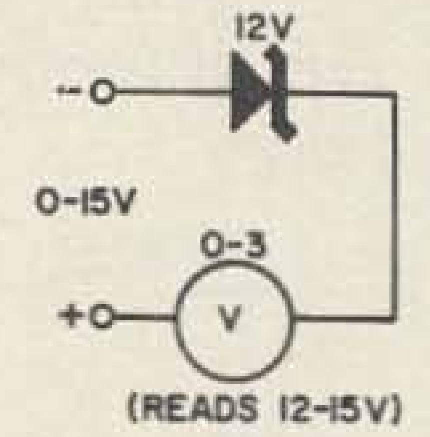


Fig. 25. A zener and a low-voltage meter can be used to suppress the low end of a range.

The last circuit for modifying meters is shown in **Fig. 26.** It partially suppresses the low end of the scale. For example, the meter can be made to read 0-9 V in the first half of the scale and 9-12 V in the second half. Values will depend on the voltages and meter.

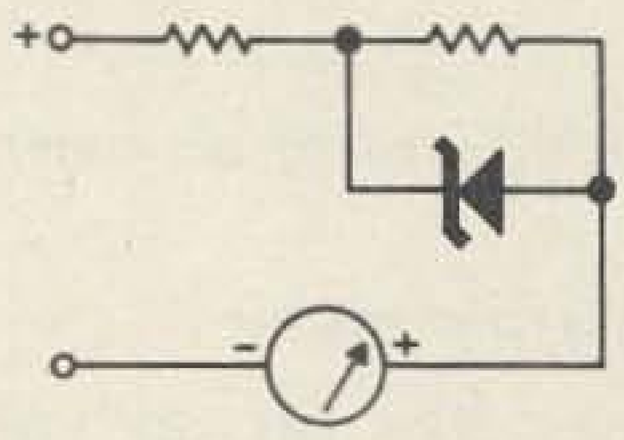


Fig. 26. This circuit partially suppresses the low end of a range.

Meter protection

You can also suppress the high end of the scale. If that sounds rather pointless, you can think of this operation as a meter protector. **Fig. 27** shows the circuit. The resistors will depend on the voltage, etc. If the zener is picked to conduct at the high end of the scale, the meter will not be overloaded even by voltages much higher than should be applied to it.

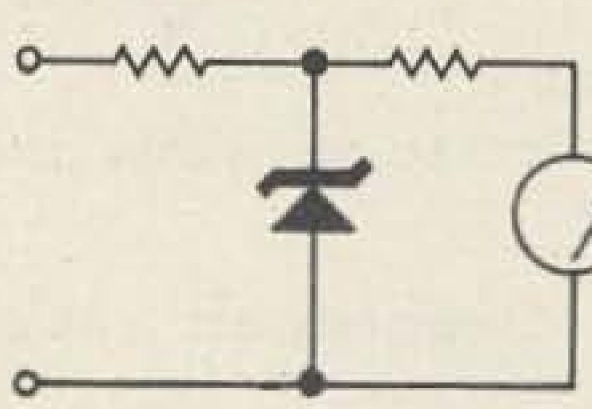


Fig. 27. This is a meter-protective circuit. The zener should be tapped on the resistor chain at a point that provides conduction when the meter pointer is pinned.

Fig. 28 is a simpler meter protector using a run-of-the-mill silicon power diode or two. A silicon diode acts like a 0.7-V zener when it's forward biased, so will conduct whenever the voltage across the meter goes over 0.7 V. It's best to use two diodes back-to-back for maximum protection. Having the meter needle take off in the wrong direction with 0.7 V is better than with 400 V. As an example of the voltages involved, a 50-μA, 4000-ohm meter has 0.2 V across it at full scale, so a 0.7-V silicon diode limits overloads to about 3½ times, which most good meters can handle. Incidentally, it's recommended that you also put a .01-μF capacitor across the meter in parallel with the diode or the meter will be very susceptible to rf.

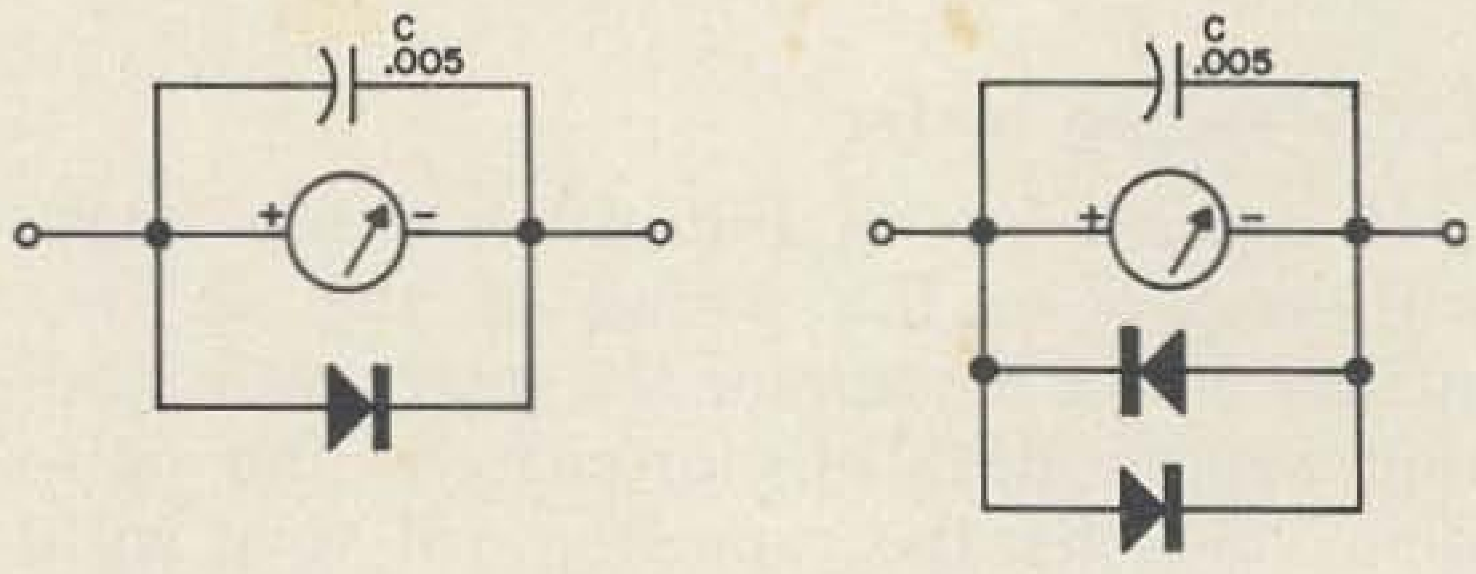


Fig. 28. Conventional silicon diodes can protect a meter movement, too. The 0.005-μF capacitor bypasses rectified rf.

Receiver Circuits

Diode mixer

Diode mixers are rarely used in modern high-frequency or VHF receivers. Transistor mixers give better performance in every respect: gain, noise figure, selectivity, and versatility. However, diode mixers are still used almost universally at frequencies above about 500 MHz, where a diode can provide better results than a transistor—at least at present. A standard type of diode mixer suitable for any frequency is shown in **Fig. 29.** The antenna and local oscillator inputs can be low impedance (as shown) through taps or loops, or high impedance through capacitors connected to the top of the coil. The input coil can be a quarter-wave trough line at UHF frequencies.

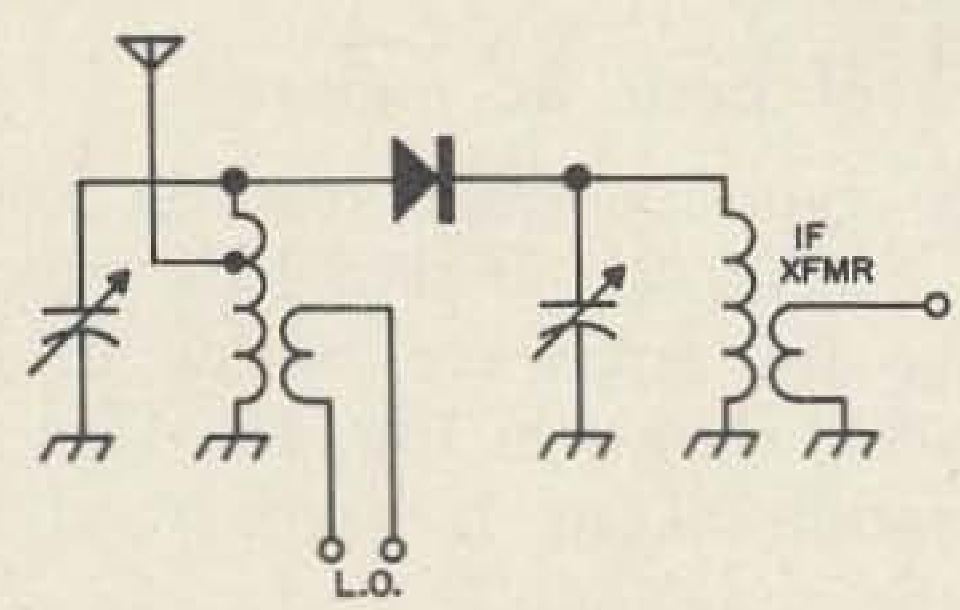


Fig. 29. A basic diode mixer as used at UHF and microwave.

AM detectors

The most popular receiver in the early days of radio was a crystal set. The typical crystal set used a large coil, a crystal detector, and a set of headphones. The most common crystal detector was a piece of galena (lead sulfide) or some other semiconductor with a springy wire contact (cat's whisker) which had to be adjusted for best results. The modern equivalent of this circuit is shown in **Fig. 30.** It is the half-wave detector used in almost all AM receivers. This detector includes a resonant circuit tuned to the frequency of interest, a diode rectifier and a load. In the diagram, the load is a resistor suitable for transistor *if* use. The capacitor provides filtering and smoothing. The resistor can be replaced by a set of headphones, and a long antenna added to make a modern crystal receiver. A good ground will also be necessary in most places.

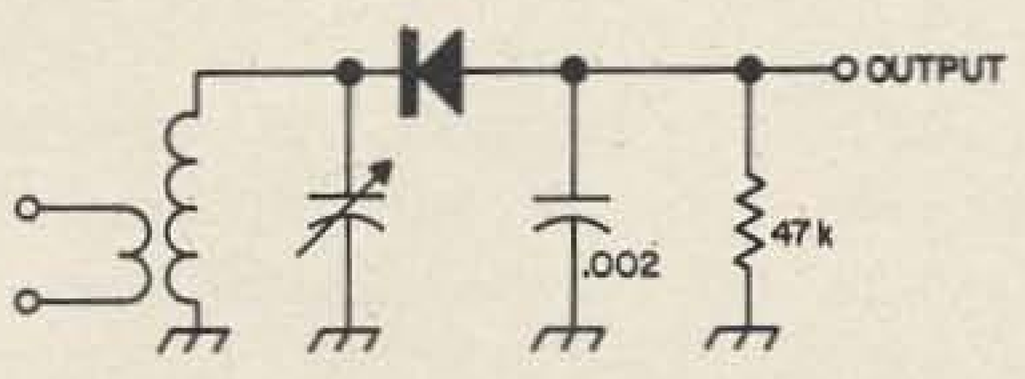


Fig. 30. A half-wave detector. This can be used as a crystal set, too.

The half-wave detector is very popular, but it's far from the best AM detector. The peak-to-peak or voltage-doubler detector in **Fig. 13** provides much higher output with lower distortion and is highly recommended for all AM receiver applications.

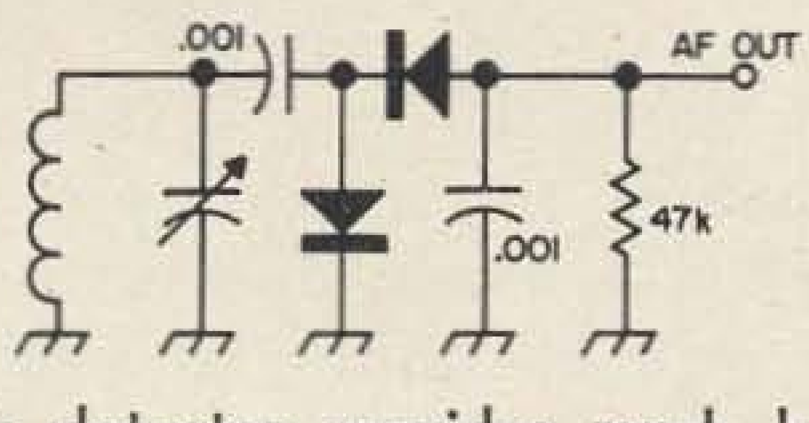


Fig. 31. This detector provides much better results than that in Fig. 30.

Ring modulator

Balanced mixers (or modulators) are becoming very popular in modern receivers as we face the problem of many strong signals in and out of the ham bands. Conventional mixers can easily be overloaded by these signals, while balanced mixers can handle more power and reduce spurious-causing frequencies. The balanced modulators used in SSB generators generally make excellent mixers, but many of them are inconvenient to use in equipment which must be tuned over a wide range. Nevertheless, we will likely be seeing more of them in the future. The balanced modulator shown in **Fig. 32** is a ring modulator which can be used in both receiving and transmitting equipment. The diodes should be matched, as described in the paragraphs in this article on SSB balanced modulators.

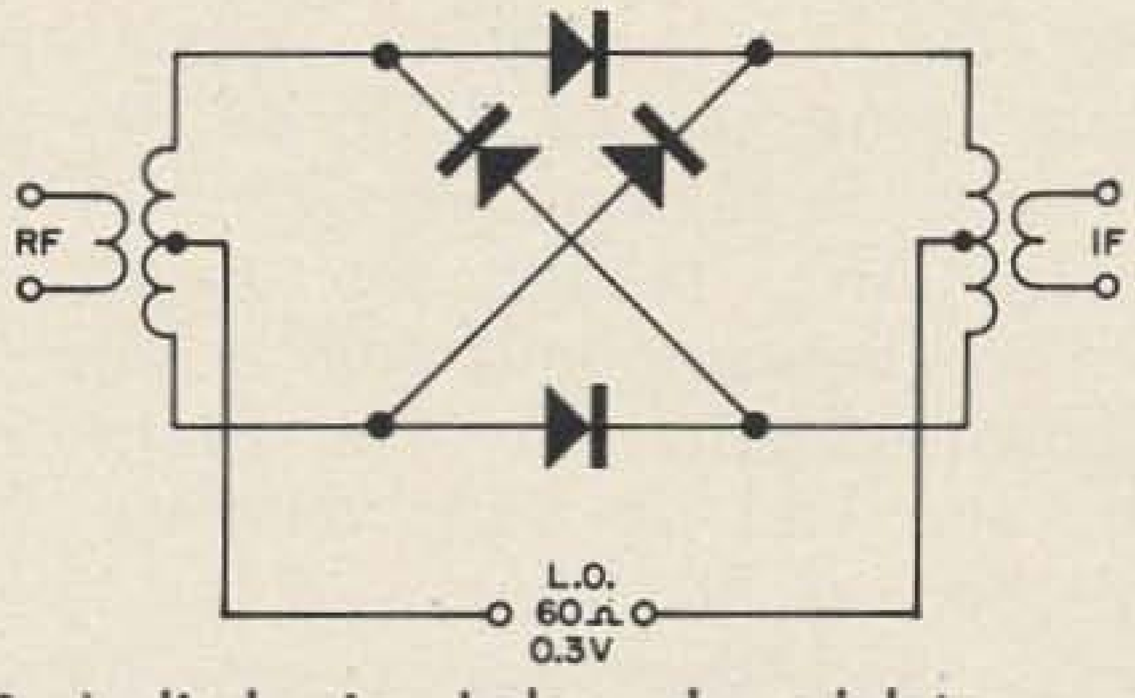


Fig. 32. A diode ring balanced modulator.

Product detectors

While any good AM detector can give excellent results on SSB signals if it has proper BFO injection, a number of circuits have been developed to make tuning and detecting SSB easier. One is the product detector shown in **Fig. 33.** This popular circuit has been used in many ham receivers. The BFO voltage should be 10 to 20 times that of the incoming signal for best results. The diodes should have high back resistance, but must have at least some leakage for the circuit to work properly (or a resistor must be added from the junction of the diodes to ground).

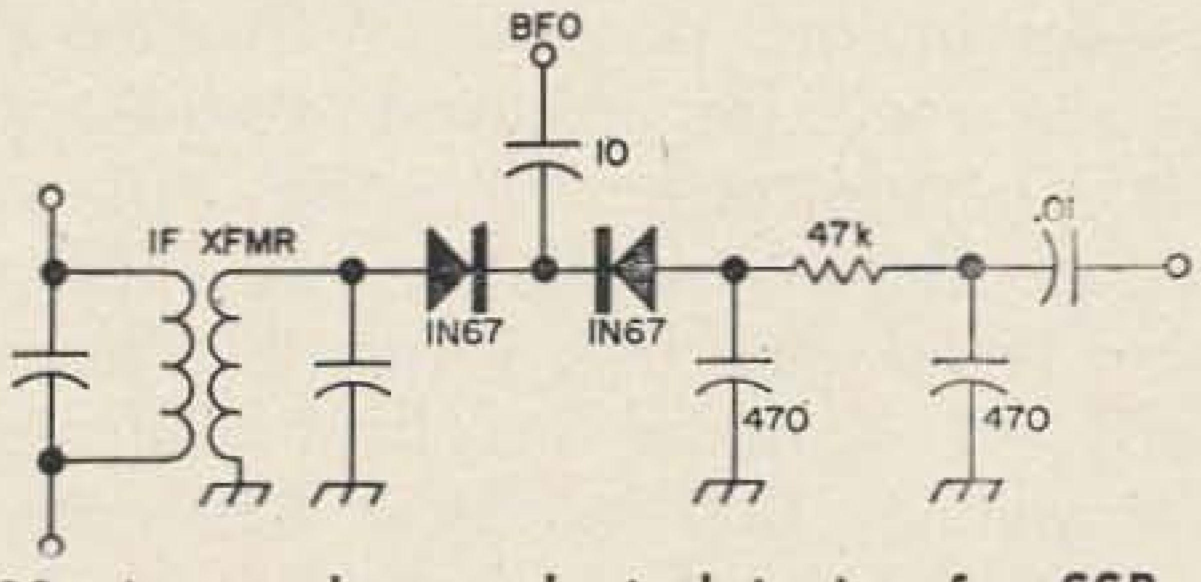


Fig. 33. A popular product detector for SSB.

Another product detector is illustrated in **Fig. 34.** Values are given for use at both 455 kHz and 9 MHz, the most popular SSB *if's*. For use at 2 or 3 MHz, the capacitors and inductors can be about half-way between the values given. Other balanced

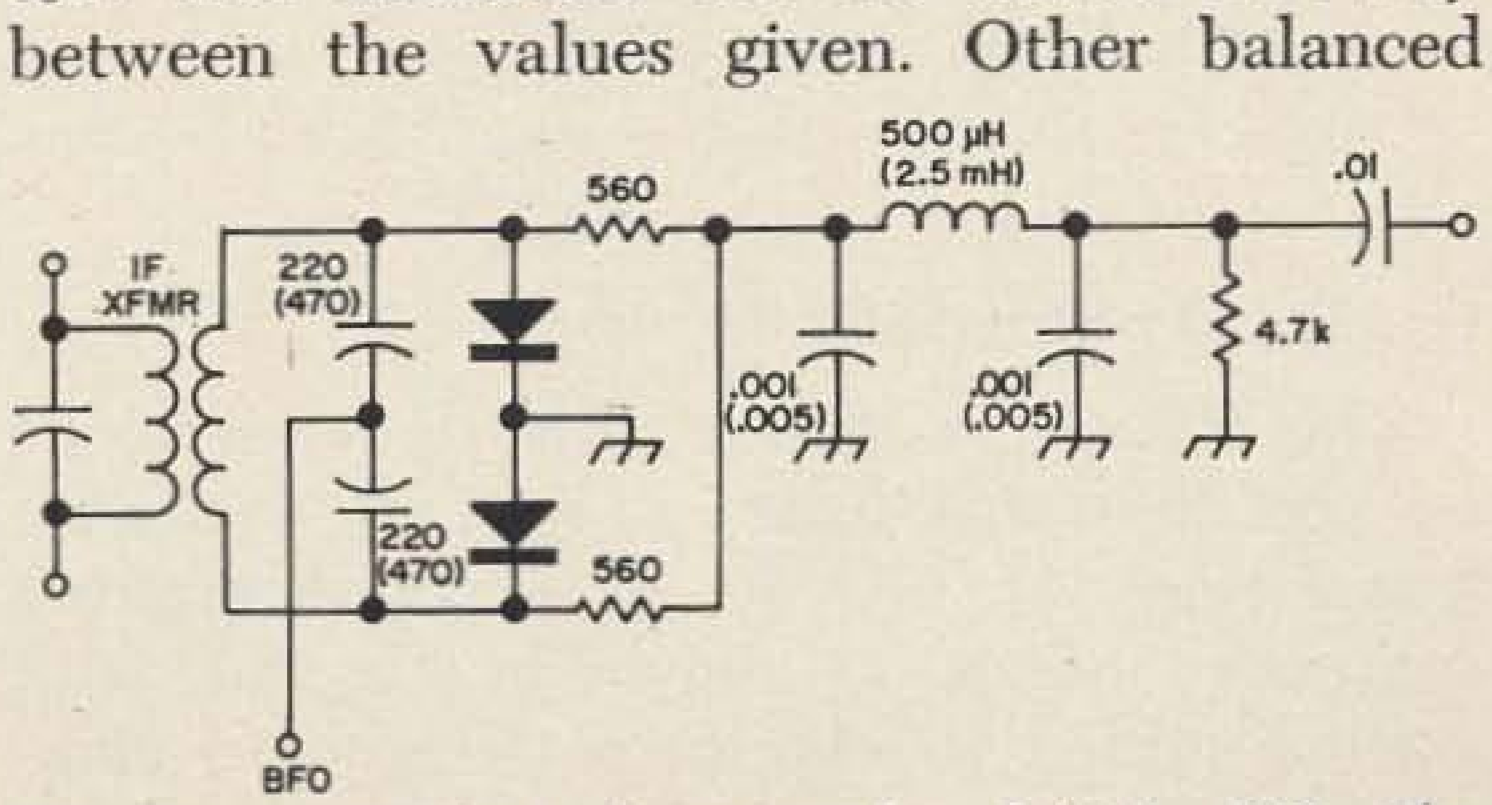


Fig. 34. A product detector for 9-MHz SSB. The values in parentheses are for 455 kHz.

modulator circuits that make excellent SSB detectors are given in the transmitter section of this article.

FM detectors

There are three excellent types of FM detectors using diodes. Two of these are well known to almost everyone in radio. The third isn't, though it's an excellent, inexpensive detector and easy to use. The well-known circuits are the Foster-Seeley discriminator and the ratio detector, shown in **Figs. 35** and **36.** They work on different principles, and the circuits are quite different. The discriminator is easier to align,

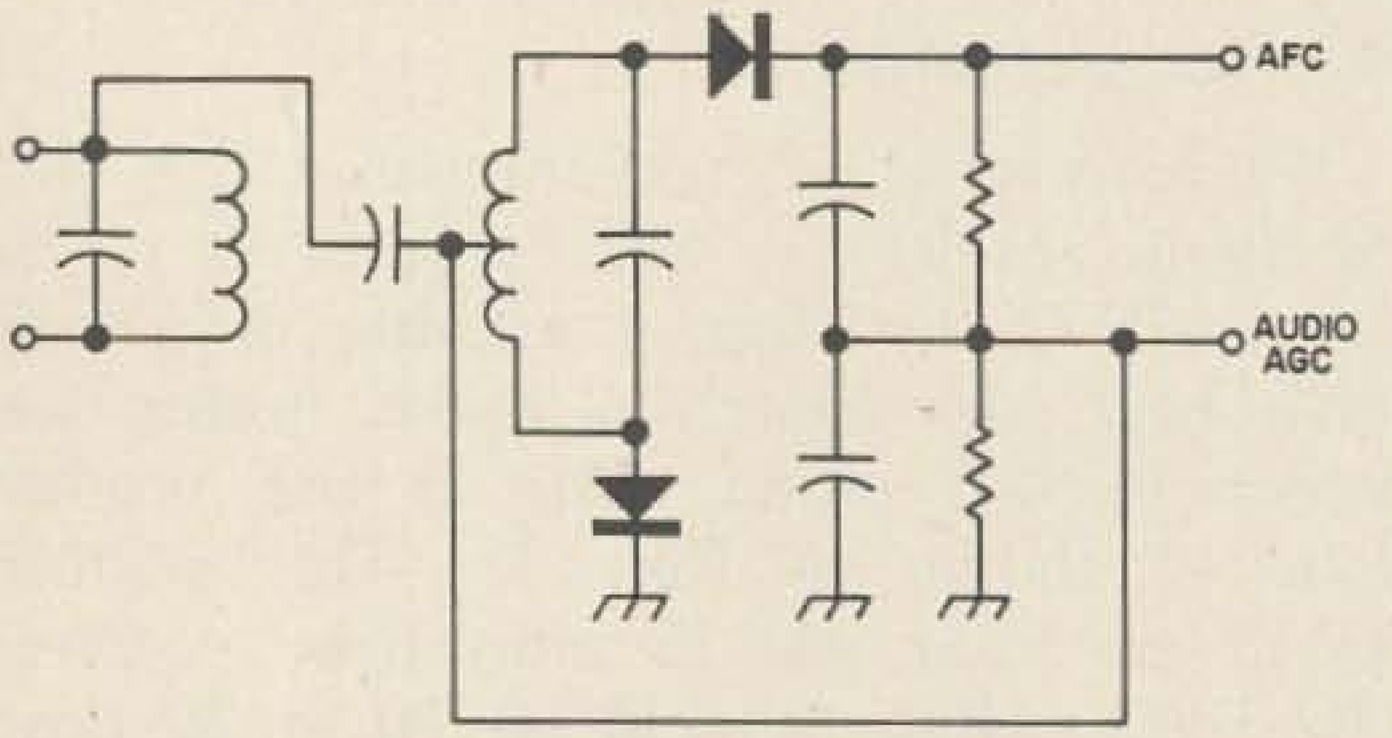


Fig. 35. Foster-Seeley FM discriminator.

but requires a separate limiter to remove AM. This can be a diode limiter or a more popular tube or transistor circuit. Otherwise it is simply a convenient AM *and* FM detector. While that might be useful for many experimental purposes, it is undesirable for most since the greatest advantage of FM is it's suppression of noise and static, which are almost completely AM. The ratio detector is self limiting. When it is adjusted properly, it provides excellent suppression of AM signals. Both of these FM detectors require special transformers.

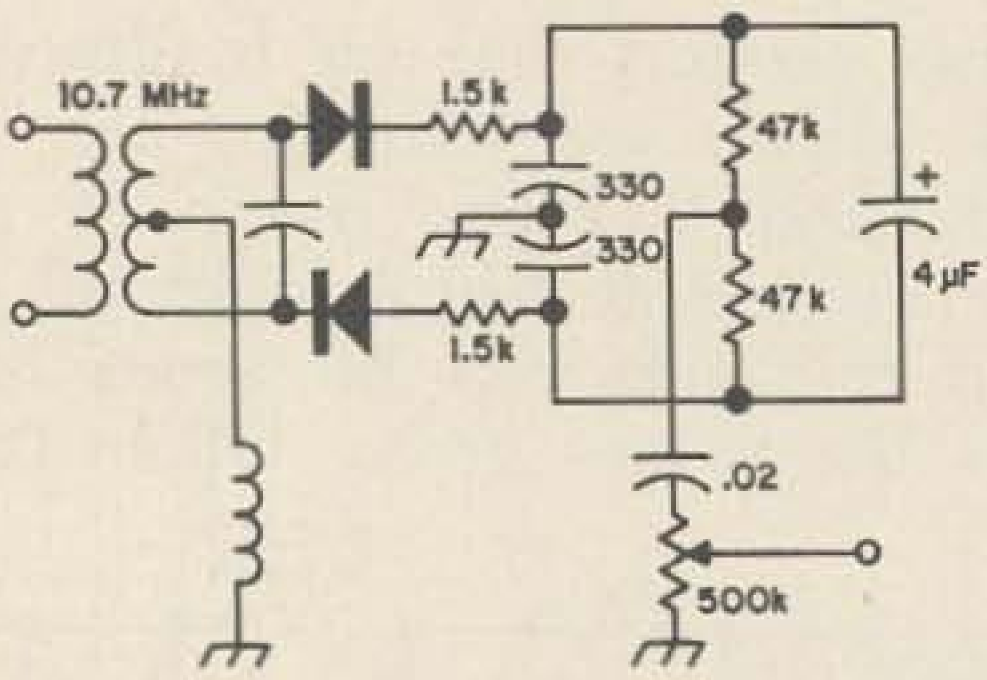


Fig. 36. 10.7-MHz FM ratio detector.

The other, less-common FM detector needs no special transformer; in fact, it needs no transformer at all. It is a pulse-counting frequency meter, as shown in **Fig. 85,** with a filter added to eliminate the carrier components. This is a very versatile circuit. It can be used as a frequency meter, tachometer and FM detector. Unfortunately, the circuit cannot be used very easily at high frequencies (say, over 1 MHz) without a good bit of care. Nevertheless, it is becoming popular and we will probably see it in many FM and TV receivers in the future.

Noise limiters

Most AM communications systems suffer from electrical noise caused by atmospheric disturbances and man-made equipment. Many noise limiters have been developed to try to reduce the effects of this interference. Some noise limiters are effective against only very short, high-impulse noise, while others can reduce more difficult-to-handle, long-term, moderate-level interference. Because of the widely different characteristics of AM, SSB and CW signals, practical limiters are usually designed for optimum results on one type of modulation, and are less effective on others. In all cases, however, noise limiting should be performed before highly selective sections in a receiver, if that is possible. Sharp filters will lengthen noise pulses and make them more difficult to eliminate. The selectivity can also lead to ringing, a very unpleasant sound to human ears.

A very simple noise limiter which can be quite effective against high-impulse, fast pulses in a moderately unselective receiver is shown in **Fig. 37.** The two diodes clip any signals above 0.3 or 0.7 volts (depending on whether the diodes are silicon or germanium). Obviously, the performance of this limiter will be quite dependent on the output impedance and power of the receiver, and the characteristics of the speaker with which it is used. As a rough idea of the levels involved, suppose the diodes are germanium and the impedance is 4Ω (which is not too likely as the impedance of most speakers is very dependent on frequency). By Ohm's Law, $P = E^2R$, $0.3^2 4 = 0.09/4 = 22$ mW. Thus the diodes will start clipping at 22 mW of output. This may well be plenty of audio. If more is desired,

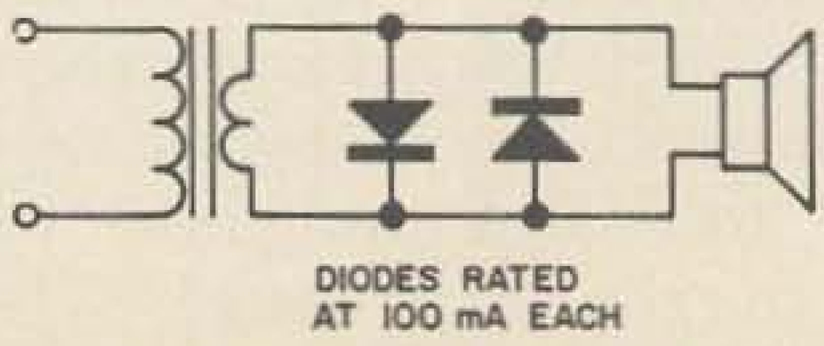


Fig. 37. Shunt diode noise limiter for use across a loudspeaker.

silicon diodes can be used. The volume control must be set for the proper level to clip noise peaks and leave any desired sound alone.

A simple shunt half-wave limiter can be installed at the second detector of the receiver, or at the input to an audio amplifier stage to accomplish much the same thing. Here a single diode may be sufficient because of the characteristics of the detector or the amplifer. **Fig. 38** shows a typical limiter of this type.

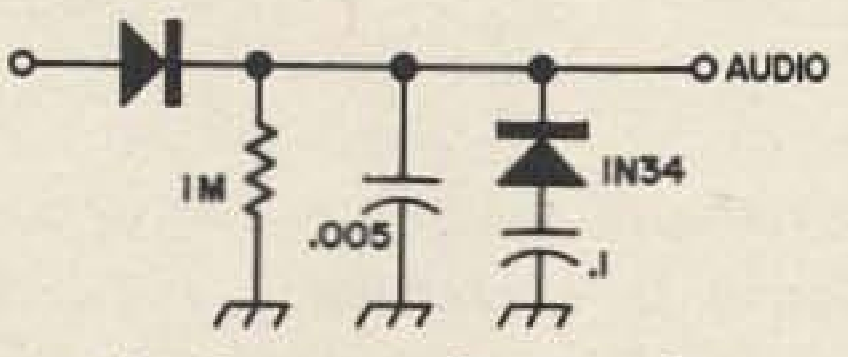


Fig. 38. Shunt diode noise limiter that can be easily added to the input of an audio amplifier.

Fig. 39 illustrates a simple half-wave series peak limiter. It requires a diode with high back resistance; the base-emitter junction of a transistor often makes an excellent diode of this type. This circuit must be adjusted to the proper clipping level for best results. Though there is no negative peak clipping in the circuit, it does a good

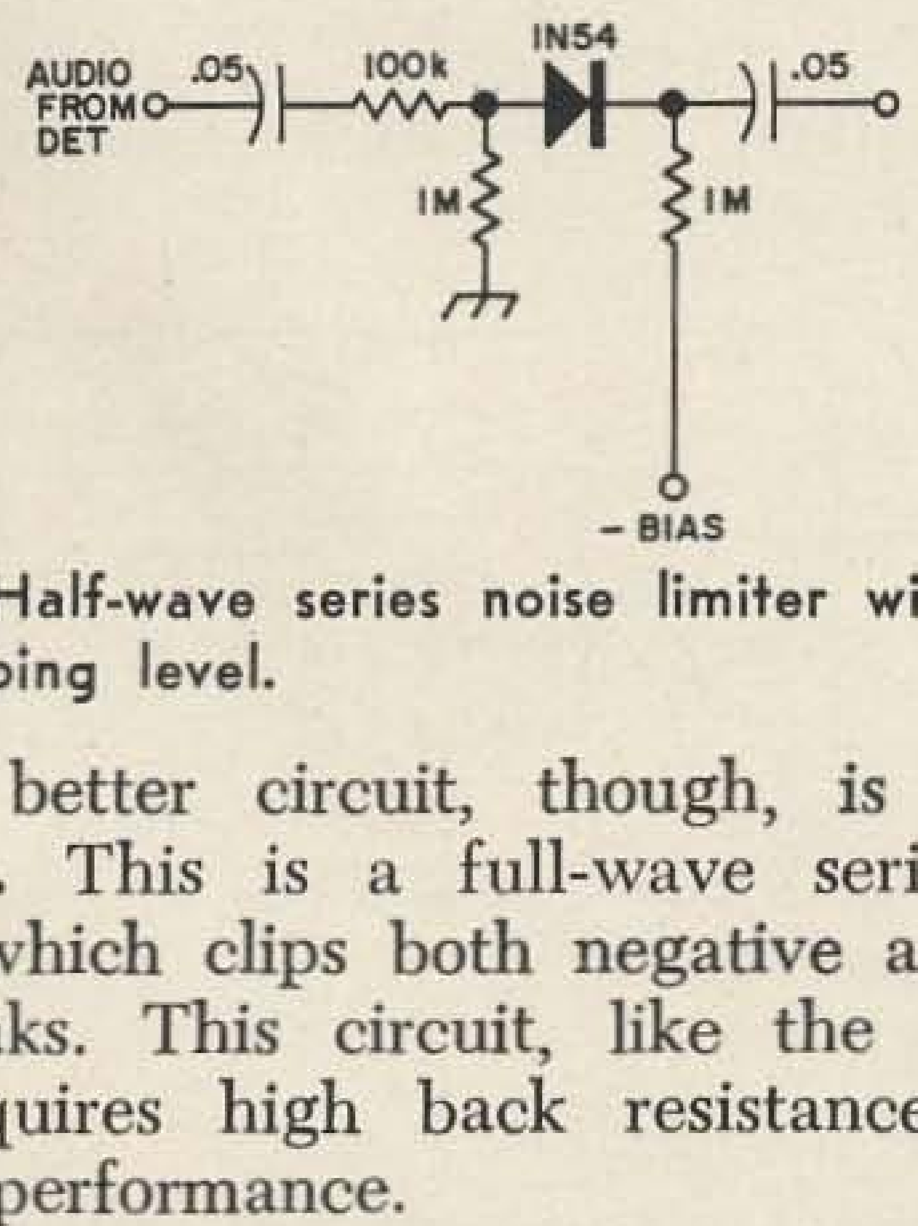


Fig. 39. Half-wave series noise limiter with adjustable clipping level.

job. A better circuit, though, is that in **Fig. 40.** This is a full-wave series peak limiter which clips both negative and positive peaks. This circuit, like the previous one, requires high back resistance diodes for best performance.

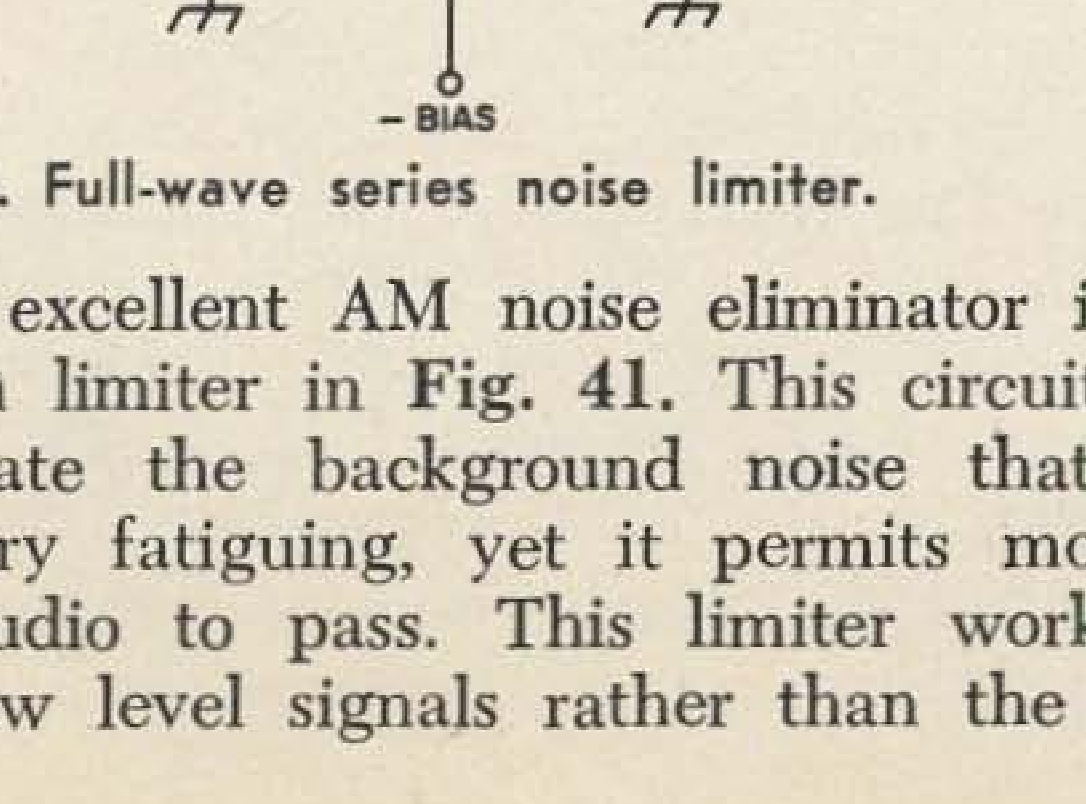


Fig. 40. Full-wave series noise limiter.

An excellent AM noise eliminator is the trough limiter in **Fig. 41.** This circuit will eliminate the background noise that can be very fatiguing, yet it permits most of the audio to pass. This limiter works on the low level signals rather than the high.

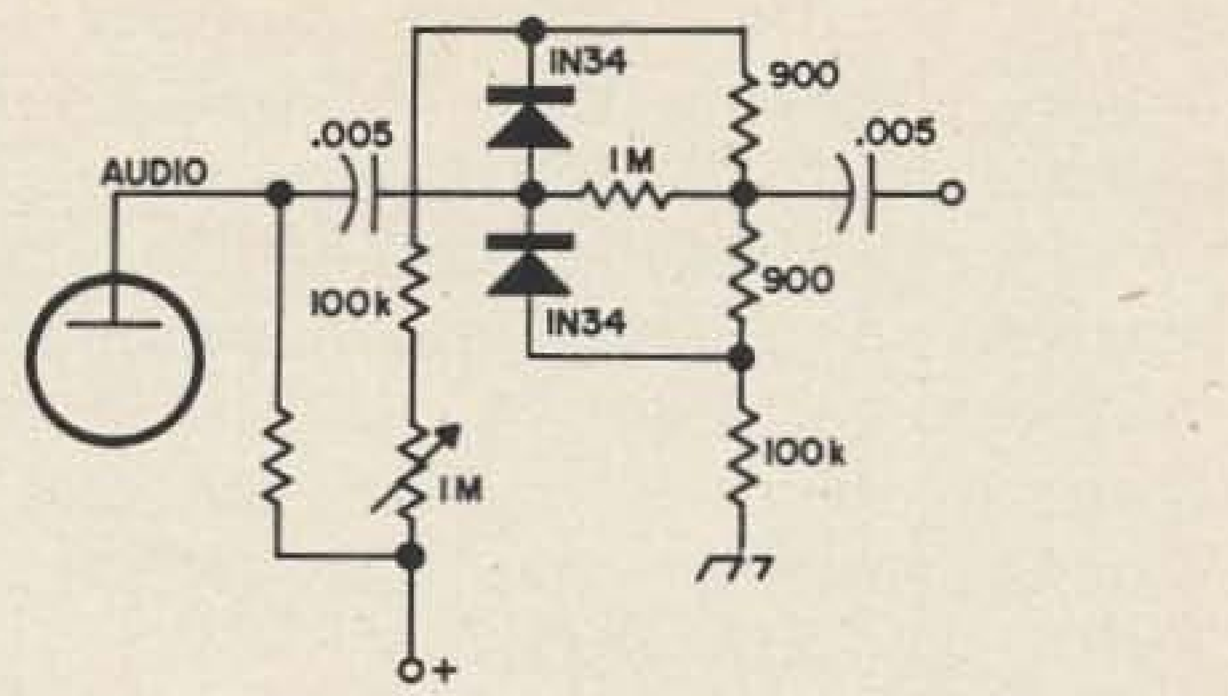


Fig. 41. This "trough" limiter will eliminate the background noise that is ignored by conventional limiters.

Perhaps the ultimate noise limiter for AM use is the rate-of-change noise limiter developed in England for use in the audio portion of TV sets. This detector works on the theory that most noise peaks have a much faster rise time than desirable modulation. The detector eliminates these peaks very effectively, as has been demonstrated by many testimonials. The limiter diode in this circuit, which is shown in **Fig. 42** must have very high back resistance. Transistor junctions have been used for this diode by some hams with excellent results. The detector diode can be any conventional diode. This circuit has some loss, so an extra audio amplifier may be needed in some receivers. The clipping can be adjusted by changing the ratios of the 27kΩ and 18kΩ resistors.

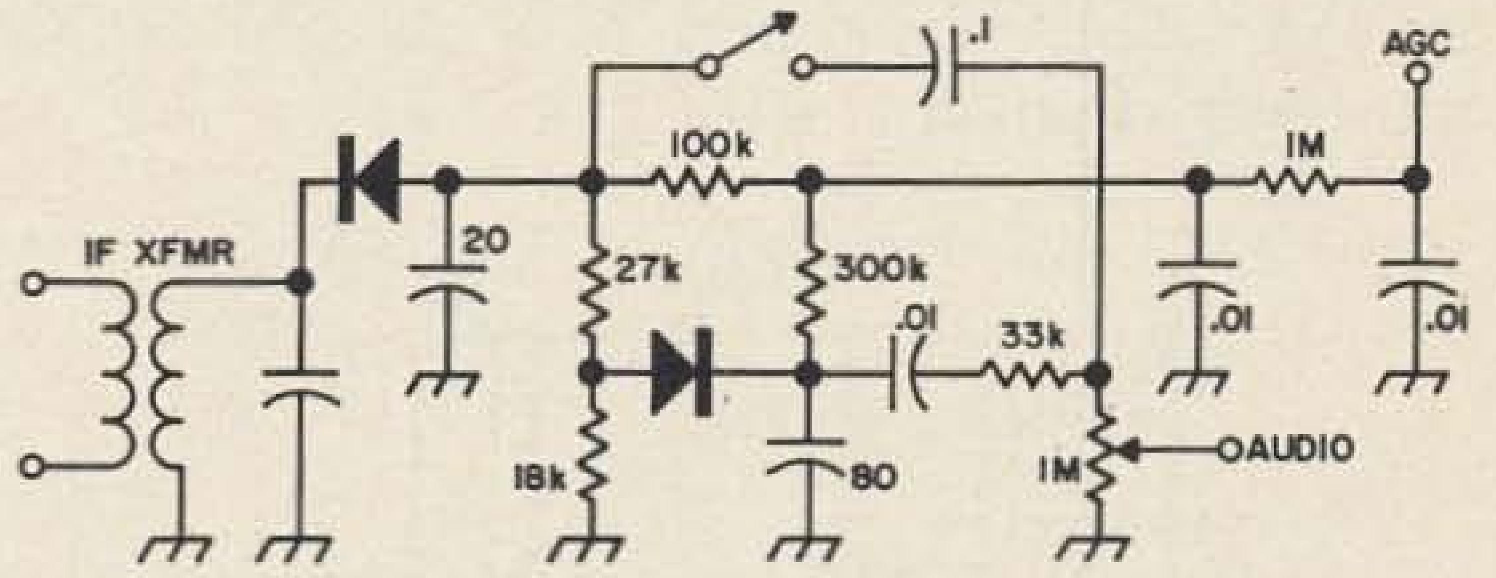


Fig. 42. One of the best noise limiters is the "rate-of-change" limiter designed for TV audio in England.

The next two circuits are installed in the *if* amplifier section of a receiver rather than in the audio section. They provide superior results on SSB and CW, but are not as ef-

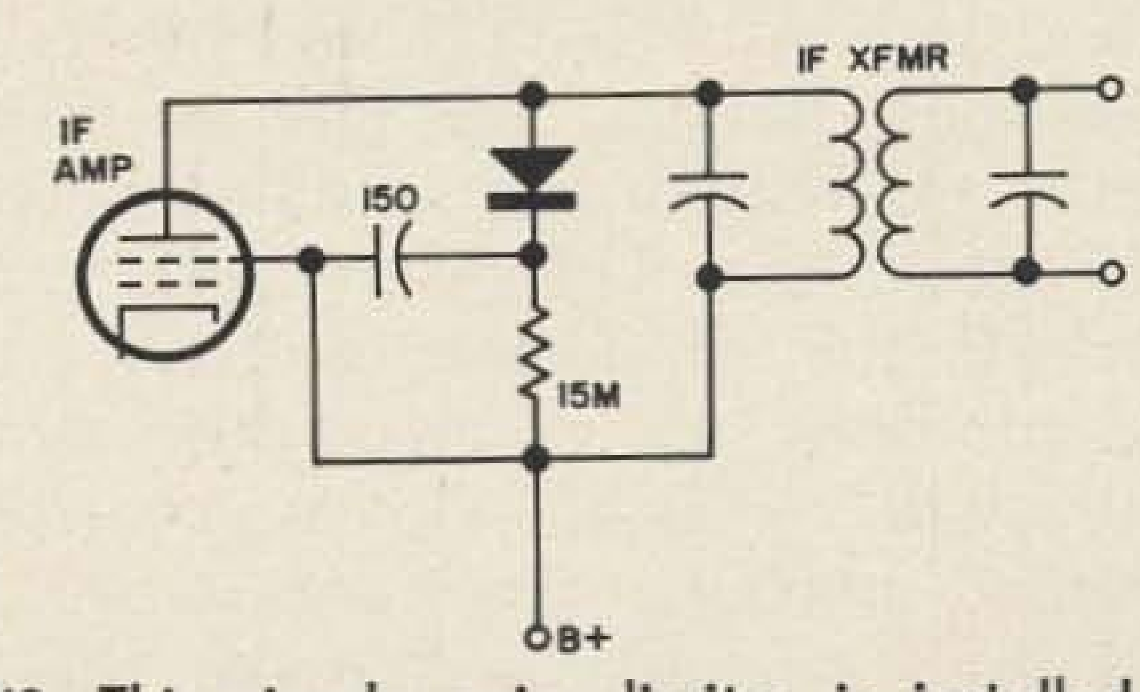


Fig. 43. This simple noise limiter is installed in an *if* stage for SSB and CW use. The diode must have high back resistance, low capacitance and short rise time.

fective as other limiters on AM. The first circuit, shown in **Fig. 43**, uses a fast diode to clip short interference pulses. It is very simple and could be installed in almost any receiver. A slightly more complex circuit is shown in **Fig. 44.** It is self-adjusting. Both of these *if* limiters use fast diodes. Among suitable ones are 1N903, 1N904, 1N916, and MA-4441.

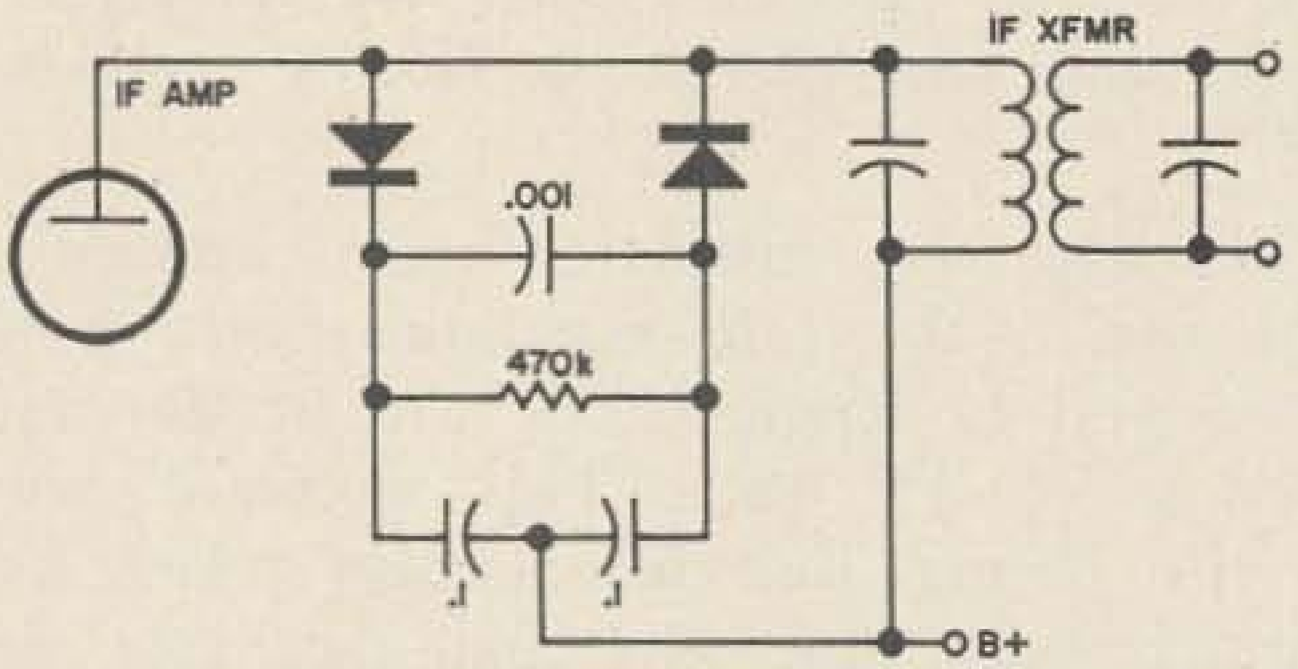


Fig. 44. This is an improved version of the SSB if noise limiter in Fig. 43.

Diode squelch

Diodes make excellent switches. This property can be used in the very simple squelch shown in **Fig. 45.** The diode detector is simply biased to the desired threshhold with the potentiometer and signals weaker than this level will not be passed. There are two major problems with the circuit. It does not quiet the receiver completely, and it introduces distortion on weak signals. However, it is simple, cheap, and easy to add to almost any receiver.

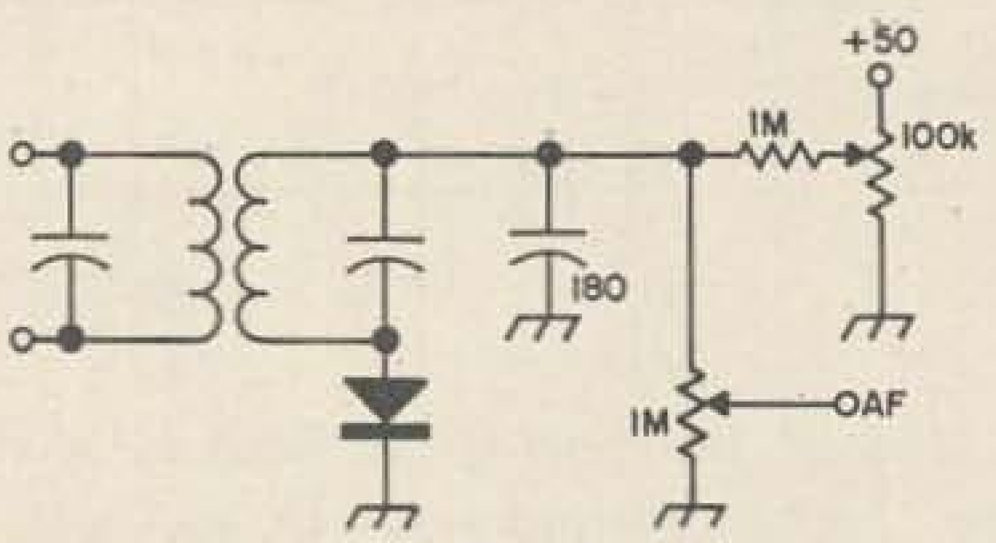


Fig. 45. Simple diode squelch.

Add-on BFO/Q-multiplier

It's very easy to add a simple beat frequency oscillator Q-multiplier to tube-type receivers, and many SWL's and others with receivers not designed for CW or SSB reception should find the circuit shown in **Fig. 46** interesting. The principle is straightforward. If the suppressor grid of a high gain pentode is not connected to ground, the tube will oscillate. We can control the impedance between the suppressor and ground with a diode and make the tube regenerate. This will increase the Q and hence, the selectivity of the amplifier. If the regeneration is carried far enough, the tube will oscillate and can be used for CW or SSB reception. The control potentiometer can be installed on the front panel of a receiver, with the diode and 1.5kΩ resistor near the tube.

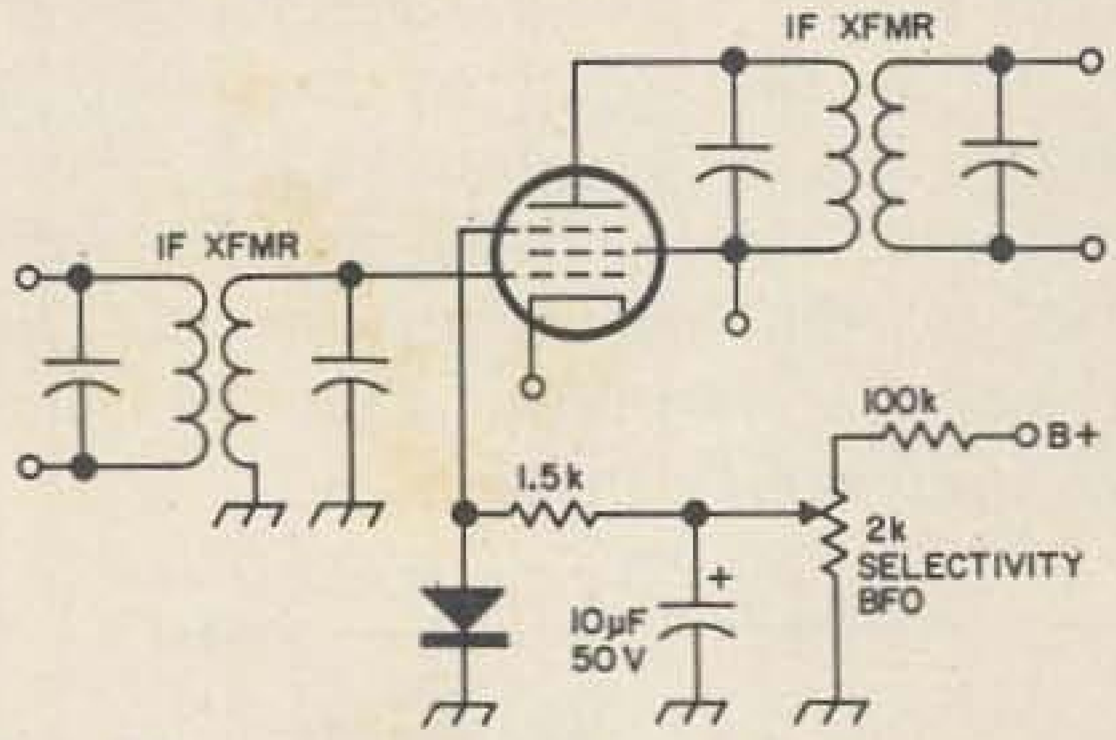


Fig. 46. Adaptor to provide SSB/CW reception and Q-multiplication in a receiver.

Oscillator limiter

It's often difficult to design an oscillator which provides a constant output as its frequency is varied. This is especially true of wide-range transistor oscillators. A circuit designed to stabilize the output of an oscillator of this type is shown in **Fig. 47.** The diode is reverse biased, so it doesn't normally conduct unless the voltage in the tuned circuit exceeds a certain level. Then it conducts on positive half cycles and damps the oscillation. The result is an output which is fairly constant across a band.

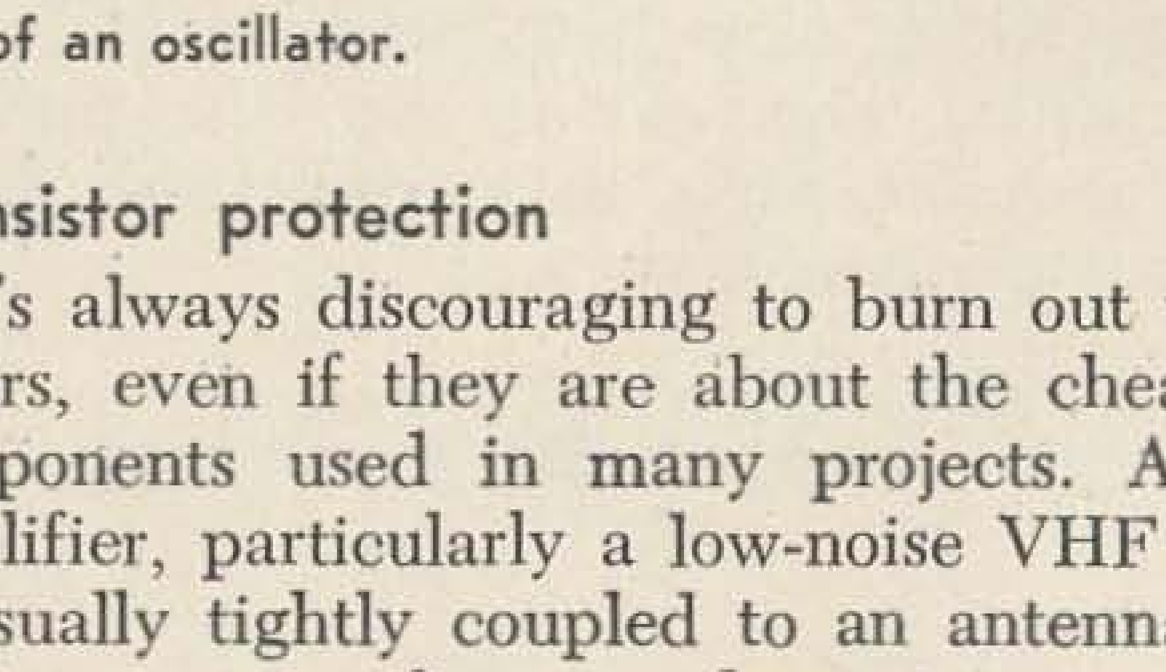


Fig. 47. This circuit uses a diode to limit the output of an oscillator.

Transistor protection

It's always discouraging to burn out transistors, even if they are about the cheapest components used in many projects. An rf amplifier, particularly a low-noise VHF one, is usually tightly coupled to an antenna for minimum noise figure and maximum power gain. Unfortunately, this tight coupling increases the chance that the transistor will be damaged by strong nearby transmitters which may inject too much voltage into the base of the transistor. A simple, effective way to reduce the likelihood that this will happen is to place two low-capacitance silicon diodes across the input coil of the

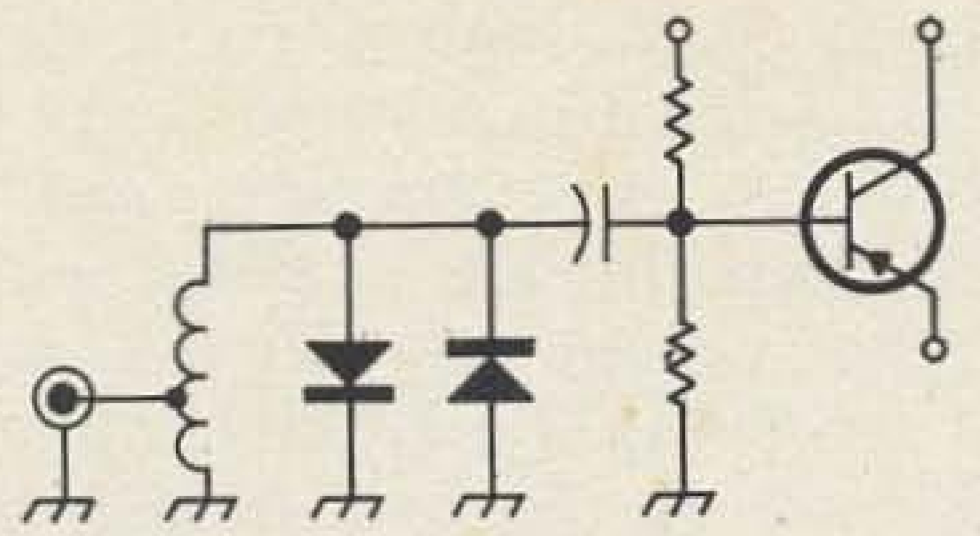


Fig. 48. Diodes can be used to protect a transistor rf amplifier from burnout.

amplifier (**Fig. 48**).These diodes will conduct if the voltage across the coil exceeds about 0.7 V, simultaneously shunting it through the diodes and causing the capacitance of the diodes to change drastically, which will detune the resonant circuit. This will often save the transistor. This pair of diodes will not cause too much signal loss as long as the diodes are suitable for the use. The easiest way to check them is to try the circuit with and without the diodes. Signal strength should be the same.

Automatic gain control

A circuit designed to adjust the amplification of a receiver for approximately constant output with varying input is called automatic gain control (AGC) or automatic volume control (AVC). The most common type of AGC for tube-type receivers is shown in **Fig. 49.** Its operation is simple The amplification of a tube is dependent on the voltage of its grid. Up to a point, the higher the negative voltage, the lower the amplification. So we simply take a part of the negative voltage output from the receiver detector and apply it to the grid of one of the *if* amplifiers. Then the stronger the received signal, the more negative the output from the detector and the less amplification in the tube. This in turn reduces the negative voltage and the receiver tends to have a fairly constant output. Normally, the AGC voltage is applied to both *if* and rf amplifiers for best results.

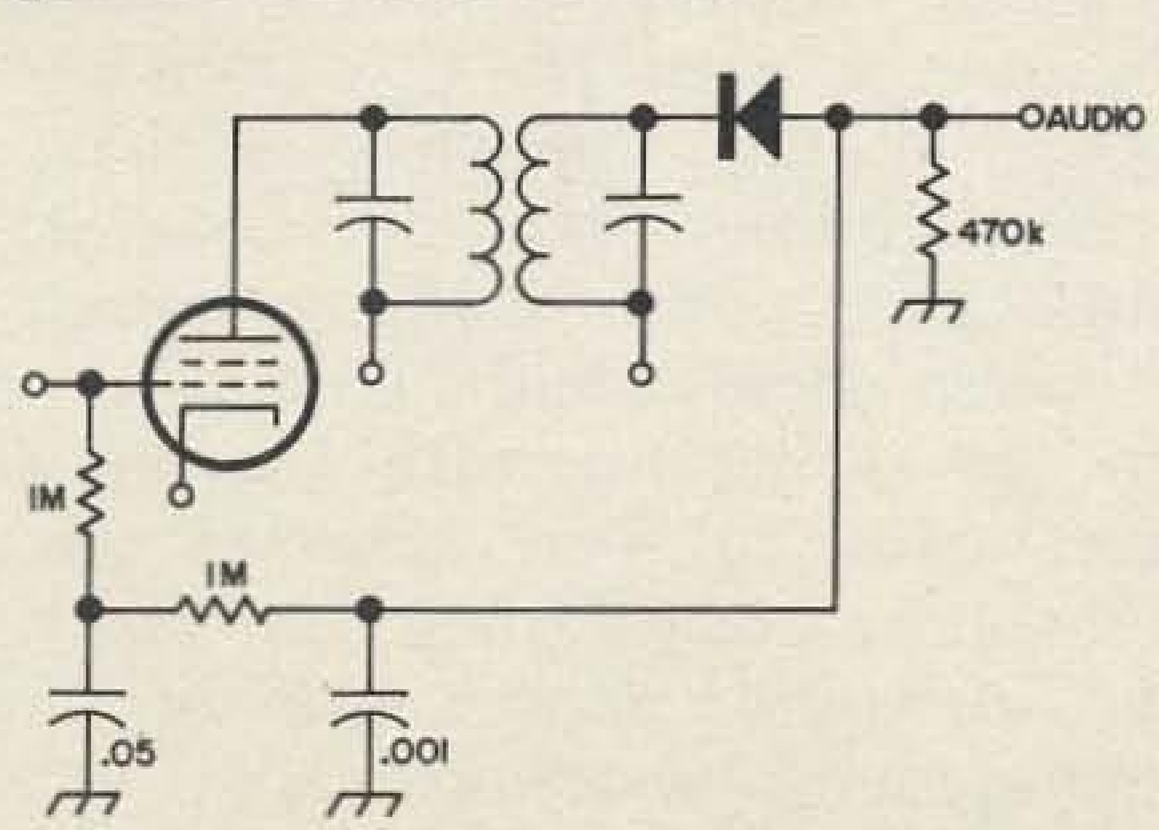


Fig. 49. The conventional AGC system used in tube-type receivers.

Of course, we really only want to reduce amplification on strong signals. The best AGC circuits should leave the weak signals alone. One way to do this is shown in **Fig. 50** It is called delayed AGC. A separate diode is used to detect a voltage for AGC. This diode is connected to a point which is slightly positive, such as the cathode of an audio amplifier. Then the diode will not conduct until it reaches a point determined by the positive voltage. This prevents the AGC from reducing the amplification of any amplifiers on weak signals.

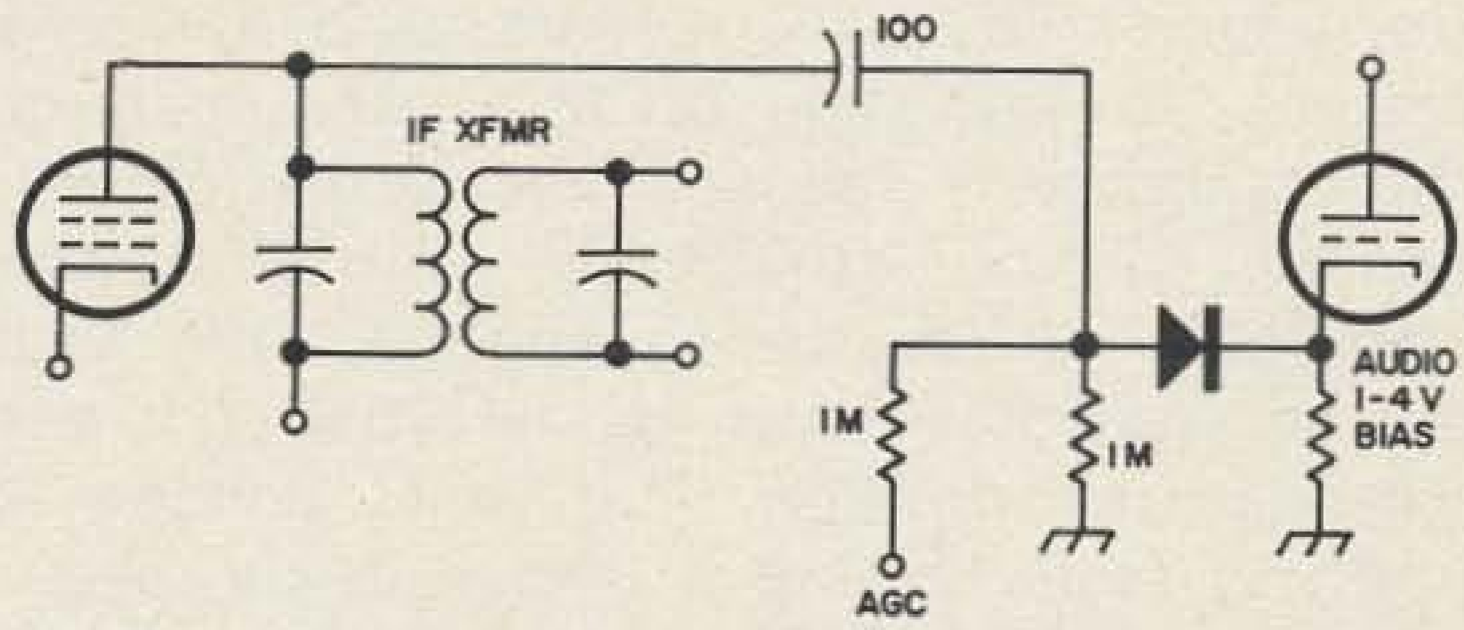


Fig. 50. Delayer AGC acts only on strong signals.

For reception of single-sideband signals, a special type of automatic gain control is needed. SSB comes in fast bunches with space between the bunches. Thus the AGC should act very quickly when a signal is received (fast attack), yet keep the receiver gain at about the same level for a short while after the burst in case another is coming (slow delay). The one-way conduction of a diode provides this action in the "hang" diode circuit shown in **Fig. 51.** The diode conducts when there is a negative voltage from the AGC detector on its cathode (in other words, when a signal is received). This charges the capacitor quickly and acts on the controlled stages. In the spaces between words or syllables, the capacitor supplies an AGC voltage to the controlled stages; there is no conduction from the capacitor back to the detector because the diode will not conduct in that direction. The size of the capacitor should be chosen for the desired AGC characteristics. In some receivers, a choice of values is available.

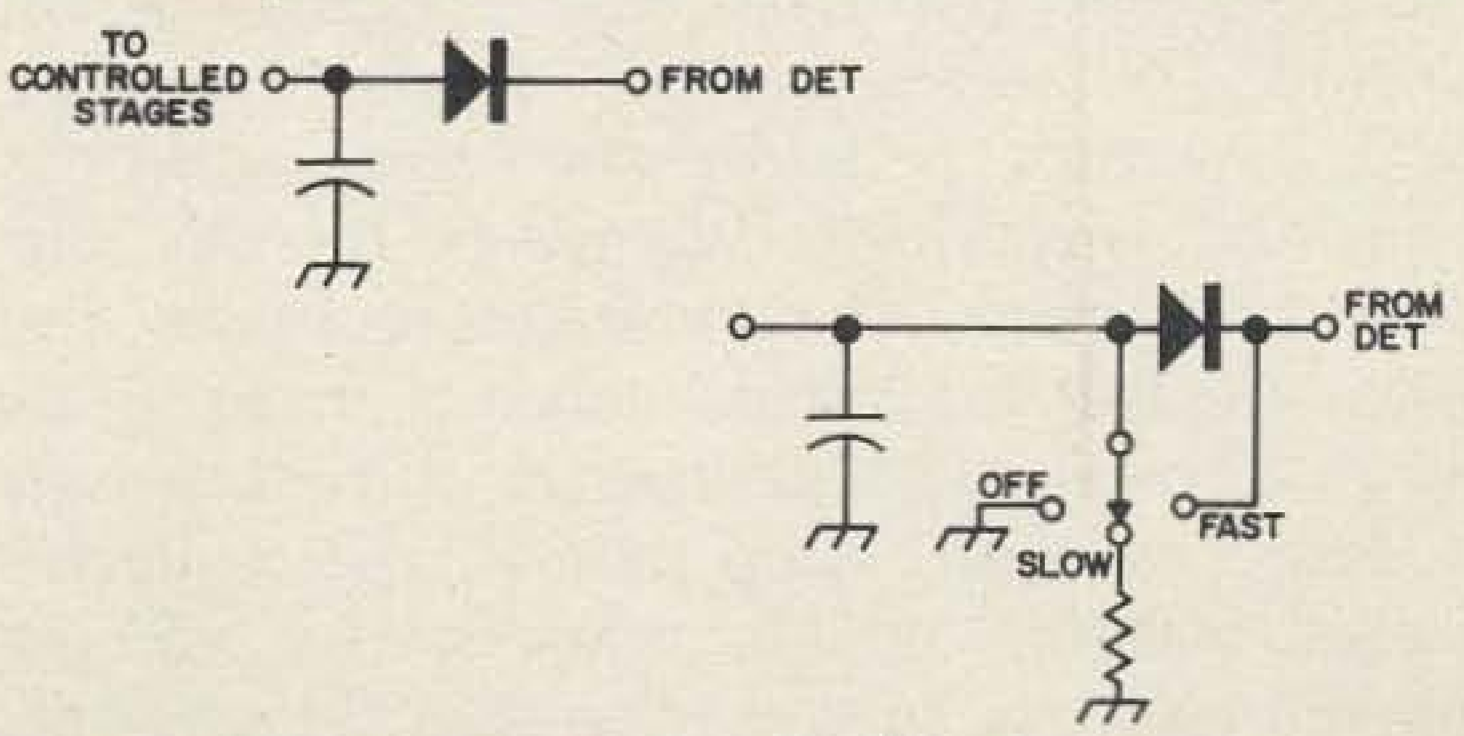


Fig. 51. "Hang" AGC for SSB/CW reception.

Fig. 51 also shows a simple type of switching to provide fast, slow or no AGC action.

Transistor AGC

Transistor automatic gain control is not as simple as tube AGC. Conventional transistors have a number of properties that complicate things slightly. There are three ways to arrange AGC in a transistorized receiver. Two are fairly common; the third is little used.

The simplest type of transistor AGC is shown in **Fig. 52.** It is called reverse AGC, since increased AGC voltage gives reduced current. In this type of AGC, the gain of the transistor is reduced by decreasing the emitter current, usually by controlling the base bias. As shown in Fig. 52, the bias of the transistor must be negative for the transistor to amplify. The AGC voltage is positive, so increasing it decreases the negative bias and hence the gain. As the current through the transistor decreases, the input and output impedances increase, resulting in greater selectivity with strong signals than weak. The transformer impedances can also be designed to be matched with weak signals so that the mismatch with strong signals will reduce the gain in addition to the transistor reduction.

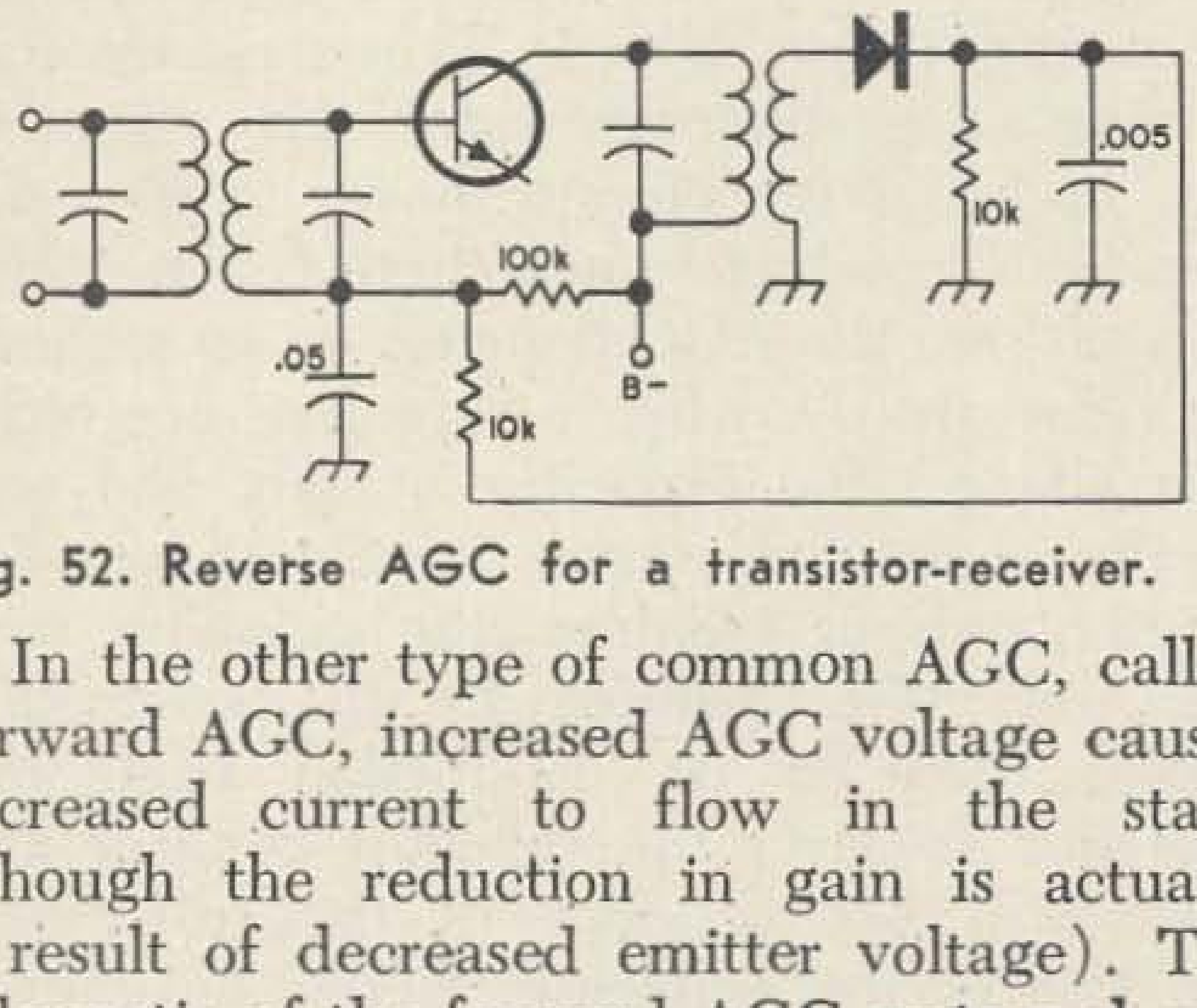


Fig. 52. Reverse AGC for a transistor-receiver.

In the other type of common AGC, called forward AGC, increased AGC voltage causes increased current to flow in the stage (though the reduction in gain is actually a result of decreased emitter voltage). The schematic of the forward AGC system shown in **Fig. 53** is identical to that for reverse AGC except that the AGC voltage is reversed (by reversing the diode detector) and a resistor is added in series with the collector transformer winding. In this circuit, increasing AGC voltage increases the bias on the transistor, causing it to draw more current. This increased current causes a larger voltage drop across the collector series resistor, which reduces the voltage on the collector of the transistor. This results in less gain. Forward AGC offers greater reduction in gain than reverse AGC and better strong-signal performance. As the current through a transistor increases, its impedances drop to low values which decreases the voltage across the transistor. Forward AGC has a few disadvantages: an amplifier may be needed to get adequate AGC voltage, the selectivity of the controlled stage is reduced, and the stage is detuned with strong signals. These last two problems may be minimized by delaying the AGC so that it does not act on weak or moderate signals.

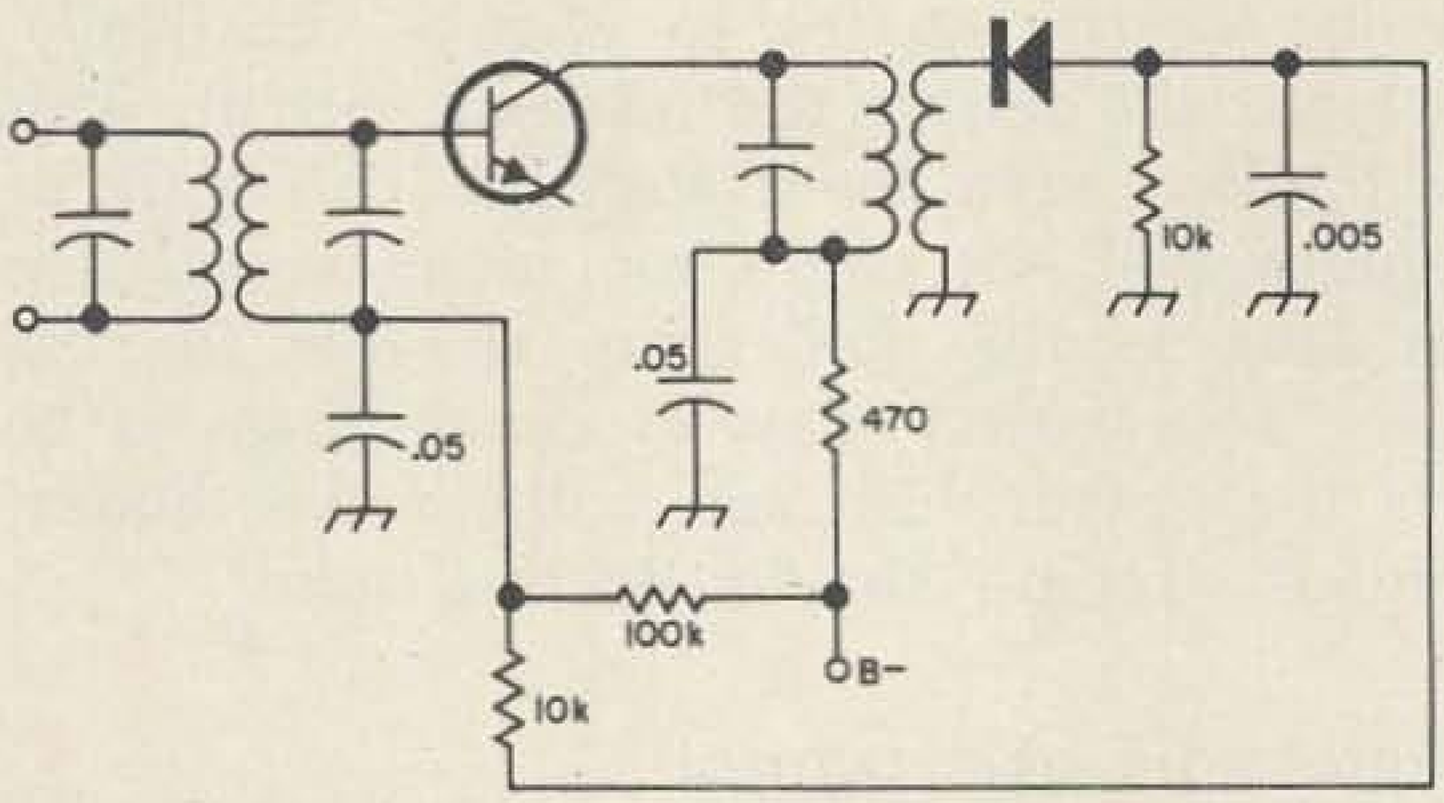


Fig. 53. Forward transistor AGC.

Reverse AGC is commonly used for inexpensive portable receivers where it's unlikely that an external antenna will be connected. Forward AGC is more suitable for receivers which are likely to have to handle strong signals. Both types of AGC may be used in some receivers. For example, forward AGC on the rf stage can be used to handle strong signals and reverse AGC could be used on the first *if* stages to maintain the proper bandwidth with strong signals. Incidentally, AGC should never be applied to the *if* amplifier feeding the detector; this stage usually needs to furnish quite a bit of power and it should be adjusted for best power-handling capability.

The other type of transistor AGC involves an attenuator rather than just reducing the gain of one or more of the amplifiers in the receiver. Diodes, transistors and other devices can be used for this purpose. The advantage of this approach is that each transistor amplifier can be designed for maximum gain, power-handling capacity, or lowest noise figure without any need to change the conditions with varying signal strengths. Most of these schemes are considerably more complicated than the simple circuits discussed above and are rarely needed in practical receivers.

A simple auxilliary AGC circuit used in most practical receivers is shown in **Fig. 54.**

The circuit is similar to conventional AGC circuits except that a diode is added as shown. The diode is reverse-biased under normal conditions (for weak or moderate signals) with its cathode more positive than its anode. However, at a certain point with a strong signal, the diode becomes forward biased and this causes it to have very low impedance. This low impedance is shunted across the transformer, causing a reduction in gain.

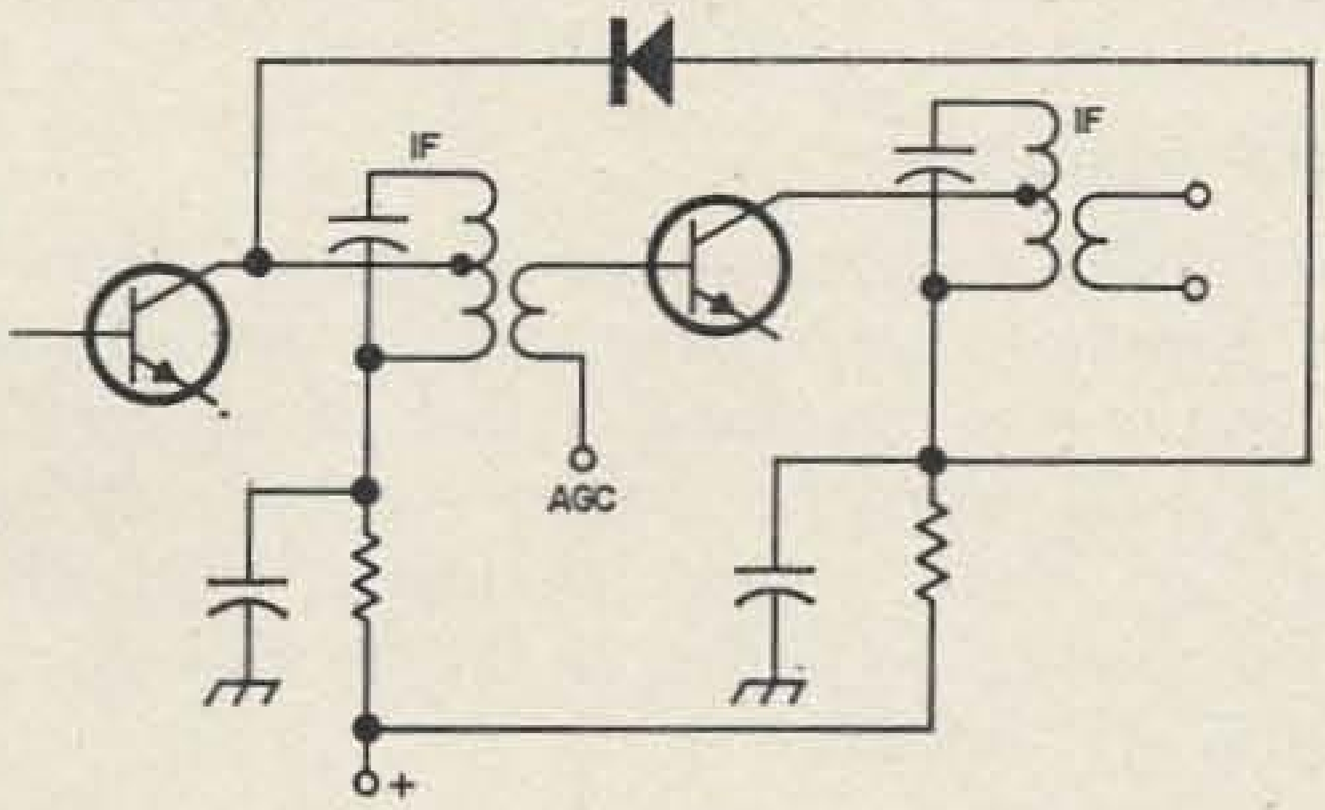


Fig. 54. An auxilliary AGC diode improves AGC action.

Many types of detectors, especially those used for SSB, FM and CW, make no provision for AGC output. A simple auxilliary AGC detector may be added in the *if* amplifier string to provide this voltage. Such a detector is shown in **Fig. 55.** It is arranged for positive output, but may easily be reversed for negative AGC voltage. The coupling capacitor should be very small to reduce the loading of the transformer.

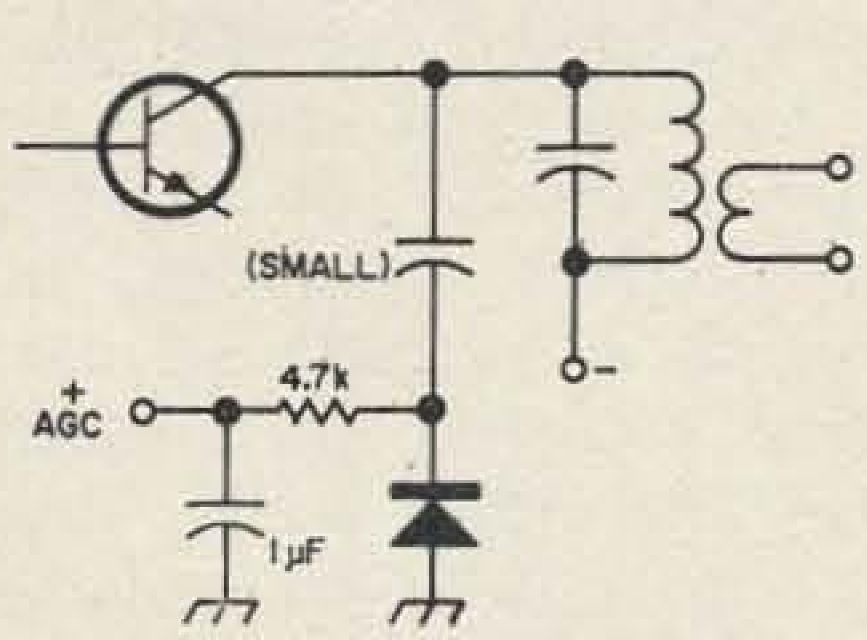


Fig. 55. An auxilliary AGC detector can be used with a product detector for SSB/CW.

AFC diode

Automatic frequency control circuits are used in many FM and TV sets as well as in commercial SSB and teletype receivers to keep locked on frequency even though the receiver or transmitter oscillator might drift slightly. The control voltage for AFC circuits is obtained from a phase detector, generally a discriminator, which provides a negative voltage if the drift is in one direction, a positive voltage if it's in the other direction, and no voltage if there is no difference in frequency. (Of course, the circuit can also be offset so that 5 V, for example, is the voltage output if there is no difference.) This control voltage is applied to an oscillator in the receiver in such a way that it varies the frequency to keep in lock. Though the oscillator can be arranged so that the control voltage varies the transistor capacitance to keep in lock, it's usually easier to use a voltage-variable capacitor diode (varicap or varactor) as shown in **Fig. 56.** This schematic is designed

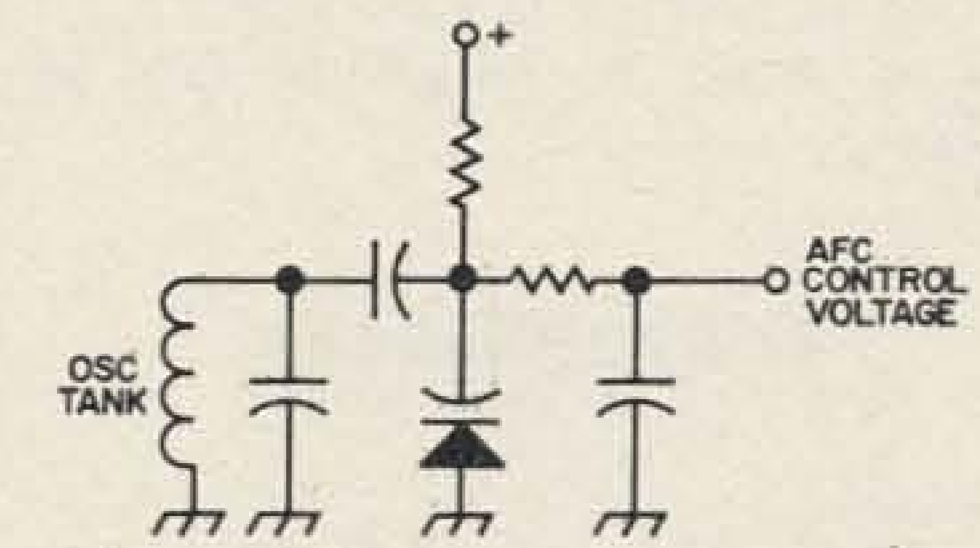


Fig. 56. A varicap is often used to provide automatic frequency control. The control voltage is provided by a discriminator.

for a conventional broadcast FM receiver; a simple filter is included to eliminate the FM deviation and a small amount of reverse bias on the diode for linear operation. The coupling capacitor should be as small as possible to simplify the adjustment of the system and prevent the characteristics of the diode from having too much effect on the oscillator–diodes have much lower Q than the other capacitors used in oscillator circuits. The diode can be a diode designed for this use (such as the Amperex 1N3182 at about 60c) or can be a small silicon diode or silicon transistor junction.

Varicap tuning

Tuning capacitors are large, expensive, fragile and hard to control remotely. But varicap diodes are small, cheap, rugged and give the amount of variation necessary for easy to control. There seems to be a pretty good future for varicaps n tuning applications. Only specially processed varicaps can use in broadcast receivers, but many others can be used for more restricted ranges. Special diode networks can be designed so that one potentiometer (which can be far from the rest of the equipment) can track both rf and oscillator stages. Varicaps, generally speaking, have lower Q's than air capacitors, so will not provide quite the selectivity of conventional tuning capacitors in most cases. This is rarely a problem, though. It's beyond the scope of this article to go into the design of wide-range, tracked tuning networks, but the manufacturers of variable capacitance diodes have published information for this purpose. **Fig. 57** gives the basic type of circuit.

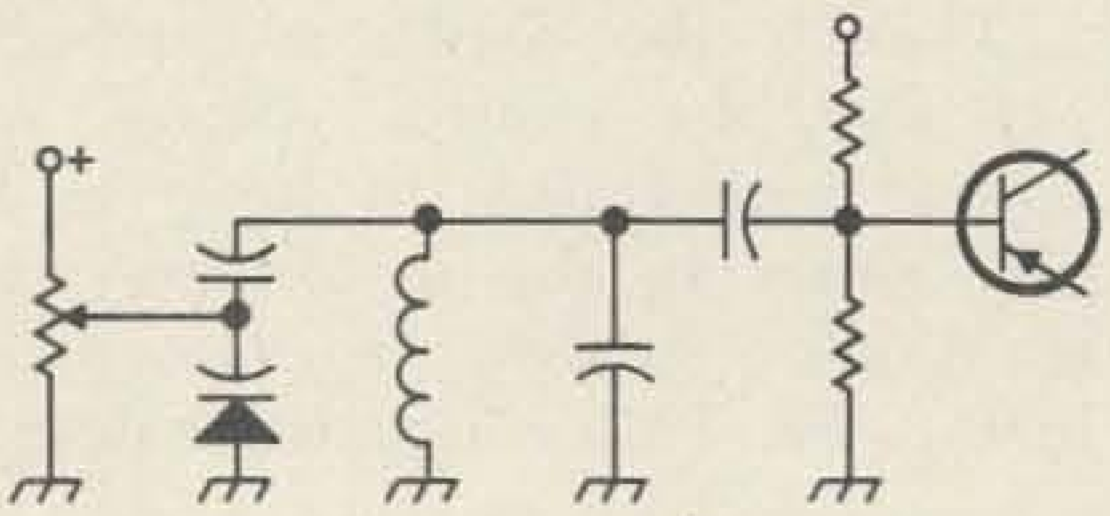


Fig. 57. An rf stage or oscillator can be tuned with a varicap.

Transmitters

Audio clippers

Many AM and FM transmitters contain audio compressors and clippers which increase the average level of modulation ("talk power") transmitted without causing overmodulation. Probably the simplest type of peak clipper is that shown in **Fig. 58A.** Here two low-voltage zener diodes are put in series across an audio amplifier stage where there is enough voltage to cause the zeners to clip. Alternately, as shown in the **Fig. 58B,** parrallel-connected germanium or silicon diodes can be used. They have the advantage over the zeners that they will clip at lower voltages (0.3 or 0.6 volts). As this type of circuit simply clips off the tops of the signal, it generates many strong harmonics which must be filtered out after the clipping. A simple resistor-capacitor low-pass filter will be adequate in many cases, though a more selective L-C filter is better.

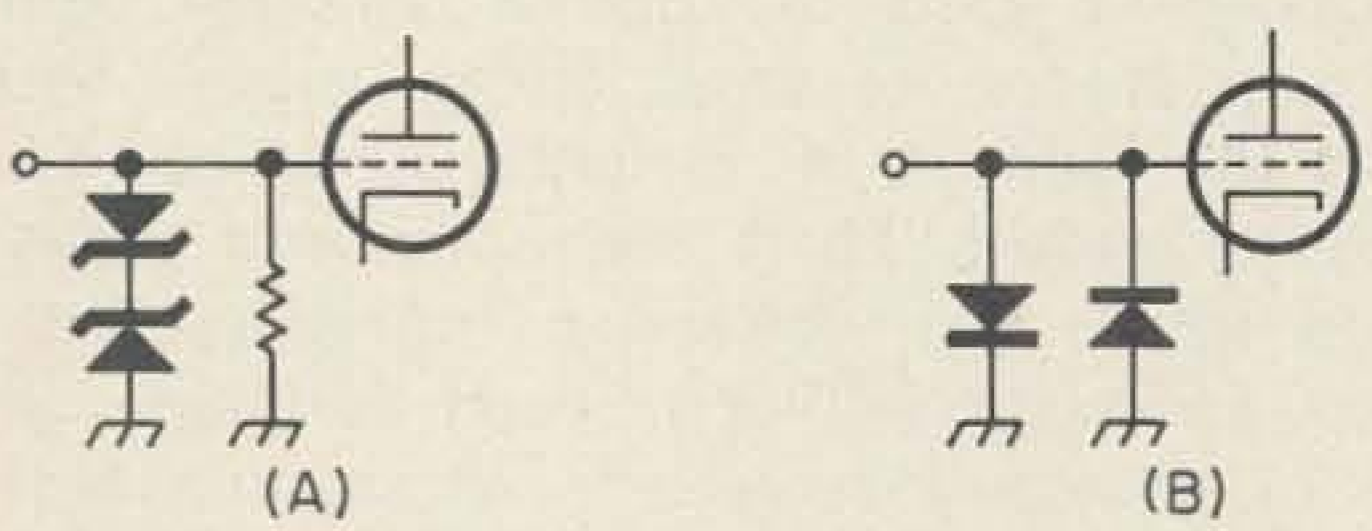


Fig. 58. Simple clippers can be made from zener diodes or silicon diodes.

A more satisfactory filter is shown in **Fig. 59.** The clipping level of this filter can be adjusted by changing the negative voltage applied to the anodes of the diodes. This circuit includes a low-pass filter.

Neither of the clipper circuits shown is useful for SSB in most cases. SSB clippers must operate on the rf envelope rather than the audio.

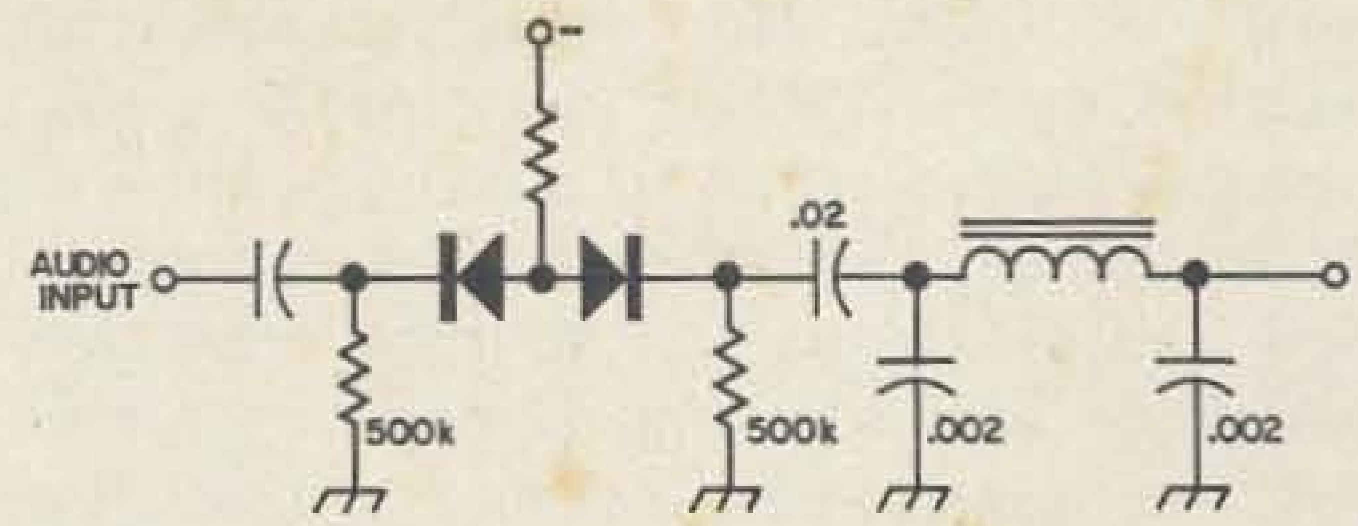


Fig. 59. A good clipper for AM or FM use includes adjustable clipping level and a harmonic filter.

Audio compressor

An audio compressor is shown in **Fig 60** This circuit is interesting, but it has a few disadvantages, including a loss of up to 60 dB. It does keep the output constant within 1 dB for 20-dB change in input. With the values shown, an input of 0.2 to 6 V gives about 5 mV output.

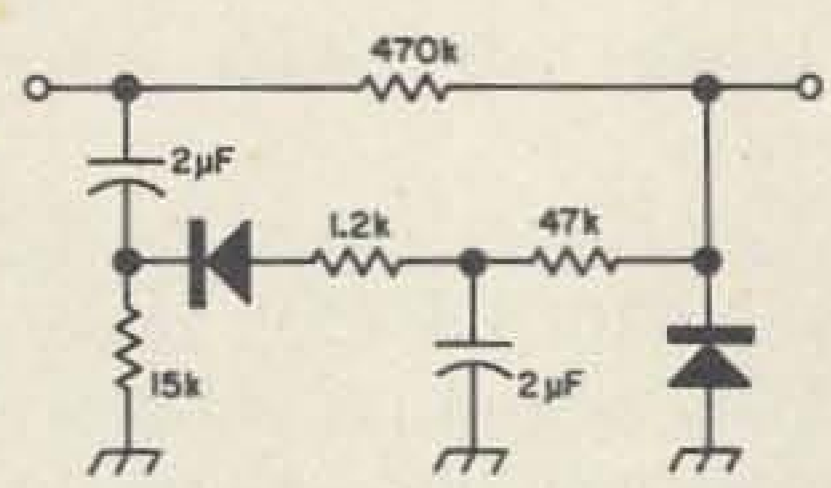


Fig. 60. The compresor can provide 25-dB compression, but at the expense of up to 60-dB loss.

Negative peak clipping

There has been a great deal of discussion among hams about negative peak clipping. Many who have tried it are very enthusiastic, but others have proved that, theoretically, it is neither necessary or desirable. Apparently a properly operating modulator well-matched to a correctly adjusted power amplifier has no need for negative peak clipping. On the other hand, simple gear which is not optimized can make good use of negative peak clipping to help reduce overmodulation and splattering. Two circuits are shown in **Fig. 61.** One uses series

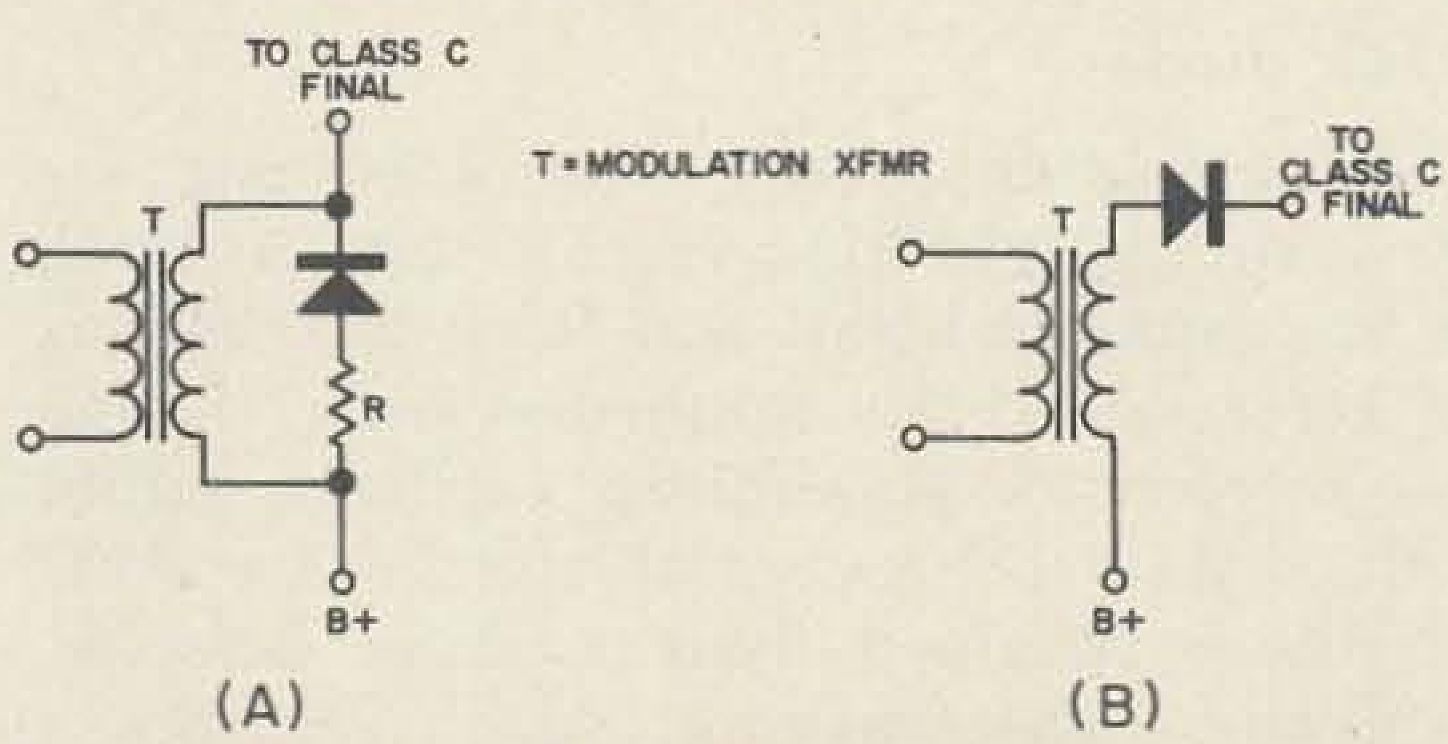


Fig. 61. The need for high-level negative-peak clipping is often debated, but its value is championed by many.

clipping and the other, parallel. The series circuit is obviously easier to install, and in view of the fact that this type of negative peak clipping is so cut-and-dry, it is recommended. Silicon power diodes suitable for the voltages encountered should be used.

FM modulator

While the battle between SSB and conventional AM has certainly been decided in favor of SSB at high frequencies, SSB hasn't threatened FM for commercial VHF use. FM has many overwhelming advantages over AM, and a number of advantages over SSB. FM has never been given a very fair test by hams, but it has been completely accepted for most VHF communications use. Narrow-band FM, as must be used on high frequencies, is not very attractive except in its simplicity and noise reduction, but wide-band VHF FM is an excellent communications medium and is becoming more and more popular for fixed-frequency net operation. FM is especially useful with transistor transmitters, as an FM transmitter can be much simpler and cheaper than an AM or SSB transmitter of equivalent power output. A simple direct FM modulator using a variable-capacitance diode is shown in **Fig. 62.** A regular varicap or varactor is best for this circuit, but almost any conventional silicon diode is usable. The audio signal input varies the bias on the diode causing a capacitance change, which varies the frequency of the oscillator. The oscillator is normally fairly low in frequency. Its output is multiplied to the VHF range to get sufficient deviation. The oscillator (including the diode) should be very stable so the only FM produced is intentional. Incidentally, the battery is used to set the bias of the diode to the most linear part of its voltage-versus-capacitance curve. It's interesting to experiment with this bias voltage; it is possible to produce greater deviation in one direction than the other. This may be desirable when the signal is being received by the slope-detection method on a receiver not designed for FM.

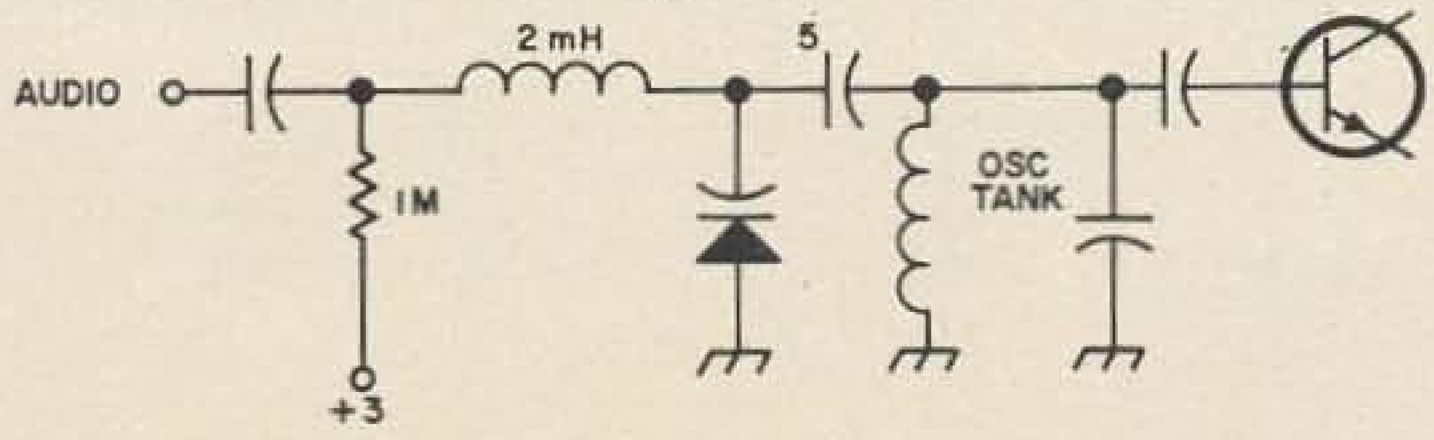


Fig. 62. A diode can be used for direct frequency modulation.

Balanced modulators

A fundamental circuit in an SSB transmitter is the balanced modulator. There are many different types of balanced modulators, and some must obviously work better than others. Unfortunately, exhaustive comparative tests on the circuits have not been published, as far as I know, and almost every SSB transmitter diagram published has used a different type of modulator. However, two which have been found excellent are shown in **Fig. 63** and **64.** One uses four diodes in a bridge, and the other uses two diodes. The diodes in these circuits should be matched if possible. Matched pairs of diodes are available (for instance, the 1N35 is a matched set of two 1N34's), or they can be matched by measuring the forward (low) resistance of a number of diodes with an ohmmeter and choosing the ones which have the closest values. Both of the circuits shown produce a carrierless double-sideband signal from an rf signal and audio.

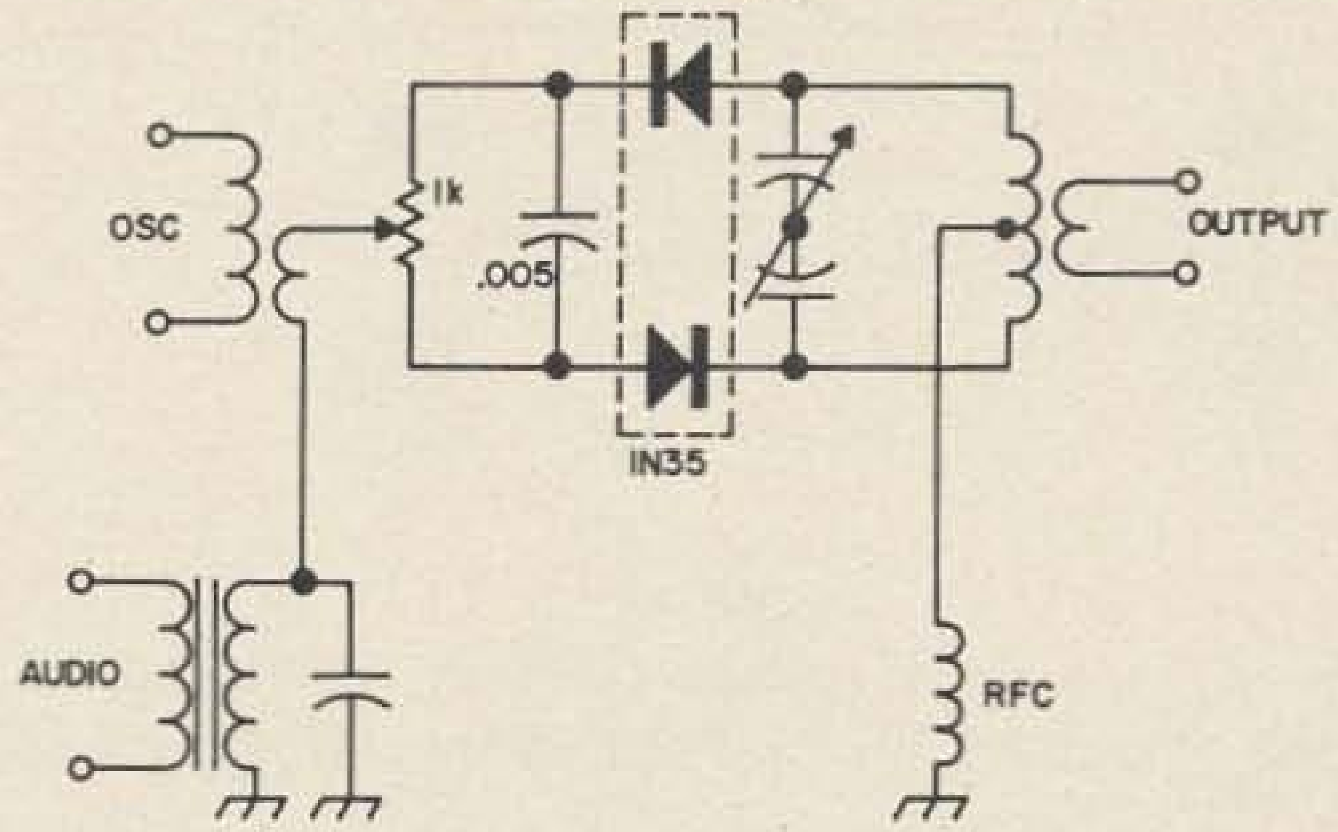


Fig. 63. This is a popular balanced modulator for generating DSB (and eventually SSB).

Fig. 64. This is a bridge balanced modulator for SSB.

Sideband switching

A sideband transmitter usually has some provision for operating on both upper and lower sidebands. There are a number of ways to do this, but one of the simplest is shown in **Fig. 65.** Here simple diode switches are used to select either the upper- or lower-sideband crystal by grounding the desired crystal and presenting the other crystal with a very-high-impedance path to ground. As the circuit is shown, applying a positive voltage will select the lower-sideband crystal, and a negative voltage the upper. The voltage should be a little higher than the peak voltage across the crystal.

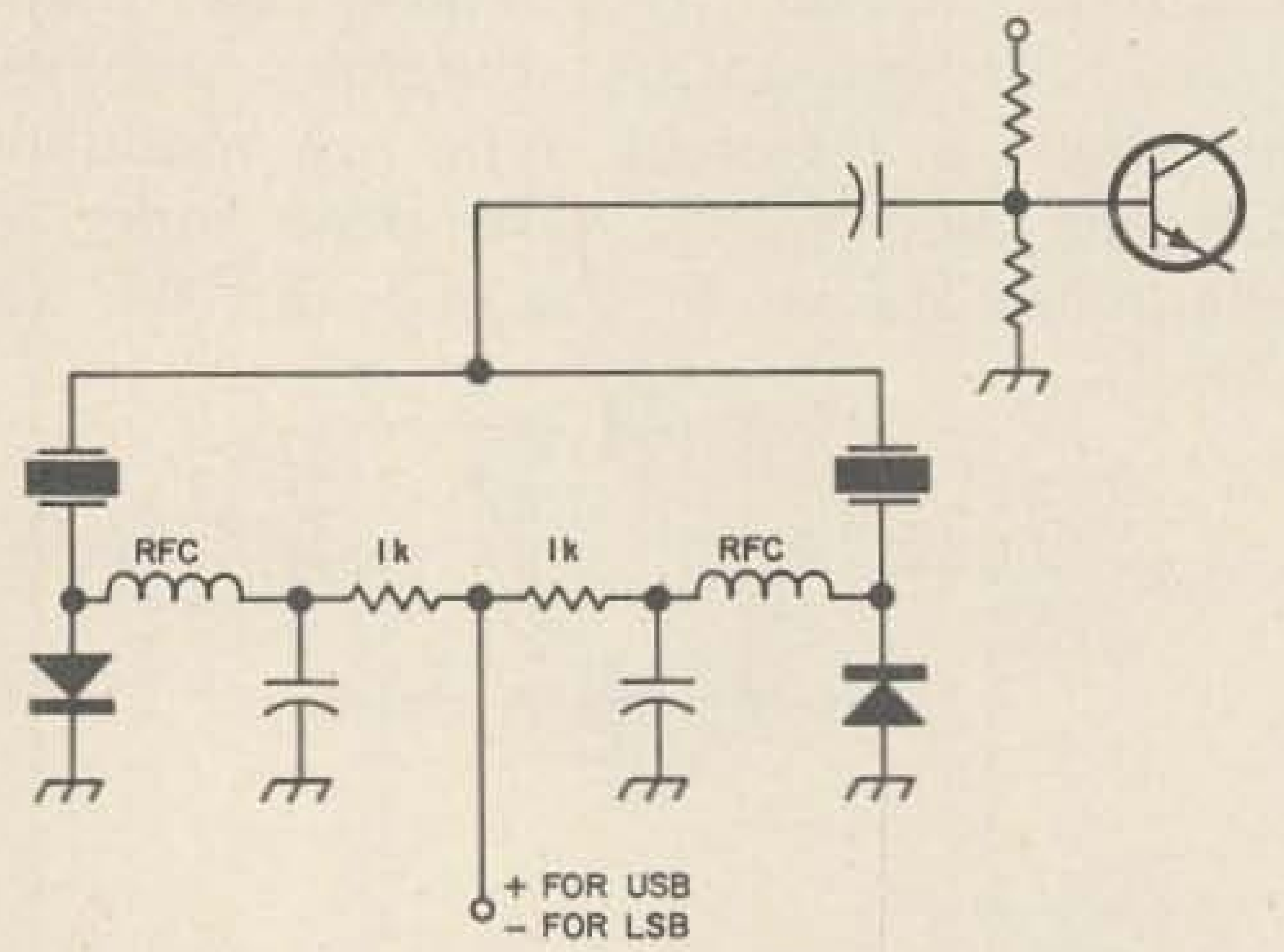


Fig. 65. A pair of diode switches can be used to select upper-or lower-sideband-generating crystals.

Another useful diode switch is shown in **Fig. 66**. This circuit is especially useful in transceivers. A positive bias voltage selects the first input and a negative one the second input. Here again, the bias voltage must exceed the peak voltage in the circuit.

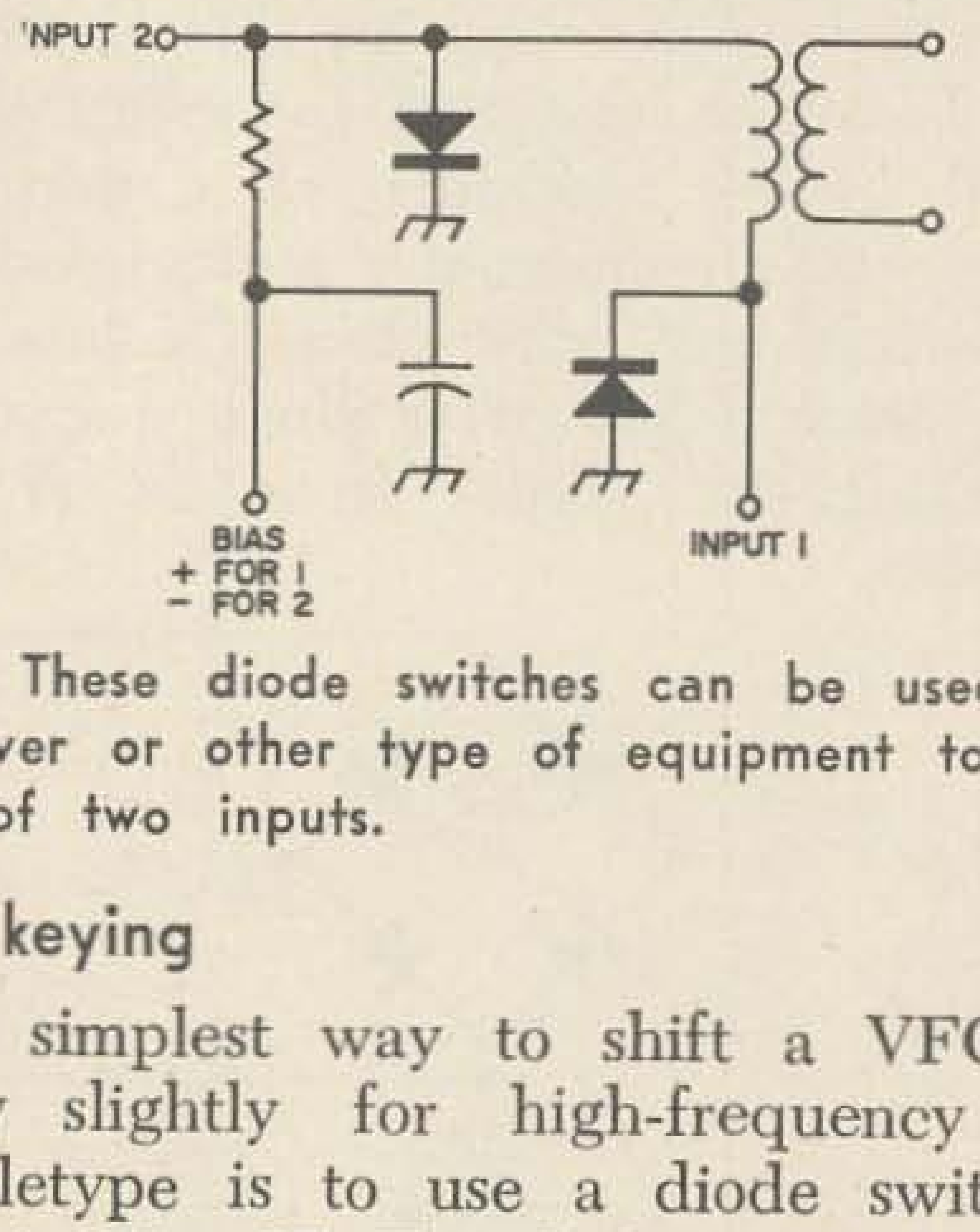


Fig. 66. These diode switches can be used in a transceiver or other type of equipment to select either of two inputs.

RTTY keying

The simplest way to shift a VFO frequency slightly for high-frequency FSK radioteletype is to use a diode switch as shown in **Fig. 67**. The shift required is only 850 Hz or less, which is easy to get in most high frequency VFO's. The trimmer capacitor is adjusted for the proper shift.

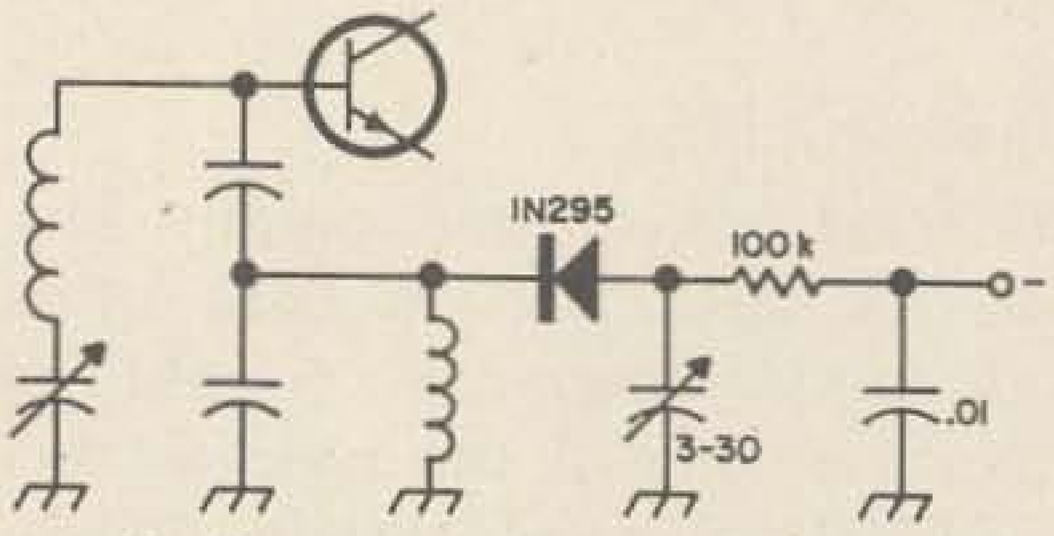


Fig. 67. A diode switch is used to connect a small capacitor to a VFO to shift its frequency slightly for radioteletype.

Varactor multipliers

Few components have simplified the work of the VHF engineer or ham more than the power varactor diode. Currently available varactors can produce as much as 30 watts or more at 450 MHz from a 40-watt 150 MHz source. These varactors are very efficient, too, with efficiencies of 75% fairly typical. Other varactors are excellent for generating power at 10 GHz or more. Step-recovery diodes are recently developed varactors that are even more remarkable in producing power at microwave frequencies from simple circuits. Many cheap, common diodes (and transistor junctions) make excellent low-power varactors. Silicon power diodes can be used at low frequencies, and fast silicon diodes such as the 1N916 are excellent as high as 1GHz in many uses. A general varactor doubler is shown in **Fig. 68**. Notice that the input and output

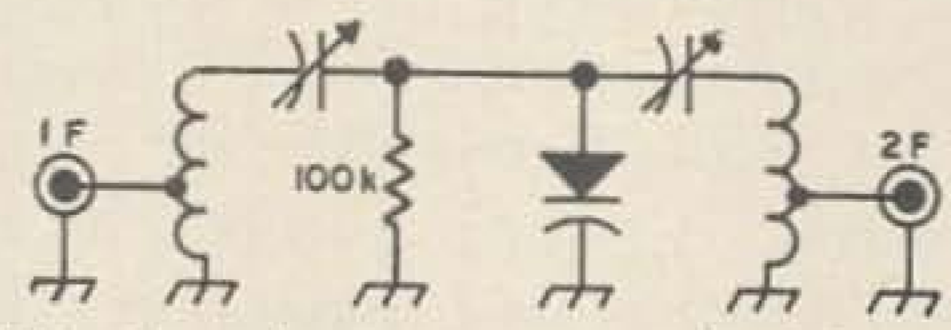


Fig. 68. This is a basic varactor doubler.

circuits are series tuned, with the diode in parallel. This is the most efficient and convenient type of varactor multiplier, since power varactors are generally designed for grounded cathode operation. The bias resistor is not usually critical, though in general, low values give the best linearity and high values the best efficiency. Applying a slight bias to the cold end of the resistor, instead of grounding it, often improves the efficiency slightly. While not shown, a varactor doubler can be built with two parallel tank circuits and a series diode. This is not as efficient as the parallel circuit, but it is often more convenient for low-power receiver multipliers and signal sources, especially if they use popular grounded quarter-wave coaxial or trough-line tanks. A varactor tripler or quadrupler

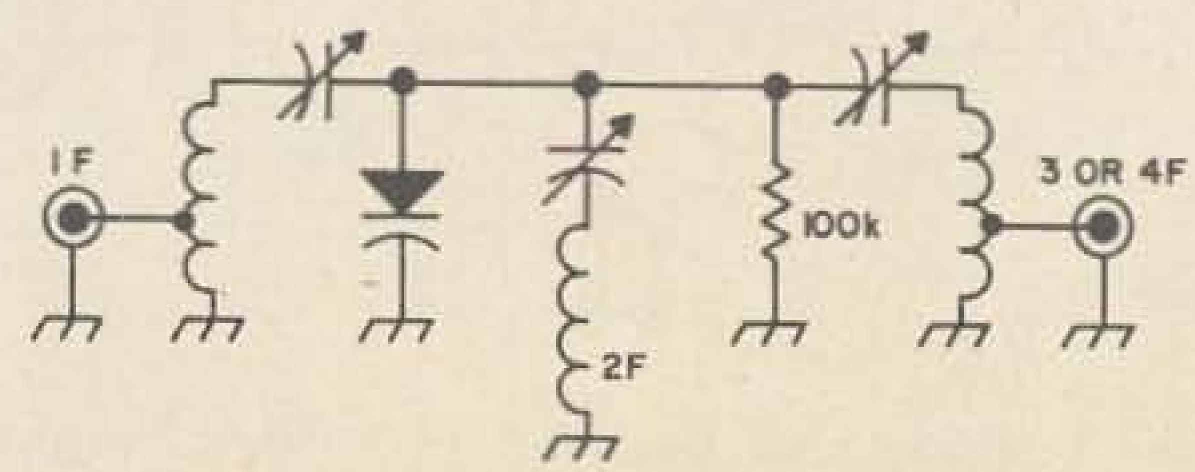


Fig. 69. "A" is a varactor tripler or doubler.

is shown in **Fig. 69A.** It requires an idler circuit tuned to the undesired second harmonic of the input. The tuning of this idler can be critical for best results, but it is often omitted in applications where low efficiency is satisfactory.

Fig. 69B shows a practical 144-to-432 MHz tripler using an Amperex 1N4885 diode ($15). 25 W input at 144 gives 17 watts of output at 432 MHz.

Since varactor multipliers are such excellent generators of harmonics, they can cause severe interference in transmitters and spurious responses in receivers. They can not only multiply by whole numbers, but can mix these harmonics together to produce strong signals at 3/2, 4/3, 5/2 and other multiples of the fundamental. Consequently, varactors should always be used with selective filters except where these extra signals will cause no problems.

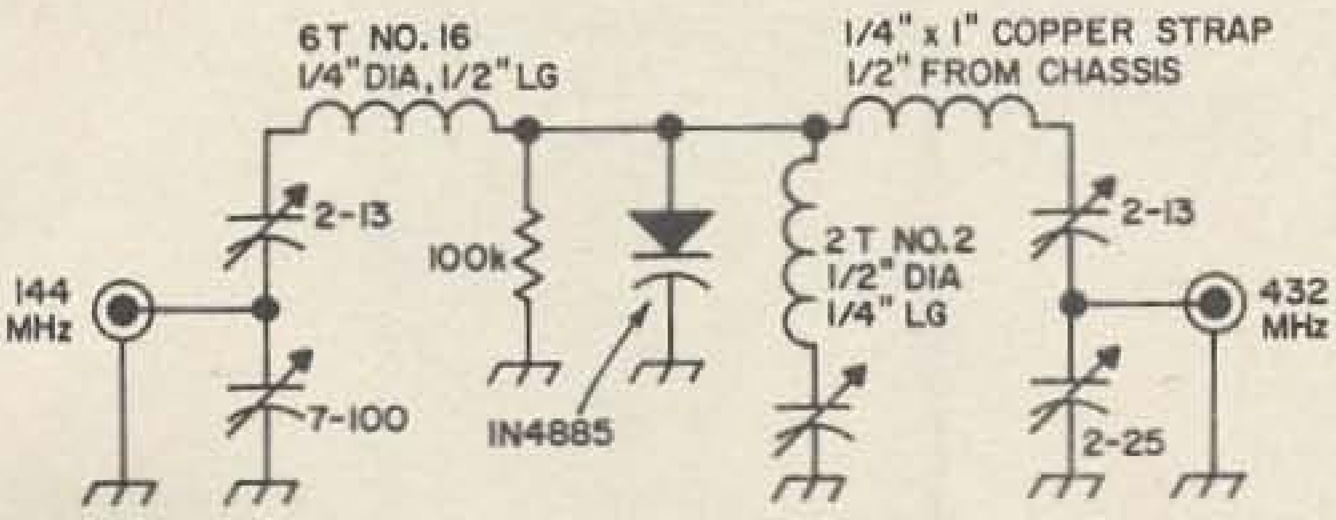


Fig. 69B is a practical high-power varactor tripler.

Transmitter spotting switch

Every CW transmitter should have some method of spotting its frequency without putting a signal on the air. Some of the schemes which have been published are quite involved; many even require stealing voltage from the receiver for spotting. A far simpler approach uses one diode along with one single-pole-single-throw switch. It's shown in **Fig. 70.** When the spot switch is thrown, the diode is reverse biased, so it does not conduct and only the oscillator can draw current. However, in normal transmission, when the key is depressed, the diode is forward biased, so all the stages in the transmitter can operate. The diode should have high back resistance. A silicon power diode is recommended.

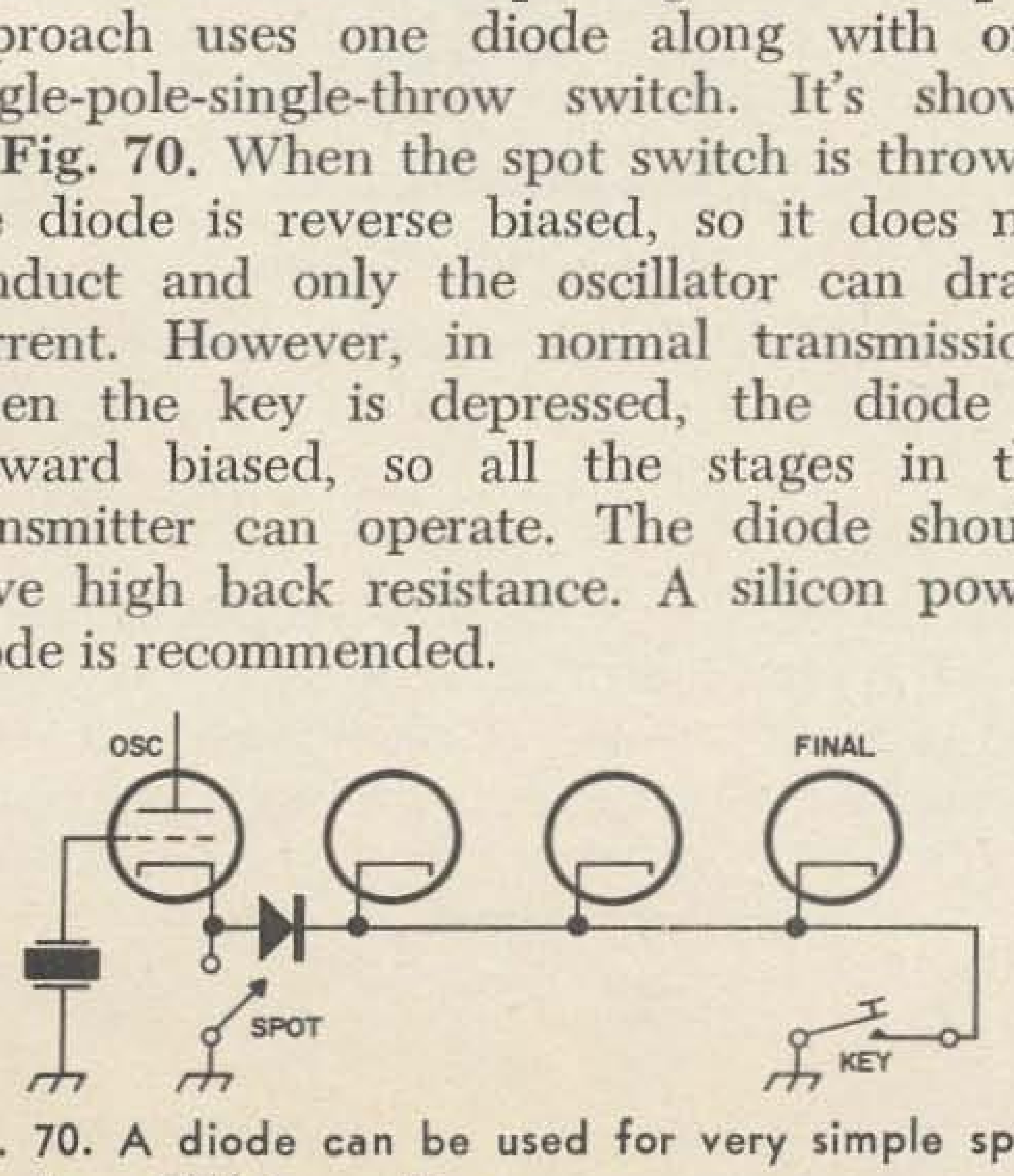


Fig. 70. A diode can be used for very simple spotting in a CW transmitter.

Test Applications

Field strength meters

One of the most useful pieces of equipment in any ham shack is a field strength meter. While FSM's can be bought for very little from any big radio supply house, they're so simple and easy to build that most hams make their own. The simplest type of FSM is untuned, and can be used at any frequency from below the broadcast band to UHF. **Fig. 71** shows such an FSM. It uses only four components: a non-critical rf choke, a germanium diode of almost any type, a small capacitor, and a meter. This

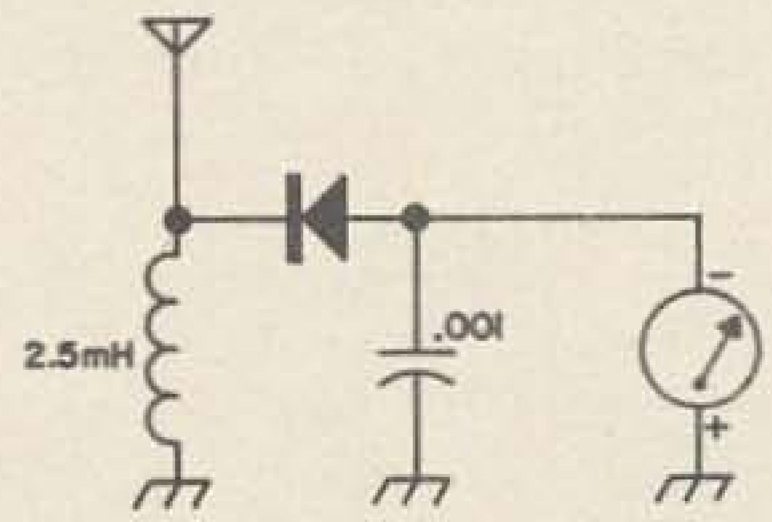


Fig. 71. A simple field-strength meter.

circuit gives a very nonlinear, relative reading. A slightly better FSM is shown in **Fig. 72.** It is less frequency-dependent than that in **Fig. 71** at it doesn't contain an rf choke. It uses a resistor to help linearize the meter. This circuit uses a voltage-doubling detector for high sensitivity, a variable resistor for adjusting the deflection on the meter, and a choice of meter output for adjusting transmitters, or a pair of magnetic headphones for monitoring AM transmissions.

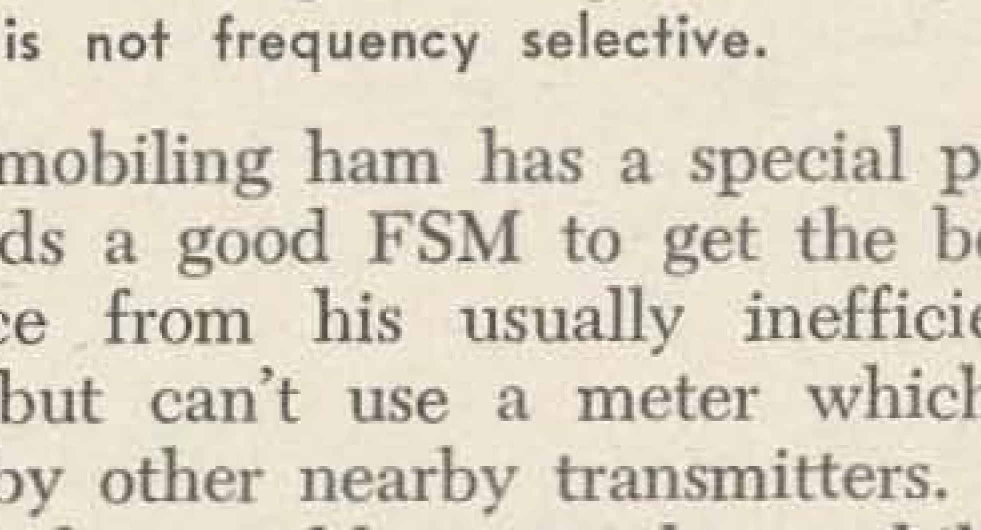


Fig. 72. This voltage-doubling field-strength meter-monitor is not frequency selective.

The mobiling ham has a special problem. He needs a good FSM to get the best performance from his usually inefficient antenna, but can't use a meter which is affected by other nearby transmitters. A solution to his problem is the mobile FSM shown in **Fig. 73.** It uses a silicon diode which doesn't conduct except on very close high power transmitters (his). This design also uses a normal BC antenna for pick-up, yet requires no switching.

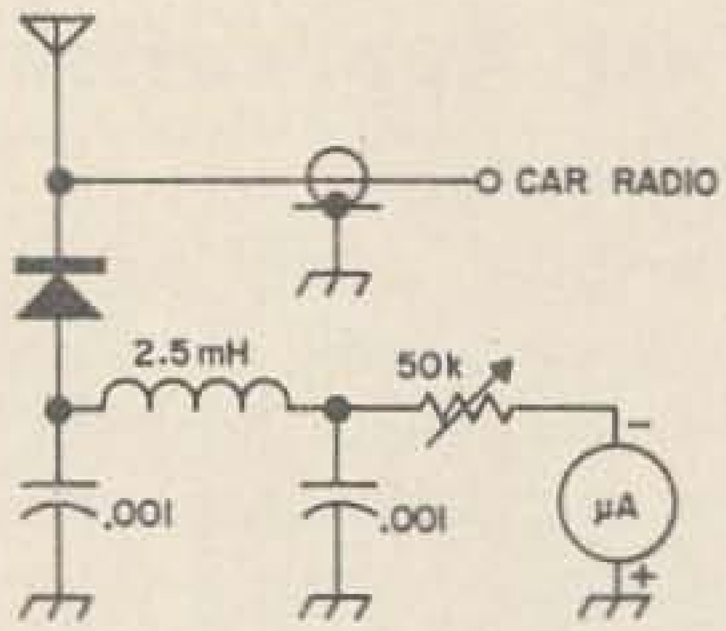


Fig. 73. A special type of FSM for use in a car.

Another simple rf detector-FSM is shown in **Fig. 74.** It's called an rf sniffer, and is especially useful for neutralizing transmitters and detecting the presence of small amounts of rf in both transmitters and receivers. The size and shape of the loop of wire is not critical, but it should be insulated for safety.

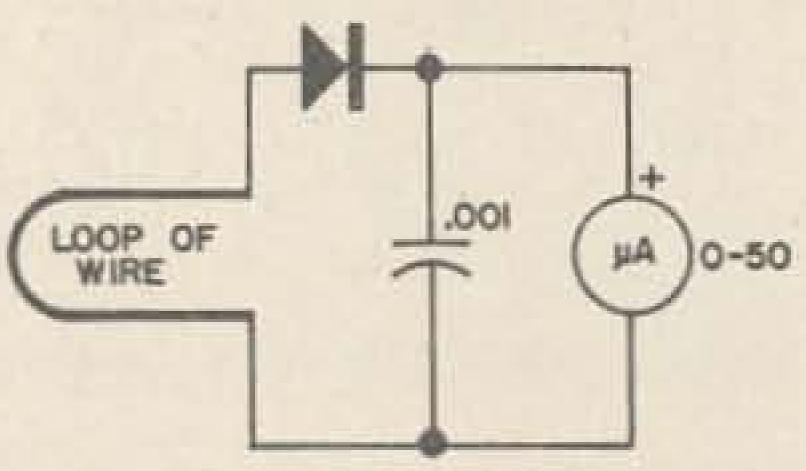


Fig. 74. The rf sniffer is a wide-range sensitive rf detector.

Wavemeters

A slightly more sophisticated rf detector is shown in **Fig. 75.** It includes a tuned circuit for differentiating between frequencies. This type of instrument is very useful in adjusting transmitters since it helps to prevent transmitting on the wrong harmonic of a crystal-controlled oscillator. The tuned circuit should tune the required range, and can be tapped as shown for the best selectivity. Bandswitching is necessary for ranges of more than about 3 to 1. This type of circuit is usually called a wavemeter. It can also be used as a field strength meter, of course.

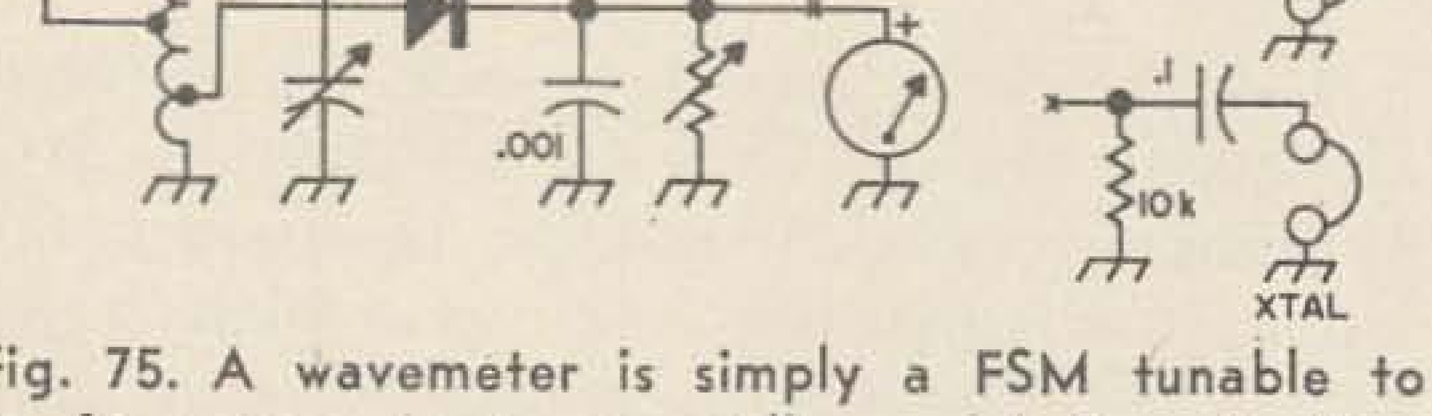


Fig. 75. A wavemeter is simply a FSM tunable to to frequency. It is especially useful for checking transmitter harmonics.

A good wavemeter-FSM for the VHF man is the simple tunable, voltage-doubling six-and two-meter unit shown in **Fig. 76.** It can be used to make sure that he's transmitting on the right frequency, help him adjust his transmitter for maximum output, and monitor his modulation if he's on AM.

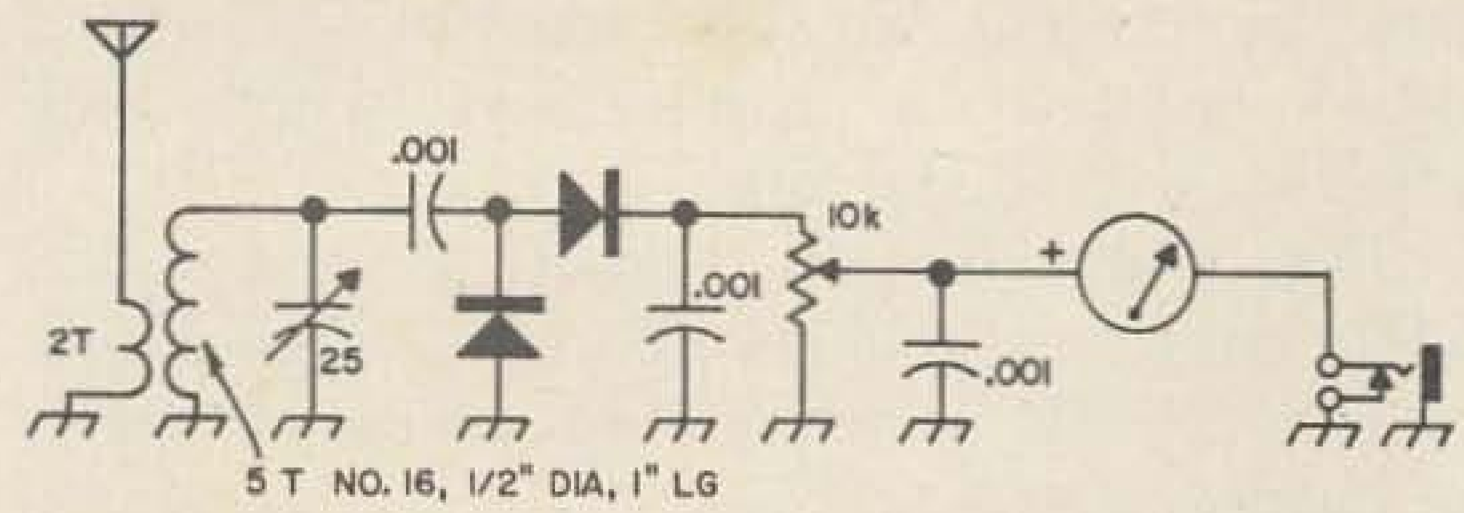


Fig. 76. This tunable VHF wavemeter-FSM-monitor covers six and two meters.

The Uhfit, shown in **Fig. 77,** is a FSM-monitor using a capacitively tuned, quarter-wave line. It tunes 215-450 MHz, covering both the 220 and 432 MHz bands. The Uhfit can be built from any type of solderable metal, or from copper-clad board.

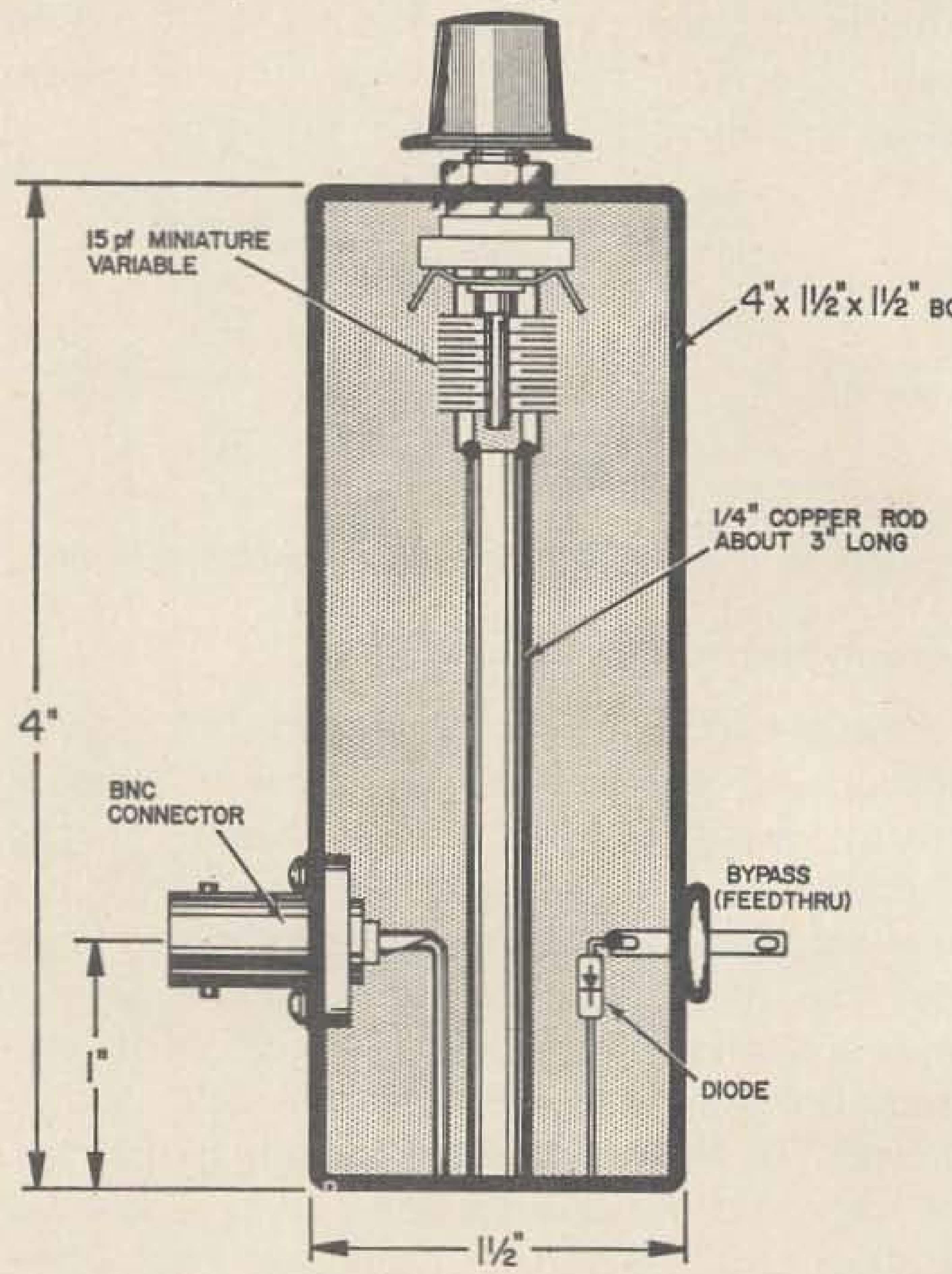


Fig. 77. The *Uhfit* is a general-purpose wavemeter and monitor.

RF probe

A necessity for the ham experimenter is an rf probe which can be used to detect and measure small rf voltages. This type of probe can be used with both voltmeters

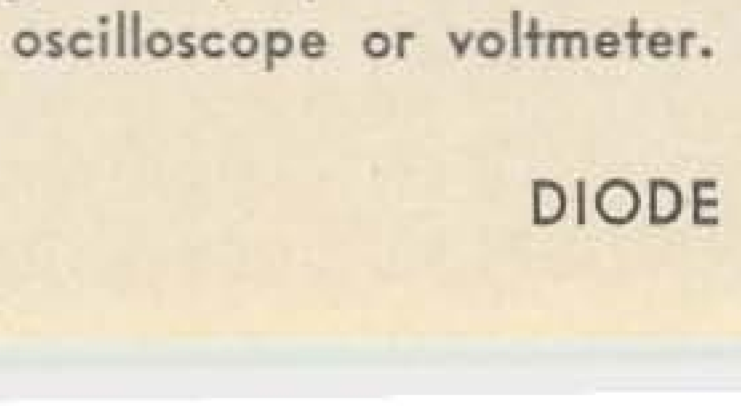


Fig. 78. A general-purpose rf detector probe for use with an oscilloscope or voltmeter.

and oscilloscopes for alignment, troubleshooting, signal tracing and many other jobs. A good rf probe for the HF and VHF ranges is shown in **Fig. 78.** The capacitors should be button or other good HF units for VHF use. They can be increased slightly in value for use down to 455 kHz or lower.

Dummy load

Every ham needs a dummy load for his transmitters. It can be used for tests to avoid transmitting a signal that could cause interference to other stations. A dummy load is simply a non-reactive resistor which matches the output of a transmitter, usually 50 ohms. A dummy load is most useful when it contains an rf voltmeter so it can be used for determining power by the familiar equation, $P = E^2/R$. See **Fig. 79A.** For low power, the diode can be connected directly across the resistor, but for higher power, enough voltage may be developed to damage the diode. For example, a typical 1N34 diode, which is often used for rf monitoring, has a PIV of only 60 volts. Assuming that the waveform applied to it is a perfect sine wave, which is unlikely, a voltage of about 20 RMS is the maximum it can take. However, that's only 8 W. Therefore, most dummy loads of this type use a voltage divider, such as shown in **Fig. 79B.**

This step-down in voltage subjects the diode to much lower voltage (about 1/100th in this case). Then, if the 50-ohm load can stand the power, the same diode could be used for up to 800 W. This type of divider is, unfortunately, quite sensitive to frequency, so cannot be trusted at high frequencies (say over 30 MHz) unless calibrated. It is possible to compensate for this by adding a small capacitor across either the large or small resistor in the voltage divider, and that will increase the maximum usable frequency somewhat. Here again, though, it must be checked against a reliable standard.

One thing to be very careful about with all of the rf voltmeters mentioned above is that they are peak-reading instruments. That means that on a perfect sine wave, they indicate about 1.4 times the RMS value of the rf if they're used with a high resistance dc voltmeter. The RMS value is what we usually use. However, it is easy to compensate for this by multiplying the value by 0.7. A more serious problem is that for wave shapes other than sine, the

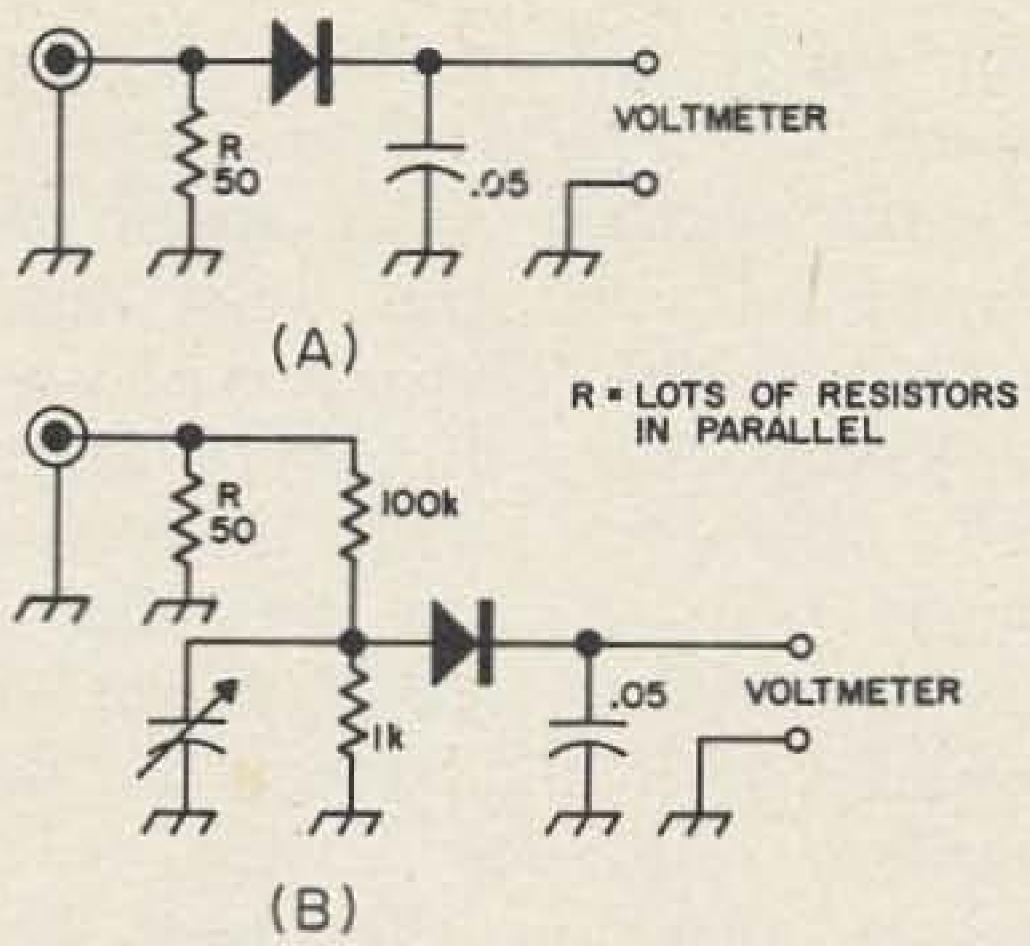


Fig. 79. A dummy load should be used for all possible transmitter testing. An rf voltmeter connected to the dummy load makes it a wattmeter. A single diode is limited in voltage rating, so a voltage divider must be used for high power.

relation between the peak value and the RMS value may be unknown, and some waves may have peak values which are very much higher than 1.4 times the RMS. For example, a wave with high out-of-phase third-harmonic content can read very high. This is often responsible for such statements as the 99% or even 75% efficiency sometimes claimed for two meter transmitters or varactor multipliers. There is no simple, universal solution to this problem.

SWR bridge

There are a number of instruments which can help you find out whether your antenna is matched properly to its feed line. Most hams use an SWR bridge, which measures the degree of mismatch in the line, but these SWR bridges really tell very little unless they're installed at the antenna feed point rather than at the transmitter. A basic and very popular type of SWR bridge is shown in **Fig. 80.** This device can be left in a transmission line when transmitting and can be used to tune a transmitter for maximum output. There are many variations on this type of bridge, using slightly different electrical or mechanical arrange-

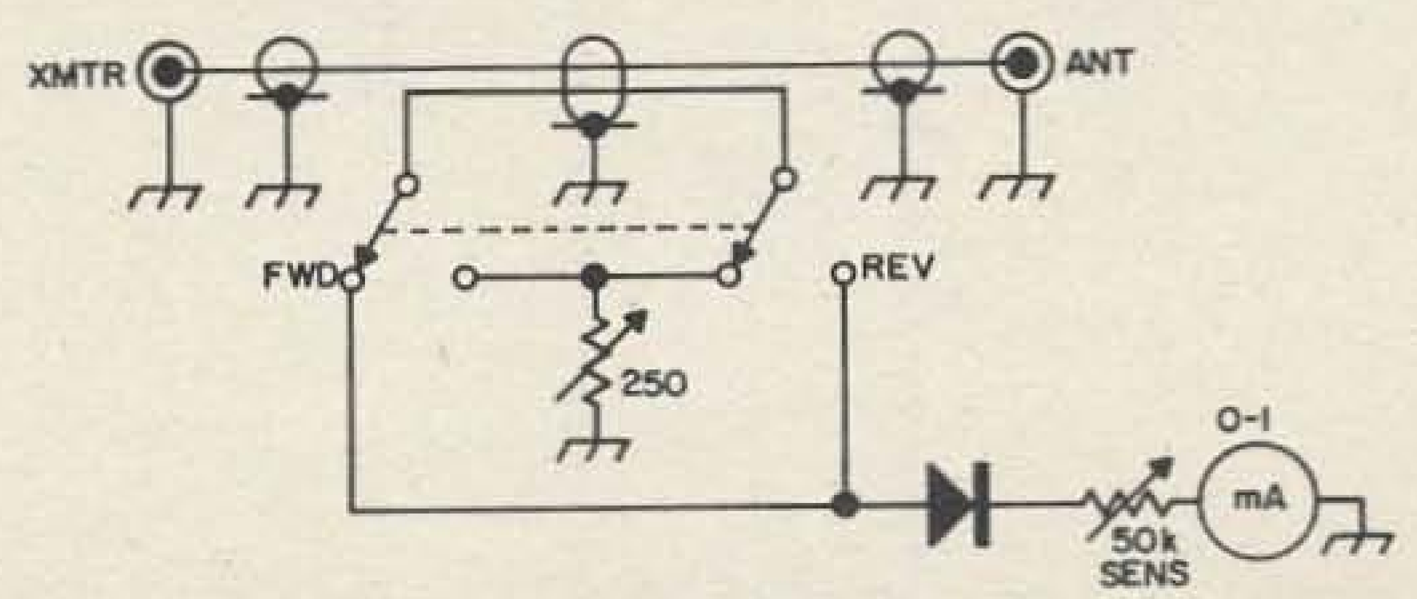


Fig. 80. An SWR bridge is invaluabe for adjusting an antenna. The critical part of the bridge is a piece of coax cable with an extra wire inserted between the cable dielectric and the shield.

ments for easier construction or improved performance. The bridge shown uses a piece of coax cable with an extra small piece of wire slipped between the inner insulation and the coax shield. The piece of coax and the other components should be kept short for VHF operation, with a symmetrical arrangement of parts. In use, the bridge sensitivity control is adjusted for a full-scale reading with the switch in the forward position, then the switch is thrown to the reverse position. The lower the reading the better, and a zero reading indicates (at least in theory) a perfectly matched line with an SWR of 1.00:1. In practice, this type of bridge is not that trustworthy, but it still can be useful in helping you tell whether your antenna is close to 50 ohms.

Antennascope

Another type of bridge used for matching antennas is better in that it can tell you what your antenna impedance is instead of just indicating whether it is close to 50Ω. This is the simple impedance bridge, called the antennascope, shown in **Fig. 81.** This bridge is designed for low power operation —a grid dip meter usually gives plenty of power. It should be built very compactly with short leads. The potentiometer should be of high quality; an Allen-Bradley Type J is fine. The bridge can be calibrated with regular composition resistors. Simply connect the resistors in turn to the antenna terminal and adjust the pot until the meter reading dips to zero. Then mark the value of the resistor by the pot pointer. In use, the meter reading will not null completely except for resistive loads, so it will not read zero for reactive antennas. Nevertheless, the minimum reading will occur at the approximate impedance reading. Remember that all antenna bridges should be used between the antenna and the transmission line.

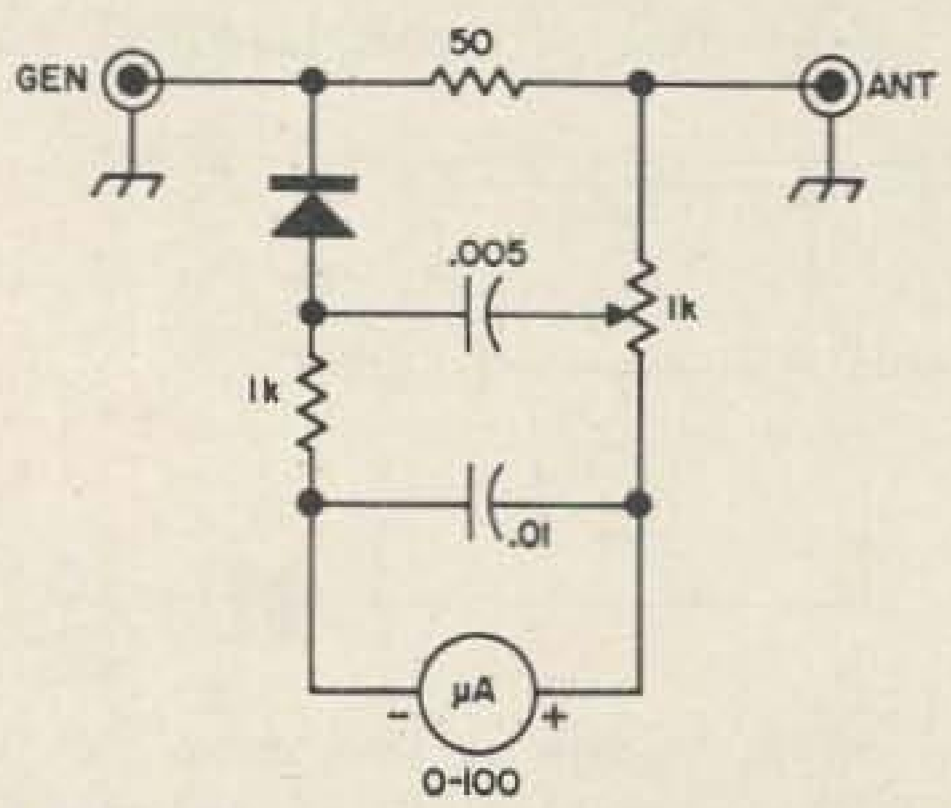


Fig. 81. This antennascope is a simple antenna impedance bridge. It should be constructed compactly for best high frequency use.

James Dandy Mixer

A little-known but very useful simple piece of test equipment is the untuned mixer, or James Dandy Mixer, as W2DXH calls it. This gadget, as shown in **Fig. 82,** has many uses. It can be used as an untuned detector or monitor, or for making an impromptu frequency meter, neutralizing transmitters, finding VHF parasitics. The James Dandy Mixer has two inputs of 50 ohms, which are fairly well isolated from each other. Shorting or opening one, has little effect on the other. This mixer is one of those instruments that finds many uses after it is built, and is so easy to build that it belongs in every lab or shack.

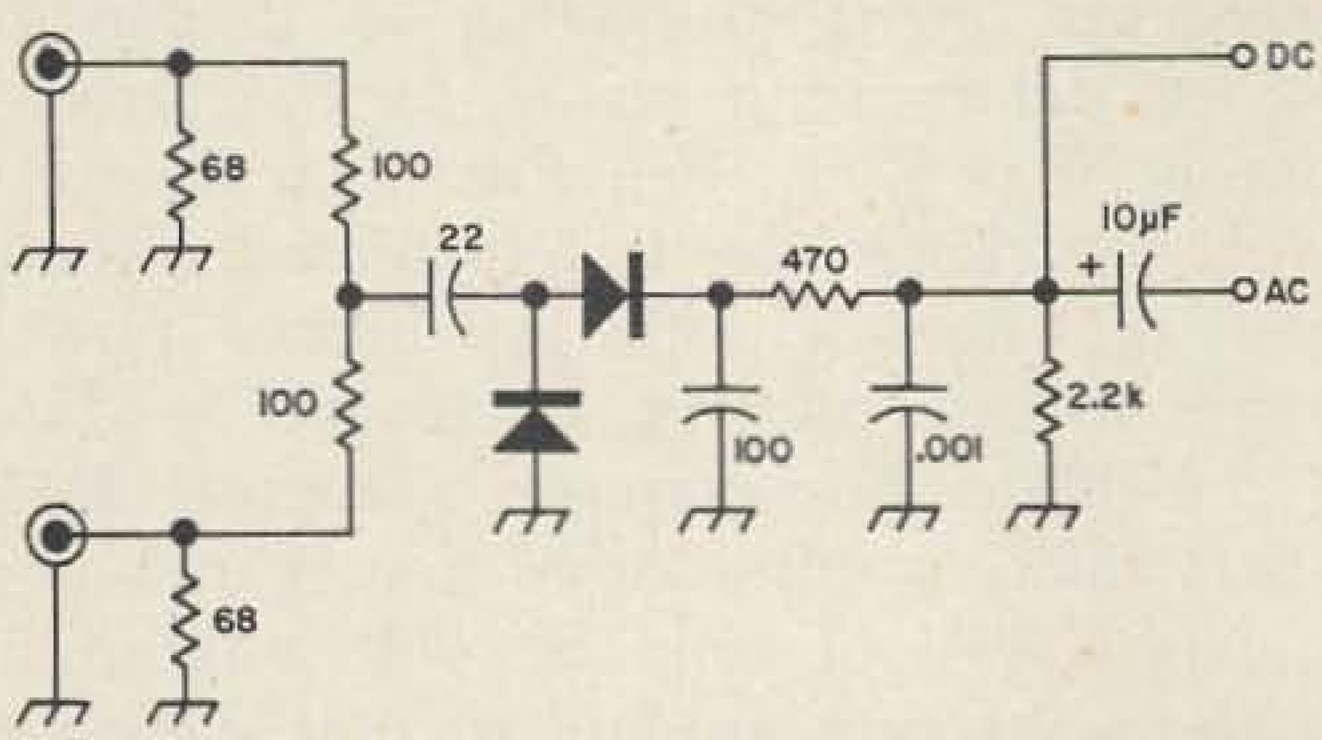


Fig. 82. The James Dandy Mixer is a general-purpose untuned mixer useful as an impromptu frequency meter, receiver, detector, etc.

Signal generator modulator

A simple diode AM modulator for an unmodulated signal generator is shown in **Fig. 83.** It can be used with an audio generator and early BC-221, for example, for receiver alignment.

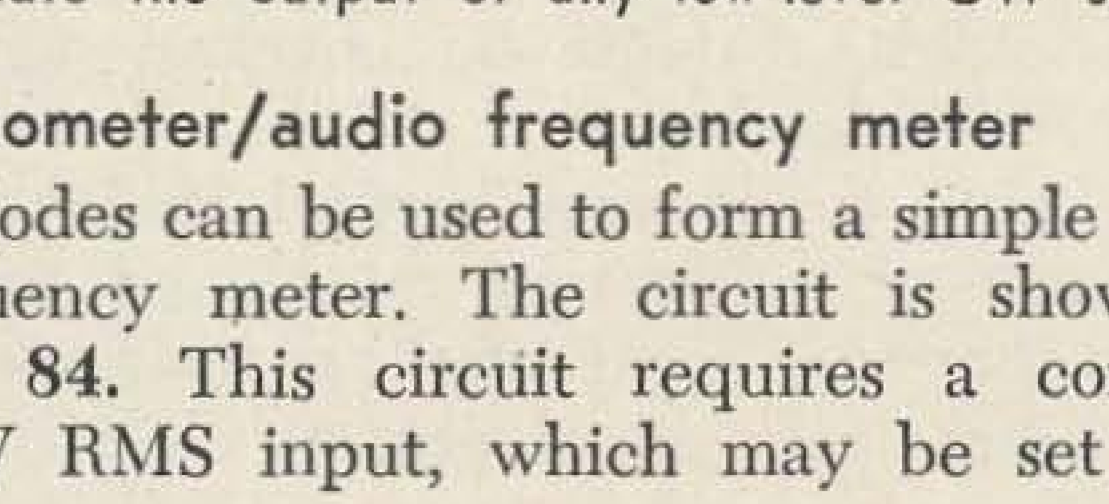


Fig. 83. This amplitude modulator can be used to modulate the output of any low-level CW source.

Tachometer/audio frequency meter

Diodes can be used to form a simple audio frequency meter. The circuit is shown in **Fig. 84.** This circuit requires a constant 10 V RMS input, which may be set by a

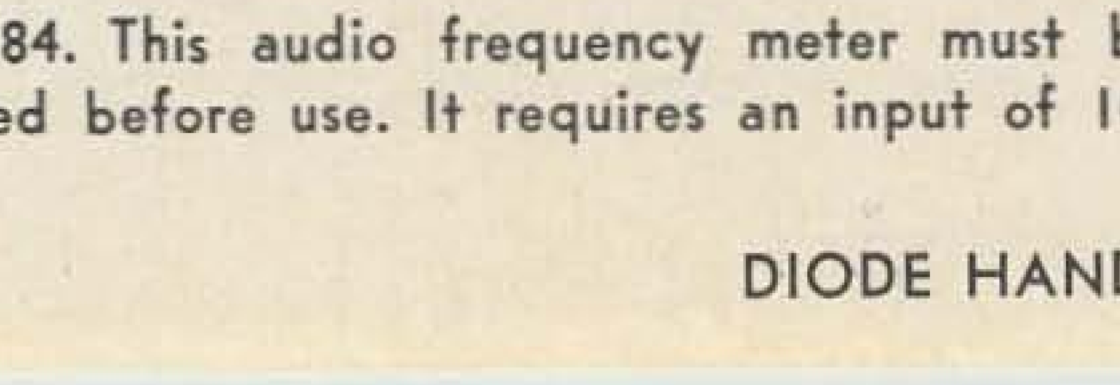


Fig. 84. This audio frequency meter must be calibrated before use. It requires an input of 10 V.

pair of zener diodes or with the help of an audio voltage meter. The circuit shown covers 20-5000 Hz; the scales are not linear, and must be calibrated before use.

A more satisfactory frequency meter for audio frequencies is shown in **Fig. 85.** Its scale is linear, and the input is automatically set to the right level by the zener diode or diode-battery clipper over quite a wide range. The same circuit can be used as an automobile tachometer. Simply connect the input to the high side of the points in the car. It can easily be calibrated on about 12 Vac. Remember that 1 Hz = 60 rpm, so 60 Hz = 3600 rpm.

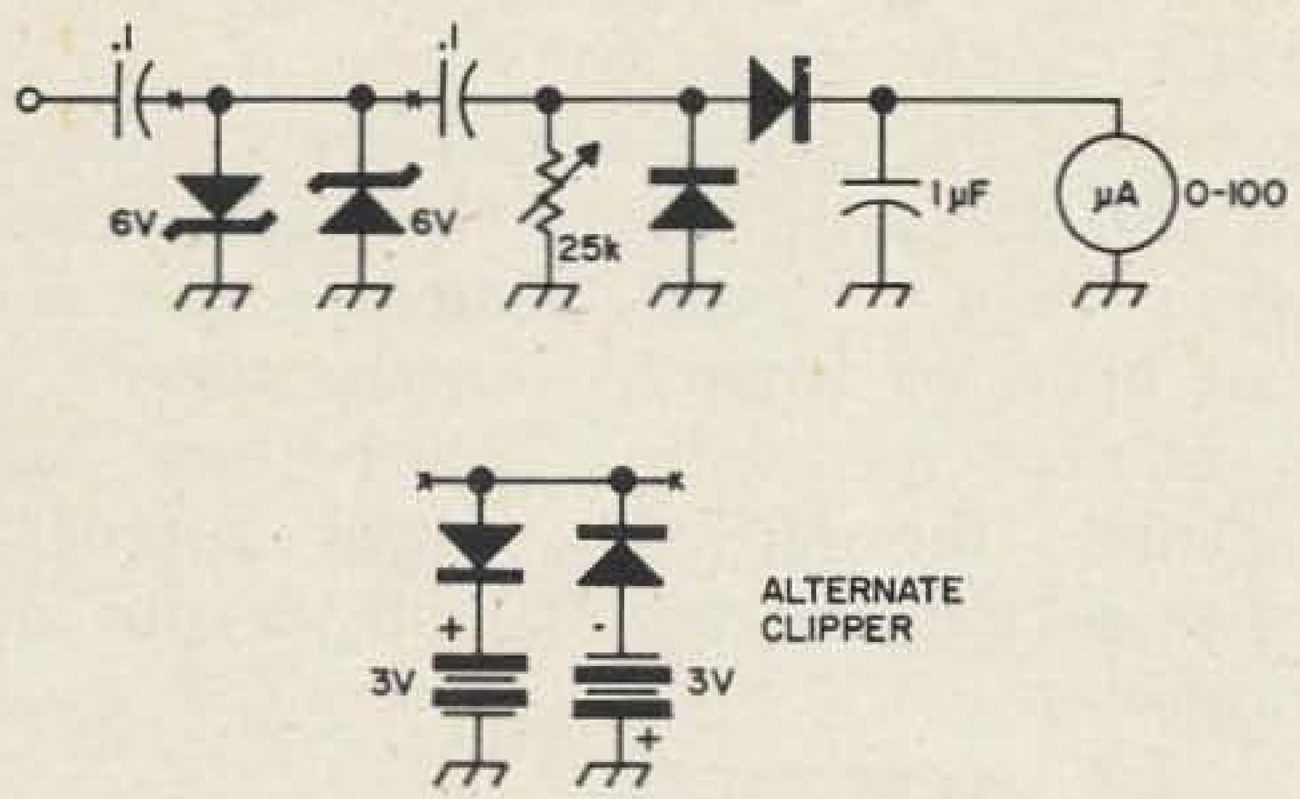


Fig. 85. This audio frequency meter-tachometer is self limiting and linear reading. Either two zeners or two conventional diodes and batteries can be used to set the proper input voltage.

Noise generator

A useful piece of equipment often used in aligning receivers is a noise generator. A noise generator is a source of controllable noise, more-or-less independent of frequency. For instance, the noise generator shown in **Fig. 86** provides noise from below the broadcast band all the way to 500 MHz. It is adjustable in output by the potentiometer. The capacitor should be a UHF button mica or ceramic feedthrough for best results. Most surplus 1N21 silicon diodes can be used, but some generate more noise than others. The resistor across the output should have the same value as the input to the receiver under test. Leads should be as short as possible. This type of noise generator is useless for quantitative tests as there is no simple relation between the amount of current flowing through a diode and its noise output, but the generator is very useful for adjusting a receiver for lowest noise figure. The procedure is to adjust the receiver while turning the noise generator on and off. You should adjust for maximum rise in noise when the generator is turned on. Incidentally, the polarity of the diode must be checked carefully. If it is reversed, it will be forward biased, and its impedance will be very low and in parallel with the 50-ohm resistor. Also, the impedance will change radically with varying current, making the output impedance of the device uncertain and consequently unreliable.

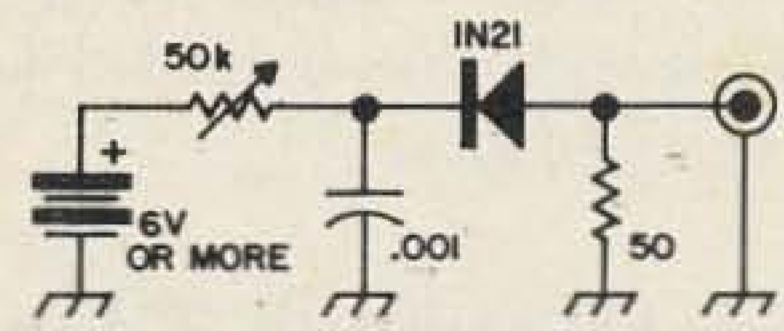


Fig. 86. A diode noise generator is very useful in aligning a receiver for lowest noise figure.

Square-wave generator

A simple square-wave generator is shown in **Fig. 87.** If a sine wave is applied to the input, an almost-square wave will appear across the two back-to-back zeners as they clip the top and bottom off the sine wave. Best waveform results when the input voltage is much higher than the output, for instance 50-V input and 5-V output. The limiting resistor must be picked for the voltage and current capabilities of the zeners.

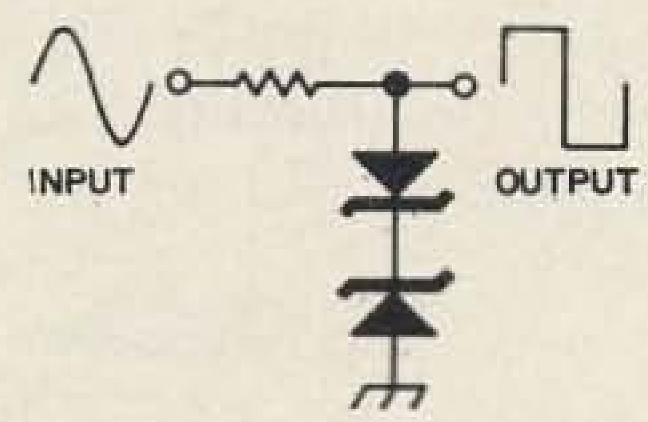


Fig. 87. Two zeners can be used to produce a highly clipped sine wave very similar to a square wave.

Sawtooth pulse generator

A simple sawtooth generator for use with simple monitor scopes is shown in **Fig. 88.** It works best with low frequency sine-wave input and very high impedance output.

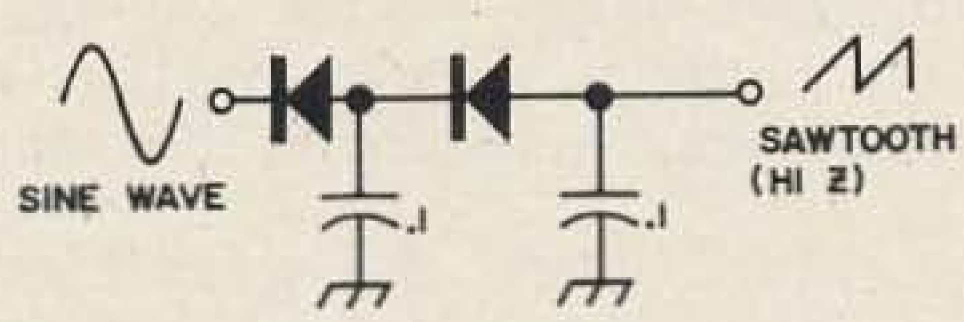


Fig. 88. This simple sawtooth generator could be added to a monitor oscilloscope.

A relative of the sawtooth generator is shown in **Fig. 89.** It can be used for generating pulses for many applications. It, too, takes a sine wave input. Among the applications of a pulse generator are adjusting noise clippers and blankers, and providing marker pulses for the time base of a scope. For instance, a 1000 Hz sine wave can provide a pulse every millisecond (1000 microseconds).

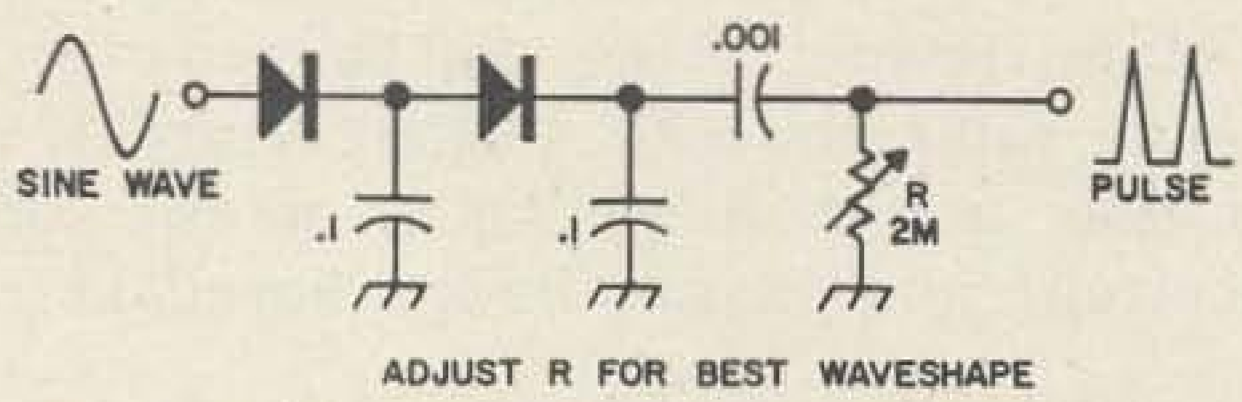


Fig. 89. A pulse generator is needed to adjust noise limiters for best results.

Miscellaneous Circuits

Dual battery supply

Many hams who operate mobile have had the embarassing experience of running their battery down by talking a bit too long. One way to avoid this is to use two batteries, one for the ham gear and one for normal car needs. However, some way must be found to keep them both charged, yet make sure that the ham battery does not steal energy from the normal battery. Schemes to accomplish this used to be complex, with heavy relays and complicated switching, but as has happened in so many cases, semiconductors have simplified the problem to almost nothing. A couple of high-current, low-voltage silicon diodes can be used as one-way switches as shown in **Fig. 90.** The

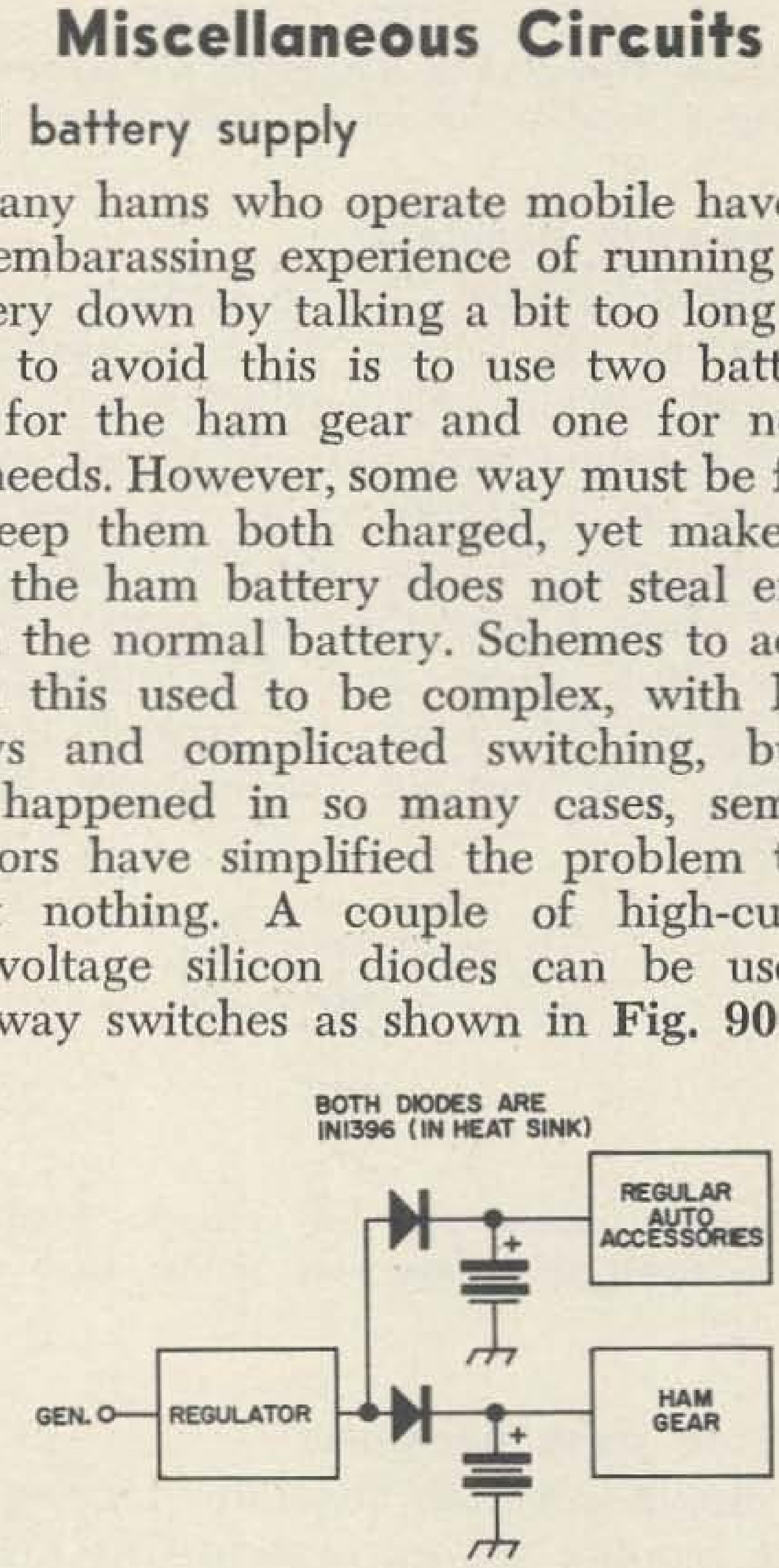


Fig. 90. Here's how to use two batteries in your car, one for ham gear and one for the rest of the car needs. The diodes act as one-way switches, keeping the batteries charged, yet preventing any power from flowing from one to the other.

diodes conduct when the generator voltage is higher than the batteries, charging the batteries, but current cannot flow in the other direction and cause one battery to charge the other. The diodes should be mounted on heat sinks in as cool a place as can be found near the batteries. Heavy wire is necessary as many amperes will flow at times. There is a voltage drop of about 0.6 V across the diodes, so it may be necessary to adjust the car voltage regulator for slightly higher output. Since charging voltage is usually 13.5 to 15 V or more, this may not be required.

Combination battery charger-power supply

It's often convenient to have an ac power supply included in equipment that is normally battery operated. Unfortunately, some switching must be provided between the two supplies so that the battery will not run down by mistake when the equipment is supposedly used on ac. One simple way to avoid this problem is to use a rechargeable battery which cannot be overcharged, and float it across the power supply as shown in **Fig. 91.** In this circuit, if the power supply is plugged into ac, the battery will be charged and the equipment can also be operated at the same time. If the ac supply is disconnected, the equipment operates from its battery supply with no manual switching. The battery cannot discharge through the power supply because of the one-way action of the diode bridge.

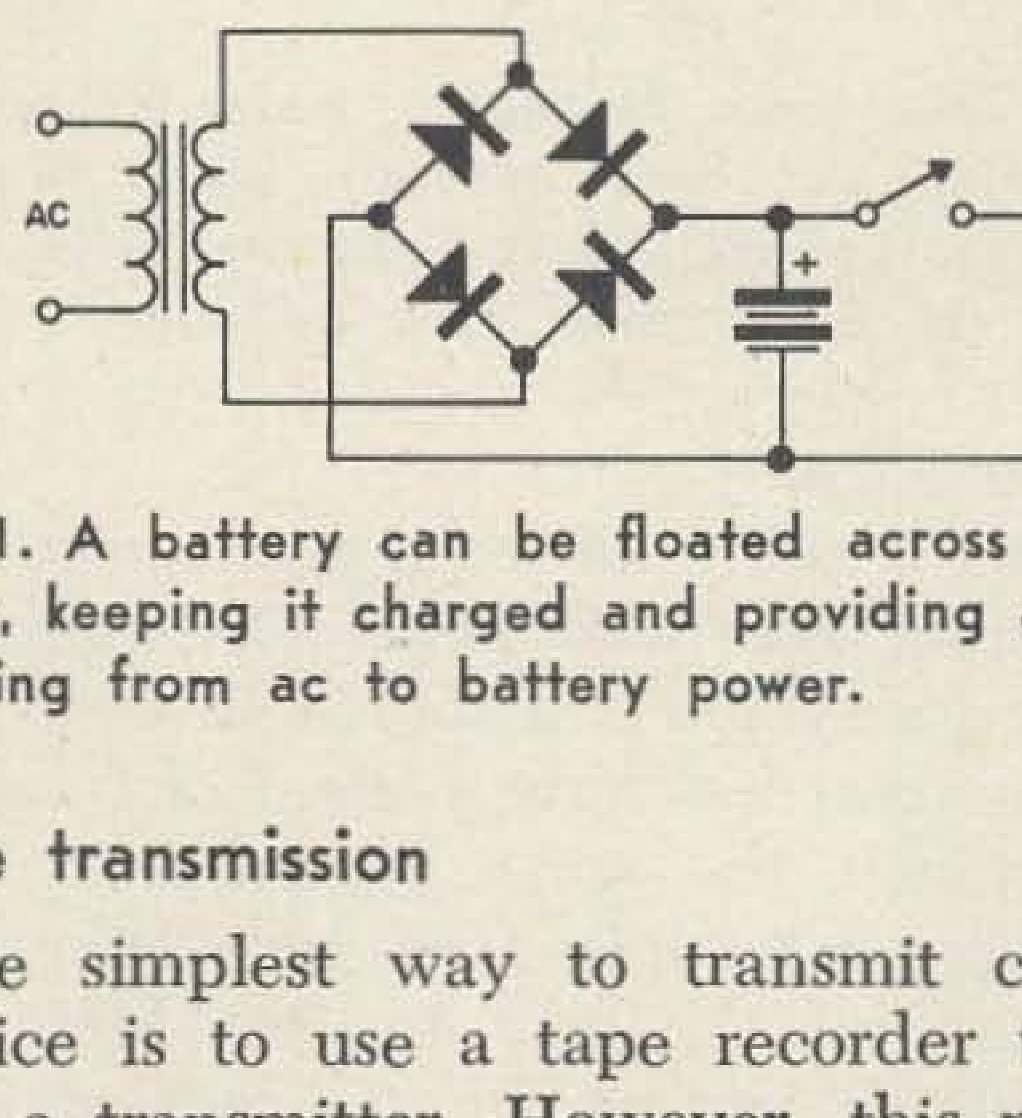


Fig. 91. A battery can be floated across a power supply, keeping it charged and providing automatic switching from ac to battery power.

Code transmission

The simplest way to transmit code for practice is to use a tape recorder to modulate a transmitter. However, this produces an AM or FM signal rather than CW (except possibly on SSB). It's generally better to transmit a CW signal as used in most communications. One way to do this is shown in **Fig. 92.** Here the rectified audio output from the recorder operates a relay which keys the transmitter. A high-speed relay and short capacitor-resistor time constant is necessary for high-speed operation.

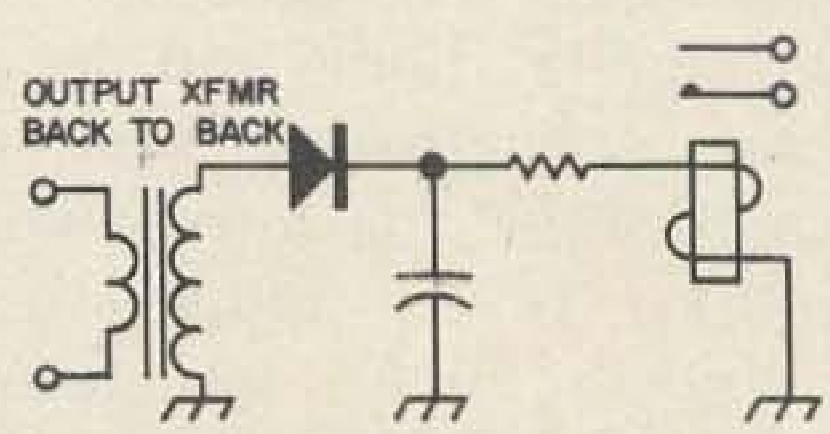


Fig. 92. A transmitter can be keyed by a tape recorder for automatic code practice with this circuit.

Code monitoring

Fig. 93 shows a simple method for monitoring the CW output of a transmitter. Antenna, choke and diode rectifier produce a dc voltage that operates a suitable code practice monitor. The monitor must be one which can operate from the keying voltage available and will turn on quickly. Some code practice oscillators operate from as little as ½ V; they would obviously be more suitable for low-power applications than oscillators requiring higher voltage. However, if you live near a broadcast transmitter, a monitor which is too sensitive may be triggered by the BC signal.

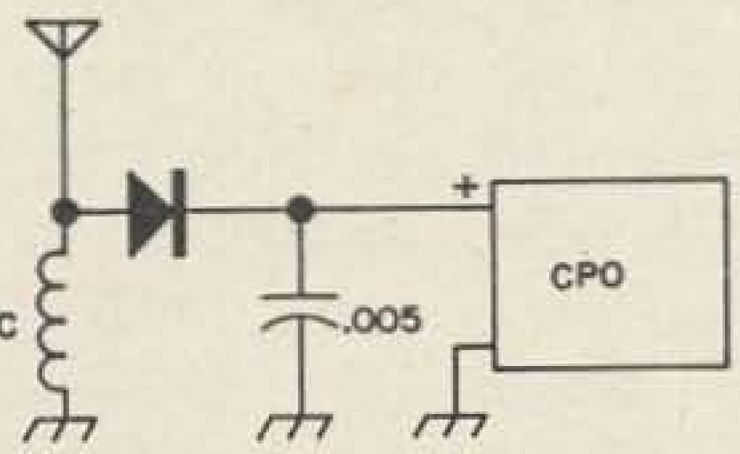


Fig. 93. A field strength meter can key a code oscillator to form a cw monitor.

Radar detector

Of limited practical use, but tremendous appeal, is a simple detector for police radar speed traps. These detectors, which consist of a diode detector in a tuned cavity and a high gain audio amplifier, are illegal in many states, but the laws forbidding them are really a waste of time because anyone who hears the police radar on his receiver is already in its beam. Nevertheless, the radar detector is interesting. As a bonus, it covers some ham bands and other possibly interesting frequencies. A detector for 2.3 to 3.3 GHz, which includes some of the police radar assignments, is shown in **Fig. 94.** It can be built from brass or copper-clad circuit board. It should be followed by a very high-gain low-noise amplifier for greatest sensitivity. This receiver will pick up many signals in almost any location, but don't count on it saving you from a speeding ticket.

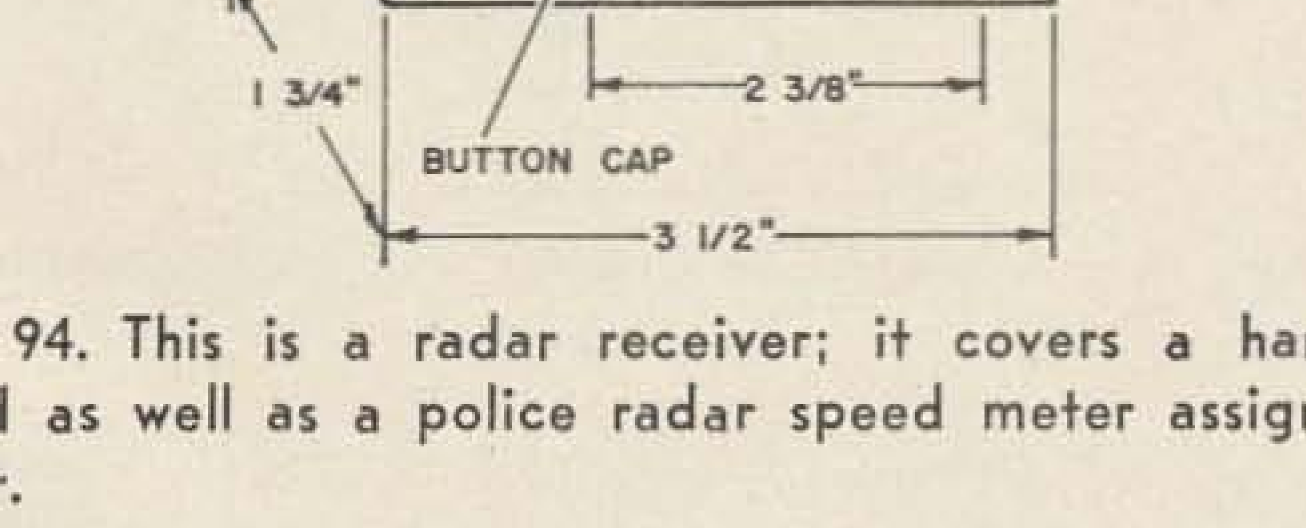


Fig. 94. This is a radar receiver; it covers a ham band as well as a police radar speed meter assignment.

Zener tricks

A zener diode can replace a large, high-capacitance coupling capacitor in an amplifier, and improve the frequency response of the amlifier in the process. The direct-coupled amplifier in **Fig. 95** uses a 15-V zener in this way. High-voltage zeners can also be used in tube circuits.

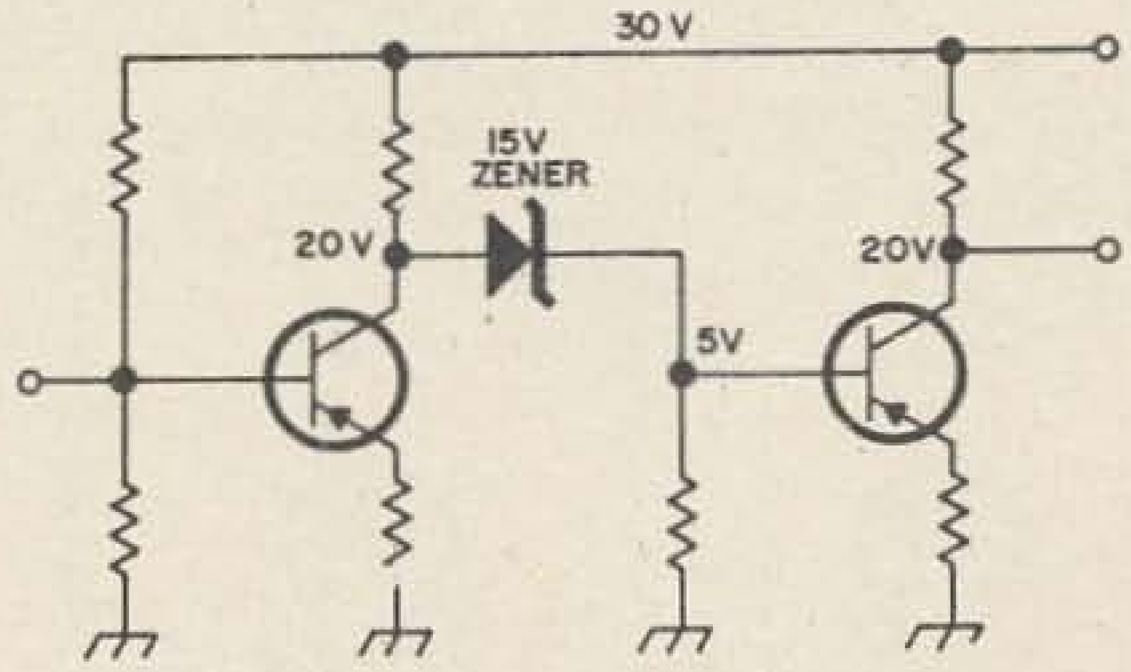


Fig. 95. Zeners can be used in dc-coupled amplifiers to replace coupling capacitors.

Fig. 96 shows a pair of diodes used to provide an artificial center tap in a push-pull transistor amplifier. This arrangement is more satisfactory than a resistive tap.

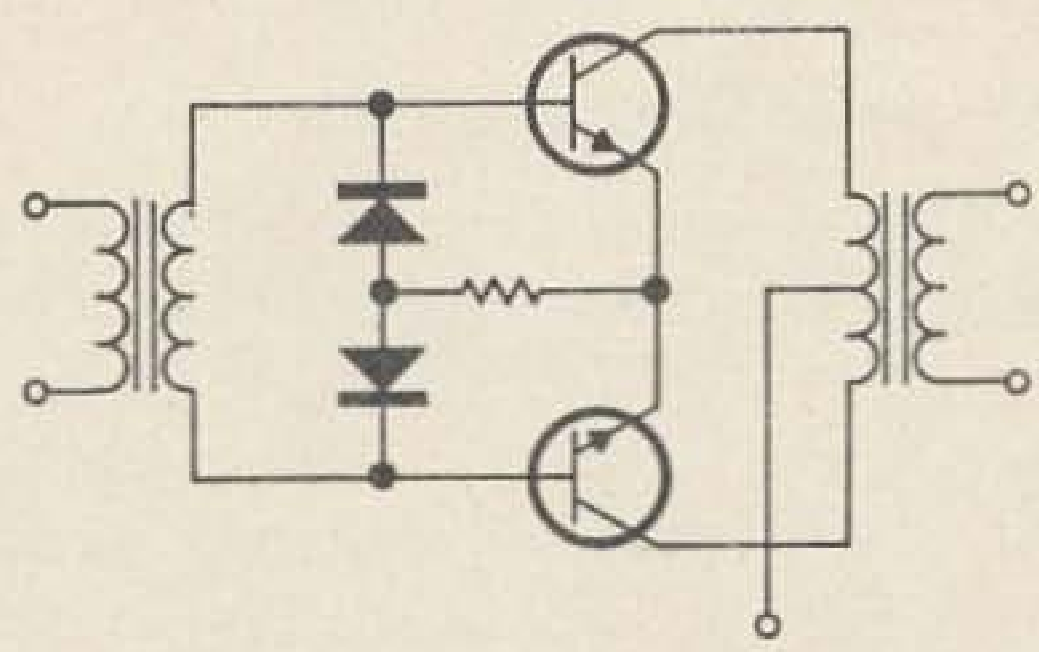


Fig. 96. Diodes can provide an artificial center tap for push-pull amplifiers.

Zeners can furnish low-impedance stable bias sources for vacuum tubes. A screen voltage zener is shown in **Fig. 97A,** and a zener in series with the tube to provide grid bias is shown in **Fig. 97B.** The resistor R may be necessary to keep the zener alive if

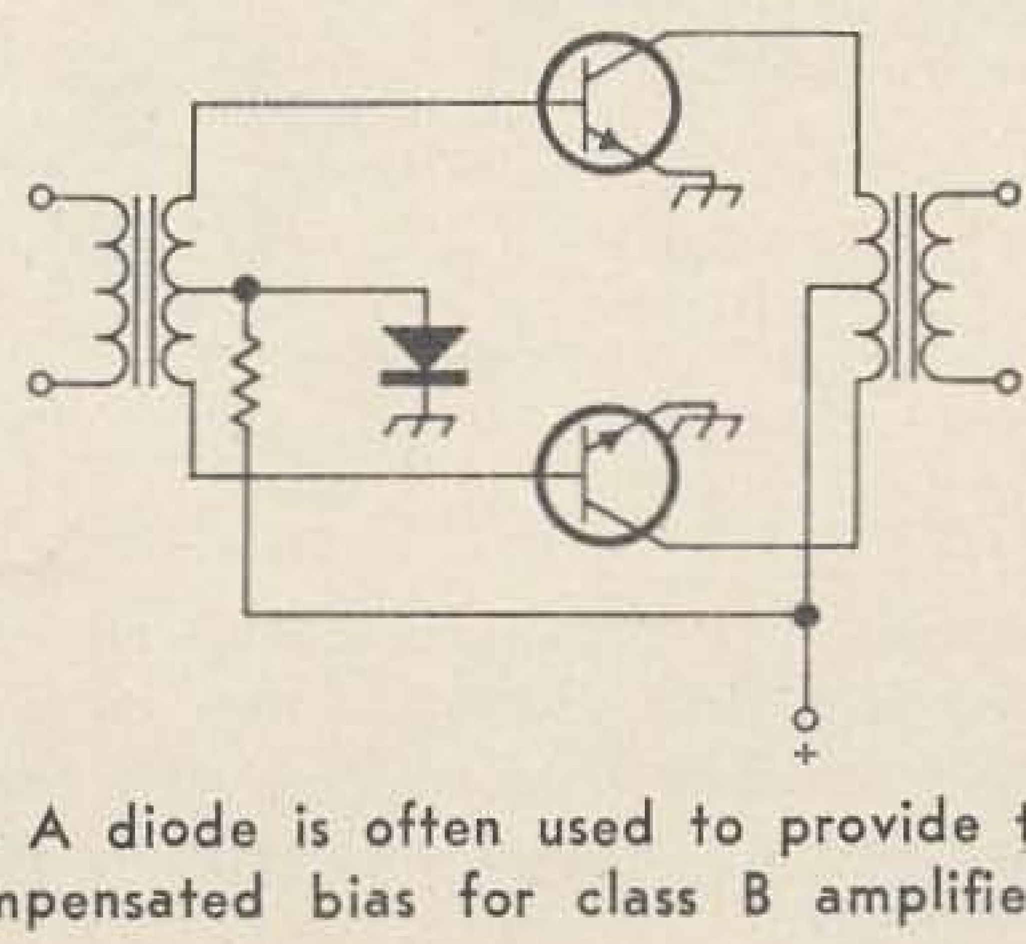


Fig. 97. A diode is often used to provide temperature-compensated bias for class B amplifiers.

the current of the tube drops to a low level or if the zener works best at a higher current than the tube.

Class B temperature stabilization

Class B transistor amplifiers are very sensitive to changes in temperature. A small resistor is generally used in the emitter circuits of these amplifiers to prevent excessive current flow at high temperatures, but resistors can waste a lot of power as well as provide varying bias. A better approach is to use a diode to maintain the bias as shown in **Fig. 98.** The diode will compensate for temperature changes because of its temperature coefficient, which is similar to that of the transistors.

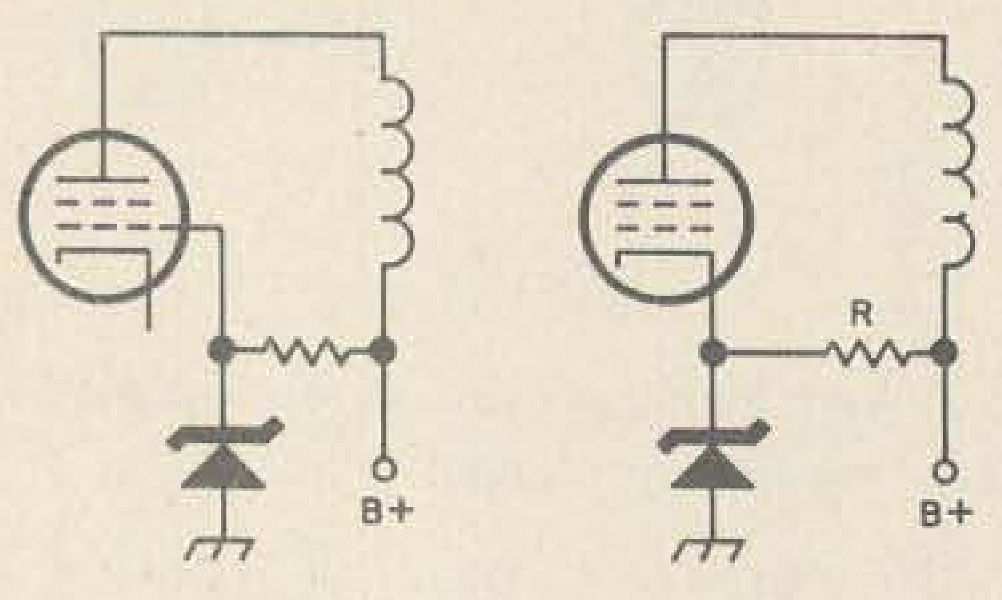


Fig. 98. A zener can furnish stable screen or grid bias for a vacuum tube.

Reverse polarity protection

Few things are as disheartening as connecting a piece of equipment to a reversed power supply and blowing out its transistors or other parts. Though this possibility has probably been over-emphasized in the past, it is true that some transistors in some circuits are very intolerant of incorrect polarity.

Fig. 99A shows a simple way to prevent this. If a diode is connected in series with the power lead, the wrong polarity will cause no problem as the equipment will simply not work. An even better arrangement is shown in **Fig. 99B.** Here the equipment will work properly no matter how you connect the power supply. The diode bridge "chooses" the proper polarity from the input voltage. In fact, it will even work on alternating current, but a filter will probably be necessary. The diodes must be suitable for the current passing through them. There is a slight voltage drop across the diodes.

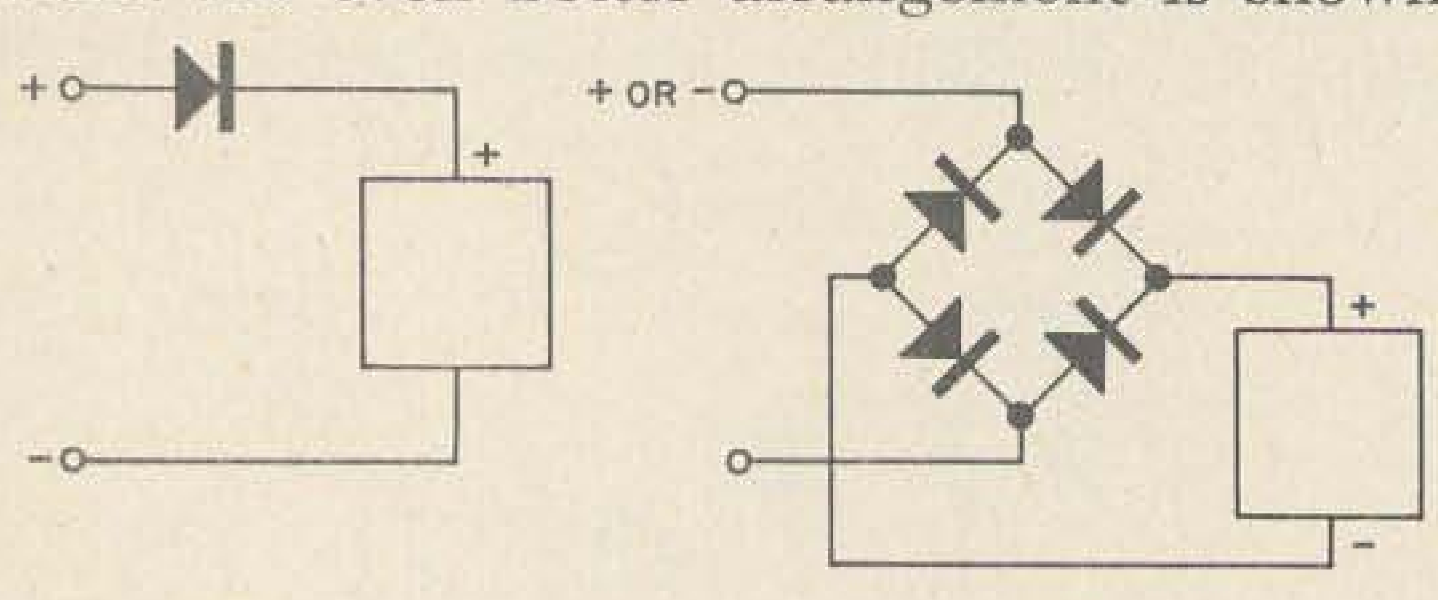


Fig. 99. These two circuits protect equipment from incorrectly polarized voltage. The single diode keeps the equipment from working when the polarity is wrong, while the bridge automatically selects the proper polarity.

Under- and over-voltage protectors

Tubes are becoming unpopular for many applications, but many are still being used. They are often expensive and critical tubes are easily damaged by excessive filament or heater voltage, such as transmitting power amplifiers and cathode ray tubes. Zener diodes can be used to protect filaments from gross voltage overloads, and with care, can also protect them from small excessive voltages. The filament voltage of most tubes used by hams should be kept within 10% of the proper value for best results and longest service. **Fig. 100** shows how a zener (or zeners) can be connected across a filament to eliminate the problem of high voltage.

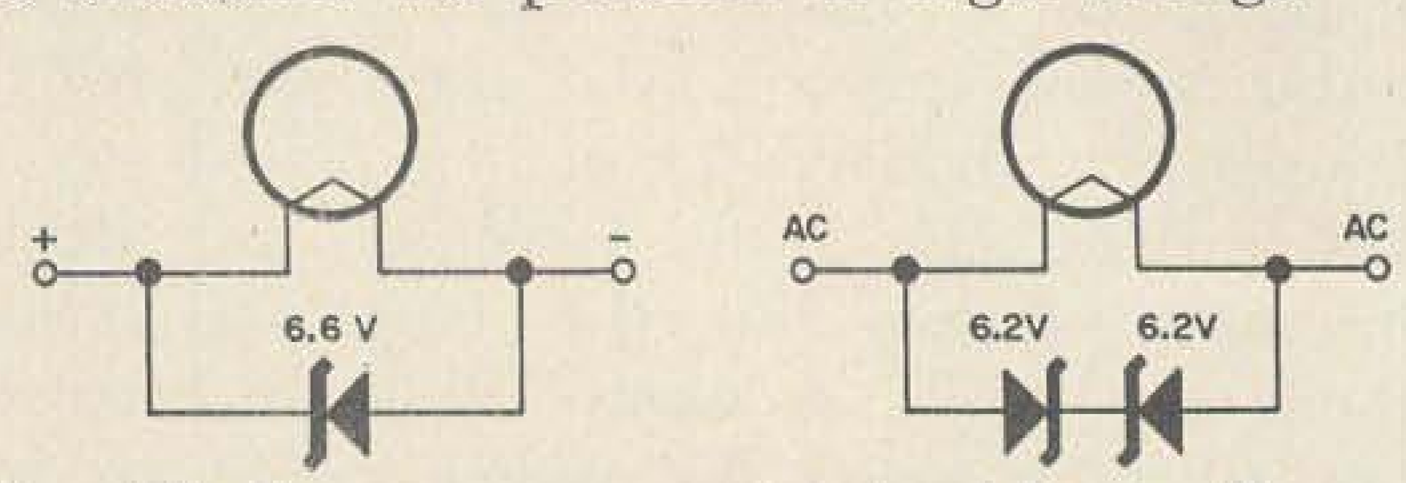


Fig. 100. Zeners can protect a delicate filament from overvoltage.

Fig. 101 shows a similar arrangement which will provide protection from high voltage for a piece of equipment of any type.

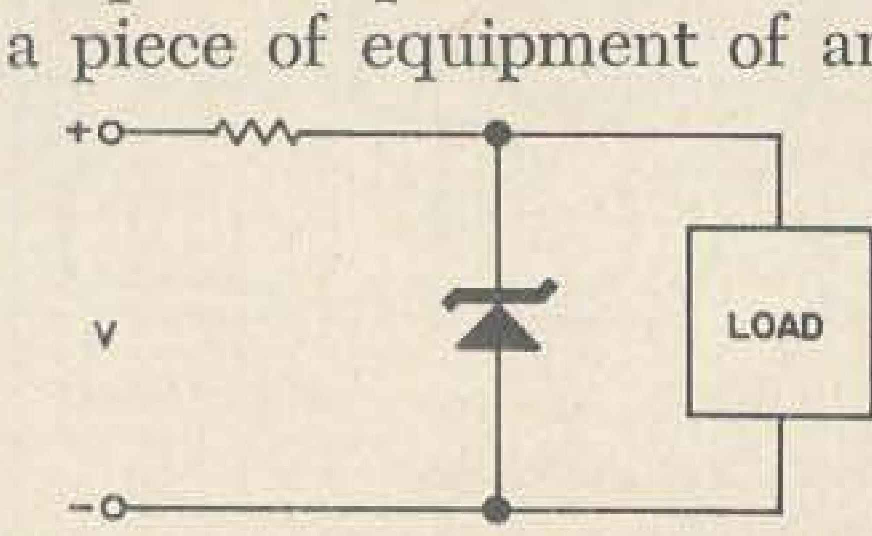


Fig. 101. A zener can protect any critical load from overvoltage.

Many pieces of equipment can be damaged from under-voltage as well as over-voltage. Many motors, for instance, will stall under low voltage, then draw excessive current and burn out. One way to prevent this is shows in **Fig. 102.** The relay disconnects the load when the input voltage drops to a value low enough to cause the zener to stop conducting. The resistor is necessary to limit zener current if the relay resistance is not high enough.

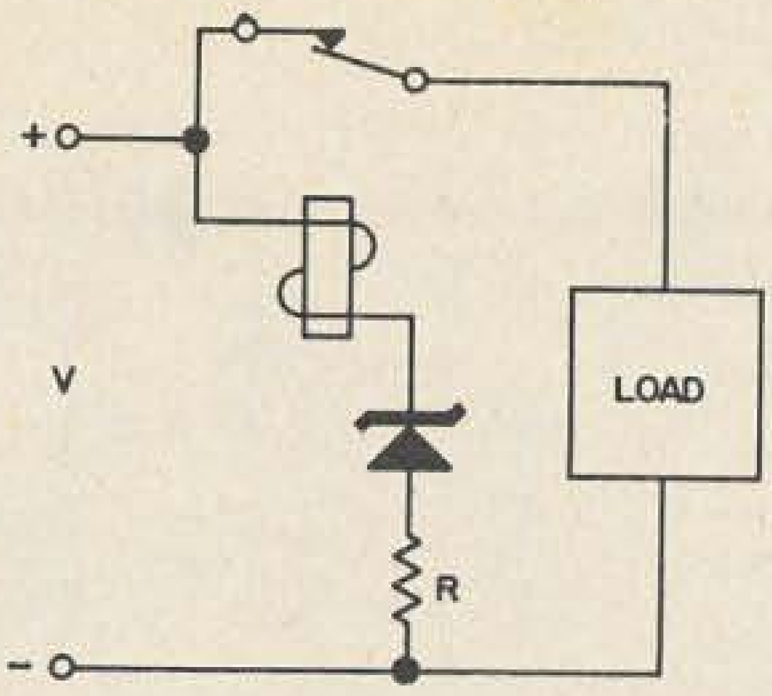


Fig. 102. This circuit will disconnect a load when voltage drops below a minimum.

Transient fields

Transformers, relays and other inductive components operating in dc circuits often generate large reverse transient voltages when their magnetic fields collapse as the dc voltage is removed. These transients can damage transistors, diodes and other polarity- and voltage-sensitive components if suitable precautions are not taken. A simple, inexpensive transient damper is shown in **Fig. 103.** A silicon diode is connected across the coil in the reverse direction. It conducts no current as long as the dc flows. When the dc is removed, the diode will short circuit any reverse-polarity voltage transient generated by the collapsing coil. The diode used must have a PIV rating greater than the voltage generated.

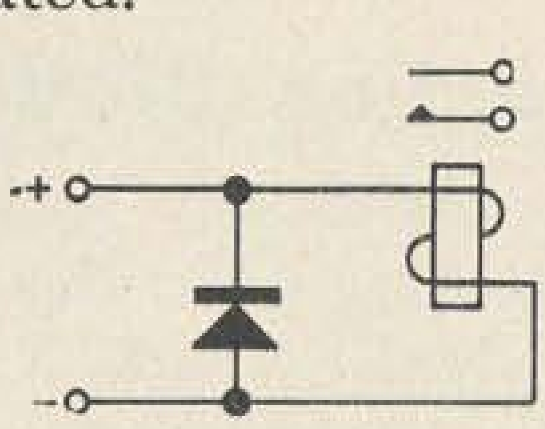


Fig. 103. A diode can damp the field generated by a coil when current through it is disconnected.

Transistor gain control

A vexing problem in transistor amplifiers is varying the gain of an amplifier without changing its dc conditions. One simple approach is shown in **Fig. 104.** Here the impedance of a diode in series with an emitter

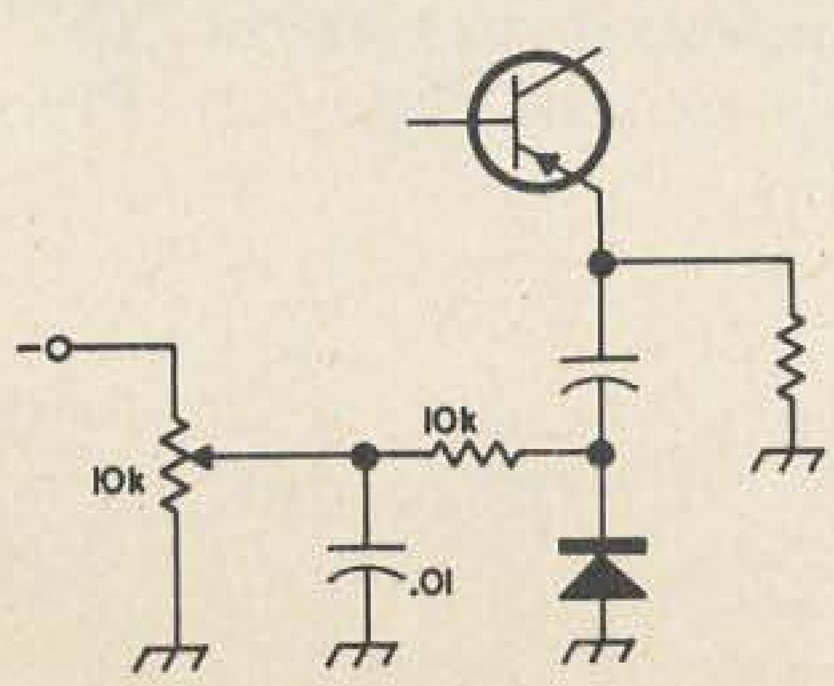


Fig. 104. A diode can control the bypassing of an emitter bypass capacitor to change an amplifier's gain.

bypass capacitor is varied to change the effectiveness of the bypassing, and hence the gain of the stage.

Lamp dimmer

Fig. 105 shows a simple non-dissipative lamp dimmer. It offers only two positions, full on and half on, but that is adequate for many uses. Its operation should be fairly obvious. The diode conducts ac in only one direction, so only half the current that normally would flow through the lamp is passed. The diode must be rated for the wattage of the lamp; a 750-mA diode is satisfactory for a 60-W lamp.

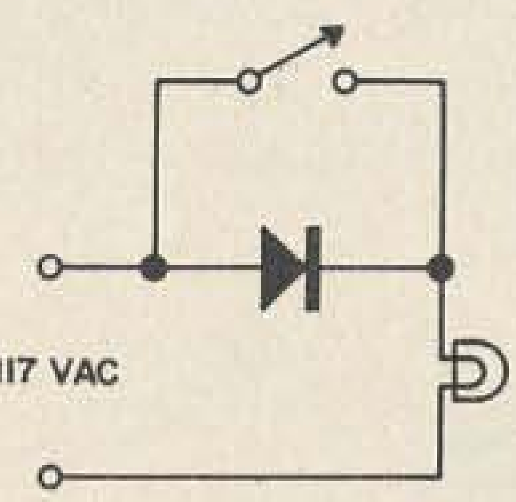


Fig. 105. This is a lamp dimmer providing two brillance positions, half on and full on.

Control circuits

Diode control circuits are among the most interesting, yet least understood, diode circuits. Some of them smack of black magic when they're not well understood. **Fig. 106** shows such a circuit. Here one switch and two wires serve to control two lamps. Do you see why it works? There is a small voltage

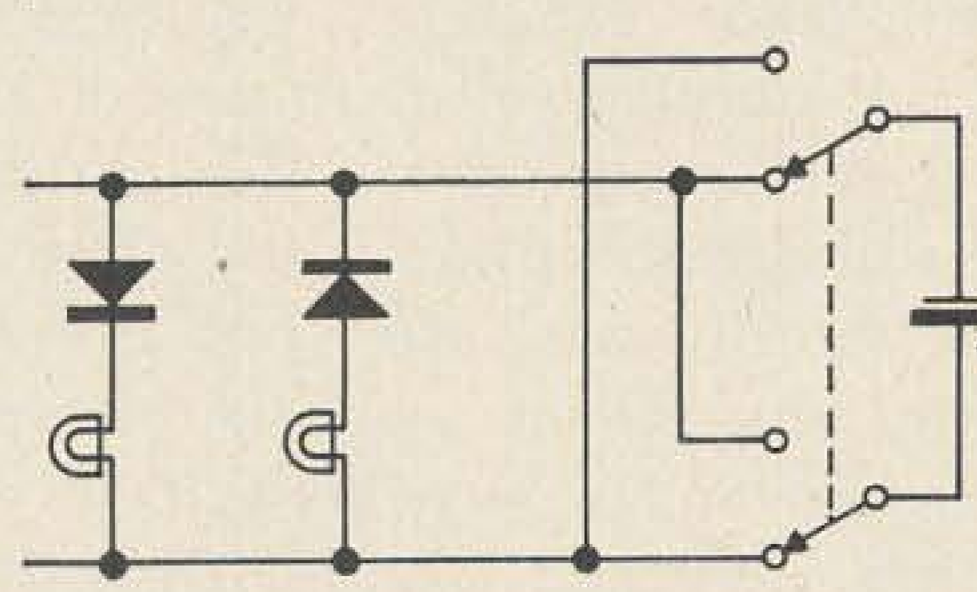


Fig. 106. Diodes can be used for mysterious switching of two lamps with one pair of wires.

drop across the diodes. **Fig. 107** is a slightly more interesting version of the same type

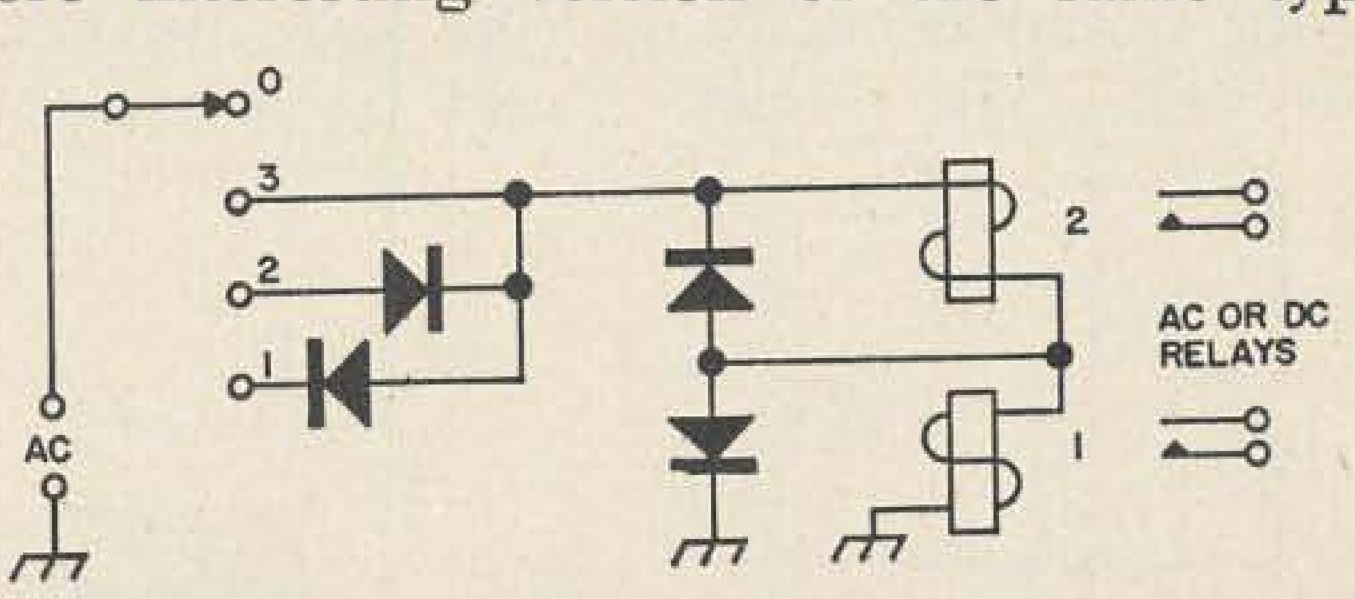


Fig. 107. This is an extension of Fig. 106. In position 0 neither relay is energized. In position 3 both are energized. In 2, relay 2 is on and in 1, relay 1 is on.

of circuit. One switch and two wires control two relays, turning them both on or off, or either one on or off, in turn.

Another interesting scheme is shown in **Fig. 108.** Here the relay receives current when the input voltage exceeds the zener voltage. **Fig. 109** is an expansion of that idea in which increasing voltages turn on the relays in sequence. This could be used for various indicators such as antenna elevators or rotators.

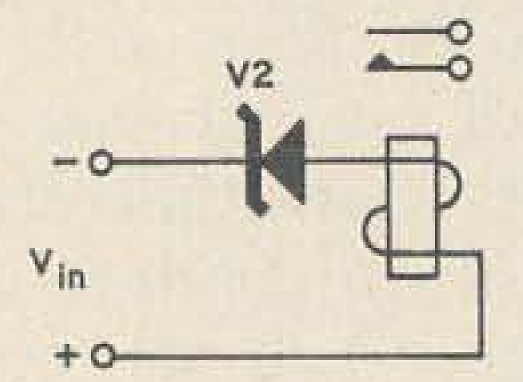


Fig. 108. An input voltage over the zener voltage energizes the relay.

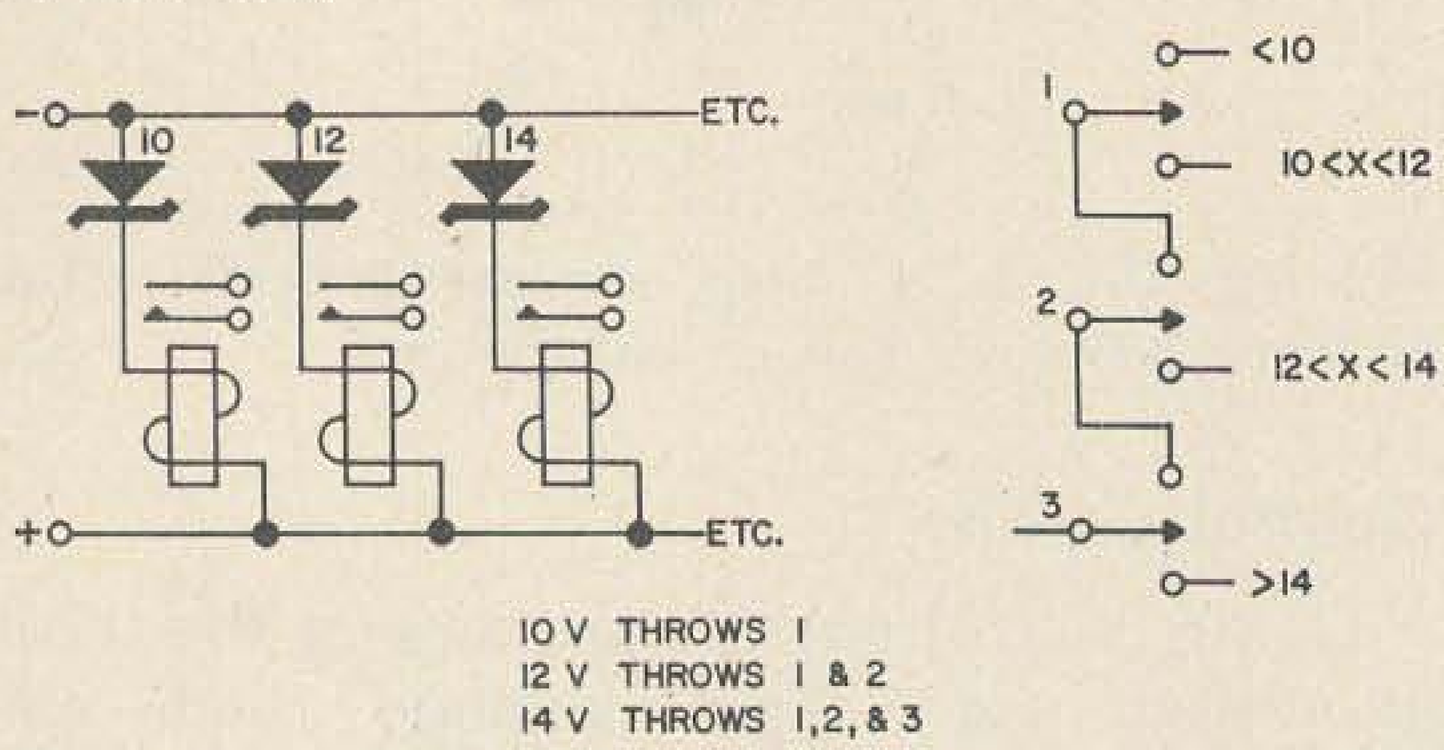


Fig. 109. In this scheme, a varying input voltage selects relay contacts in turn.

Transmit-receive switches

Diodes make excellent transmitter-relay switches. A number of manufacturers make diodes especially suited for this service. You can buy solid-state antenna switches for HF, VHF or microwave use, but they aren't cheap. For ham HF use, simple, cheap silicon power diodes make excellent T-R switches that switch very fast and provide excellent isolation and low loss. Such a circuit is shown in **Fig. 110.** It will handle quite a bit of power. **Fig 111** shows another semiconductor antenna switch. This one is a little more symmetrical than **Fig. 110** and better for VHF. The diodes should be special microwave varactors, but the circuit will likely work with common diodes such as the 1N21 if the diode ratings are not exceeded.

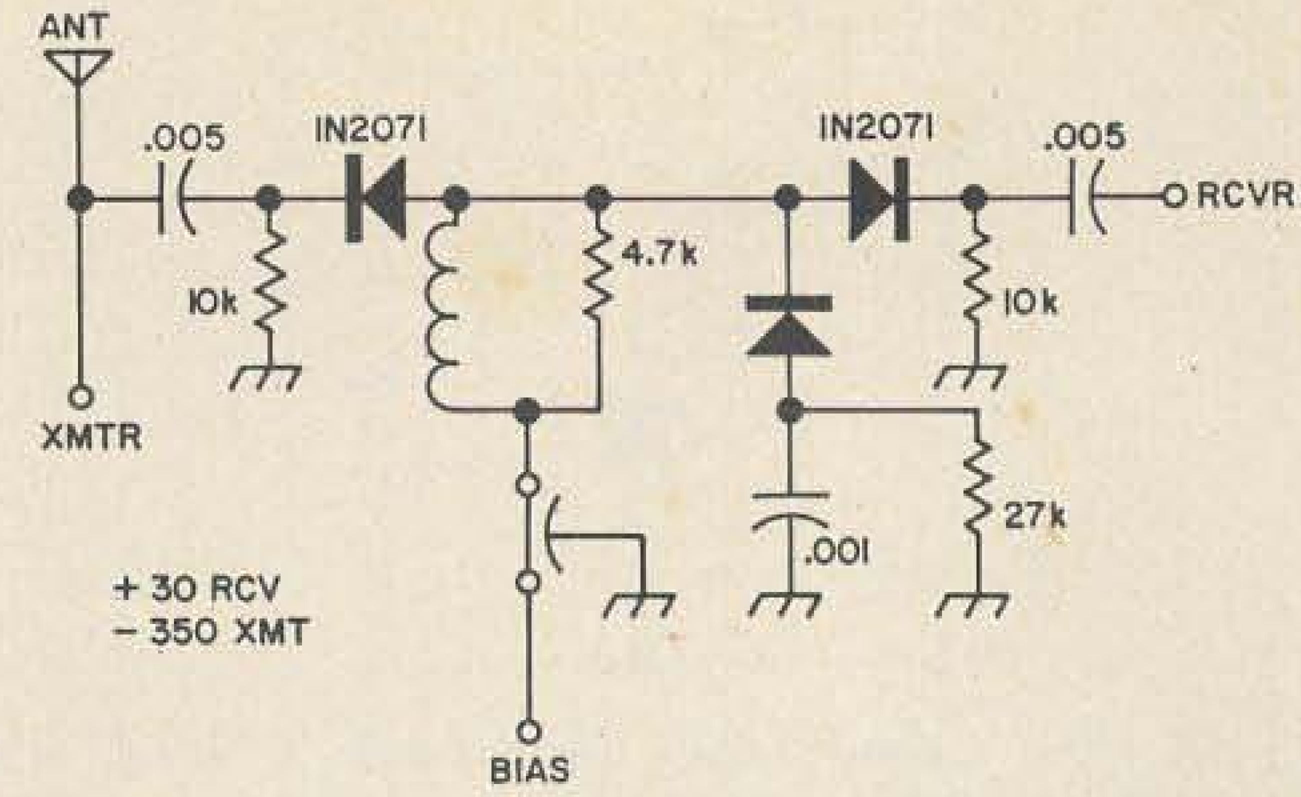


Fig. 110. This is a high-frequency antenna switch using diodes.

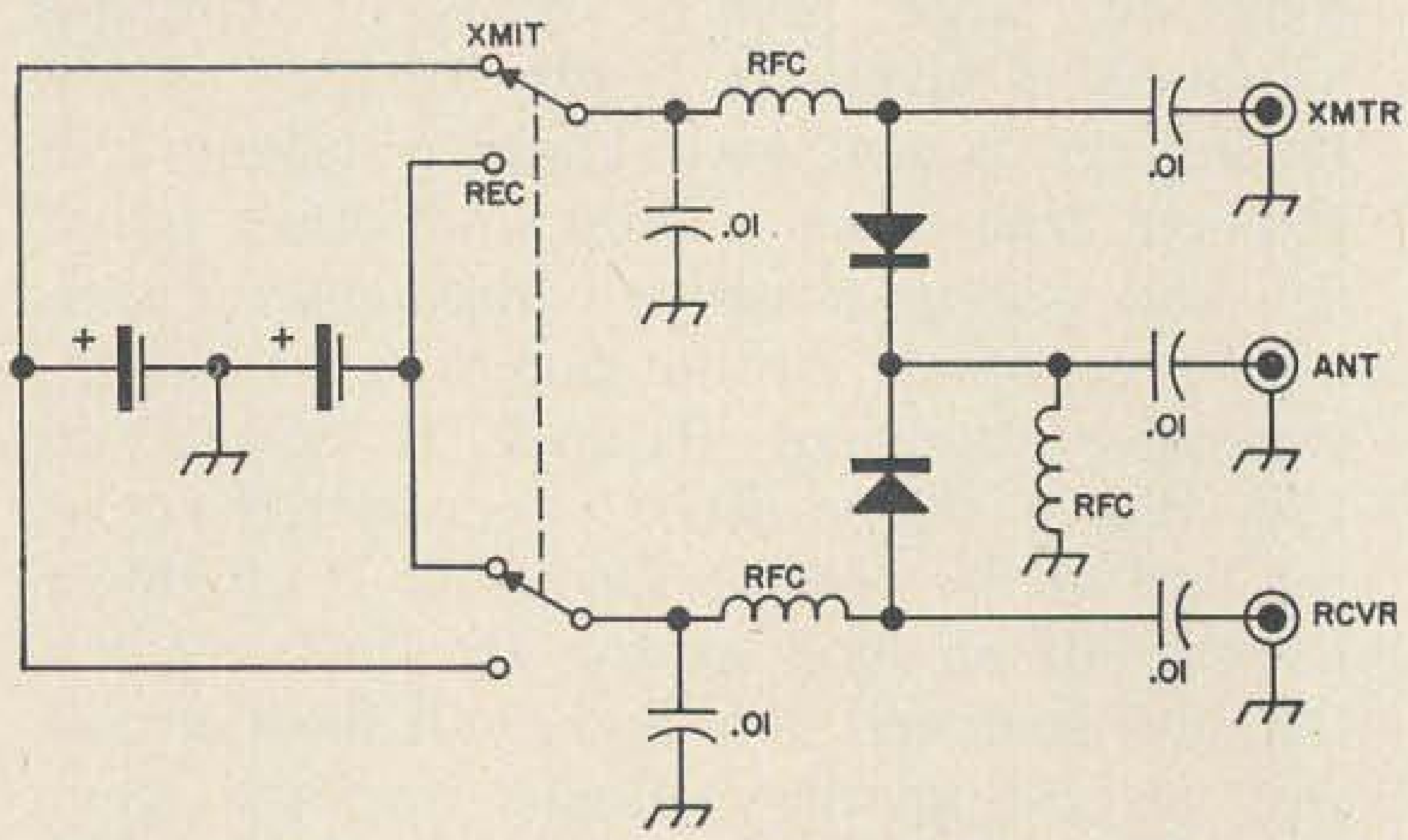


Fig. 111. This transmit-receive switch can be used at VHF if it is constructed carefully.

Testing Diodes

Probably the best way to check a diode is to display its characteristics on an oscilloscope, as described by W2DXH in the April 1967 73. Jim's checker puts a maximum of about 225 volts across the diode, so tells little about the properties of the diode under higher voltage. It is often desirable to test diodes at higher voltages. It's easy to modify Jim's circuit for this, but you have to be careful in using a higher voltage or the diode, the instrument, or you, may go up in air pollutants. On the other hand, you can test diodes at low voltages with the popular (It has appeared in almost all electronics magazines.) scheme shown in **Fig. 112.** This

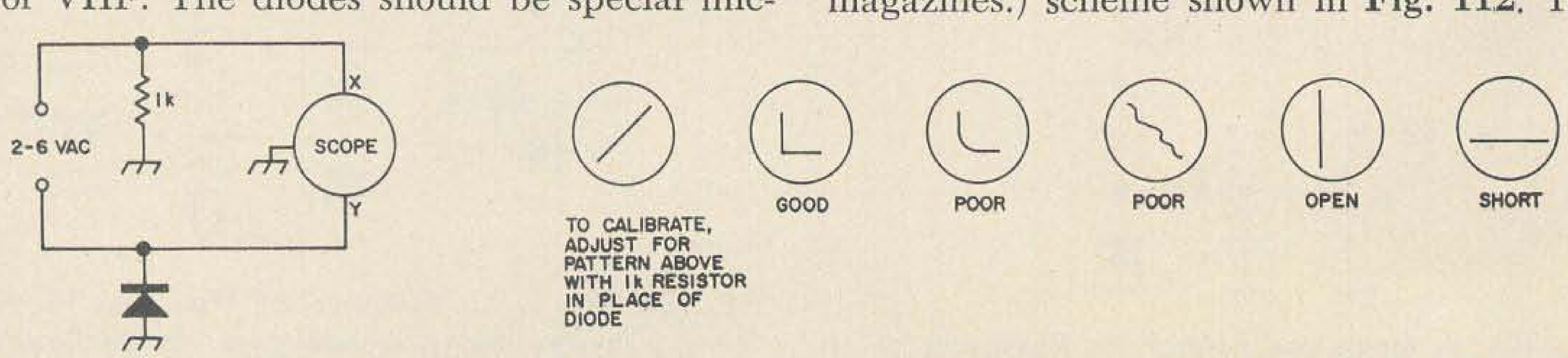
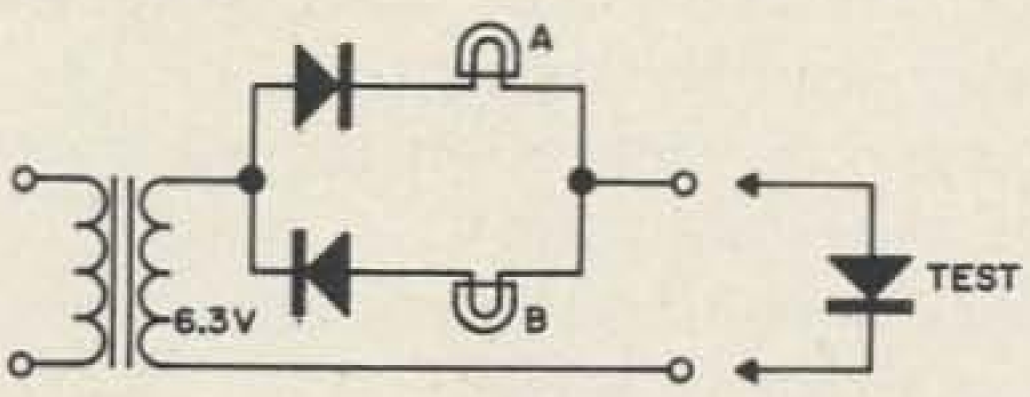


Fig. 112. One of the easiest types of diode checks for a person with a scope is this, but it tells nothing about a diode's high voltage performance.

arrangement works on the same principle as the more complex instruments mentioned above. It is interesting, and very simple. It makes an excellent diode rejector; any diode which doesn't pass this test should quickly be thrown away. Incidentally, silicon diodes seem to have sharper knees and straighter traces than germanium ones.

Another and even simpler, gadget that quickly tells whether a diode is hopeless, is shown in **Fig. 113.** It is also identifies the diode's cathode (if it has one). The principle of this one should be obvious if you've been paying attention. Use low current lamps to avoid cooking small diodes. Operation is very simple. Connect the diode. If lamp A lights, the diode is good. If B lights, the diode is good, but you've got it in backwards or the diode is mismarked. If both A and B light the diode is shorted. If neither lights, the diode is open.



"A" & "B" ARE NO. 48 OR 49 LAMPS

Fig. 113. This simple device gives a quick check of diodes. If lamp A lights, the diode is good. If B lights, the diode is good, but connected backwards. If neither lamp lights, the diode is open, and if both light, it is shorted.

A simple way to check diodes is with an ohmmeter, and a simple ohmmeter is shown in **Fig. 114.** If the diode is connected with its cathode to the positive terminal of the ohmmeter (reverse biased), no current flows (or at least very very little). Conversely, if the diode is connected with its anode to the positive voltage (forward biased), lots of current will flow. In simpler terms, the diode should have low resistance with the ohmmeter leads connected in one way, and high resistance if the leads are reversed. Almost any ohmmeter is usable. Be careful that your ohmmeter doesn't furnish enough current to damage the diode.

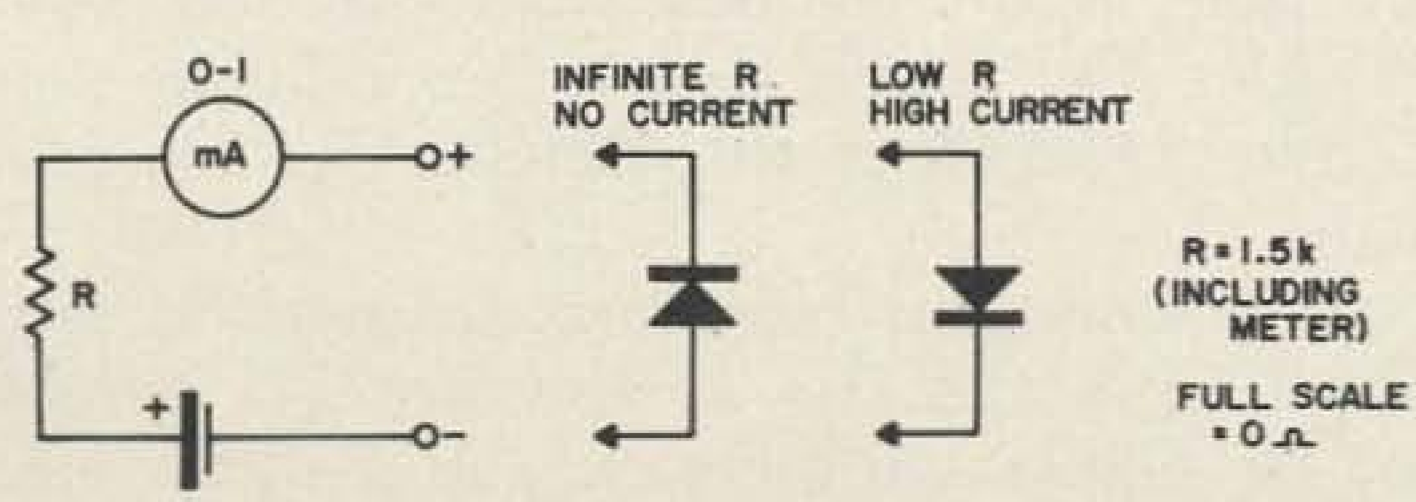


Fig. 114. This simple ohmmeter demonstrates how a diode can be checked with an ohmmeter.

An easy way to check zener diodes (incidentally, snobs call them **zayners** not **zeeners**) is shown in **Fig. 115.** Start with zero voltage, and increase it until the voltmeter stops rising. That's the zener voltage. If the voltmeter stops at about ¼ volt, you have a forward-biased germanium diode, and if it stops at about ¾ volt, it's a forward-biased silicon diode, instead of a reversed biased zener. Turn it around. It's a good idea to place a milliammeter in series with the diode to make sure that you don't exceed the power the zener can dissipate. You can figure the power input by Ohm's Law; power in watts equals voltage across the zener times the current flowing through it in amperes.

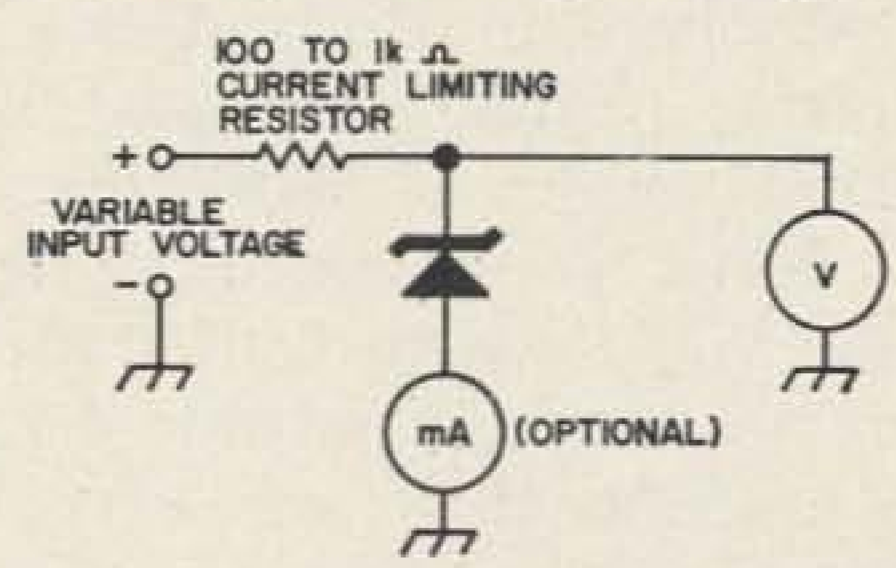


Fig. 115. Here's a simple way to find the breakdown voltage of zener diode.

For example, if a 10-volt zener has 10 mA (0.01 amps) flowing through it, the power being dissipated by the zener is 1/10 watt (100 mW), which isn't likely to cook it. Most of the small glass zeners are rated at 250 or 400 mW, the small metal cased ones 1 W and the studs (with heat sinks) 10 W. There's no need to push the ratings when you check the zener break, though. Diodes have almost the same zener point with maximum dissipation and 1/10 dissipation.

You can check varicaps and varactors by the above methods, but that just tells whether they're diodes. You can also check them in practical circuits, or simplified test jigs. For instance, if you want to find a good frequency multiplier, make a multiplier and try diodes until you find a satisfactory one.

Transistors can be thought of as two diodes (emitter-base and base-collector), so you can check them for use as diodes by ignoring the unused lead. Silicon transistor emitter-base junctions often make excellent zeners, for example, while old germanium VHF transistor base-collector junctions can make good varactors, and old germanium power transistors make good low voltage rectifiers. Though it's a bit out of the scope of this article, you can even cut off the top of a transistor case and get a photocell.

. . . WA1CCH

RTTY In Holland and Belgium

In the last 18 months RTTY has been becoming popular in Holland and Belgium. For many years we have been reading about the activities of the American stations, but we couldn't get the machines. So RTTY was abacadabra to us. There were about four machines in Holland and they were very thick with dust! It is not so nice to work only with the same few stations! And, until two years ago, RTTY was not permitted in Belgium.

Moreover, here in Holland, we have different licenses. First, a general license for all the bands, and a C license for 144 MHz and up. When you have a C license and a machine, you have to wait until the right conditions to work. England, for instance. Even in England there are very few hams who work RTTY on two! Until two years ago Belgium didn't give a license for RTTY at all, and in Germany there are no 2-meter RTTY hams. Also, none in Denmark.

Toward the end of 1964, on the Belgium market, we began to get Creed machines, and that was the beginning of the Dutch RTTY enthusiasm.

We started the Dutch RTTY Gang with PAØAA, YZ, TED, CR, CPD, XW and VDZ, who had machines and were at the first meeting. Every month the Dutch RTTY hams have a meeting now in the center of Holland, at Woerden. In the summer months about 30 amateurs come to our meetings from all parts of the Netherlands. In Holland we have a total of 60 RTTY amateurs; in Belgium, about 40 or 50.

For years PAØAA has been sending a RTTY Bulletin weekly on Fridays (on 80, 20, and 2 meters). Recently ON4VB started a RTTY Bulletin on Sundays on 80 and 2 meters. While there was interest growing, more machines were becoming available. Practically all of the machines were from Creed (England) and Lorenz (Germany).

Our group was interested in buying a great number of machines together, but for a large party you need a lot of money!!

So, our members who didn't yet have a machine took a share of about $40 and some weeks ago we bought 27 Teletype printers, tables and rectifiers. We now have TT-14 perforators, TT-15 machines with and without perforators, etc.

The machines (from Germany) arrived in Rotterdam. We took a transport-car and transported the load to Leiden. The Dutch RTTY-managers PAØYZ and PAØVDZ controlled the gear and put it in working order. So we provided 60 hams with printers, and most of them work on two meters! Every RTTY'er gets a special license from our Government Post Office. Lectures were held about TU's, auto-start, basic principles, and so on.

Many of the Dutch and Belgium RTTY stations use the famous printed-circuit 5R6 TU (from DL6EQ). From the same manufacturer, we have the tone coils, the band-pass-filter, and the indicator.

We have the intention to use a clover leaf antenna for auto-start. A model is made by a local manufacturer and, after our tests, it will be made in series.

For two meters, for auto-start and call frequency, we have chosen 145.800 MHz. Crystals were exactly ground by a manufacturer to that frequency. In general we use the CCIT norm, that is 50 Bauds.

In the future we hope that the RTTY amateurs in Holland will have a VHF receiver on the frequency of 145.800 24 hours a day. By using a dial, such as is used in a telephone, you can make a selection of tones and you choose one or more amateurs, for whom you have a message.

All above is what the Dutch RTTY Gang will accomplish. We get publicity by writing articles in the Dutch Amateur Magazines (*CQ-PA*, weekly, and *Electron*, monthly) and we can say that "RTTY is in".

Since the Belgian Government began giving licenses, the Belgian RTTYers have also become active. At the end of 1965 and the beginning of 1966 two meetings were held in Brussels in the national shack of the UBA. ON4VY did much to get the Belgian gang active; ON5AJ is the Belgian RTTY manager.

It is now possible for the American amateurs (and the rest of the world) to make RTTY QSO's with Dutch and Belgian amateurs!

. . . PAØVDZ/ON8NC

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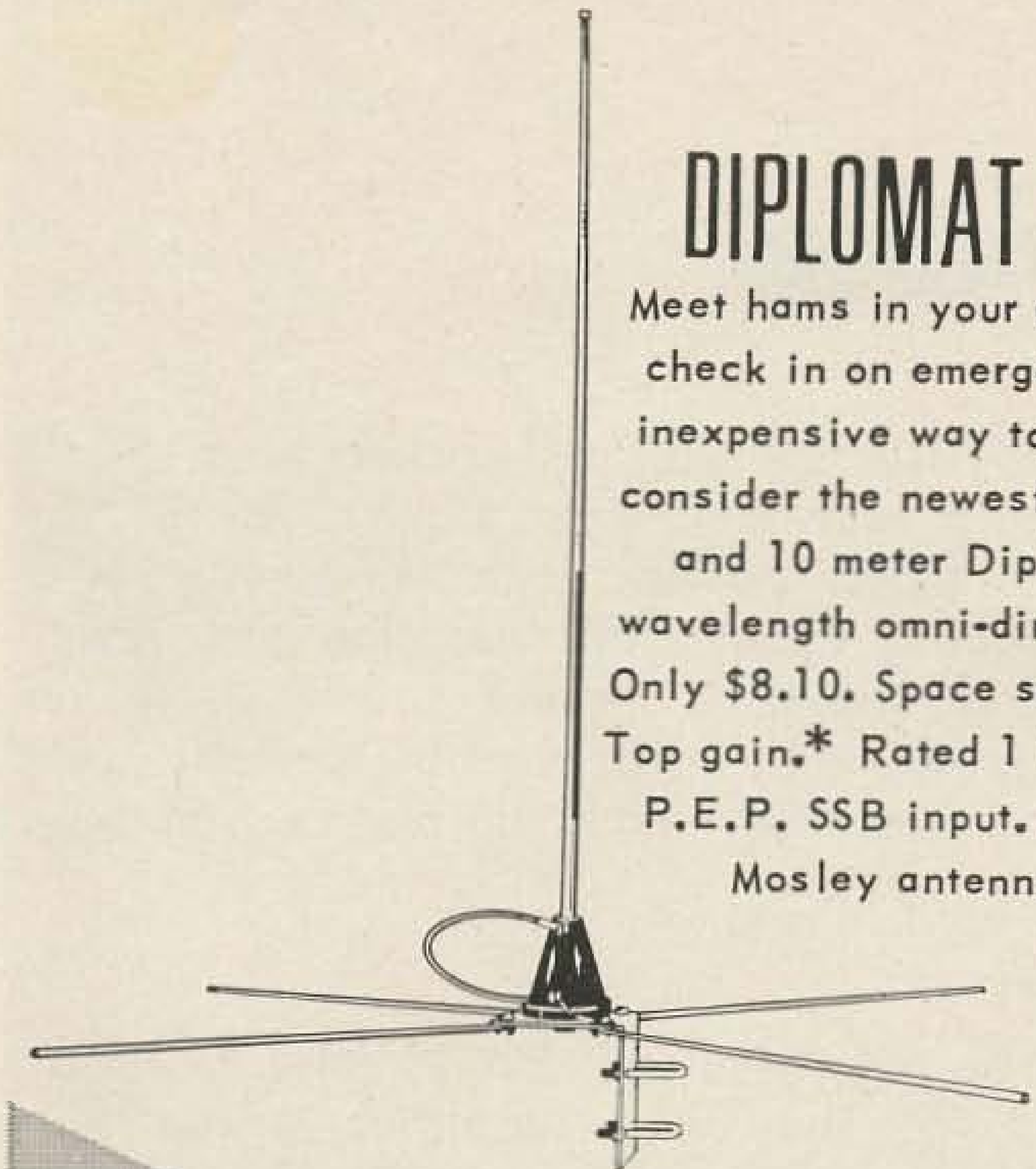

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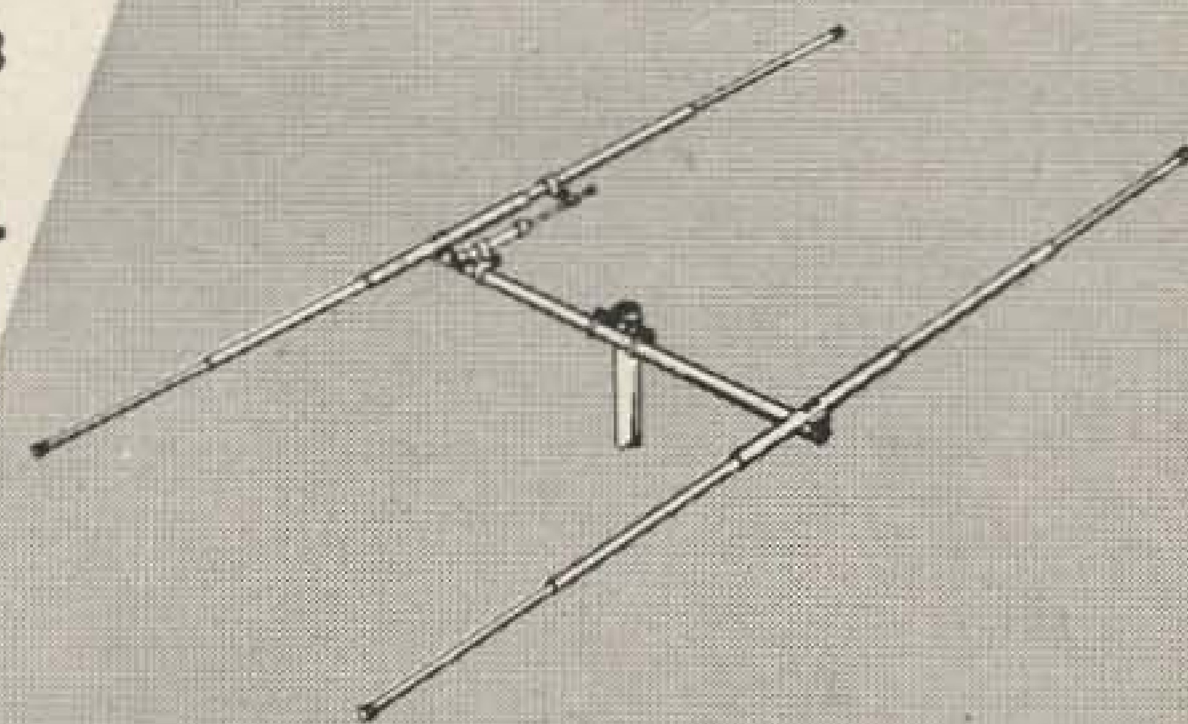

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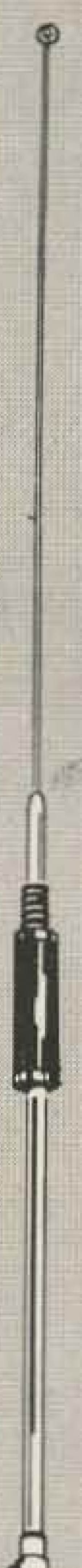

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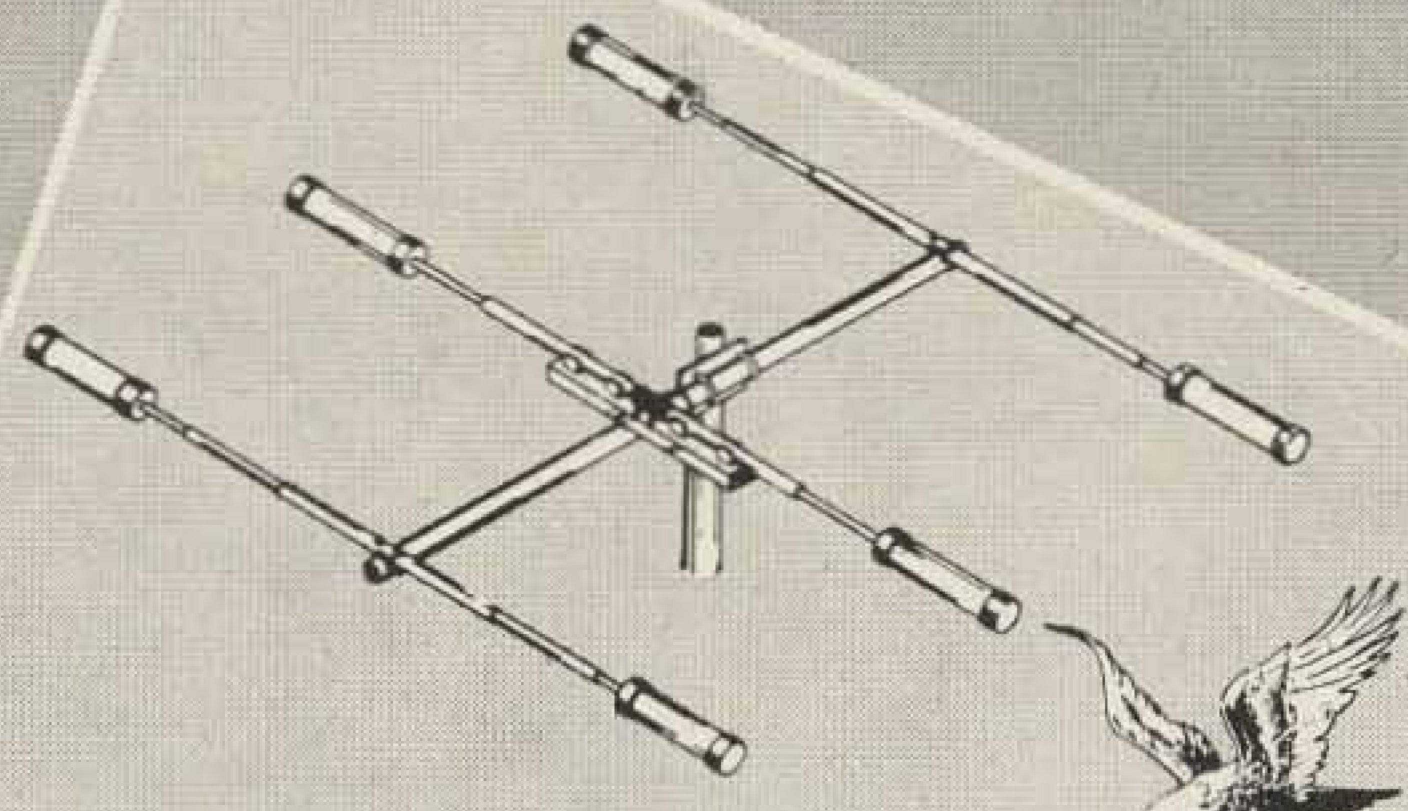

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The Wolverine

This transmitter is a 6AG7 crystal oscillator driving a 6146 on the 160-80-40-20-15 and ten-meter amateur bands, CW only. The editor will probably look askance at publishing this old circuit, but it does have advantages; it is a cheap, simple CW rig that satisfies all CW operation. A VFO can be plugged into the crystal socket when used at the home station. The rig is useful for that once a year 160-meter CW contest, or for the summer vacation trip, and it is worth having around the shack for a spare rig.

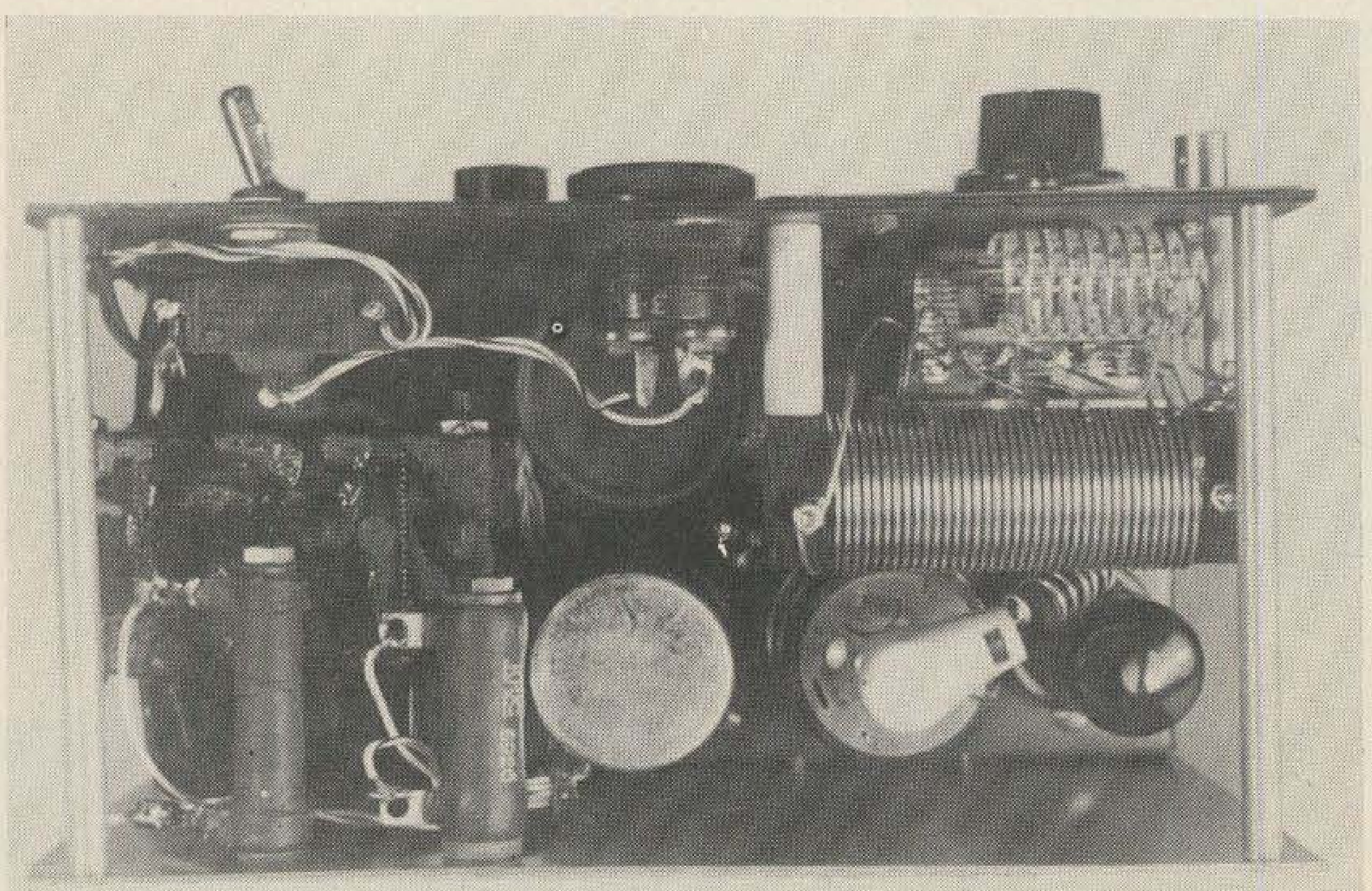
This transmitter is no toy, it runs 150 mA at 750 volts using a 6146 in the final, and a 6146B could be plugged in and the power increased beyond the 100-watt input limit. The set will work straight through on any crystal frequency, or the plate of the crystal oscillator can be tuned to a higher frequency band. With a 7 MHz crystal, the plate can be tuned to the 20-, 15-, or 10-meter bands, and by adjusting the screen voltage on the oscillator, the drive can be controlled for proper excitation to the 6146 tube.

"Old Fashioned?", Let me point out the tubes are *cheap*, and the 6AG7 has a metal shield. Also, the old octal sockets lend themselves to easy mounting of parts. If the rig is put together with lock washers it will handle any shock and vibration test given it when bouncing around in the back of the car. Foreign readers will especially welcome a circuit in which the parts are obtainable.

Theory

To be redundant, the 6AG7 crystal oscillator drives the 6146 amplifier which has been biased to cut-off for protection of the 6146 if the crystal stops functioning for some reason. This cut-off point was selected as −75 volts dc bias which is more bias than class AB-1 and less than class C. This may sound strange, but the crystal oscillator output is hard to control to keep it below the point where it would not drive the 6146 into grid current when it was class AB-1, and by using less bias than class C allows adjustment of the grid voltage between 2-5 mA reducing harmonics. Class-C operation is biased way beyond cut-off and is often a generator of TVI.

Advantage was taken of bridge rectifying a small receiver power transformer to ob-



Top view of the Wolverine transmitter. The 6146 power amplifier and 6AG7 crystal oscillator are on the left; the power supply to the right.

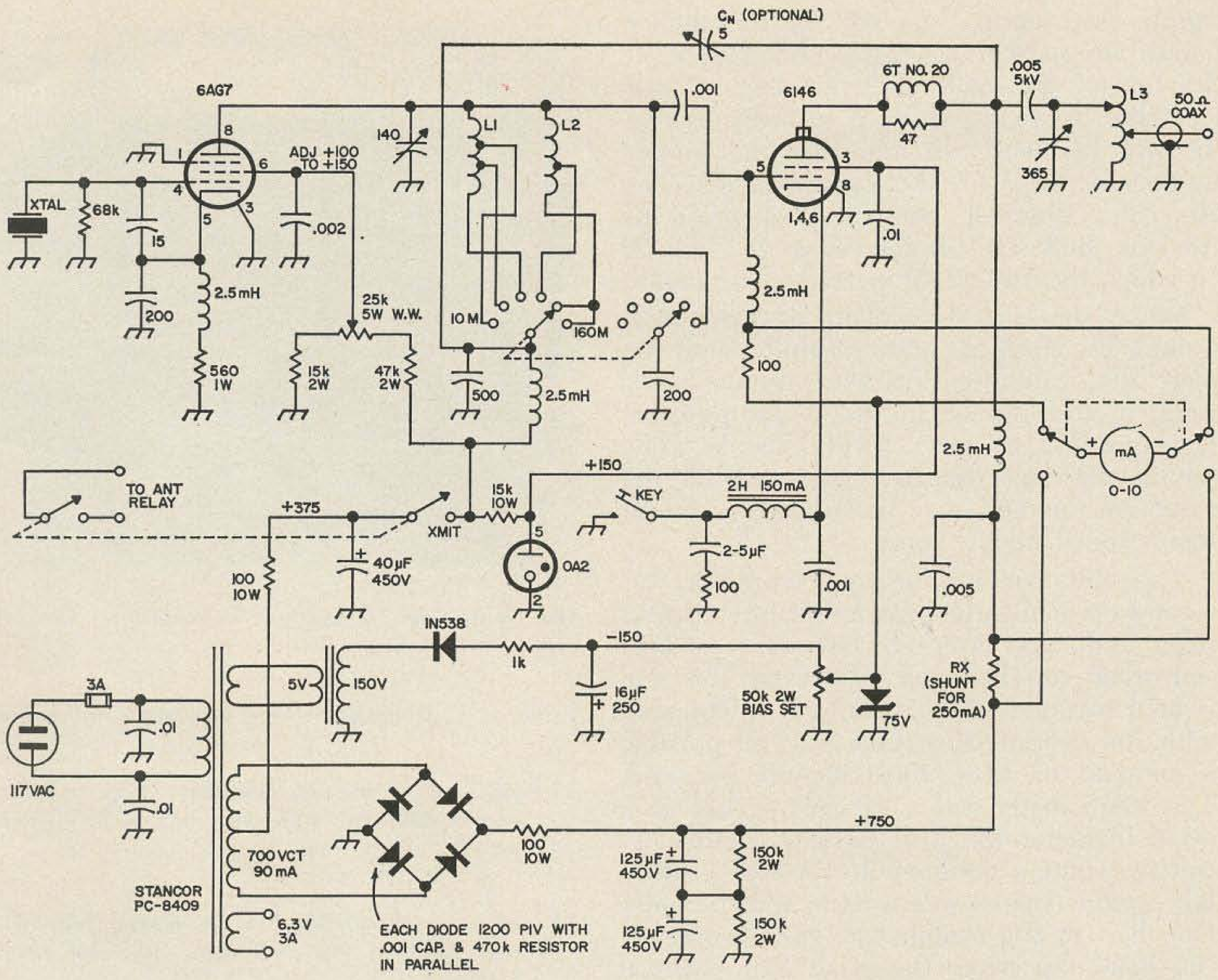


Fig. 1. Schematic diagram of the Wolverine transmitter for 160 through 10 meters. Coil data is given in Table 1.

tain 750 volts and keep the rig small. This could be done because of the low duty cycle operating CW, and the 90 mA transformer over-loaded for short keying periods does not heat too much. The supply voltage remains almost at peak values during keying because of the high value of filter capacitors and the use of a resistor instead of a filter choke. During sending periods the toggle switch turns on the crystal oscillator voltage with one half of the switch, and the other half turns on the antenna relay. The cathode of the 6146 is keyed while the crystal oscillator runs full time during keying; this makes a good sounding CW signal, and there is less chance of frequency shift and chirpy signals which might occur if the oscillator were keyed. There is no need to fear clicky signals using cathode keying because the clicks can be eliminated by using a 2-henry filter choke in series with the cathode and key to ground. A 100-ohm resistor and a 5-μF filter capacitor in series across the key will round off the keying pulse. Any oil-filled capacitor, 2 to 5 μF will be satisfactory. If larger values of capacitance are used, the signal sounds too much like primary keying and very soft. The lead going to the key should be RG-17/U coaxial line with the braid grounded to cut down on any radiation. The rig will be TVI proof if it is built into a sealed metal box. This rig has been used on all bands with no trouble.

Construction

The transmitter is built on a California chassis number A-147 which is 4 x 8 x 2 inches. A Novice constructor would do well to use a larger chassis and spread the parts out. It is suggested that the crystal oscillator be constructed first and checked out on all bands. The crystal socket is mounted on the back of the cabinet and was a two crystal socket sawed in half so the crystal mounts vertically. The plate coil of the crystal oscillator is shorted out from the bottom end of the coil which moves the supply lead up on the coil as the higher bands are used. The higher bands are at the top of the coil, and the slug is half way screwed in the form. A grid-dip oscillator will be handy in adjusting the proper number of turns for the various bands. The 20-, 15-, 10-meter bands use a piece of Air-Dux bulk coil rather than the XR-50 on which the 160-80-40 meter coil is wound.

When the crystal oscillator is finished it should be checked very carefully and the plate dial calibrated for the various bands using a grid dipper in the diode position. It is possible to cover several bands while tuning the capacitor to resonance, but the value of the coil can be adjusted so that it only tunes the one band.

The tank coil for the final amplifier was wound on a micarta tube found in a surplus store and was grooved, although Air-Dux coil stock can be used. However, this coil is held together with plastic and might melt with the extreme heat and if at all possible a ceramic or fibre form should be used. The 10-15 meter coil is Air-Dux and of such small diameter the heat does no harm. For coil switching a double-pole PA type Centralab ceramic switch was used to switch bands. One half of the switch was used to change the band tap while the other half changed to 50-ohm output tap point. This output tap is rather unusual but it is fool proof. The proper point was found by tuning the rig up on any one band and adjusting the tap for maximum output into a 50-ohm carbon resistor. A field strength meter was placed alongside the resistor and a clip was worked back and forth along the coil until a point of maximum output was reached. The output circuit is more stable than a pi-network for a simple rig because the load is on the tube at all times more or less constant, and there is less possibility of the 6146 taking off on its own when the impedance is changed. The tapped coil arrangement works well either into a dipole antenna direct, or into a link-coupled antenna coil. The drive control adjustment on the crystal oscillator will correct the grid current flowing in the 6146 grid to the proper value between 2-5 mA and prevent overdriving the tube. On the higher bands the output of the oscillator falls off and the output can be increased by adjusting this control to increase the screen voltage so that enough output is obtained to drive the 6146 tube.

The Wolverine transmitter—a low-power CW rig with a lot of bite.

Table 1. Coil data for the Wolverine transmitter.

L1—160 and 80 meters, National XR-50 coil form wound full with #28 enameled wire. 40-meter tap 3/8" down from top.

L2—17 turns of Air-Dux 516. 20 meters tapped at top, 15-meter tap at 9 turns, 10-meter tap at 5 turns.

L3—38 turns no. 18, 1" diameter, 18 turns per inch. 160 meters, plate tap at 38 turns, antenna tap at 7 turns; 80 meters, plate tap at 27 turns, antenna tap at 4 turns; 40 meters, plate tap at 16 turns, antenna tap at 2 turns; 20 meters, plate tap at 11 turns, antenna tap at 1 turn. 10 and 15 meter coil consists of 7 turns Air-Dux 508, plate tap at 7 turns, antenna tap at 1 turn.

Tuning

Plug in the desired crystal and turn the crystal switch on. Peak the crystal plate tank for maximum drive while watching the 0-10 mA grid meter. You could use a neon bulb. Adjust the screen drive for 2-4 mA drive, while the key is pressed. For a grid current reading the cathode of the 6146 has to be grounded. Next adjust the final tank tuning condenser for maximum output by watching your SWR meter or FS meter rather than the plate meter in the supply of the 6146. The rig should load up to 150 mA for operation.

. . . W6BLZ

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Ranger II (wired)	359.50	259.50
Ranger II (kit)	249.50	195.00
P&H	**Reg.**	**NOW***
6-150 6m Transmitting Conv....	$299.95	$149.98
LA-500M "Spitfire" Linear	189.95	94.98
POLYTRONICS	**Reg.**	**NOW***
PC-2 2m Transceiver	$349.50	$225.00
REGENCY	**Reg.**	**NOW***
AR-132 Aircraft Receiver	$ 59.95	$ 29.98
SBE	**Reg.**	**NOW***
SB3-DCP Mobile Inverter (1 KW).	$249.50	$124.75
W-72 Control Cable (SB3-DCP)..	7.50	3.75
SB1-VOX VOX Unit	39.50	19.25
SINGER	**Reg.**	**NOW***
PR-1 Panadaptor	$144.50	$ 72.25
SQUIRES-SANDERS (CLEGG)	**Reg.**	**NOW***
SS-1R Receiver Ser.	$995.00	$495.00
SS-1S/RS Silencer/Speaker.....	170.00	85.00
99'er 6m Transceiver	179.95	119.98
Thor 6 6m Transceiver	249.95	175.00
418 DC Supply for Thor 6	159.95	79.98
Allbander Tuner	129.95	64.98
Video Bandscanner	445.00	245.00
Zeus 2-6m Transmitter	745.00	450.00
372 6m Low-pass Filter	14.95	7.48
SWAN	**Reg.**	**NOW***
SW-117B AC Supply for 400.....	$ 85.00	$ 65.00
TRANSCOM	**Reg.**	**NOW***
SBT-3 80-40-20m SSB Xcvr	$299.50	$198.00
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SWAN 250 6m Transceiver	(11.55)	325.00
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Power Supply for Mark II Linear	(8.30)	235.00
117XC AC Supply w/spkr. in cabinet		95.00
14-117 12v DC Supply w/Cable		130.00
405X MARS Oscillator - less crystals		45.00
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210 6 Meter VFO		120.00
VX-1 Plug-in VOX		35.00
SSB-2 Selectable Sideband kit for 350		18.00
22 Dual VFO Adaptor		25.00
100kc Calibrator kit for 350		19.50
500kc Calibrator kit for 250		19.50
RC-2 Mobile Remote Control kit		25.00
45 Swantenna – manual		65.00
55 Swantenna – Remote control		95.00
Custom Contour Bumper Mount		24.95
Kwik-On Antenna Connector		3.25

NOTE: Above are listed the "Standard - Everyday" Swan Products – Below are listed some Special Purpose items:

14X 12v DC Module/cable	$ 65.00
14XP As above, but Positive Ground	70.00
117X Basic 117v AC Supply ONLY	65.00
230X Basic 230v AC Supply ONLY	75.00
117 or 230vac Line Cord (specify)	5.00
8' Cable w/ plug (Supply to Transceiver)	3.00
Cabinet w/Speaker & AC Line Cord	30.00
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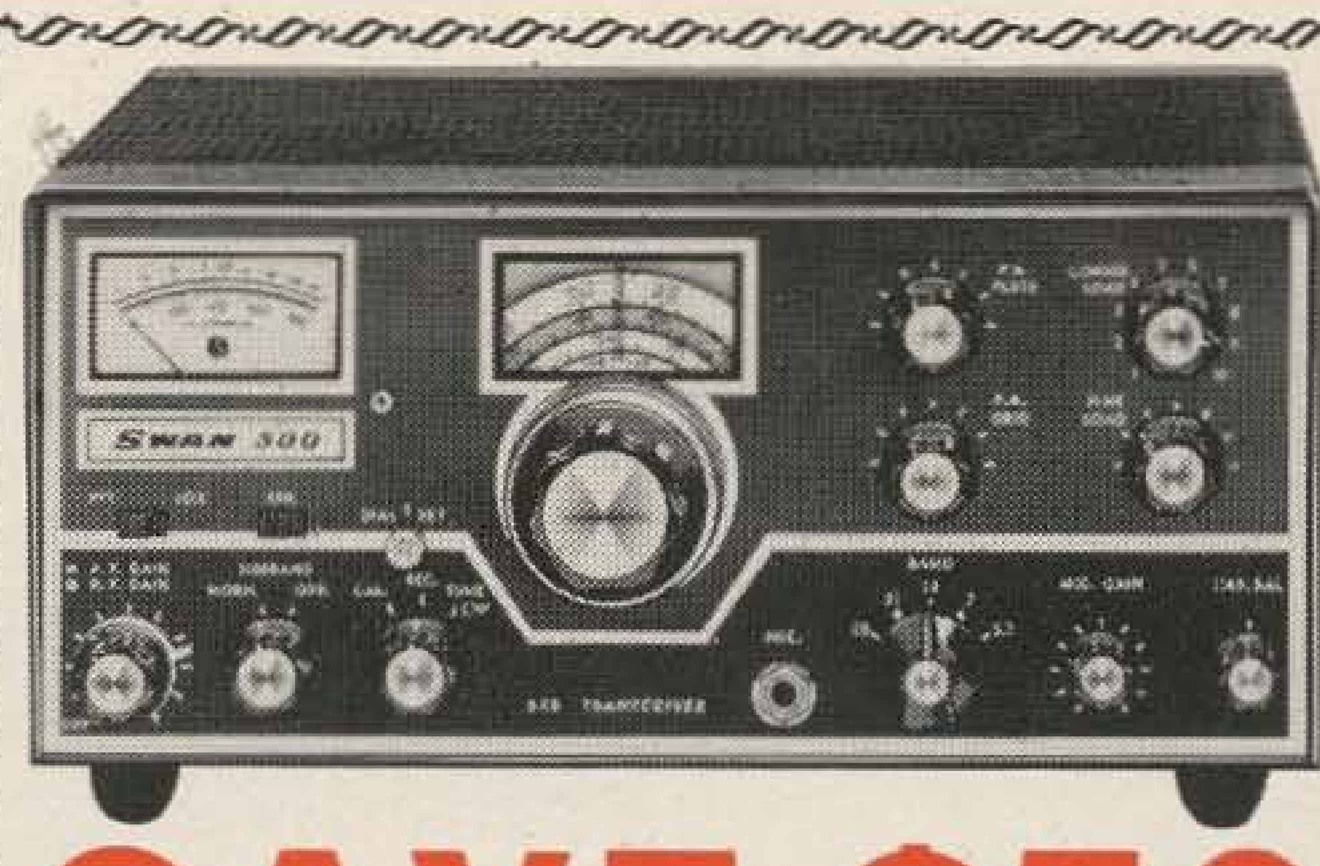

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A Homebrew Operating Desk

Overall view of desk. Top is covered with linoleum, with anodized aluminum trim. The wood is painted cream, with a dark brown door. Complementary knobs and drawer pull from Sears, Roebuck.

I just finished reading Bob Leffert's article, "The Basic Desk", in your magazine. His design is good, and the article well written. I'm sure we all have our pet desk designs, to fit our particular needs. Let me toss in my two cents, for what it's worth, 'cause I've got a desk design too!

Low cost, limited building time, simple, attractive and portability were the goals to achieve. The inclosed photos tell the story of construction, design and finishes.

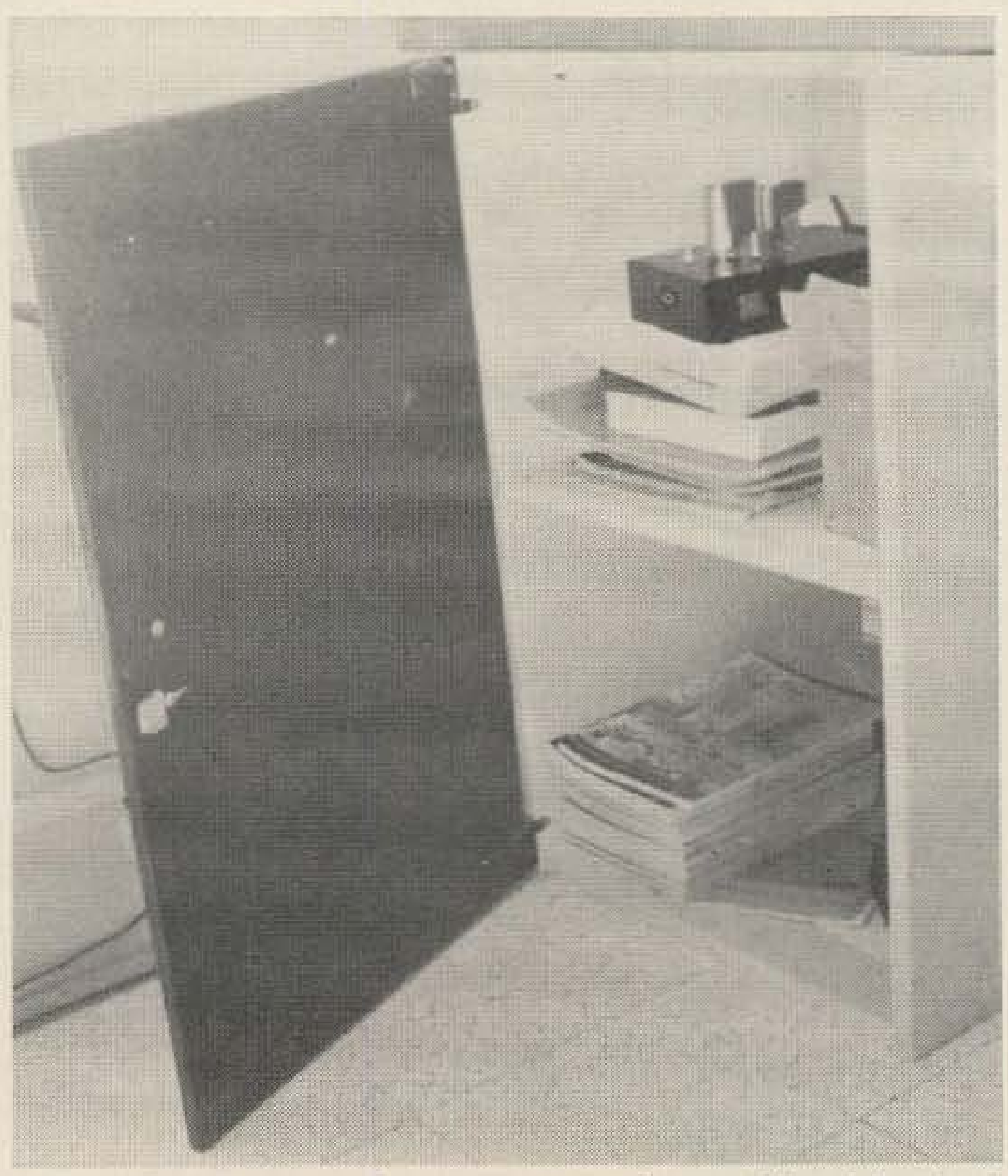
The cabinet built as an accessory to stretch desk top space. The back is ventillated by punching large (1") holes in the masonite. This cabinet is not bolted to the desk in any way, and can be shifted around at will.

Some side comments are in order. The entire affair, including paint, linoleum covering for the top, and aluminum trim around the top, came to just under \$15.00. Time to design, build, finish, and final-assemble at the shack site, took three weeks of evening work; off and on. (I would estimate about 12 hours all together.)

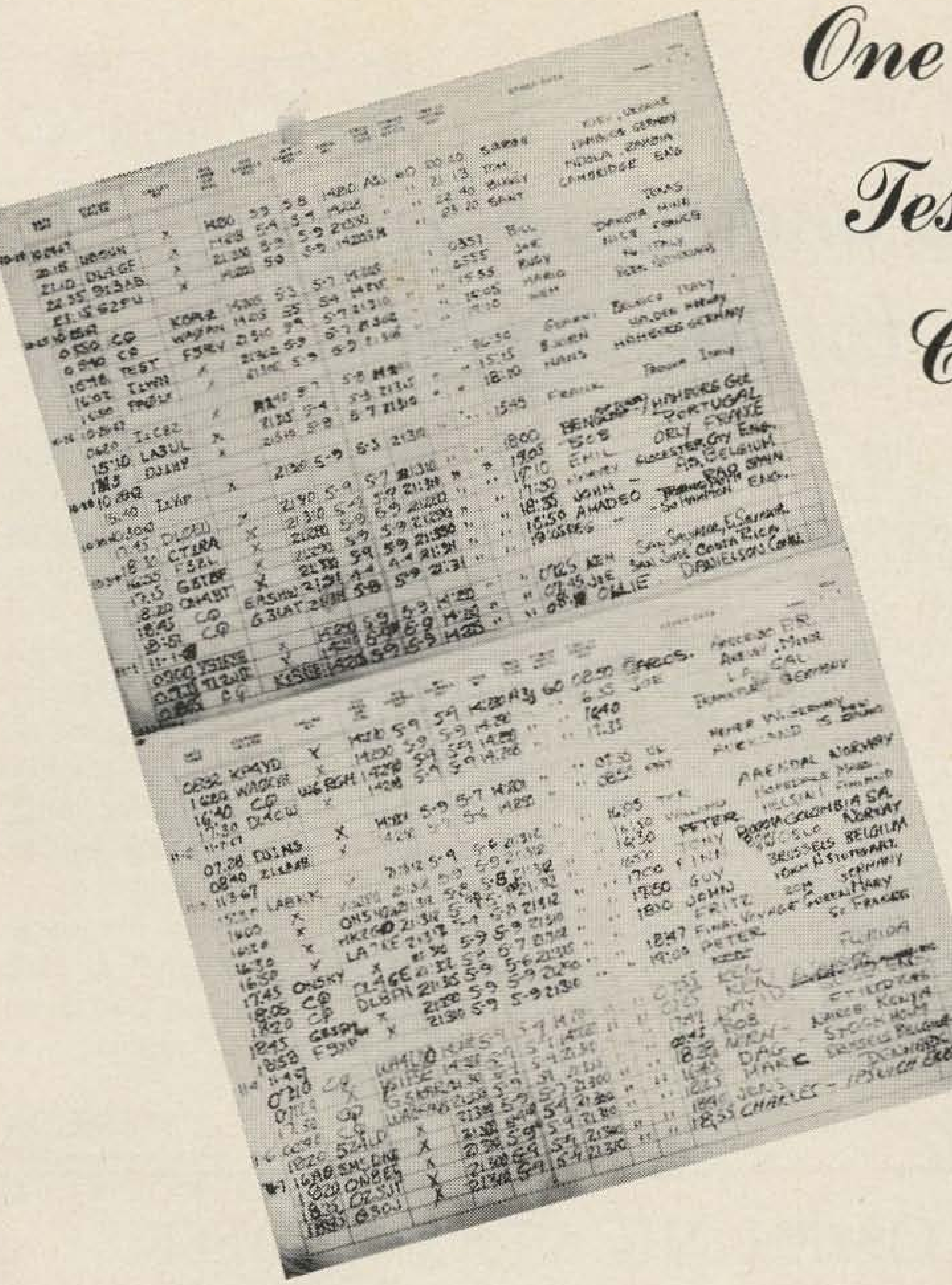
I stretched my desk-top space, as you can see from the photos, by use of a wooden cabinet. The cabinet is not screwed down to the desk, and can be moved or removed at any time. It is a real space saver, and helps group all operating controls in one area. The back of the cabinet is ¼" masonite, drilled out with 1" holes to allow adequate air flow around the receiver.

All the goals stated above were met. I've been sitting at this desk for over a year, with no nagging desires to change the design. Besides, I have a piece of furniture that my wife is not ashamed to show to visitors; to me, the greatest compliment of them all!

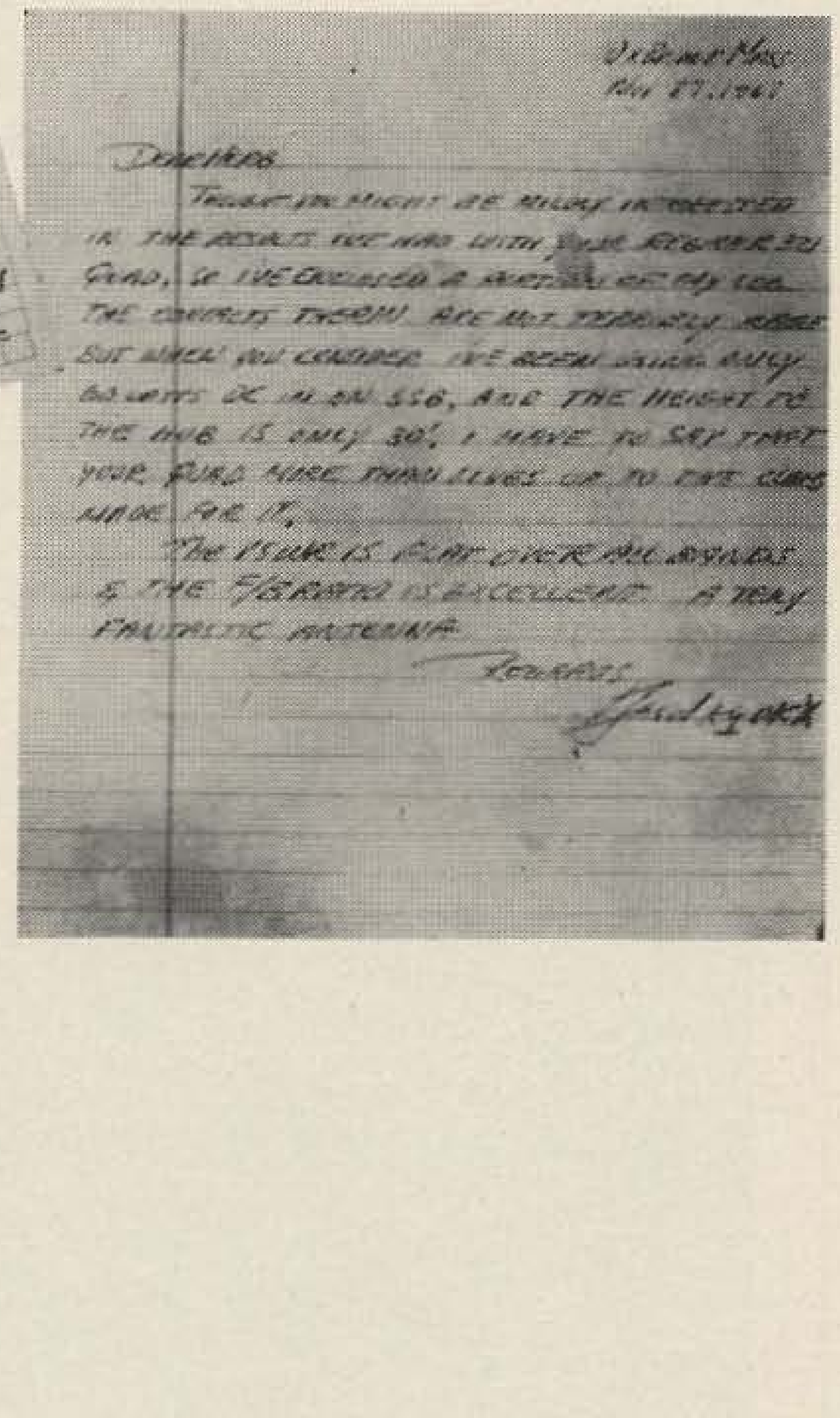
. . . Bud Michaels, WB2WYO
Mendon, N. Y. 14506



The cabinet is made to accomodate 19" wide rack panels, if so desired. Thus, a power supply, or linear could be easily built in. In my case, I have two shelves for odds-n-ends. Door is held in place with "hidden" hinges, and a magnetic latch.



One of Our Many Testimonials Concerning the Reginair Quad



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A Simple and Inexpensive Cavity for Six Meters

Here is a simple capacitively loaded coaxial cavity for use on six meters. It should help reduce TVI caused by harmonics of your crystal oscillator which fall in TV channels. I won't go into the theory of cavities at this time, but will just say that the cavity described here, has been in operation for some time and it works very well. As you can see, the cost is very low, with the coax connectors and trimmer being the most expensive parts.

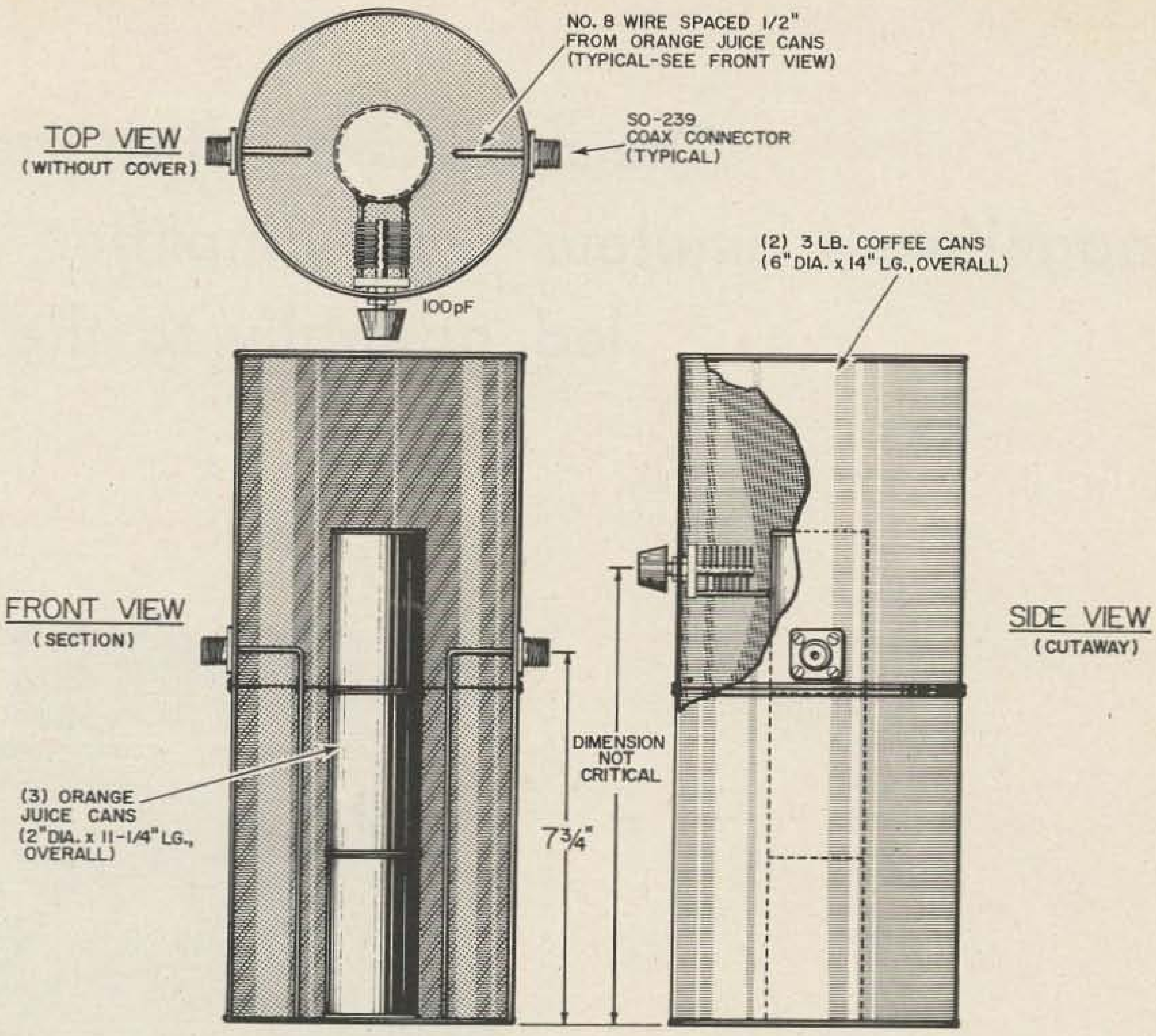
While I'm not a coffee drinker, myself, I was able to scrounge up a couple of empty cans from my neighbors who were more than glad to donate something for a project which would help them enjoy channel 2 again.

All the parts, including the coax connectors, were soldered together so that the entire unit was sealed. Be sure when you get the small cans, that they are steel. Most of the cans are made of aluminum, which makes it difficult to solder. The top and bottom plates were made from flashing copper, but can be of tin or any other fairly rigid material so the inside will not move.

I found that the setting of the capacitor was pretty critical on this particular unit, and had to be reset when moving up or down the band.

If you wish, the entire unit can be made out of copper and then silverplated. It will help, but not enough to warrant the extra time, trouble, or expense . . . unless you like things nice and fancy.

. . . K9SOA



A low-cost cavity for six meters made from two three-pound coffee cans and three orange-juice cans.

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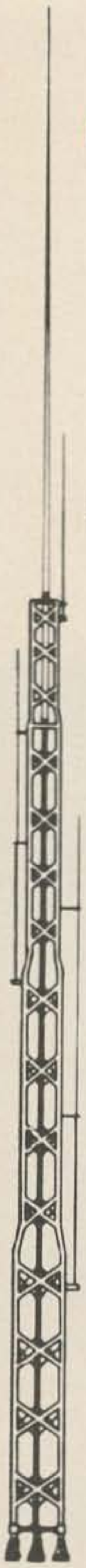

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Assignment of Two Letter Call Signs to Amateur Extra Class Licensees

The FCC has amended the amateur rules, effective November 22, 1967, to provide for the assignment of two letter calls (call signs with a single letter prefix and a two letter suffix) to applicants holding an Amateur Extra Class Operator license and who held any amateur operator license issued by the Commission, or by one of its predecessor agencies, 25 years or more prior to the receipt date of an application for such assignment. This provision is in addition to that which permits the assignment of such calls to previous holders of two letter calls.

Applications for two letter calls may be filed on or after November 22, 1967 as follows:

1. Complete FCC form 610 indicating that the application is for a two letter call.
2. Attach current amateur extra class license (or photo copy thereof) in the space provided.
3. Furnish evidence that an amateur operator license issued by the Commission, or by one of its predecessor agencies, was held 25 years or more prior to the date the application is received by the Commission. Such evidence may be an expired license, the call sign and date such a license was held, if the license is not available; or any evidence of eligibility which can be verified by the Commission.
4. Mail check or money order in the amount of $20.00 payable to the Federal Communications Commission with form 610 to Federal Communications Commission, Gettysburg, Pennsylvania 17325. If modification or renewal is also requested the filing fee is $22.00 or $24.00 respectively.

Requests for specific call signs will not be honored. Present holders of two letter call signs will not be assigned an additional two letter call, and only one two letter call will be assigned to licensees made eligible by this rule amendment. ■

1968 YL/OM Contest

All licensed amateur operators throughout the world are invited to participate in the 1968 YL/OM contest. This is a "fun" contest where the YLs get out in force to let the men get acquainted with them. The contest runs for 24 hours, so it is fairly easy. All bands may be used but a station may be contacted only once during the contest. The phone section of the contest will begin February 24, 1968 at 1800 GMT, and will end February 25 at 1800 GMT. The CW section will start March 9 at 1800 GMT and end March 10 at 1800 GMT.

The procedure is for the men to call "CQ YL" and the gals call "CQ OM". Exchange must include QSO number, signal report, and your ARRL Section, or country if you are not in an ARRL Section.

Scoring

A. Phone and CW contacts will be scored separately. Submit separate logs for each contest.

B. One point is earned for each station worked.

C. Multiply the number of contacts by the number of different ARRL sections (or countries) worked.

D. Contestants running 150 watts input or less at all times during the contest may multiply their final score by 1.25 (low power multiplier). This multiplier applies to SSB stations using less than 300 watts PEP.

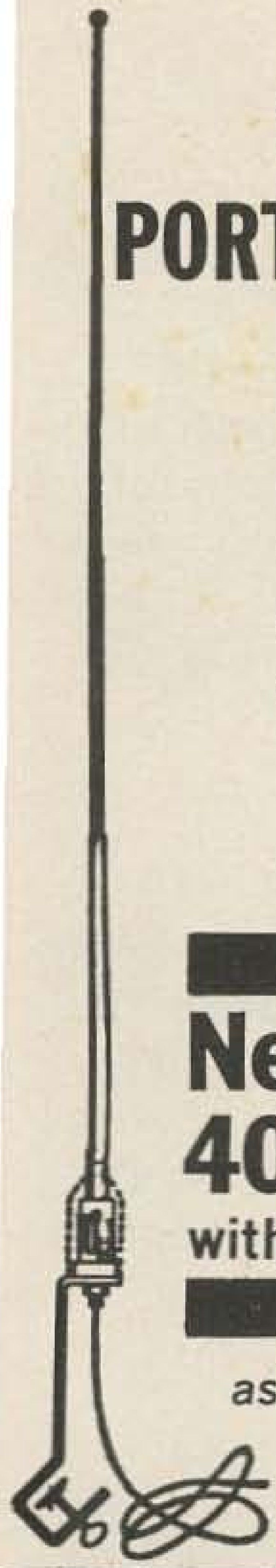
Logs

Copies of all logs, showing claimed scores, and signed by the operator, must be postmarked no later than March 21, 1968 and received no later than April 9, 1968 to be eligible. Send copies of logs to Claire E. Bardon W4TVT, 2238 Morgan Lane, Dunn Loring, Virginia 22027.

A gold cup will be awarded to the first place YL and OM in each contest. The winner of a phone cup is also eligible for the CW cup. Certificates will be awarded to the high score winner from each district of the U.S. and Canada, and to the winner from each country.

No logs will be returned and copies must be legible.

. . . WØHJL



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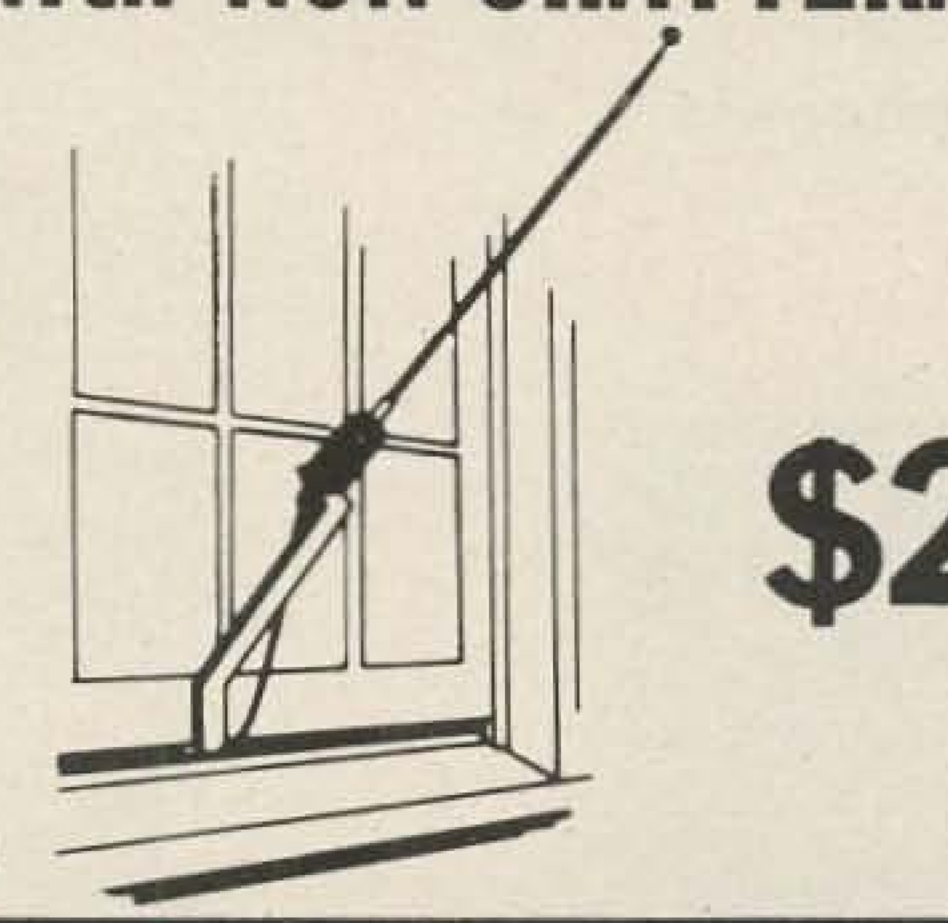

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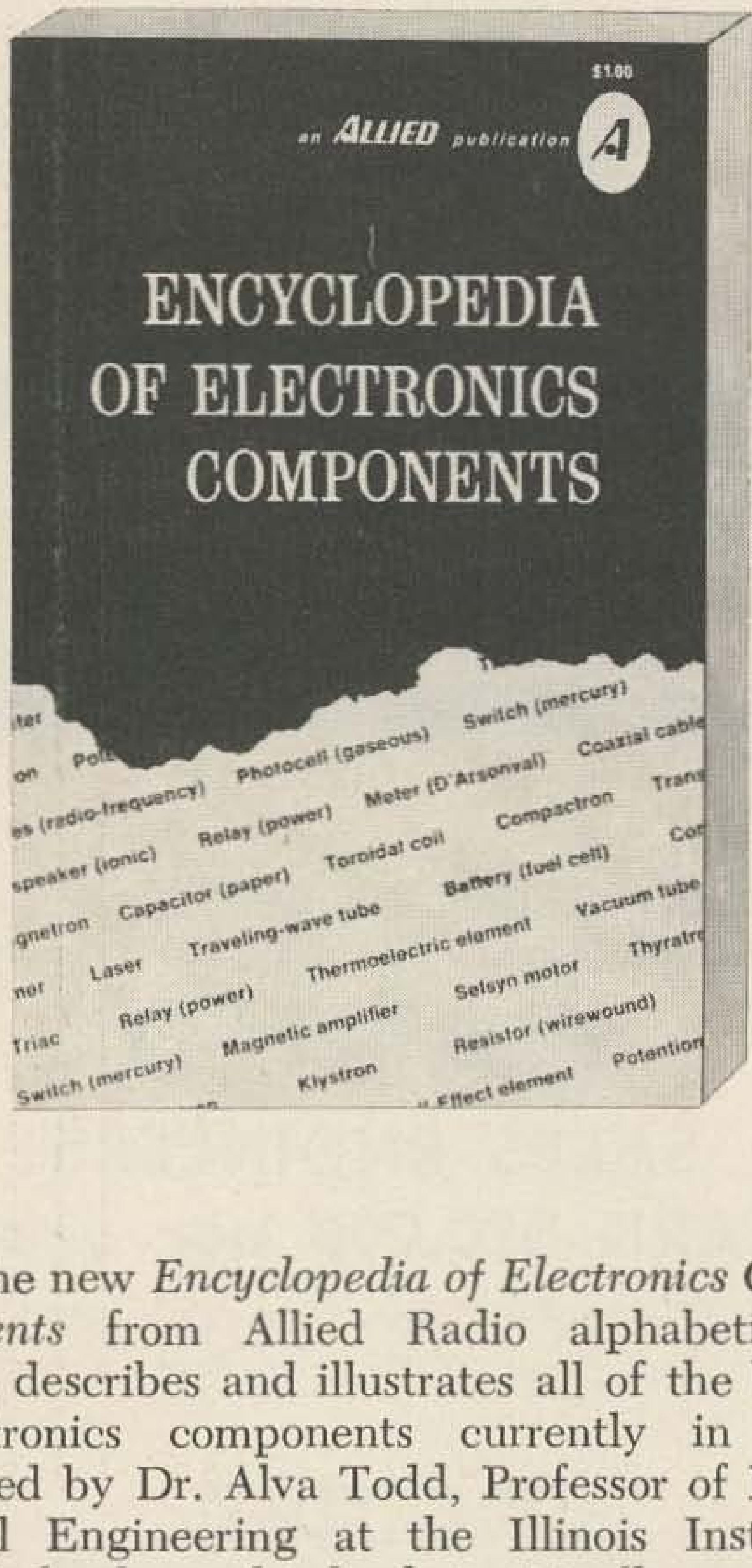
New Books

Encyclopedia of Electronics Components



The new *Encyclopedia of Electronics Components* from Allied Radio alphabetically lists, describes and illustrates all of the basic electronics components currently in use. Edited by Dr. Alva Todd, Professor of Electrical Engineering at the Illinois Institute of Technology, this book is virtually an electronic text that provides an understanding of the individual units used in electronics devices and systems in one reading.

The material is put together in a very readable form, and the descriptions are in non-technical language. Each components is clearly identified, its use is carefully explained and any special handling or installation requirements are carefully covered. All in all, it is a handy reference for anyone in electronics, even the old time ham; it is of particular interest to students, novices and experimenters. $1.00 postpaid in the U.S.A. from the Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

New Books From Sams

ABC's of Vacuum Tubes, by Donald A. Smith, is an introductory book presenting the basic understanding of vacuum-tube theory. No study of electronics and modern circuitry is complete without a good understanding of the electron tube. Catalog No. 20576 List Price $2.25.

Walkie-Talkie Handbook, by Leo G. Sands, describes the various types of walkie-talkies now on the market—including both licensed and unlicensed types. It covers the circuitry, accessories, specifications, maintenance and the licensing required. In addition it covers Part 95 of FCC Rules and Regulations covering the Citizen's Band. Catalog No. 20572 List Price $3.95.

Lasers and Masers, by Charles A. Pike, describes the basic operating principles underlying all lasers and masers. Questions and answers are included at the end of each topic to assist in study and review. Catalog No. 20559 List Price $495.

Servicing Closed-Circuit Television, by Melvin Whitmer, introduces the technician to the operation and maintenance of closed-circuit TV systems. It gives a large amount of service information previously available only from TV manufacturers. Catalog No. 20574 List Price $4.25.

Controlled Guidance Systems, by Hal Hellman, is a new programmed text covering the fundamentals of guidance systems. It encompasses such areas as ballistic trajectory, hyperbolic guidance, motion, translation, proportional navigation, and construction of various systems. Catalog No. 20573 List Price $4.95.

ABC'S of Hi-Fi and Stereo, by Hans Fantel, presents that needed information in an informal, non-technical manner in this revised edition of an old favorite. It discusses in detail the requirements of amplifiers, turntables, tone arms, cartridges, tuners, speakers, and tape recorders. Catalog No. 20539 List Price $2.25.

CB Radio Antennas, by Dave Hicks, points out the vital necessity for a good antenna system in CB due to the power restrictions. Included are discussions on the characteristics of radio waves and how they affect the design of an antenna, what communicating ranges to expect, base and mobile installations, methods of improving present systems, and maintenance. Catalog No. 20567 List Price $3.25.

Measuring Hi-Fi- Amplifiers, by Mannie Horowitz. Both vacuum tube and transistor amplifiers are covered extensively. It discusses in detail the checking of frequency response, harmonic and inter-modulation distortion, sensitivity and overload, measuring and matching phono, tape playback, and microphone equalization curves. Catalog No. 20561 List Price $3.25.

Tape Recording for the Hobbyist, by Art Zuckerman, tells not only what you can do with a tape recorder, but how to do it. While dealing mainly with tape recordings as a hobby, this book gives many ideas for more serious uses of recorders in the home and office. It covers special sound effects, candid recordings, party tricks, "detective type" work, and also describes home video tape recording methods. Catalog No. 20583 List Price $3.25.

A new *ABC Beginners Library* series of technical books has been introduced by Howard W. Sams & Co., Inc.

Each 5-book set is a complete library for students and beginners in one of three popular areas of electronics: Electricity/electronics, Computers and Semiconductors, and Communications.

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Titles in *ABC's of Computers & Semiconductors* 20578, are:

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Titles available in ABC's of Communications 20579 are:

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Each 5-book set is packaged in a handsome slipcase and retails at $9.95 a set, a considerable savings over the individual book prices.

Look for these Sams books at your electronics distributor, or write directly to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

New Books From Editors and Engineers, Ltd.

Ten new Skilfact electronics books have just been released which provide useful information for anyone interested in learning about the many facets of the rapidly expanding field of electronics. These 96 page paperbacks sell for $1.00 each.

Introduction to Basic Electronics, by Louis M. Dezettel, explains the fundamental concepts of electronics from the structure of matter to the action of electrons. It also provides a basic understanding of the vacuum tube, transistor, and other components showing how they are used in electronics work.

Fundamentals of Transistors, by Louis M. Dezettel, can be useful in the repair of home electronic equipment. This book presents a simplified explanation of transistors that may be understood without more than a basic knowledge of general electronics.

Basic Electronics Circuits, by Farl J. Walters, explains the theory; operation, and primary application of the basic electronic circuits. This book tends to take the reader a step further into the world of electronics and to serve as a review and reference for readers with more experience.

Electricity/Electronics Science Projects, by Edward M. Noll, teaches the reader about electricity, electrical current, and what comprises an electrical or electronic circuit. Both ac and dc electricity are covered and their operations demonstrated. Practical skills are developed in assembling and testing by constructing various experimental units.

Television: How it Works, by Len Buckwalter, presents a general view of the basic function of television systems—how they convert light and sound into electrical signals, transmit them through the air, and convert them back into light again.

Electric Motors and Generators, by Allan Lytel, is a basic introduction to motors and generators. The book explains what they are, how they operate, and what they can be expected to accomplish. Included are simplified explanations of the various types of motors and generators. This book is a good guide for either the technician or the layman.

Computer Programming Fundamentals, by Lawrence Buckmaster and Allan Lytel is ideal for anyone interested in understanding computer programming as a field of employment or wishes to have a handy source of reference for general information.

Picture Guide to TV Troubles, by the technical staff of Editors and Engineers, is an easy, methodical guide to the repair of television receivers. This book explains through the use of tube displays, how a fault can be readily isolated and corrected.

Easy To Build Ham Radio Projects, by Charles Caringella W6NJV, is an exciting book for ham radio enthusiasts and contains construction projects for the beginner as well as the advanced amateur.

Electronic Test Equipment, by Louis M. Dezettel, is written for the technician, the experimenter in electronics, or the man who likes to build his own electronic circuits both for fun and to expand his knowledge of the science. He introduces the basic test and measuring equipment needed for fundamental circuit exploration.

All of the above books are available from Editors and Engineers, Ltd., Post Office Box 68003, New Augusta, Indiana 46268.

73 on Microfilm

Interested in looking back through the previous issues of 73 *Magazine*? How about those scarce issues that are no longer available? If you want to keep a permanent record of outstand amateur radio articles, the answer is in the new microfilm edition of 73 which will be available shortly. Write to University Microfilms, Inc., 300 North Zeeb Road, Ann Arbor, Michigan 48106 for further information.

What's New for You?

Have you found a simple new circuit, or new semiconductor or other component, that has been useful in your building? There are plenty of hams who would like to find out about it. Why not send in a short note for this column and we'll publicize it and make it available to all the other experimenters who read 73. We're also looking for technical comments on 73 articles—corrections, modifications, or compliments—and newly available surplus, technical nets and meetings, new records and other information that's likely to be interesting to the technically-minded ham. Please keep the comments short, and send them soon before someone beats you. Send to Paul Franson WA1CCH, "What's New for You?", c/o *73 Magazine,* Peterborough, N. H. 03458.

Where Do You Get an EL229?

In Frank Jones' (W6AJF) article in January on improving his transistor converters, he mentions an excellent Motorola transistor, the EL229. Edward Randall now tells us that this transistor is available from Motorola distributors as the MPS6542 for about $1.20. This transistor is in a plastic case. Edward also suggests some possible replacement titles for *What's New?*: Scatter Patter, Ham Hot Line, Ama News, Techni-Notes, Ethofone (?) and Tek Tock.

70 cm Surplus Coming?

Kent Mitchell, W3WTO, sent a note he clipped from the USAF Communications-Electronics Doctrine Newsletter, stating that the SCR-718 radio altimeter, which operates in the 420-460 MHz range, will be prohibited from use in the U.S. after February 15, 1968. Perhaps these units will start appearing in surplus in not too long.

More Gain for the SB-100?

In the May *What's New,* there appeared a note suggesting that changing the value of a resistor in the SB-100 increases the gain of the unit. At least two readers K2RDM and WNØRAC checked this with the Heath Company about this modifioation, and Heath doesn't recommend it. Here's a quotation from their letter to WNØRAC: We do not recommend the change of resistor R221 from 470 ohms to 47 ohms. The reason for this being that this is a load in isolation resistor for the LMO. It is true that the reduction of resistance increases the injection voltage to the various mixer stages. However, a side problem that does occur occasionally is the shift between transmit and receive frequencies of the LMO. The actual frequency shift in some cases has been measured to be as much as one kilocycle. However, in many other cases it does not shift at all. Thus you will have to check on your own to verify whether or not the condition is apparent.

The Great Dipper

In the schematic of WAØAYP's "Great Dipper" in the August issue, the 1 k emitter resistor to the 2N2398/2N918 oscillator stage should be returned to the nine-volt supply, *not* to the junction of the 39k resistor and .02 μF capacitor. The pictorial diagram is ok. Thanks go to WB2UMH for finding this one.

$2.00 200-watt Dummy Load

The author of the 200-watt dummy load article in the May issue, W2OLU, wrote in to tell us that he had been informed by one of our Australian readers that the resistors used in the load were capable of a short-time overload (5 seconds maximum) of ten times their rated wattage. The Australian should know what he's talking about since he's a sales engineer for Corning Glass, manufacturer of the resistors. The short-time overload will only result in a permanent resistance change of 1% or less. The CGW resistors are made of Pyrex glass, and coated with tin oxide at red heat. Maximum "hot spot" temperature is 235 degrees Centigrade (about 450° F). With this information at hand, some enterprising ham will no doubt try to run 1 kW, ICAS, to the thing!

New GE Consumer IC's

General Electric has introduced three new inexpensive, plastic-cased linear integrated circuits designed for consumer use. They follow GE's 1-watt audio amplifier, the PA222, which was mentioned in this column a few months ago. The new IC's are the PA237, a 2-W audio amplifier (about $4), the PA189 70-dB gain amplifier-discriminator for the sound channel of TV sets or for FM receivers, and the PA230 general-purpose low-level audio amplifier. All come in small flat plastic packs.

$1 Phototransistor with Built-In Lens

Photocells and other light-sensitive devices aren't used much in ham equipment. Nevertheless, those of us who like to build and experiment are often interested in many of the gadgets that can be built with photocells: automatic lights, burglar alarms, TV commercial quieters, and many more. General Electric has recently introduced a new economy phototransistor (L14B) packaged in a clear epoxy case. The case is curved and acts as a lens, eliminating the expensive optics required for many photocell applications. This phototransistor can also be used as a standard photocell by ignoring one lead. This brings to mind the old trick of making your own phototransistor by cutting off the top of a metal-cased transistor. Unfortunately, this often leads to contamination, so the devices made in this way are often unreliable. A power transistor is best for this use.

The Ancient Marriner

Fig. 1. in the article on the Ancient Marriner (page 54, February issue) is correct. However, there is a reference to 6250 pF in the text, but this is a typographical error. Thanks to the Not-So-Ancient Marriner, W6BLZ.

Repairs to the Clegg 99er

After a few years of use, the vernier tuning shaft of the Clegg 99er tends to deteriorate. Factory replacement is expensive so I began looking for a less costly way to replace this part. I took a Lafayette tuning capacitor No. 32-C-0917 at $1.50 and a No. 32-C-0928 knob at 35c and made the replacement. The dial calibration comes out just about right with a little touching up of the dial calibration slug and one is right on frequency.

. . . Jim Hysan W1VYB

Silver Plating

If you are interested in silver plating that VHF tank circuit, or high-frequency linear amplifier tank coil, you should look into the silver-plating powder available from The Cool-Amp Company. Although this material has been mentioned a number of times in the past, we still get requests for their address.

This material comes in powder form and is very easy to use. All you have to do polish the item to be plated with a sharp steel wire brush or abrasive cloth, wipe clean and rub on the Cool-Amp silver-plating powder with a damp cloth. Then rinse the item thoroughly with clean water and wipe dry with a clean cloth. Presto—beautiful silver plate. A quarter pound of material costs $4.50, but this will do an awful lot of plating. Order from Cool-Amp Company, 8603 S.W. 17th Avenue, Portland, Oregon 97219.

Inexpensive Zener Diodes

If you're looking for an excellent, low-cost zener diode, you should investigate the new 1-watt zeners made by Schauer. These tiny (½-watt-resistor size) plastic-cased zeners sell for only 43¢ apiece in single quantity (20% tolerance). The 10% zeners are 50¢ and the 5% ones are 67¢. They are available in voltages from 2.4 to 16 volts, with type numbers SZ2.4 to SZ16.0. The minimum order from the factory (Schauer Manufacturing Company, 4500 Alpine Avenue, Cincinnati, Ohio 45242) is $10, but they'd be happy to send you more information and a list of distributors free.

Collins Switching Unit

It appears that part of the plugs in the diagram of W6EUV's article on page 82 of the July issue were mislabeled. Here are the corrections from W6EUV: "J2 as shown in the diagram should read J1 and J1 should read J2. The VFO Input label of J2 should be changed to VFO output."

. . . WA1CCH

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Novice Data

If you are thinking about getting the Novice license, or if you already have it, W6DDB has some excellent words of advice. Bill has taught hundreds of amateur licensing classes, so he knows what he's talking about.

This article provides helpful tips to those who are presently operating as Novices, and it will make things easier for those who are about to start their Novice operation. The author has helped thousands of people obtain their Novice, Technician, and General class tickets and has spent a lot of time helping students select their station equipment and get it set up. Despite the fact that each Novice believes his problems are unique, most problems are common and they can be avoided or overcome if the reader heeds the advice provided. This article is separated into three parts; (1) setting up the station, (2) operating the station, and (3) getting the General ticket.

Setting up the station

General

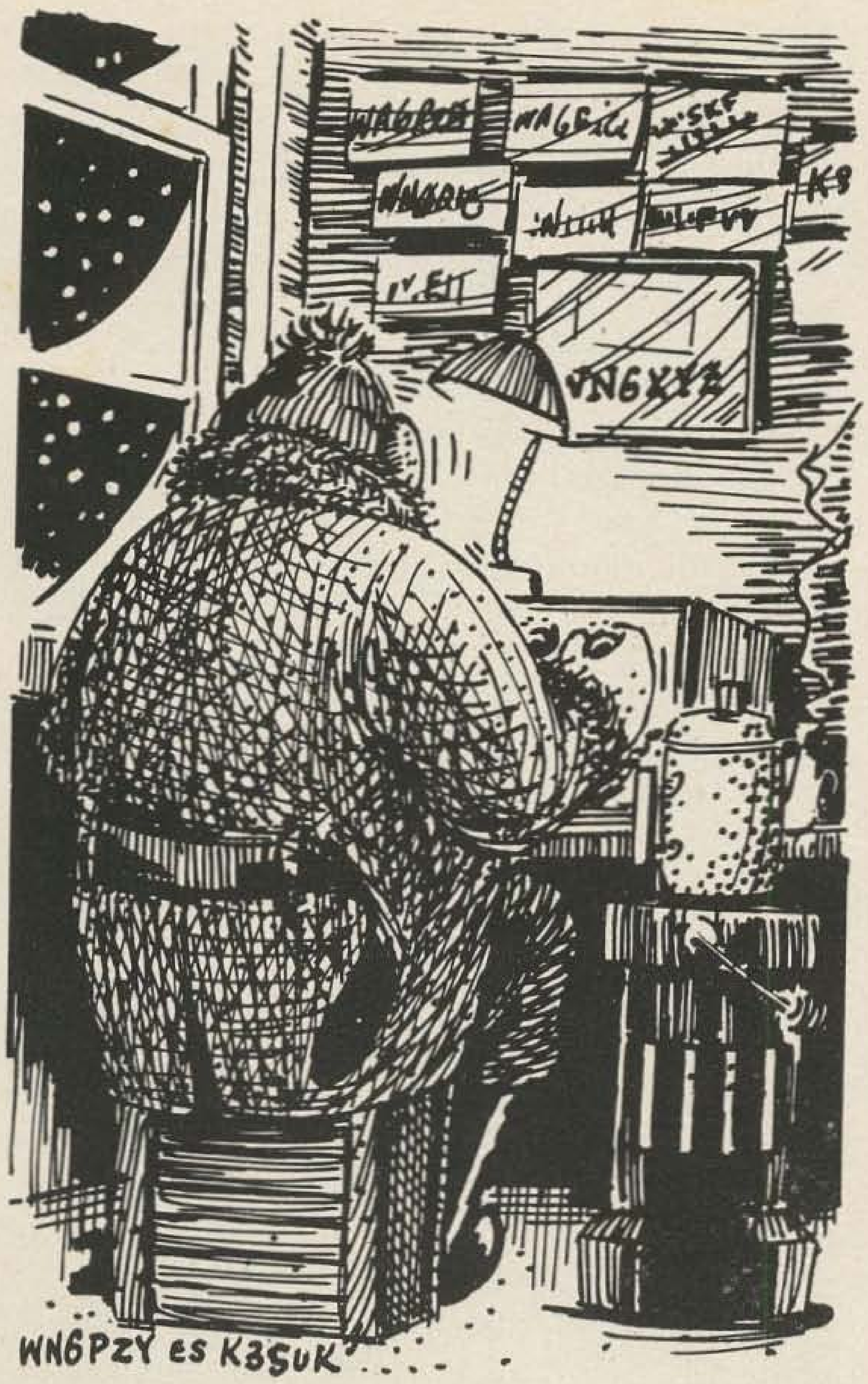
Location. Don't set up your station in a garage, cellar, or any other damp area. Long periods of relative inactivity, while exposed to cold or dampness, will eventually cause illness. Set up a neat station at some comfortable location in the heated/cooled portion of your home; there's no reason why a ham station should be so messy that it is not acceptable in the house.

AC power. It is best to power your station from a separate ac power line which you can fuse and control independently. If this is not readily accomplished, it is easy to install a fused ac strip connector on the rear of your operating table with its own on-off switch and indicator light. You will probably find it necessary to install noise filters to keep household electrical interference (from can openers, hair dryers, vacuum cleaners, etc.) out of your equipment.

Lighting. Don't install fluorescent lighting at your station because it will introduce a bothersome noise source which you should avoid.

Safety. Make sure there is no way children (or inquisitive adults) can come in contact with exposed voltages external to your equipment; make your station completely safe. The most common danger is exposed 115 Vac terminals on antenna change-over relays; tape over these terminals.

Antenna change-over. Make sure you set up your station for single-switch change-over between transmitting and receiving, including antenna change-over and receiver muting. There's no sense in having to throw two or more switches (plus adjusting receiver gain controls) each time one changes back and forth between transmit and receive.



Set up a neat station at some comfortable location in the heated/cooled portion of your home. Not in the garage or cellar.

Building. Don't use any of your Novice license term building ham gear. Building and experimentation are fascinating parts of ham radio but the Novice license term rushes by too quickly to permit one to do anything but operate and study to prepare for the General exam. If you plan to build any part of your Novice station, have it built and smoke-tested before you even pass your Novice 'written' exam. There's plenty of time to enjoy building and experimenting after you get your General ticket. Have your Novice station set up and ready to operate before your license arrives in the mail.

Used and new gear. Used equipment provides the best possible station at the lowest cost. An initial Novice station usually costs \$150 to \$750, complete. Don't make the mistake of assuming that all radio distributors recondition or check out used equipment before reselling it; sad experiences have taught us that most of them give used gear little more than a superficial inspection before putting it up for resale. If possible, purchase your used gear from a fellow ham, particularly if you are in a radio club. It is okay to listen to the advice of long-licensed hams in regard to what equipment is good for an initial station, but bear in mind that it is natural for them to recommend receivers and transmitters which performed well for them—and that may have been 10 to 50 years ago! Remember that such equipment is usually quite old and a lot of it has been superseded by units which are lighter, smaller, and more efficient on today's crowded Novice bands.

Receivers

Cost. Once you have determined the total amount you are going to spend on your initial station, set aside about two-thirds of the amount for the purchase of the best used receiver you can locate. Don't buy a junk or inadequate receiver with the intention of fixing it up; get the best unit you can find. A good used communication receiver costs from \$100 to \$250.

Selectivity. Selectivity is the receiver's ability to separate two or more stations when they are nearly on the same frequency; several receivers combine excellent selectivity with built-in adjustable rejection which lets you drop an unwanted strong interfering signal down below the level of a desired weaker signal. Check out selectivity and notch rejection on a crowded band.

Sensitivity. Sensitivity is the receiver's ability to detect weak signals and to produce usable audio output levels from them. Almost all receivers seem quite sensitive on the lower bands, so check the sensitivity on the higher bands (particularly 15 meters).

Electrical stability. If a receiver has good electrical stability, there will be very little frequency drift as it warms up. A simple check is to tune in a frequency standard station (such as WWV, on 2.5, 5, or 10 MHz) as soon as you turn on a cold receiver; after the receiver has run 5 minutes, check how much dial correction is needed from the original setting. Repeat the 5-minute checks until the receiver shows no detectable drift.

Mechanical stability. If a receiver has good mechanical stability, you can tune to a stable signal (such as WWV) and touch the front panel controls (as necessary) without having the frequency change until you actually adjust the frequency or BFO control. Make this check after the receiver has warmed up and has reached electrical stability. A quick check can be run by just flicking your fingernail against various parts of the receiver's cabinet and control panel with the receiver set for maximum selectivity and tuned to a stable signal.

Crystal calibrator. A crystal calibrator in your receiver provides an inexpensive way to meet the FCC's requirement for a frequency measurement device of laboratory standard accuracy which is independent of one's transmitter frequency control. Most of the better receivers now include a 100-kHz crystal calibrator which you will find is worth its weight in gold.

Transmitters

CW-only rig. Purchase a transmitter which you plan to use just until you get your General ticket. There's no sense in purchasing big rigs which include high power, modulators, VFO's, and other goodies which will be useless to you on the Novice bands. The medium and high power AM/CW transmitters are a drag on the present market and they command very little resale value. Select a code-only 50 to 75 watt input rig for use in your Novice station; make sure it covers the 80, 40, and 15 meter Novice bands. Typical popular Novice transmitters include the Eico 720, WRL Globe Chief, and Johnson Adventurer.

Make your station completely safe. Tape over any exposed leads.

Crystals. There is no need to purchase a lot of crystals for each Novice band because a few rocks will cover each band very well. Typical popular trios of crystals for the 80, 40, and 15 meter Novice bands are: 3705, 3720, and 3735 kHz; 7160, 7175, and 7190 kHz; and 7036, 7043, and 7050 kHz (for tripling to 21.108, 21,129, and 21,150 kHz). Crystals within 2 kHz of the stated frequencies would be satisfactory; there's no reason to buy rocks exactly on the suggested frequencies.

Dummy loads. Don't assume that light bulb (and similar) transmitter loads don't radiate; they have been heard for more than a thousand miles. When you have your station hooked up and ready for a final checkout, don't test your rig into a dummy load or antenna before your ticket arrives; have a licensed friend check the rig out for you using his own call portable from your location. Make sure your station includes a good dummy load for test purposes; actual on-the-air testing should be minimized.

Transceivers

Novice requirements. It is a sad fact that there is very little equipment on the market which is specifically designed for Novices. Novices continue to be a prime market for radio equipment but most manufacturers have failed to produce the gear Novices need. A natural market for a top-quality transceiver is the Novice but none of the present units do the job completely; a Novice transceiver should include the following built-in features:

Excellent sensitivity, selectivity, stability, and rejection capability in the receiver.

WWV coverage on 5 MHz.

100-kHz and 10-kHz crystal calibrators

Code monitor/oscillator

Antenna coupler and VSWR meter

If possible, erect an antenna for each band you use and place them as high and clear of objects as possible.

Transmit-receive relay

Grid-block, break-in keying

75-watt, crystal-controlled, Novice-band-only transmitter covering 3.7-3.75, 7.15-7.2, and 21.1-21.25 MHz

Three internal crystal sockets for each band, with front-panel selection plus write-on material to permit each frequency to be pencilled on the front panel at the switch.

Low-pass filter in output, plus adequate filtering of AC and keying leads.

Switch-selectable metering which permits the final amplifier's input voltage and current (power) to be read directly; no idiot-type output meters.

Separate low- and high-voltage fuses and indicator lights, plus separate fusing of the final amplifier high voltage line.

Heavy-duty ground post.

No VFO, modulator, linear amplifier, or other accessories (or built-in units) which are not used by Novices.

Transmitter, receiver, power supply, antenna relay, etc. all in one stylish cabinet; no outboard accessories.

24-hour numechron-type clock with 10-minute warning buzzer.

All front panel controls tilted up to be directly in line with the operator's line of vision.

Excellent detailed manual which enables a Novice to completely understand how the unit works in addition to the setup, operation, adjustment, and repair procedures.

Antennas

Monoband. If possible, erect an antenna for each band and place each one where it is as high as possible and clear of surrounding objects, including the other antennas. If parts of antennas must come in close proximity to each other, try to have them at right angles to each other to minimize interference between them. Try to avoid having a leg of your antenna fold back on itself but (short of that), don't worry about it if your antenna runs all kinds of crazy angles.

Marconi and Hertz antennas. The quarter-wave (Marconi) and the half-wave (Hertz) antennas are particularly popular on 80 and 40 meters because they require very little 'flat top' space, since their 'feedline' and their 'flat top' are both part of the resonant antenna lengths. In addition, Marconi and Hertz antennas have no transmission lines and, hence, no transmission line losses. Both of these atennas require an excellent rf ground attached to the transmitter or more rf power can dissipate between the transmitter and ground than is radiated by the antenna.

Inverted Vee. The modified inverted Vee antenna is very popular on the 40-meter band. This antenna just requires that the center portion of the dipole be elevated as high as possible; the ends can be attached to lower points which are easily accessible. Most hams cut the legs a bit long and check the SWR each time as they trim the ends back evenly; careful pruning can produce an antenna which is resonant smack in the middle of the Novice band.

15 meters. Due to its more convenient (shorter) length, the 15-meter antenna presents fewer problems. If you can do it, you would do well to erect a rotatable directive antenna (quad or beam) to provide the best possible results on this excellent band. There have been cases where Novices have worked more than 100 foreign countries on 15 meters; this is unusual, but it is common for a Novice to work 30 to 45 states and 15 to 40 countries on this band.

Harmonic and trap. The harmonic/trap antenna is more efficient than the extremely short mobile antennas, but they are not as good as individual full-length antennas for each band. If you plan to use a harmonic antenna, understand that you must be extremely careful to minimize the harmonic output from your transmitter because the antenna will accept and radiate any harmonic energy it receives.

Verticals. The verticals (including ground planes) offer low-band operation in a minimum of horizontal (flat-top) space. The ground plane offers low angle of radiation with respectable DX results. The verticals are quite susceptible to ignition interference, though, and proximity to heavy traffic can give one severe problems. Remember that the multiband vertical is not as efficient as a singleband vertical and it does present the danger of freely radiating harmonic output from a transmitter.

Mobile whips. Don't waste your time searching for a miracle antenna which will mount on your windowsill and provide efficient operation on all bands. No shortened antenna radiates your transmitters's output as efficiently as a fullsized antenna. To emphasize the inadequacy of mobile antennas and why you should avoid using them (except mobile), a check of a popular mobile antenna provided the following results on the 80-meter band:

Ohmic (loss) resistance	3.0 ohms
Radiation (useful) resistance	0.2 ohms
Efficiency	6%

To make you realize just how unacceptable this is, understand that you'd be tickling the ether with just 3.72 watts of radiated rf power if you ran a full Novice gallon (75 watts input) and fed 62 watts to this mobile antenna from an efficient transmitter. Despite their high cost, mobile and special portable antennas usually don't even equal the performance of a random length of long wire located as high and clear as possible and used in conjunction with an antenna tuner.

Tuners. Simply stated, the antenna tuner adds inductance in series with short antennas to increase their electrical length or adds capacitance in series with long antennas to decrease their electrical length. One of the best long-term investments you can make is to purchase an antenna tuner with a built-in SWR meter. The antenna tuner has become a necessity with most modern transmitters because the manufacturers are leaving the antenna matching circuitry out of their units and hams haven't sense enough to raise a fuss.

Material. As a general rule of thumb, use good insulators and the best possible materials when building antennas. Avoid the plentiful power line type of brown insulators; they are relatively lossy at the frequencies you'll be expecting your antennas to operate on. The copperweld type of conductor has a steel center with assures a constant antenna length and a copper outer coating which assures good radiation characteristics; this is a preferred type of antenna conductor which will allow you to build an antenna which will not lengthen out to lower resonant frequencies as it is buffeted by wind storms.

Feedlines. Select and use the best possible feedlines. 75-ohm twinlead and RG-58/U coax are so lossy that they should never be used, even at the lowest frequencies. Old-fashioned open-wire feedline is excellent, as is RG-8/U coax. Transmission line length is not critical unless the line is radiating energy, which it should not do. The function of the transmission line is to transfer the rf output from your transmitter to the antenna input. Think twice about purchasing any antenna which has a stated critical transmission line length.

SWR. Don't strive for perfection in getting your SWR down on each band. It is good to keep the SWR low because it is obvious that we want our transmitter's output to be accepted by the anenna and usefully radiated into space, rather than to be reflected back towards the transmitter. Nevertheless, you can live with a bit of reflected power and you should not be concerned once you get the SWR below 2.5:1.

Grounds

General. You must establish an excellent dc/rf/ac ground if your station is to be operated safely and efficiently. There is nothing which is more important to one's station despite the fact that many hams stumble along with inadequate grounding. Eight years service on a TVI committee provided plenty of proof that hams are not careful enough in establishing dependable grounds. Don't assume that a wire connected between your transmitter and a ground rod, ac conduit, water pipe, or radiator provides an adequate ground at all frequencies. Ground rods are ineffective when they are driven into a non-conductive material such as sand. An ac conduit which is satisfactory at 60-Hertz housepower can offer several thousand ohms impedance at the radio frequencies you'll be trying to ground. Water pipes are often made of materials which are poor rf conductors; even when good rf conductors are used for piping, they are usually insulated from each other by sealing compound, dirt, and oxide between pipe sections and couplings. Pure water is an insulator, so the better your water supply the lousier your ground will be when you depend on conduction through the water in your pipes. Steam lines and radiators are usually inadequate grounds due to the use of poor rf conducting materials and poor electrical continuity between sections of the system.

Need. Remember that a good ground is vital to the efficient and safe operation of your station. If you are using Marconi and Hertz antennas, you can easily have thousands of ohms impedance between your transmitter's chassis and actual ground, which will cause you tremendous loss in the amount of rf output power you usefully radiate. In addition, all your equipment bypassing and shielding is tied to the chassis which must be connected to a good external ground if they are to be most effective. Don't underestimate the importance of a good ground system and make sure all of your station equipment is tied to a common ground system. It is best to attach your main ground line directly to your transmitter's ground post and then to connect ground lines to your other equipment from that point.

Water pipes. If you find it necessary to depend on your water line for a ground, make sure you make excellent mechanical and electrical connections to the ground point. Coat the connection with white petroleum vaseline (preferably mixed with a

Operate; don't do any building until you get your General Ticket.

little Molykote) and you'll have an excellent electrical contact which will not become oxidized and ruined. You must take care to clean your connection point down to bare metal and to make certain that all pipe sections have the best possible electrical bonding all the way back to your input water meter. Don't even assume that your water meter provides a good ground path because they often require a good ground jumper.

Braid. It is quite possible that your station may have adequate grounding on one frequency (band) and inadequate grounding on other frequencies (bands). The groundline length itself could be a resonant quarterwave at a particular frequency and this would make it serve to insulate your transmitter from ground rather than to connect the two points. It is best to use thin flat copper sripping or braid to connect your rig to ground and it sometimes helps to connect to several ground points using ground leads of different lengths.

An inexpensive way to obtain good ground braid is to purchase old RG-8/U (or similar) coax, peel the outer covering off, and strip the shielding braid off the inner conductor; this shielding braid makes excellent ground leads. Don't bother using lugs on ground braids of this type; just clean the connection point down to bare metal, flatten and trim the end of the braid, solder the end of the braid for about one inch, and then drill a hole through the soldered braid end to slip over your grounding screw. If you don't intend to use ground braid, at least use the largest multi-stranded wire you have available; those 22-gauge ground leads leave a lot to be desired.

Ground rods. If you decide to use a ground rod and your soil is rather non-conductive, it would be best if you dug out a 25 to 75 cubic-foot hole and specially prepared a good ground by mixing cheap salts into your soil before refilling the excavation and implanting your ground rod. Some hams take the time to install 6 to 12 quarter-wave radials (like spokes from a hub) for each band and this is an excellent ground system. These ground radials are often just aluminum guy wires buried 6 to 12 inches below the surface of the ground.

Effectivity check. You can run a quick check to determine whether or not your ground system is acceptable. Load your transmitter to full input, using your antenna for a load. While running full output (with your key closed), touch your finger against a bare metal portion of your transmitter's chassis or cabinet; if your ground is good, your plate current will not budge when you touch the transmitter. If your ground is poor, you'll have a warm sensation (light rf burn) at your fingertips and the plate current will vary noticeably when you touch the transmitter. Conduct the first check with your fingertips dry; if you don't experience any rf tingle, wet your fingertips and repeat the check. This check should be conducted on each band you are going to use.

Operating the station

Compatibility. When operating your station in the house, don't be a grouchy old bear when others make normal noises as they continue their usual household routines. It is good practice to concentrate on what you are doing to such an extent that you are not distracted by regular household noises and activities. Don't blast everyone into submission either; use earphones to lessen the chance of bothering others.

Two meters. Keep away from the 2-meter band; it has proven a death-trap to thousands of Novices who would otherwise have progressed to their General-class tickets long ago. Most Novices who make the mistake of operating on 2 meters and up as Technicians who have a rough time upgrading to their Generals. Don't kid yourself that you'll operate code on two meters; there's not enough good code operation there in a year to match one day's use of the 40-meter Novice band. Keep off 2 meters and spend your time on the productive 15, 40, and 80 meter Novice code bands. It will be a blessing when the FCC eliminates Novice voice operating privileges on the 2-meter band.

15 meter. The 15-meter Novice band provides opportunities to contact all parts of the word. Fifteen-meter oeration does require a good receiver and the best 15-meter antenna your finances (and space) will allow. It is true that the Novice 15-meter band extends from 21.1 to 21.25 MHz, but you' quickly learn that almost all the activity is between 21.1 and 21.16 MHz, so purchase crystals which provide outputs in this frequency range. It is wise to operate 15 meters whenever it is open and then to move down to 40 or 80 when 15 closes down.

40 meters. The 40-meter Novice band provides contacts with hams all over the country plus occasional contacts with foreign countries. Forty meters is consistently the busiest Novice band and it can be used to good advantage both night and day. The foreign broadcast stations do raise heck in this band when conditions are good, but you'll soon learn that you can work around (or through) them with excellent results.

80 meters. The 80-meter Novice band is usually a little less hectic than 40 and it can be used to get those relatively long contacts which do so much to help build up one's code speed. Make good use of 15, 40, and 80; don't make the mistake of stagnating on one band.

Operating schedule. Set a reasonable operating schedule and stick to it. You should be operating (not just listening) at least 7 hours per week while you are a Novice, preferably one hour per day. You don't need a ham ticket to be a shortwave listener; if you have a license, use it!

Calling and listening. Learn to keep your

CQ calls brief and to listen carefully for answers before sending another CQ call. The major difference between a good operator and a poor one (one who makes very few contacts) is that the good operator expects an answer to his call and he listens very carefully to hear anyone who answers. After sending a CQ call, slowly tune above and below your transmitting frequency for an answer. Do not SWL or 'read the mail' after sending a CQ call; as soon as a station sends even one letter which is not part of your call sign, tune past him and listen to the next station. If you don't hear an answer close to your transmitting frequency, tune above and below your frequency a bit further and faster. If you don't hear an answer within 2 minutes of tuning, make another brief CQ call on the same (or a new) frequency. Most answers are received close to one's transmitting frequency and slow careful tuning, plus proper listening habits, let you spot answers; fast panic-type tuning does not produce good results. Poor listening techniques can make answering operators wonder whether or not you have your receiver turned on; please put your brain in gear before you operate on the ham bands.

It is easier to send from written text until you become experienced and more at ease. You have enough trouble at first without worrying about what to send. To make initial transmissions a little easier for new operators, here is a series of typical transmissions which you can use by just substituting your own call:

CQ CQ CQ CQ CQ DE WN7ABC
CQ CQ CQ CQ DE WN7ABC WN7ABC
CQ CQ CQ DE WN7ABC WN7ABC WN7ABC AR K

WN7ABC WN7ABC WN7ABC WN7ABC WN7ABC
DE W6DDB W6DDB W6DDB AR K

W6DDB W6DDB DE WN7ABC BT GM ES TNX FER DE CALL BT UR RST 579 ? 579 HR IN SEATTLE, WASH ? SEATTLE, WASH BT NAME IS JOHN ? JOHN BT HW ? W6DDB DE WN7ABC AR K

WN7ABC DE W6DDB BT R ES TNX BT UR RST 579 ? 579 HR IN BURBANK ? BURBANK ES NAME IS BILL ? BILL BT

(at this point, this station opens the general conversation on anything he wishes—equipment, antennas, weather, job, family, etc.)

That first QSO. When a new ham makes his first contact on the air, he usually feels pretty much like the hiker who walked off the cliff's edge; that last step was a dilly! There have been cases where new hams have become so panic-stricken by answers to their CQ calls that they just turned off their gear and ran out of the shack; there have been other cases where they didn't wait to turn off the gear before fleeing the scene! Just do the best you can do and keep your contacts short until you become relaxed enough to enjoy longer on-the-air conversations with your fellow hams. Remember to keep your calls short; long CQ calls net you very few answers but lots of enemies.

Sending speed. Send slowly and carefully. Accuracy is far more important than speed. No one enjoys a contact with a ham who makes frequent errors but errorless code sounds good even at very slow speeds. Don't send code at a rate which is faster than you can copy comfortably. Remember that your sending speed is naturally faster than your receiving capability so make yourself slow down by sending very carefully. Don't speed up to work Generals you hear in the Novice bands; they come into your bands to give you a contact with a new station/state, to give you a little additional code practice, to help you learn proper operaing techniques, and to send you a card. The Generals will be patient with you so don't

Don't assume that all distributors recondition or check out used equipment before reselling it . . . because they don't.

hesitate to ask them to slow down or to repeat information. Your fellow Novice is much more likely to be impatient with you than any General.

Sending accuracy. Make clear corrections of sending errors. If you goof the first letter of a word (or a single-letter word), send an error sign and go back to the start of the previous word. It is acceptable to use a series of seven (or more) dits as an error sign or to send a question mark for this purpose; the question mark is the preferred sign to indicate a repetition.

Identification. Include a 24-hour numechron-type clock in your station, complete with a 10-minute warning buzzer. It is best to keep your log in four digit 24-hour time (0000–2400) rather than to bother with AM and PM time designations. As you become increasingly proficient (and as you start to work foreign stations), you will find it more convenient to do all your hamming and logging in Greenwich Mean Time (GMT/Z), rather than in local time. Remember that we are required to identify at 10-minute intervals during long transmissions, as well as at the beginning and ending of each transmission which is 3 (or more) minutes long; obey the law and identify both stations each time your 10-minute buzzer sounds a warning.

Keys

Handkey selection and mounting. Do not use a cheap handkey either for code sending practice or for keying your transmitter because a poor handkey can ruin your sending. Purchase a top-quality handkey and mount it in position at your operating table so that it can't move. The handkey should be mounted where it is easily within reach and in line with your forearm, with your arm comfortably positioned on the surface of your operating table and your elbow on the table. A good handkey has adjustable pivot points, contact spacing, and spring tension; it also has a smooth keying action and large serviceable contacts. Avoid handkeys with large knobs and skirts (bottom knob plates) because they tend to let one develop lazy sending habits which are hard to break. If you can't mount your handkey directly on the surface of your operating table, mount it on a board which is no thicker than three-eighths of an inch and which has good adherance qualities so that it won't move about as you send.

Handkey use. Make yourself send correctly with your wrist rather than to be a finger-tapper type of sender. Correct wrist sending sounds better, is less tiring, and includes far less errors. You can force yourself to send correctly by opening up your key contacts to one-sixteenth inch and adjusting your spring tension to where it takes a lot of pressure to close the key contacts. Use he simple system of placing a quarter on the wrist of your sending hand; if you're sending correctly, it will not fall off.

Code monitor/oscillator. Incorporate a code monitor in your station to permit more rapid code speed build-up and cleaner sending. Usually, a combination code monitor and oscillator is a much better investment than a separate code oscillator and monitor.

Bugs and keyers. Don't be over-anxious to leave the handkey to rush to a bug or an electronic keyer. You will not develop the required rhythm on a bug or keyer; it must be acquired with long hours of practice with a good handkey. When you have developed good handkey sending techniques and rhythm (plus a code speed of about 18 WPM), you are ready to learn how to operate the higher-speed bugs and keyers. Please don't practice your bug or keyer sending on the air; learn how to send with the aid of a code practice oscillator before you connect either to your transmitter.

Recorded sending checks. No matter what type of keying device you use, it is good to tape record your practice sending and to set it aside for your critical evaluation two or three weeks later. You can spot your own goofs and correct them with the aid of these recordings. Don't check a recording immediately after you make it because you may still remember what you intended to send and you may automatically read in corrections which don't exist; set the recording aside until you have forgotten it well enough to be able to honestly copy what is recorded.

Logs

General. Maintain an accurate station log in ink. Fill in your name, location, and call sign on the inside front flyleaf of the log so that you can use an "X" throughout the rest of your log to indicate your operation from your fixed location.

Clutter. Do not repeat your emission type, power, frequency, and date entries in the log when they remain the same for a series of contacts; there is no sense in having a cluttered, messy log. Indicate the month and year in the upper left margin of each log sheet and write the day in the blank left margin beside the contact concerned; this avoids wasting log sheet entry lines and makes it easier to spot contact dates.

Equipment changes. Indicate equipment and antenna changes in your logs, along with all other data which pertains to your operator/station license and your station's operation.

Dog ears. Don't let your log-book pages become dog-eared and torn; just purchase a pair of #20 binderclips at a stationery store and attach one to each bottom edge of your log book. Your logs provide an excellent history of your amateur radio operating achievements and they deserve reasonable care.

QSL Cards

100% QSL. As soon as your ticket comes, order 200-500 good-quality QSL cards. Good cards indicate a better reply ratio than cheap ones. Make it a practice to send a card to each station you work for the first time. Remember that no cards would ever be exchanged if everyone waited to receive a QSL before mailing one. The cards you receive during your Novice operation count towards hundreds of awards you may seek later on when you have your General (or higher) class ticket. A QSL is as much a part of a QSO as the CQ call itself.

Addresses. Thousands of QSL cards end up in the dead letter office each year. There's no sense in using improper addresses. Make it a practice to tell the other ham your name (first and last) and address (including ZIP) so that his card, time, and postage will not be wasted. Don't assume that there's no longer any need to send your name and address just because they finally appear in the latest call book 3 to 6 months after you get your ticket; most hams use a call book which is more than a year old. If you have a call book, check for the other ham's address while you are working him and let him know if you have it okay. There's usually no need to ask a General for his name and address because it should be in the call book you have; just tell him you're going to QSL to the address shown in the (specific issue) call book.

Promptness. It is a particularly good habit to write the QSL out completely during the QSO and then you are ready to continue on with your next complete contact. Indicate sent and received cards in your log and don't file a received QSL until you have checked your log and made sure you have sent your QSL.

Getting the general ticket

Code

On-the-air practice. The best code practice is to operate your station every day. Code-practice tapes and records are not as effective as a regular diet of station operation during which one must copy what the other follows have to say, to answer questions intelligently, and to send QSL cards.

Contests. Participate in as many on-the-air contests as possible. Do not miss the chance to operate in the Annual February Novice Roundup; this contest provides a wonderful opportunity to work many new stations and states in a short time. Keep track of all local, national, and international contests so you'll be able to participate intelligently.

Goal. When your code speed reaches the point where you are making passing runs at 15-16 WPM (plain language), you are ready to take your general-class code exam.

Theory

Clubs. The best way to obtain the theory knowledge needed to pass the 'written' portion of your General Class License Examination is to attend a free licensing course at a local radio club. Most of these courses are advertised far in advance in local newspaper articles, club bulletins, and notices posted at local radio distributorships. If your local club does not conduct Novice, General, and Extra Class licensing courses, do your best to get one started; there's no surer way to obtain a continuing supply of new amateurs (and club members) than to produce them in a club's own licensing classes. A free copy of the 'Licensing Classes' brochure is available to the instructor of any League-affiliated club who requests one from the ARRL. Join a local radio club and actively participate in all its activities. You may not immediately realize how much benefit you derive from participating in club field days, auctions, hamfests, etc., but you will be learning new things about ham radio all the time. Understand that the newer hams are usually the ones who keep the clubs perking; they are more active than most of the long-licensed hams.

Examination scope. Don't swallow the big lie that the long-licensed ham knew his onions a lot better when he got his General than his modern counterpart; the long-licensed ham may have become an expert due to long association and commendable effort but the simple fact is that he passed a general-class theory exam which was much simpler than the one used today because the modern exam covers many facets of electronics and radio theory which were not included in exams of just 5, 10, or 15 years ago. The modern ham doesn't have to take a back seat to anyone and modern technology is opening the doors to fantastic break-throughs in communications. We've just been crawling along so far and we are about to stand up and walk.

Technician exam use. The Technician/Conditional 'written' exams are the older (easier) general class exams. When you've built your code speed up to the point where you are about ready to take the General exam, it is a good idea to invest four dollars in a Technician exam as a dry-run for the General-class theory exam before you go downtown to take the big test. The Technician exam will point out where you need to do some additional studying before you take your General-class exam.

Summary

Get your Novice license, set up the best possible station, and operate that station as much as possible. The unforgiveable sin is to allow any of your Novice license term to pass without operating. As soon as your General Class License is in your hot little hand, start your campaign to get a higher grade of license. Make yourself a useful member of the amateur radio service.

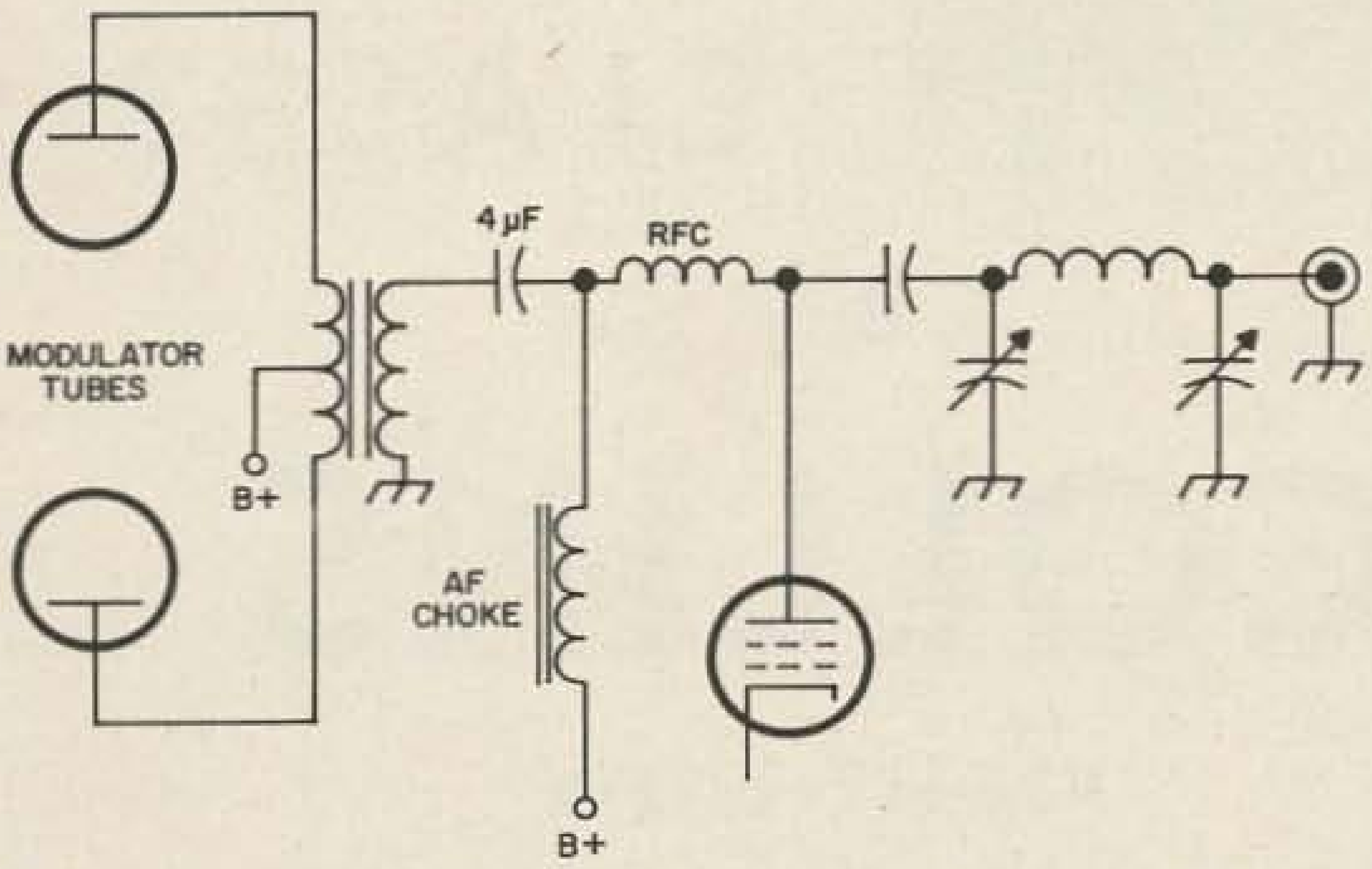
It is realized that some subjects have been brushed over lightly in a sentence or two which would well warrant an entire article, but it is hoped that the main points are adequately covered. There are no big mysteries in the amateur radio service.

. . . W6DDB

Getting the Most out of Small Modulation Transformers

Are you, like me, using an under-sized, over-run modulation transformer, which is running almost red-hot, distorting the audio, and giving low modulation?

Of course, it could be replaced with a much, much larger one, but think of the cost. Strange to relate, one never finds a large mod tranny* going for a few cents in a junk sale!



By using shunt feed as shown here, small mod trannys will operate much cooler and with less distortion. In push-pull modulators it's the PA plate current, not the modulating signal, which tends to saturate.

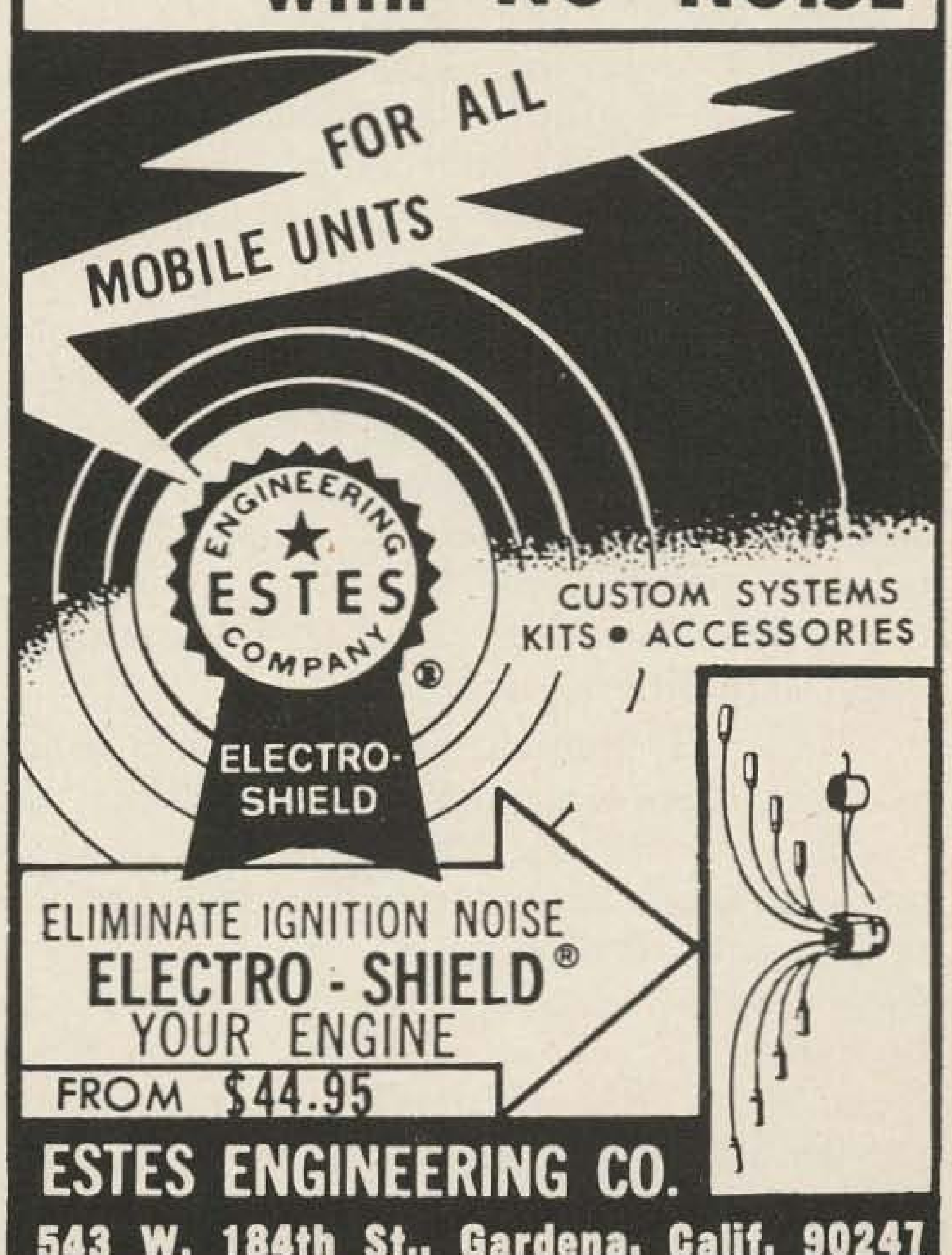
So what to do?

The answer is simple. Parallel feed, as in the old days, with audio coupling in reverse. Feed the B plus to the PA through a hefty choke, and couple to the mod tranny by means of a hig-voltage condenser of 4 mF.

This removes the heavy direct current from the transformer, which saturates the core. Remember that the current taken by the modulator tubes flows in opposite directions thru the primary windings, and so cancels out. It's the PA current—unidirectional—which tends to saturate.

. . . Douglas Byrne G3KPO

*In case you haven't guessed, a "mod tranny" is British vernacular for modulation transformer!



International Amateur Radiocommunication

The following recapitulation of the International Radio Regulations (Geneva, 1959) concerning communication between amateur stations and transmission of third party traffic by amateurs is published for the information and guidance of United States licensed amateurs:

Article 41, Section 1. "Radiocommunications between amateur stations of different countries shall be forbidden if the administration of one of the countries concerned has notified that it objects to such radiocommunications." Cambodia (XU), Indonesia (8F), Thailand (HS), and Viet Nam (3W) have so notified.

Article 41, Section 2. "(1) When transmissions between amateur stations of different countries are permitted, they shall be made in plain language and shall be limited to messages of a technical nature relating to tests and to remarks of a personal character for which, by reason of their unimportance, recourse to the public telecommunications service is not justified. It is absolutely forbidden for amateur stations to be used for transmitting international communications on behalf of third parties. (2) The preceding provisions may be modified by special arrangements between the administrations of the countries concerned."

Arrangements permitting third party communications have been effected between the United States and the following countries only:

1. Argentina
2. Bolivia
3. Brazil
4. Canada
5. Chile
6. Colombia
7. Costa Rica
8. Cuba
9. Dominican Republic
10. Ecuador
11. El Salvador
12. Haiti
13. Honduras
14. Israel
15. Liberia
16. Mexico
17. Nicaragua
18. Panama
19. Paraguay
20. Peru
21. Uruguay
22. Venezuela

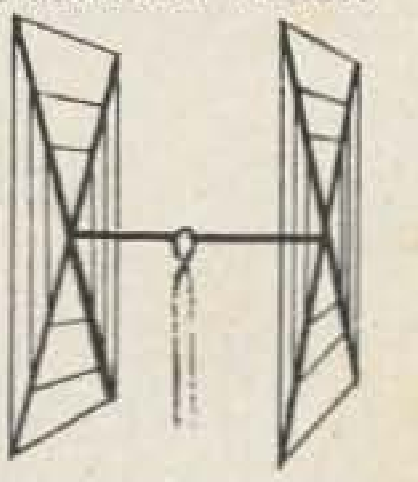
Only amateur stations identified by properly authorized call signs having a one or two-letter prefix beginning with "W" or "K" are authorized by the United States, and third party communication is presently permissible with all such stations except those identified by prefixes KA2-KA9, inclusive.

GOTHAM'S AMAZING ANTENNA BREAKTHRU!!

How did Gotham drastically cut antenna prices? Mass purchases, mass production, product specialization, and 15 years of antenna manufacturing experience. The result: The kind of antennas you want, at the right price! In QST since '53.

QUADS

Worked 42 countries in two weeks with my Gotham Quad and only 75 watts . . . W3AZR



CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount; uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a foolproof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!

10/15/20 CUBICAL QUAD SPECIFICATIONS

Elements: A full wavelength driven element and reflector for each band.

Frequencies: 14-14.4 Mc.; 21-21.45 Mc., 28-29.7 Mc.

Dimensions: About 16′ square.

Power Rating: 5 KW.

Operation Mode: All.

SWR: 1.05:1 at resonance.

Boom: 10′ × 1¼″ OD, 18 gauge steel, double plated, gold color.

Beam Mount: Square aluminum alloy plate, with four steel U-bolt assemblies. Will support 100 lbs.; universal polarization.

Radiating elements: Steel wire, tempered and plated, .064″ diameter.

X Frameworks: Two 12′ × 1″ OD aluminum 'hi-strength' alloy tubing, with telescoping ⅞″ OD tubing and dowel insulator. Plated hose clamps on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings.

Feedline: (not furnished) Single 52 ohm coaxial cable.

Now check these startling prices — note that they are *much lower* than even the bamboo-type:

10-15-20 CUBICAL QUAD $35.00
10-15 CUBICAL QUAD 30.00
15-20 CUBICAL QUAD 32.00
TWENTY METER CUBICAL QUAD. 25.00
FIFTEEN METER CUBICAL QUAD. 24.00
TEN METER CUBICAL QUAD 23.00
(all use single coax feedline)

BEAMS

The first morning I put up my 3 element Gotham beam (20 ft) I worked YO4CT, ON5LW, SP9ADQ, and 4U1ITU. THAT ANTENNA WORKS! WN4DYN

Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history! Each beam is brand new! full size (36′ of tubing for *each* 20 meter element, for instance); absolutely complete including a boom and all hardware; uses a single 52 or 72 ohm coaxial feedline; the SWR is 1:1; easily handles 5 KW; ⅞″ and 1″ aluminum alloy tubing is employed for maximum strength and low wind loading; all beams are adjustable to any frequency in the band.

2 El 20 ...... $16
3 El 20 .... 22*
4 El 20 .... 32*
2 El 15 12
3 El 15 16
4 El 15 .... 25*
5 El 15 .... 28*
4 El 10 ...... $18
7 El 10 .... 32*
4 El 6 15
8 El 6 .... 28*
12 El 2 .... 25*
*20′ boom

ALL-BAND VERTICALS

"All band vertical!" asked one skeptic. "Twenty meters is murder these days. Let's see you make a contact on twenty meter phone with low power!" So K4KXR switched to twenty, using a V80 antenna and 35 watts AM. Here is a small portion of the stations he worked: VE3FAZ, T12FGS, W5KYJ, W1WOZ, W2ODH, WA3DJT, WB2-FCB, W2YHH, VE3FOB, WA8CZE, K1SYB, K2RDJ, K1MVV. K8HGY, K3UTL, W8QJC, WA2LVE, YS1-MAM, WA8ATS, K2PGS, W2QJP, W4JWJ, K2PSK, WA8CGA, WB2-KWY, W2IWJ, VE3KT. Moral: It's the antenna that counts!

FLASH! Switched to 15 c.w. and worked KZ5IKN, KZ5OWN, HC1-LC, PY5ASN, FG7XT, XE2I, KP4-AQL, SM5BGK, G2AOB, YV5CLK, OZ4H, and over a thousand other stations!

V40 vertical for 40, 20, 15, 10, 6 meters $14.95

V80 vertical for 80, 75, 40, 20, 15, 10, 6 meters $16.95

V160 vertical for 160, 80, 75, 40, 20, 15, 10, 6 meters ... $18.95

How to order: Send check or money order. We ship immediately upon receipt of order by railway express, shipping charges collect.

GOTHAM, 1805 Purdy Ave, Miami Beach, Fla. 33139

WE WANT YOU TO MAKE THE SWITCH.

JOIN OUR GROWING LIST OF THOUSANDS OF SATISIFED CUSTOMERS.

Our semiconductors have full factory length leads, are American made, unused and in good physical condition. Our technical descriptions and pictures are completely accurate.

TRIACS

TO-66

PRV	100	200	300	400	500
5.A	.90	1.40	1.75	2.25	2.60

☐ **ZENERS:** 1-watt 6-33 V, 50¢; 10-watt 6-200 V, 75¢; 50-watt 6-200 V $1.75.

☐ **500 HFe** plastic transistors (NPN). TO-18, SI units sim. to 2N3565 .... 3/$1.00

☐ **SILICON BILATERAL SWITCH.** Replaces 2 SCR's by firing in either direction when breakdown voltage is exceeded. Used in light dimmers, etc. .... 2/$1.00

☐ **1000 PRV** at 3A, full wave bridges .... $3.50 each

☐ **NEON LIGHT OR NIXIE TUBE** drivers. An NPN, TO-18, S, transistor with a VCBO of 120 ....3/$1.00

☐ **Sim. to 2N3429 (NPN) SI ⅞" stud,** min. HFe of 30, 7.5 A, 175 Watts, VCe of 75, ... $1.75

☐ **HIGH VOLTAGE NPN 150V.** VCBO at 2.5A. High HFE in TO-66 pack .... $.75

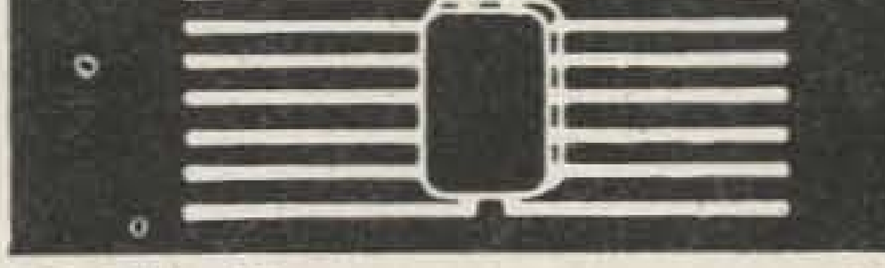
SILICON POWER RECTIFIERS

PRV	3A	12A	20A	40A
100	.09	.30	.40	.75
200	.16	.50	.60	1.25
400	.20	.70	.80	1.50
600	.30	1.00	1.20	1.80
800	.40	1.25	1.50	2.30
1000	.55	1.50	1.80	2.70

Terms: FOB Cambridge, Mass.

Send check or money order. Include postage. Rated companies 30 days net. Average weight per package ½ lb. Allow for COD. Minimum order $3.00.

INTEGRATED CIRCUITS



SR Flip Flops .... $ .90
SR Clocked Flip Flops $1.15
SRT Flip Flops $1.15
Expandable OR Gates $1.00
JK Flip Flops $1.15
Dual NAND NOR Gates $1.00
8 input NAND NOR gates $1.00
Dual AND Gates $1.00
Quad NAND NOR Gates $1.00
TO-85 flat pack, with holder. Guaranteed to work. They come complete with schematic, elect. characteristic sheet & some typicial applications.

Top Hat and Epoxy, PRV 1 .AMP

100	.07	600	.18	1400	.65
200	.09	800	.22	1600	.80
400	.12	1000	.35	1800	.90
		1200	.50		

Silicon Controlled Rectifiers

PRV	3A	7A	20A
50	.35	.45	.70
100	.50	.65	1.00
200	.70	.95	1.30
300	.90	1.25	1.70
400	1.20	1.60	2.10
500	1.50	2.00	2.50
600	1.80	2.40	
700	2.20	2.80	
1000		4.00	

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SEND FOR OUR FALL CATALOG

Hams Cooperate to Locate Endangered Child

Radio amateurs from all over the southwest cooperated in a successful search for a nine-month-old girl who had been given a lethal prescription by mistake. K6EJT, a sightless operator, heard a news report indicating that the prescription was in error and that the family were on their way to southern Oregon. He immediately put the bulletin on the West Coast Amateur Radio Service monitored frequency, 7255 kHz, at 0900 PDT on September 27, 1967. Net Control WA6VIB and a multitude of others spread the information as widely as possible via the Net, to other hams and other agencies. Additional information was gathered concerning the family and the description of their car. At 1543, W6FKQ reported to the net that he had located the family at Oroville Dam in northern California. He advised them of the danger and accompanied them to a hospital. Fortunately the child, Dianne Baida, had taken only a small amount of the medicine and the warning came just a few minutes before the parents were about to administer another dose.

The parents were, of course, extremely grateful to the amateur radio service, as were the various law enforcement agencies from four states who participated in the operation.

Known to have been instrumental in the search were W6VNI, WA6HYU, WB6KOH, W6MLZ, W6DZJ, with several hundred others assisting.

West Coast Amateur Radio Service, monitoring 7255 kHz for the purpose of providing service to the public and other amateurs during the daylight hours, always has at least 50 stations listening on the frequency. ■

Tristao Tower Catalog

A new 24-page catalog for the complete line of Tristao Towers has just been released. The catalog includes, in addition to their complete line of towers, all accessories, guying charts, and other general information. Each tower is briefly described and lists the price range, thus making for quick reference.

The new catalog is easy to read and is fully illustrated. Anyone desiring a free copy should write to Tristao Tower Co., P. O. Box 115, Hanford, California 93230.

Season's Greetings

Would You Believe - - - -

1. That Dymond's has Collins in stock for immediate delivery?
2. That Dymond's is the smallest large ham distributor in Fresno, California?
3. That Dymond's supplies what other promise?
4. That Dymond's wants your business more than anyone else?
5. That Dymond's needs your business more than anyone else? (I have expensive habits and tastes)

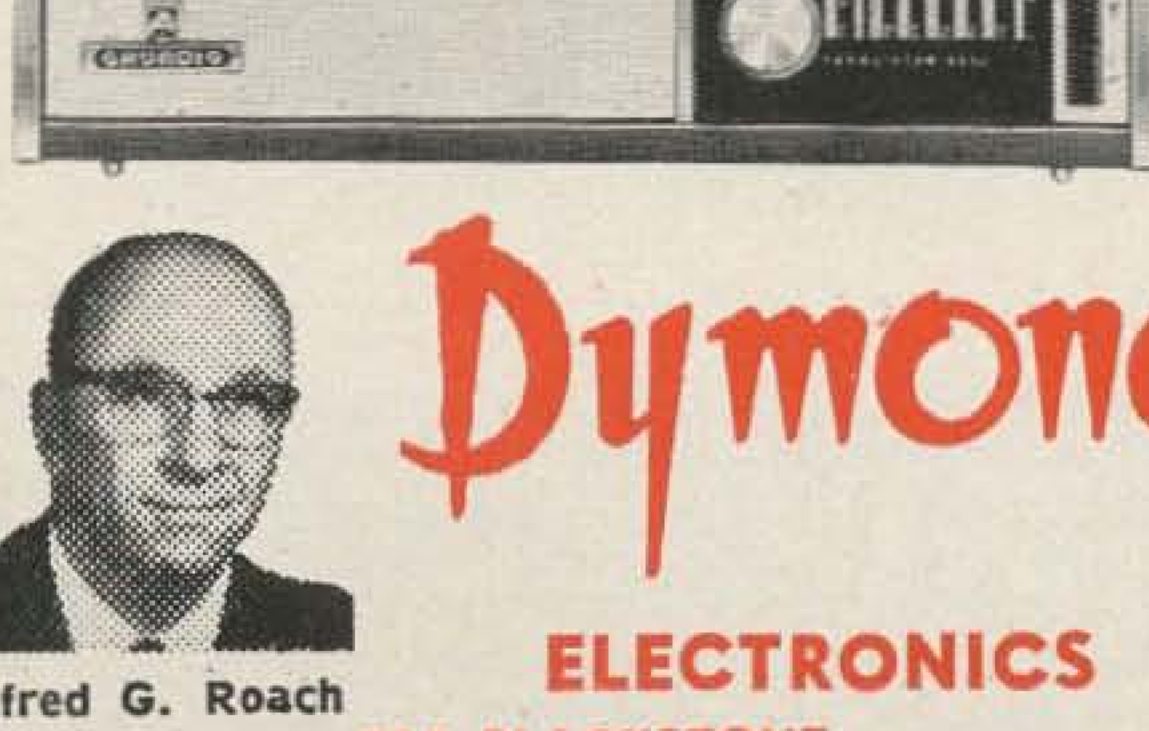
COLLINS IN STOCK — KWM2, KWM2A, 75S3B, 75S3C, 312B5
516F2, 62S1, 30L1, 30S1

ALL INQUIRIES ANSWERED PROMPTLY

BCNU—Al Roach
W6JUK

GRUNDIG

Most Versatile All-Band Portable-Fixed ever built.



AMATEUR TR5000

- Will receive SSB-CW-AM-FM-LW
  All frequency from 350 Kc to 30 Mc
  88 Mc to 108 Mc.
- Has BFO—noise limiter—adjustable AVC
- 2 speakers
- Tweeter on-off switch
- Continuous bass control
- Continuous treble control
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- Telescopic FM antenna—opens to 32"
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- ACF on-off switch
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- Dual drive tuner knob—engages separately for FM and multi-wave scales
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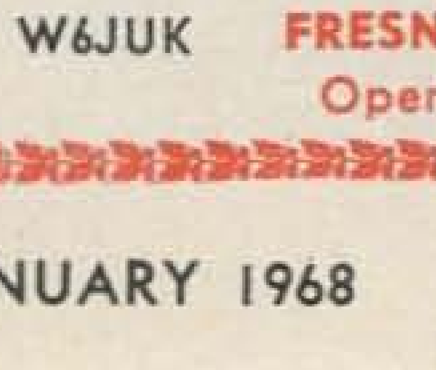
- AM tuner
- 4 SW tuning ranges
- AC and battery operation

$225.00 **limited quantities**

Shipped Prepaid Continental U.S.A.



Alfred G. Roach
W6JUK

Dymond
ELECTRONICS
515 BLACKSTONE
FRESNO, CALIFORNIA 93701
Operated by Hams for Hams

Station Custodian Al Lee W6KQI. Photo by TRW Systems Photo Lab.

Long Live the Queen

The ocean liner, Queen Mary left Southampton, England on October 31, 1967 on her last voyage under the ownership of Cunard Lines. This last voyage of the stately Queen took her to Long Beach, California via Lisbon, Portugal, the Canary Islands, Rio de Janeiro, around Cape Horn then north to Chile, Peru, Balboa, and Acapulco with the trip taking nearly six weeks.

Four California hams were on board and were honored by the British government with the special call sign GB5QM for this special event. The amateurs who participated in this event are Al Lee W6KQI, Ray Harter W6HO, Ray's wife Jean K6TUE, and Walt Barnes K6IMK.

Equipment for the station was provided through the courtesy of the Swan Engineering Company.

Boy Scout Jamboree

More than 160 Cub Scouts and Boy Scouts of Greater Lawrence, Massachusetts were given a chance to talk to other scouts throughout the world by amateur radio recently from Camp Onway, Raymond, New Hampshire.

The Jamboree station of the air was set up by Scouters William C. Loeffler and Fred J. Waters who hold the call letters of W1PFA and W1GPV. Antennas were strung up among the pine trees, and scouts from ten different countries were contacted. More than fifty contacts were made in the U.S.A., including the World Jamboree station W7WSJ at Faragut State Park in Idaho.

Among the DX worked were: Germany, England, Peru, Norway, Panama, and Antarctica. Only contacts with other Scouts are counted.

Hams who have any connection with the Scout movement are urged to participate in future Hamborees. What better way to get youngsters interested in our great hobby than an activity like this one with the Scouts. ■

NEW PRODUCTS

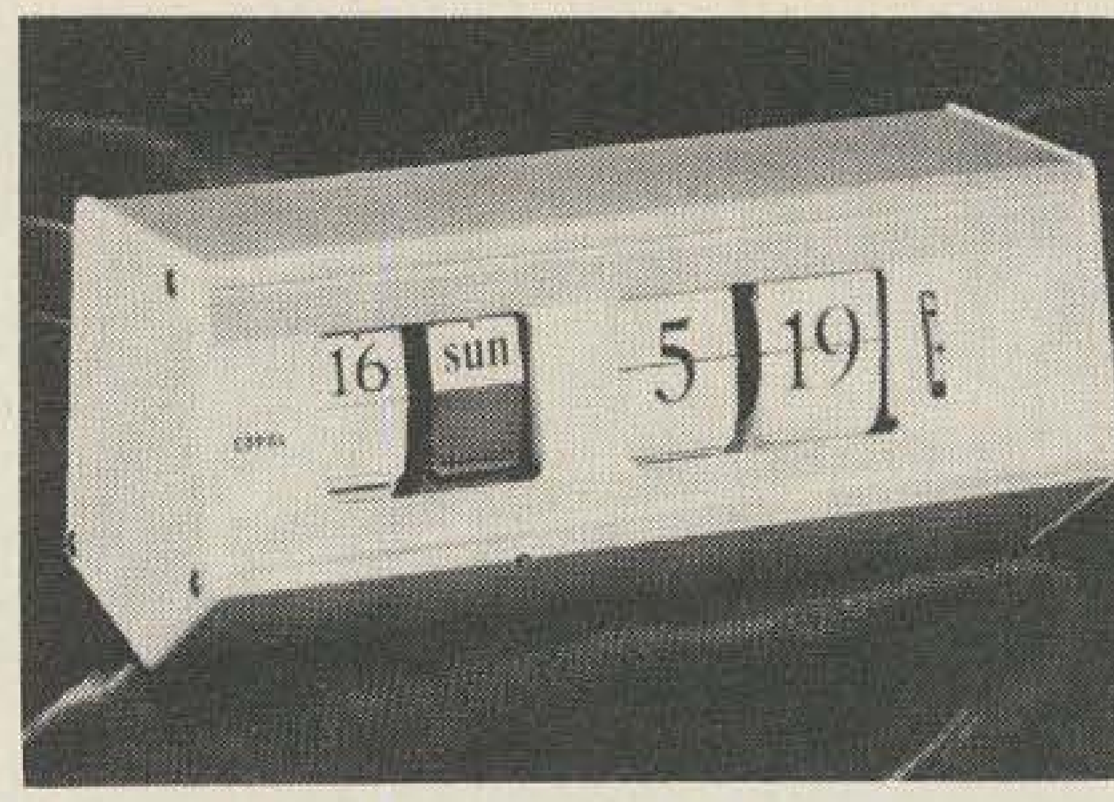
Omega DA Keyer

Omega Electronics Company introduces the DA Digital Automatic IC Keyer. The DA is fully solid state using six dual integrated circuits, two transistors, and one diode for an equivalent of 100 semiconductors. The DA is a double paddle "squeeze" type keyer with both dot and dash memories. Most letters are formed with a single squeeze, enabling an inexperienced operator to master automatic sending in a short time. Provision is made for use of an external straight key to provide remote keying and monitoring. The monitor is self contained, eliminating the need for any connection to a receiver. $85.00 F.O.B. San Diego, California. The optional 6.3 Vac power supply is priced at $12.50. Omega Electronics Co., 10463 Roselle St., San Diego, California 92121.

Drake FF-1 Fixed Frequency Adaptor

The Drake Model FF-1 Fixed Frequency adaptor is a solid-state frequency-determining unit. It provides crystal control of any two operating frequencies falling within the normal operating range of the TR-4 Transceiver (operating frequencies outside the normal range may be feasible with realignment depending on the band and frequency excursion). The FF-1 is well suited for net operation since it provides crystal controlled transmit frequency with VFO controlled transmit and receive frequency. $24.50 Amateur Net.

Caslon Digital Electric Calendar



The newest member of the Caslon clock family is the Model 601. This beautiful time-at-a-glance unit is designed for desk or table. It is housed in an attractive aluminum case and has a noiseless precision motor which provides exact time keeping. Having no hands, the easy-to-read digital cards indicate the time by flipping the minutes into hours. Every five seconds is also indicated by a rotating dial. An added feature is the date and day of the week, with each day of the week having its own color card. A built-in diffused pilot light keeps constant vigil through the night.

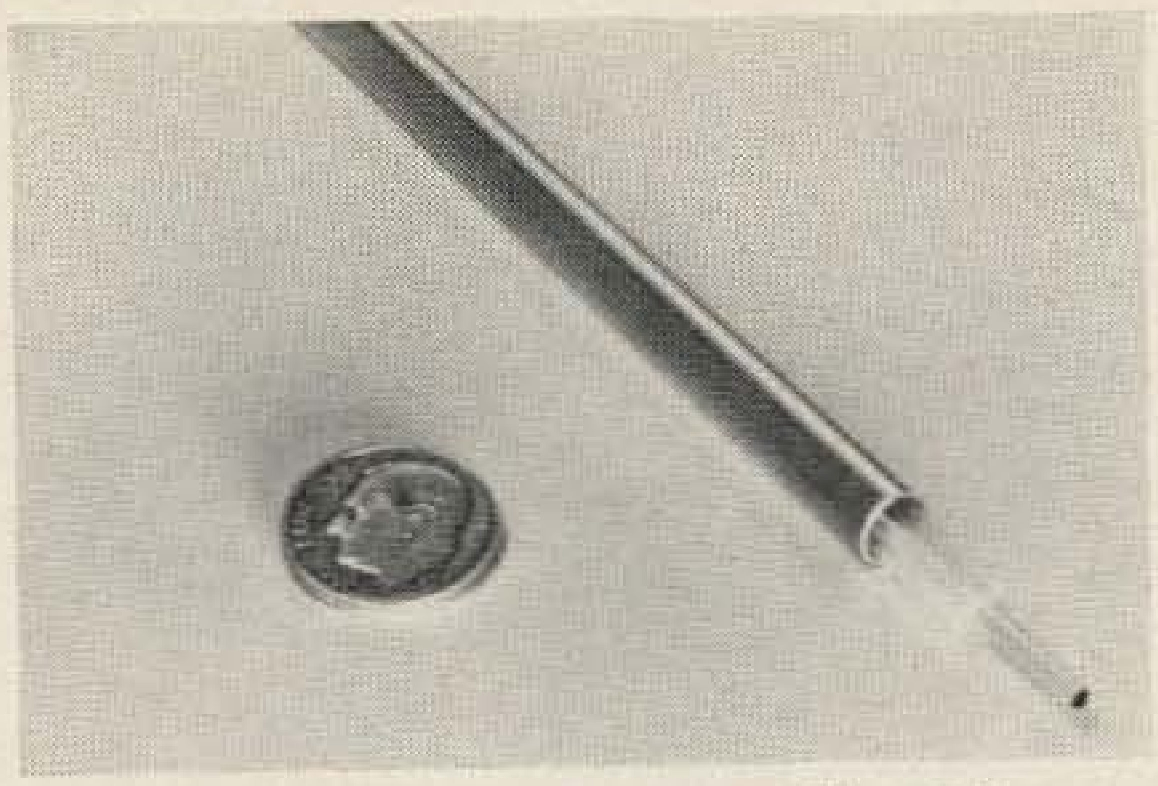
Write to Ropat, 5557 Centinella Boulevard, Los Angeles 66, California for additional information on this unique, up-to-the-minute clock. Retail Price $49.95.

Winco Pace-Setter Alternator

Wincharger Corporation, subsidiary of Zenith Radio Corporation, Sioux City, Iowa, announces the new Winco Pace-Setter portable power alternators. These new alternators offer economical, compact, lightweight, portable power for amateurs, contractors, utilities, fire departments, campers, home and farm. The new Winco Pace-Setters are made in three popular sizes: 2500 watts, 1750 watts, and 1250 watts.

For complete details and prices, contact Wincharger Corporation, 1805 Zenith Drive, Sioux City, Iowa 51102.

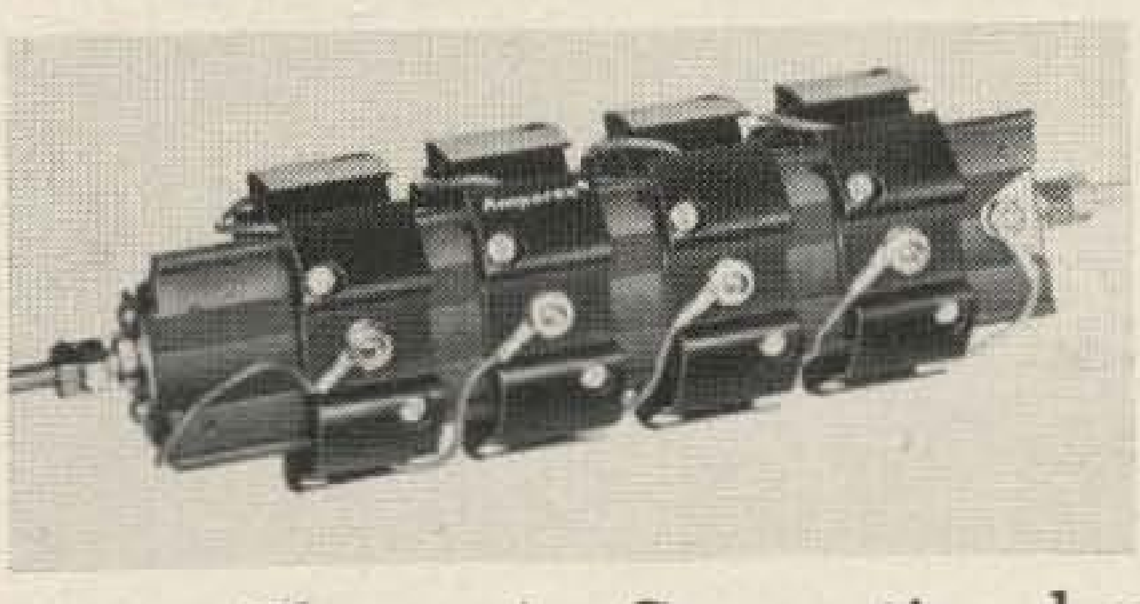
Alumispline Semiflexible Coax



A newly designed semiflexible coaxial cable made with a tubular or solid center conductor, which is completely enclosed by a dielectric consisting of five longitudinally extruded splines is available from Times Wire and Cable, a division of International Silver Company. This new cable is ¼ inch O.D. size and exhibits VSWR's of 1.06:1 at C-band.

The new cable is designed to be used at frequencies up to 15 gHz. It's construction allows it to be bent on a 2½ inch bend radius without the creation of reflections. The cable is especially useful for phased array antenna applications where good phase performance, low attenuation, and little reflections are required. It is now being stocked in 20 to 24 foot lengths. For further information, write to Times Wire and Cable, International Silver Company, Wallingford, Connecticut.

Amperex High Voltage Silicon Rectifier Stacks



Amperex Electronic Corporation has announced the introduction of a new line of high voltage silicon rectifier stacks. The line consists of three families designated as the OSB-9210, OSM-9210, and the OSS-9210. The entire line can deliver an average forward current of from 5 to 20 amperes depending on the method of cooling employed when used as half-wave single phase rectifiers. An important feature of these stacks is that they can withstand high surge and peak currents. They can also withstand a maximum non-repetitive peak current of 360 amperes for one cycle of sinusoidal current at 60 Hz.

For further information please contact the Product Manager, Power Devices, Amperex Electronic Corporation, Slatersville, Rhode Island 02876. Phone 401-762-9000.

Blonder-Tongue RF Switch

A new switch, the Model 4130, is a handy aid for testing rf devices in the frequency range from DC to 900 MHz, has been announced by Blonder-Tongue Laboratories, Inc., Newark, New Jersey 07102. The model 4130 is a manually-operated unit consisting of a 75-ohm DPDT coaxial switch and an eight-pole, double-throw wafer switch. The coaxial switch permits selection of two rf signals, such as the input and output of a device under test.

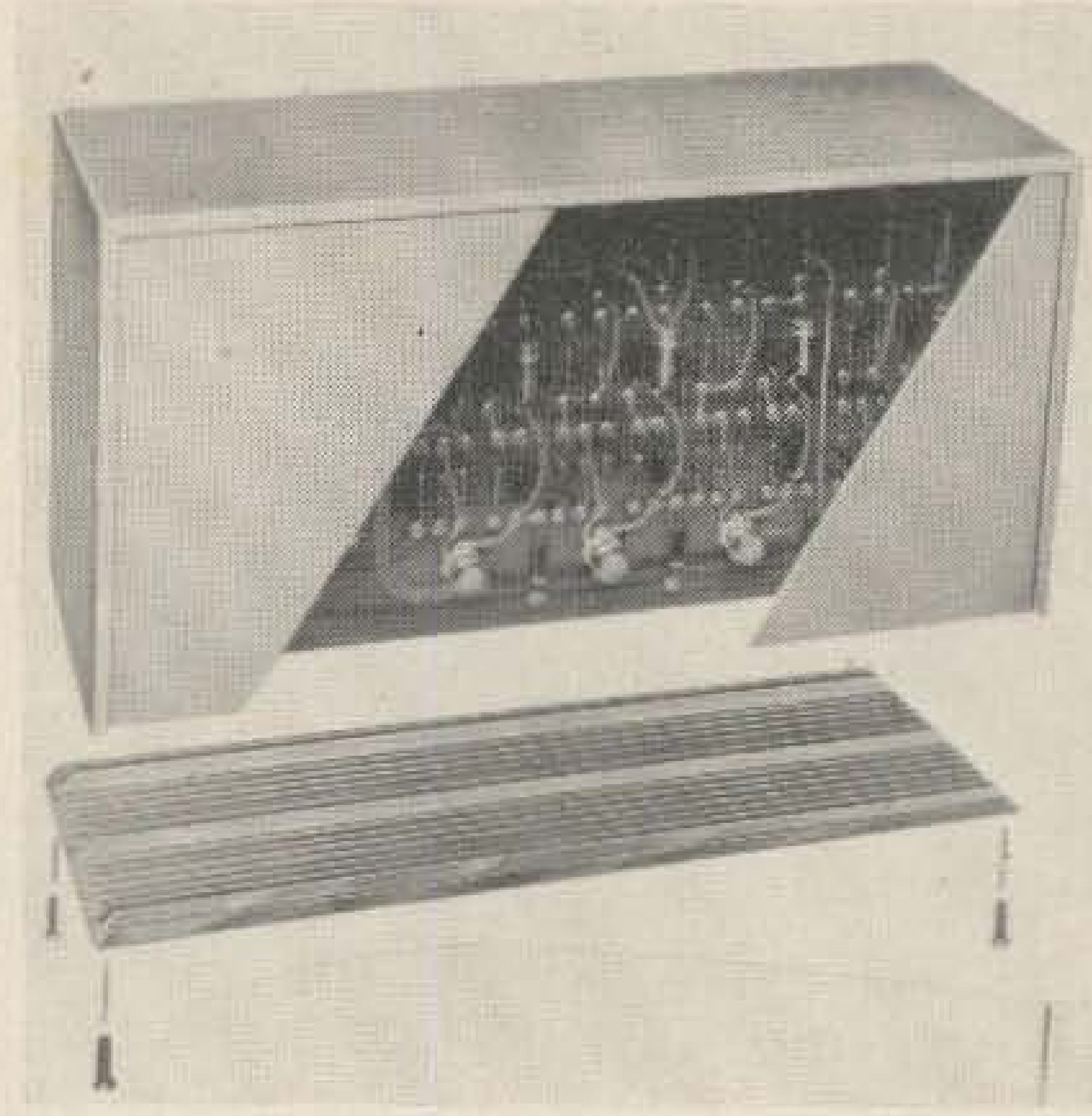
The eight-pole, double-throw wafer switch may be used for controlling associated dc or low-frequency circuits. The coaxial switch section has a frequency range from DC to 900 MHz, so that it can be used on TV sub-channels 2 to 83 and FM. All switch contacts have a power handling capability of 2 amperes maximum.

Versatile Storage Bin Units

Bay Products has come out with some extremely useful Bin Units with adjustable shelves on 1½" centers and have full-width label holders. The bin dividers are secured with "snap-fasteners" and can be adjusted horizontally on 1" centers. Bay Bin Units are also available with drawers or sloping bin dividers, or in combinations using both within the same unit.

Literature and prices are available from Bay Products, 155 E. Somerset St., Philadelphia, Pennsylvania 19134.

Multi-Mod Extruded Aluminum Cases



Vector Electronics Company has introduced a new line of "Multi-Mod" aluminum cases suitable for housing instruments, controls, circuitry, and miscellaneous small equipment. These cases should be applicable to many ham building projects.

The cases consist of a wrap-around extrusion available in 1.6", 2.0", 3", and 4½" widths and are eye appealing in that they contain screws on only one of the six sides. All joints overlap to provide excellent rf shielding. The interior surfaces have parallel grooves to hold circuit boards running the long dimension of the case.

For further information contact Vector Electronic Co., Inc., 1100 Flower St., Glendale, California 91201 Phone 213-245-8971.

Technical Manual Catalog

If you have been looking around for a manual for a piece of surplus equipment, you're missing a good bet if you don't have Quaker Electronics' new *Technical Manual Catalog*. This catalog lists hundreds of out-of-print TM's and instruction books which are practically unobtainable. In addition, if you need a particular TM that Quaker does not have in stock, they will try to locate it for you. The *Technical Manual Catalog* is 25c from Quaker Electronics, P. O. Box 215, Hunlock Creek, Pennsylvania 18621.

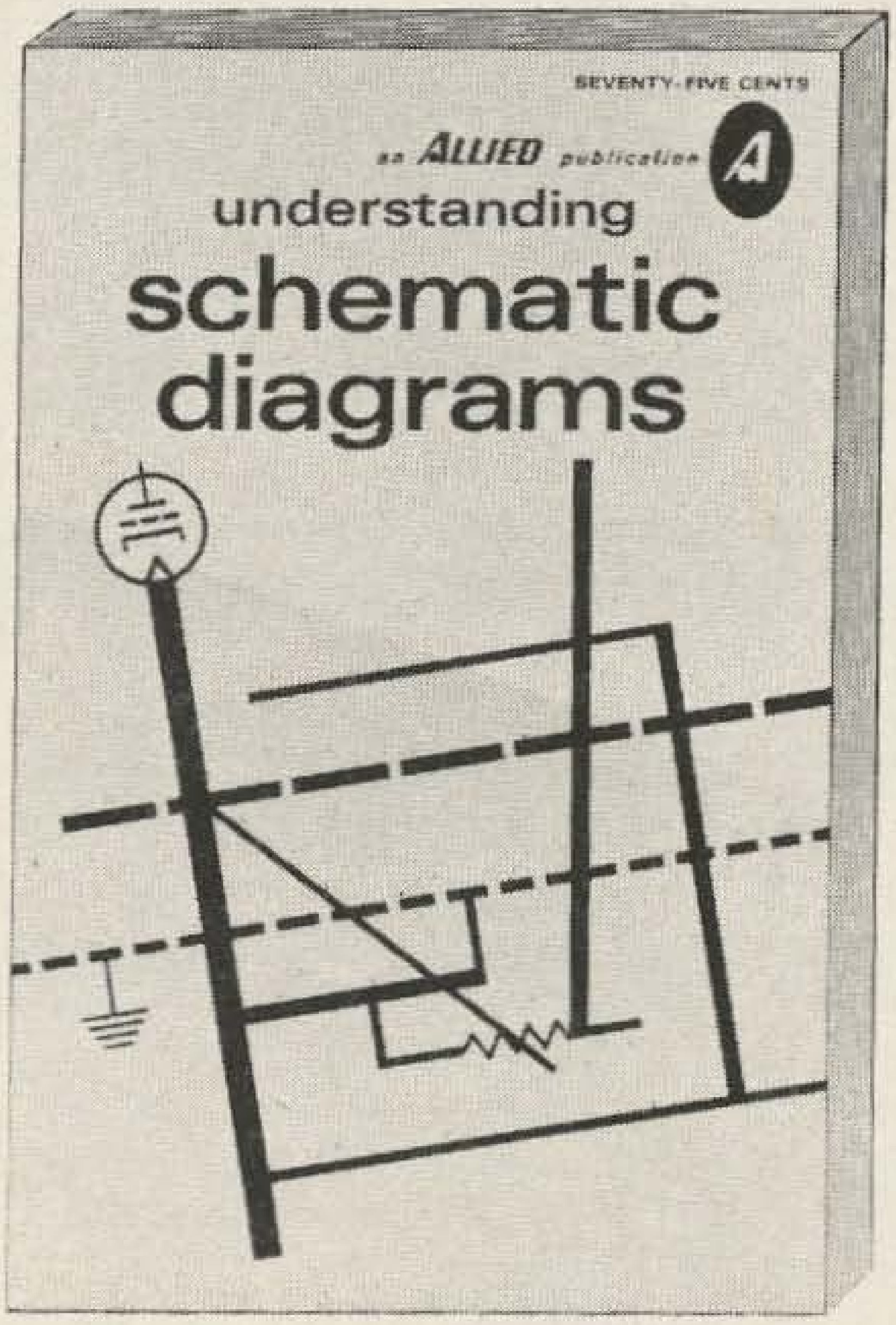
Motorola HEP Semiconductor Catalog

The latest edition of the Motorola HEP Solid-State and Projects catalog introduces eight new HEP semiconductor devices which will be of interest to the hobbyist, ham, experimenter and service dealer. The catalog is available from any HEP distributor or by writing to Motorola HEP, P.O. Box 13408, Phoenix, Arizona 85002.

Northern Engineering Labs Catalog

The new Northern Engineering Laboratories Catalog 367 has a lot of interesting information. In addition to a complete selection of quartz crystals, crystal ovens and oscillators, there is basic information on equivalent circuit theory of oscillators and oscillator design data along with a listing of the characteristics of various crystal cuts, listing the advantages and limitations of each. Material is also given on the selection of a crystal oven. For a copy, write on your company letterhead to Northern Engineering Laboratories, Inc., 357 Beliot Street, Burlington, Wisconsin 53105.

Understanding Schematic Diagrams



This new book, although entitled *Understanding Schematic Diagrams,* covers much more—it is actually a rather comprehensive introduction to the subject of electronics. Edited by Julian Sienkiewicz, the book explains in non-technical language the functions of components, their use in electronics circuits, and the symbols and techniques of schematic diagrams. The material in every chapter is made easy to understand by the generous use of illustrations and diagrams. Two pages are set aside in the back for all of the commonly used electronic symbols. 75c postpaid in the U.S.A. from the Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

1968 Heathkit Catalog

The new 1968 Heathkit catalog, illustrating the world's largest selection of electronic kits, is now available for the asking. This 108-page kit-builder's dream book has 56 pages in color and boasts over 300 kits for every budget and interest. It contains complete lines of amateur radio equipment, stereo/hi-fi components, test and lab instruments, CB, Photographic aids, TV, electronic organs as well as many others.

The new catalog also illustrates actual kit assembly manual pages. Just mail a post card or note with your name and address to the Heath Company, Benton Harbor, Michigan 49022 to get your free copy.

Gus Browning W4BPD
Cordova, South Carolina

Gus: Part 31

In last month's episode, I was on my way to Durban, South Africa via train. I had plenty of time to think along the way, mostly about the radio gear I had in those three suitcases, which the government didn't know I had in their country. Equipment I had been told I would never get out of the country again. Being on a DXpedition, this did cross my mind.

I was met at the railway station in Durban by three well known DXers: ZS5QU, ZS5JY, and ZS5JM; Roy, Oliver, and John. The first thing, as usual, was Cokes for us all. Oh yes, there are Cokes in South Africa, but by the time I departed there were a lot less.

I visited Roy's QTH first, where I met his beautiful wife, Pam, and got a demonstration of the hard way to control a VFO. Roy lived on the top floor of about a six-story plush apartment and was using some rather old surplus-looking gear. On one which has been designed as a crystal controlled rig, Roy had installed (I use the word installed rather loosely) a home brew VFO. Now, fellows, I have seen lots of VFOs, and have built 35 or 40 of them myself, but to this day I have never seen one that was built more haywire than that VFO Roy had hanging out of the side of his rig. His rig was turned up on its side, and he told me it has always been sitting that way. The VFO was only supported by the wires from it to the rest of his rig and the VFO's power supply. Now get this . . . it had no tuning capacitor to change frequency. To change frequency, he turned the slug with a small screwdriver, and when the screwdriver touched the screw in the VFO, the frequency jumped about 43.7 kHz. Plus this, his hand made it change 11.2 kHz when it was placed near the VFO while tuning it. Can you picture Roy trying to zero in on a station? Well, he could do it. I tell you fellows, that's doing it the hard way. It involves tuning the receiver 53.9 (thats 43.7 + 11.2) kHz below the station he wanted to zero in on. Remember, the receiver he was using was not too well calibrated either, and this made it that much more interesting watching him. Well, all I can say is he certainly did not tune up on top of anyone by this method. Roy now has a new rig, but that VFO would make Ross Hull turn over in his grave, and T.O.M. weep. It should be placed in the ARRL's museum of real "haywire". The art of haywire may soon be gone, and, if possible, should be revived before all us oldtime haywirers are pushing up daisies.

Anyhow, there I was at the home of Roy and Pam, after all the many QSOs I had had with him all these years. Roy is a young fellow and I would estimate his age at about 30 when I was there. He had a very efficient antenna (a ground plane) and it was defiinitely not haywire. How Pam stood for that haywire rig and VFO in that modern up-to-date apartment, I don't know, but they were a happy couple and looked as if they were living a very nice life.

Next, we went over to John's (ZS5JM) operating site, which was on the outskirts of Durban. It was some five to ten miles from the city, down beside the beach. His father and mother lived there year round, and John and his wife, Maureen, usually stayed in the city during the week and came out there on the week end to operate, swim and boat.

I have a strong opinion that John went there mostly to do some DXing. He had a fine looking rig that used either one or two 813's and a 3-element beam that was hand tuned. Boy, this beam sure did make those W/Ks boil through, some of then S-9 plus. I told John I wanted to return there with my rig and set it up and do a little operating from that QTH with that beam. The beam was on top of a 50-foot homemade tower. This tower looked almost exactly like a windmill tower, only it was made from wood and it was unguyed.

After drinking a few more Cokes and

talking to John's mother and father for a wonderful eyeball QSO, Oliver (ZS5JY) and I departed for his QTH some 30 or 40 miles down the coast from Durban. Oliver had a Mercedes-Benz and he had a real heavy foot, too! With that high speed traveling, we covered those miles in very short order. Oliver's home is out on a sugar cane plantation, which covers a tremendous amount of acreage. I don't really know how much, but a wild guess would be maybe 10,000 acres and his house is about in the middle of it. He had plenty of Cokes in the Fridge.

In the garage, there were two Mercedes-Benz, both exactly alike. One for the nice XYL, and one for Oliver. His station was very nice. He had a Collins S-line and even a 30L-1, which he called his "beam". In the yard, besides his private tennis court, was a fine home-brew 5- or 6-element beam on top of a good high windmill-type tower. I found that Oliver could *tune* the beam from the operating position with two push-buttons and could get the SWR down to 1:1 on any part of the 20-meter band. I think the two push buttons controlled a small motor that, in turn, tuned a capacitor connected to the Gamma rods, or something like that. Anyhow, it worked great. Oliver turned over the station and his home to me and told me to go in the air whenever I wanted to, stay up as late as I wanted, and sleep as late as I wanted. He said to help myself to the cokes, and if I felt like it jump into the swimming pool. Now, fellows, this was what you might call DXing *deluxe*. I had three weeks to wait for my ship, so I had some mighty fine QSOs from there. Although ZS5 is not rare enough to be exciting, I had some little pile-ups from there when I turned up on my usual frequencies for the Gus watchers.

I had plenty of time to visit all around the place, and saw many ZS5 stations, and as usual, I found all of them just as nice as DX'ers I met at all the other places I had visited in my travels.

Oliver even had a big get-together one night for me. All the ZS5's from around Durban showed up, and there was quite a bit of drinking, fancy eating, swimming, etc. As for myself, I never had it so good. While they were drinking all kinds of stuff, I stuck to my Cokes, as usual. Oliver was a wonderful host, and the gathering was a very nice one.

Oliver was a graduate of some sugar institute in Louisiana, and was a good friend of Ack's (W4ECI) while he was going to school there. Oliver has a sugar refinery where all the sugar cane is squeezed out, the juice boiled out, and it all ends up as some of the best sugar in the world (according to Oliver). This is a very modern refinery and all the very latest machinery and methods are used.

Plenty of the ZS5 fellows were always on hand to take me here and there when Oliver was tied up with his business. Many hours were spent in Durban watching the Zulu Rickshaw boys with their colorful costumes. They are very tall, husky fellows and never did seem to tire out when they had a paying customer in their rickshaw. They could cut flipflops right in the middle of traffic and not even let loose of the two handles of the rickshaw. Those rickshaw boys were about the happiest lot I have ever seen anywhere. We visited museums, zoos, and snake houses. Lots of interesting times and sights were seen and had in and around Durban, South Africa. It is a sea-port city with wonderful temperatures they say, all year round. Oranges and other citrus fruits grow well there, but to me it looked as if sugar cane covered the most acreage.

I visited ZS5QU any number of times and for some strange reason that VFO always seemed to draw my eyes in its direction. I spent a number of days out at ZS5JM's QTH, operating right on the seacoast with his beam. The long path openings to the states were fantastic.

Time was coming to depart, and I began thinking about how to get that radio gear out of the country so I could take it home with me.

Note: Well, Peggy and I are back from our vacation and things are beginning to jump again with my *DXer's Magazine*. I did get up my 150-foot tower and now am starting on the 4-element tri-band quad to put on top of it. I gotta get this job done before cold weather sets in. Plus the fact that I want to be able to hold my own in some of the DX pile-ups which are heard occasionally on the bands. Looks like I may have a 40-meter quad up one of these days too, so look out, fellows. I am tired of being trampled on. I want to come up for air and I hope I will be in there with the top layer boys again.

. . . W4BPD

Letters

Bricks and Bouquets

Dear 73,

I wish to thank you for your article "A Stable VFO for SSB" in the November 1964 issue of *73 Magazine*. I built this unit for a total cost of less than $6.00 and used the chassis, cabinet, tuning coil and capacitor from an old Heath VF-1 VFO. It works beautifully. Drift is about 100 Hz, which is negligible.

I have built several small projects and found your VFO to be the most satisfying one so far. Thank you.

Fred W. Fetner, Jr. WB4EFA
Rock Hills, South Carolina

Dear 73,

I would like to compliment you on the series, "Climbing the Novice Ladder". I am not a ham yet, but I found it was a help and encouragement to me.

Joe Martenson
Santa Rosa, California

First let me thank you for the fine job on *73 Magazine*. I have taken it (plus *CQ* and *QST*) ever since it came out, and have gotten many fine ideas and information from it. It carries so much more construction dope than the other two.

I also purchased from you, the fabulous *RSGB Handbook* some time back, and it is so good that I also purchased from you recently, the *Technical Topics for the Radio Amateur*, by Pat Hawker. It really is a gold mine. Thanks again for your fine magazine, and keep up the good work.

Chester M. Benson W9IFB
Richmond, Indiana

Dear 73,

After reading your DXing aricles in September 73, I won't "bug" you with the details of my vertical and 150 watts of CW. But you bug me at times. But I enjoy the magazine, so no matter how outrageous you get, I will still subscribe for the excellent constructional articles.

The SSB/AM hoo-hah is a dilly! It's "yak-yak", no matter how it's dressed up. A good el-bug in the hand of a good man can make sweet music to the initiated, as you well know. Keep on the good work and more power to your elbow.

R. W. Armstrong G3PGC
England

Dear 73,

In reference to the SSB versus AM controversy, after being away from the amateur radio bands for almost two years, I honestly did not think the battle would still be.

The world is changing, and with it—man. Because we are advancing technically, there has developed a problem, not of credibility, but compatibility. Since history, this pattern has been repeated by man. In the end, progress has destroyed or modified that which is not compatible with present or future needs.

Carefully, slowly, and with difficulty, the old is replaced. For science is a search for truth, and the truth renovates and reshapes the old making it useful. Unfortunately amateur radio, being a hobby cultured by individual attitudes, ignores what is fact and fantasy.

The next time one "gets on the air", he should think: Am I doing what amateur radio is—not what it was, or will be? Am I in any way contributing to the advancement—not of amateur radio—but to welfare or mankind and this society in which we live? Am I so selfish that I will disdain possible truths that are of benefit to everyone? Fellows, *stop*, and live a little.

Charlie Channel WA6ZLK
Venice, California

Dear 73,

. . . In your October issue Letters, there is a well written article that just about says what the whole ham radio picture looks like to an outsider. I was going to start a ham club at my high school, but there weren't enough people to attend the code and theory classes. Most kids liked the idea very much, but as one fellow put it, "When you have your license, equipment, and are all primed and loaded, there is such a mess on the air at night after school that there isn't even any use getting your ticket because you won't be heard anyway". I wonder how many of the rest of the fraternity would still be licensed and active if they had to start all over again now.

When I read your Letters column every issue, I find nice little arguments between SSB and AM, with such niceties as "slop bucket, silly side band, stupid slot brain" and others a 13 year old isn't supposed to say. Against the AM crowd are things like "ancient modulation, agonizing mess, etc.", and such things make me mad. I thought ham radio was a hobby of builders and tinkerers, not a battlefield between ancient modulation and slop bucket.

I'm sending my picture so when the two rivals read this they might throw darts at it.

Stephen L. Blakley WN7GUC/WA7GUC
Phoenix, Arizona

Dear 73,

Re your article "The Death of Amateur Radio" in the November issue. I am sure that Mr. Zurawski does not know all the facts! First of all, going through the efforts of passing the examination is a challenge to me. I plan to take the General Exam in a week and hope to conquer that goal. Secondly, I disagree that all hams are appliance operators. I converted my own ARC-5 transmitter, built my own power supply, and strung my own antenna. Since the three most popular Novice rigs are in kit form, I think this indicates something. Sure, SSB is more complicated, so most hams don't risk building it, but there is nary a shack in which there is not some homebrew equipment.

Now look at the kid who has to decide between CB and real radio. He sees this article telling how it's so easy to run a kw on CB. What would you do? Keep this discouraging type of writing out of a fine amateur radio magazine like yours.

Bruce Bursten WN9UVE
Milwaukee, Wisconsin

Dear 73,

"When winter comes can spring be far behind?" We have lost the 11-meter band, and big chunks of the 10-meter band are sure to follow. Although they probably won't take it until after the sunspot cycle has declined, thus catching many hams off-guard or in a mood of indifference.

It is up to us as the most-interested parties to come up with a plan for the intelligent, constructive use of these "empty" frequencies if we expect to lay any claim on their retention by the amateur radio service.

I would like to see the Technician Class privileges extended to include A-3 emission, up to 1000 watts dc input, in the top kHz of the ten meter band, i.e, 29.5-29.7 MHz.

If this were done, an even stronger case could be made for the suggestion of permitting Novice phone operation (75 watts maximum), in the same 200 kHz. Since the typical novice operates mostly on 80-40-15 with a five band rig, and should he turn out to be one of the unfortunate 25% who cannot psychologically cope with the code, he could become a Technician and still operate with the same basic rig.

Should we wish to become really radical, why not let the Technician retain his CW privileges in the novice bands with vfo operation and full power thrown in. Who knows, someday he might finally crack that 13-wpm barrier!

Bill Lindblom WAØMNK
Chillicothe, Missouri

AM on MARS

Dear 73,

In the Letters column of your November issue, you made an unfounded and inacurate statement. I refer to the bottom of page 131, first column, where, in reply to Bruce Cline, you stated, "MARS has eliminated AM operation on all frequencies except VHF". This statement is unfounded and untrue!

Marc Leavey WA3AJR
Adelphi, Maryland

Sorry, this statement should have read Air Force MARS. AF MARS has eliminated AM from the HF bands, showing a progressive attitude.

Incentive Licensing

Dear 73,

Attached is a letter to FCC and their reply. The information helped clear up some points for me—it might help somebody else too.

Ken Piletic W9ZMR
Streamwood, Illinois

Exerpts of these letters follow:
Engineer in Charge
Federal Communications Commission
Chicago, Illinois
Dear Sir,

. . . The written requirement for the Amateur Extra class license consists of Element 4A and 4B. These elements appear to be the same as Element 4 of the Commercial examination. If this is the case, it would seem that holders of a First Class Radiotelephone

License (commercial) have already taken this examination. Would you please answer the following questions for me?

1. Are element 4A and 4B the same as Element 4 of the Commercial exam?
2. If so, is the holder of a First Class Radiotelephone license required to take this same test again in order to obtain an Amateur Extra License? Or would such a person be given an Amateur Extra License upon successfully passing only the code requirement before an FCC examiner
3. Would an Advance Class License automatically be given to General Class license holders who also hold a First Class Radiotelephone license?

Thank you.

Yours Truly
Kenneth A. Piletic

Dear Mr. Piletic,

Elements 4A and 4B of the amateur radio examination to which you refer in your letter, are not the same as Element 4 of the Commercial radio operator examination.

. . . The holder of a first class radiotelephone license is allowed no credit on any type of amateur license examination.

Examination credits on amateur radio examinations are given only to the extent specified in Section 97.25 of the Amateur Rules. Applicants for higher classes of amateur radio licenses should review this section of the Rules for information on examination credits. There are no examination credits except as specified in this section of the Rules.

Very Truly Yours
E. J. Galins
Engineer in Charge

'Limited Class' Licensing

Dear 73,

This letter is about what we can do to save amateur radio . . . There are a lot of people who like to talk and have a mild technical interest in electronics. They could be a valuable addition to "our" ranks. At present these people are untrained and naturally go to the "free" (of tests) license of CB. Couldn't we interest them in ham radio by providing a "Limited Class" license? With time they would provide many full amateurs plus a large source of trained voice operators, an asset to the nation.

The "Limited Class" license could provide for equipment which the operator would not change or adjust (until he obtained full amateur rank). Self policing (which CB does not have) must be written into the regulations. A test should be given which shows basic knowledge of the laws and operating techniques (since they would be principally operators). This is about what it takes to get a driver's license. Let's provide incentive for these new hams by providing what they want . . . a place in the spectrum, for example, with a number of fixed channels in our less used bands. Let's limit the power too, in order to provide incentive to become full rank amateurs, but make the power level higher than CB to entice the more intelligent our way.

Let's keep our minds open and active . . . it's the only way to exist. No fighting among ourselves. SSB has its place on crowded bands but AM still sounds great when it can be heterodyne free. Remember the old days, but look to the future. If we don't, then we are *dead*.

R. C. Wilson WØKGI
Littleton, Colorado

All of the qualities you mention in the "Limited Class" license you propose are incorporated in the Novice License, which was the first step in the incentive licensing program.

ANTENNA NOISE BRIDGE

Dear 73:

As the design engineer on the "Antenna Noise Bridge", I would like to express my appreciation for the well written article in the October issue.

Also, I would like to make one note covering the most common problem with the unit. Several of the units have been returned to the factory for repair because the user was unable to find a null. In every case this was due to the use of a receiver with only ham band tuning capability, and the antenna being tested was outside the frequency tuning range of the receiver. In most cases the antenna had been tuned using a VSWR bridge. A VSWR Bridge will give an indication of a 50 ohm impedance which does not necessarily indicate the true resonant frequency of the antenna. It is only at the true resonant frequency of the antenna that maximum radiation will occur. Typical measurements have indicated a significant increase in antenna performance when tuning the system with an Antenna Noise Bridge as compared to operating on the frequency of minimum VSWR as read on a VSWR Bridge. This is particularly true on high Q mobile antennas.

It should be pointed out that if an electrical half wave length of feed line (or multiple) is used between the transmitter and antenna, the actual radiation resistance of the antenna is relatively unimportant so long as the transmitter will load. The fact that the transmitter sees a pure resistive load is of primary importance. If the feed line is other than a multiple of ½ wave length, the antenna radiation resistance must be the same as the coax. Otherwise, the coax becomes a part of the antenna resonant circuit.

An additional question often asked concerns the use of the Antenna Noise Bridge at high frequencies. The production unit will work satisfactorily on 2 meters. For best results above 100 MC, a small trimmer capacitor across the antenna terminal will compensate for the distributed capacitance of the potentiometer and allow usage of the unit to frequencies in excess of 200 MC. The trimmer will allow the dial calibration to remain accurate over the entire range.

R. T. Hart W5QJR
Engineering Associate
Omega-t Systems Inc.

Homebrew Kilowatt

Dear 73,

Did you ever write an article that you later wished you had not written? I have written several. The latest is the 6KG6 KW amplifier appearing in January 73. The third paragraph states, "It is assumed that the ham who starts out to home brew a kilowatt is not embarking on his first construction project". You wouldn't believe the letters I have received from neophyte hams, who, by their very questions, reveal that they have never built anything at all. So suddenly they decide to build a KW with 2000 volts on it. I sincerely hope nobody gets electrocuted as a result of my article.

I belive you need a good article entitled, "If you want to get your feet wet, start at the shallow end of the pool". Then go on to describe a good linear (or other amplifier) that has a supply of less than 500 volts. Go through it piece by piece and explain what the parts are for and why they have to be within a certain size range. The stock question about the above amplifier was "What's the size of the capacitor between the plate and the pi-network?" This is noted in at least ten places in every handbook in the land. A ham who doesn't comprehend, even vaguely, the purpose and limitations of a dc blocking and rf by-pass capacitor, has no business building anything as lethal as a KW final.

R. E. Baird W7CSD
Klamath Falls, Oregon

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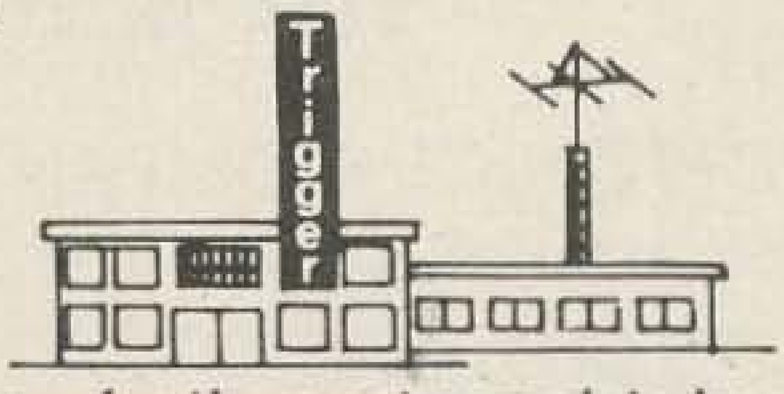

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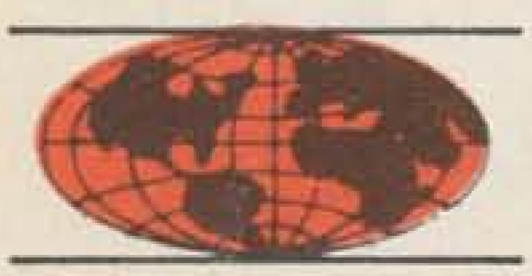

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P&H LA400C..... 117	NC183D......... 199	SB630 CONSOLE.. 74
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CONVERTER SALE: three transistor, 50-54 Mc in, 14-18 Mc out, wired, tested printed circuit. Crystal controlled, $6 ppd. Adjustable, $5 ppd. Syntelex, 39 Lucille, Dumont, N.J. 07628.

GRAVELY TRACTOR 30" Rotary, 30" Reel Mower, 48" Snoblade, Chains, Governor, Oil Gauge, Hitch, MINT. Cost $750. Trade for TR-3 and DC or SBE 34. Nathan Vance, 908 N. Countyline St., Fostoria, Ohio 44830.

DAYTON HAMVENTION April 27, 1968—Wampler Arena Center, Dayton, Ohio, sponsored by Dayton Amateur Radio Association. Informative sessions, exhibits, hidden transmitter hunt and ladies program for the XYL. Watch the Ham ads for information or write Dayton Hamvention, Box 44, Dayton, Ohio 45401.

WOULD LIKE TO CORRESPOND with a Ham or SWL in Israel. I am 23 years old, male, interested in sports, photography, electronics, & motorcycles. I would also like to receive any Hebrew magazines. I will answer all letters. Wm. Rothstein K3WOL, 341 E. 3rd., Erie, Penn. 16507 USA.

JOHNSON INVADER 2000, legal input on SSB and CW, 800W on AM. Excellent condition, $425. Ed Carpenter, Rt. 7, Box 152, Fairmont, W. Va. 26554.

8121 TYPE TUBES WANTED. Any condition; but state condition and price. R. W. Campbell, W4KAE, 316 Mariemont Dr., Lexington, Ky. 40505.

UPM-70 OS-56. Need schematic or manual. Tom Shinal, W4HCP, 2331 John Marshall Drive, Apt. 101, Falls Church, Va. 22044, 703-532-5899.

TOROIDS: 88mhy, unused, center-tapped, 5/$1.50 POSTPAID. RTTY paper, $3.50/case. Hallicrafters HA-8 Splatter guard modulation indicator $8.50. Ameco CN-144W two meter converter with P.S. $35. Globe/Chief 90A $38. Mainliner tt/L RTTY T.U. $75. Heath TC-2 tube tester $15. Viking tape deck #75 with preamp $45. Typewriter; Royal, 20" carriage, touch/control, table, perfect $35. Dumont 324 scope, $30. Ballentine 300, $35. WANTED: NC-300, Gonset communicator for 2 meters. Rotator, AM mono tuner. Stamp for list. Van W2DLT; 302X Passaic, Sterling, N.J. 07980.

COLLEGE CALLS: must sell NCX-3, NCX-A ac supply, NCX-D dc supply, Hustler (mast, 80 & 40 coils). Package only $375. WA9RNP, 1211 Fairfield, Indianapolis, Indiana.

SELL DRAKE 2B with book $190.00, Johnson Navigator with book $65.00, both very good. James Brennan, RFD #1, Exeter, N.H. 03833. Tel. 642-3421.

WRL's used gear has trial—tradeback—guarantee —terms. SB34—$284.95. 650 & VFO—$89.95, HQ170AC—$239.95; HQ110A—$159.95; 753—$119.95; SB300—$249.95; SR150—$269.95; SX110—$99.95; SR46 —$99.95; G76—$99.95; 75S1—299.00; 62S1—$589.00; Thor 6 & VFO—$169.95. Request free "Blue-Book" hundreds more. WRL, Box 919, Council Bluffs, Iowa 51501.

QSL CARDS???? Samples 35¢. Sakkers Printery, W8DED, Holland, Michigan 49423.

GONSET GSB-2 Communicator w/ac supply $250. Heath HW-22 Single-bander $95. Ray Hein, 147 Grandview Circle, Camarillo, Calif. 93010.

TRADE: General Radio Strobotac, for test equipment CB transceiver Model RC airplane gear, or what have you. W9BPG, 609 Henrietta St., Gillespie, Ill. 62033.

GOING OFF THE AIR—send $3.00 for surprise package. Collins 75A3 $250—Globe Champ 300 $150 —Millen 90651 GDO with 9 coils $40—Hickock 610A TV generator $35—LM20 with P.S. and book $65—LM18 with P.S. $35—60 ft. tower $60 local—TA33 Jr. beam and CDR rotator $50 local—TS239/UP scope and spare tubes $85—2 RCA 7094 tubes new $15 each—UTC CVM3 new $10—Millen 90501 secondary frequency standard as is $20—Triad 33A choke $5—2 Superior powerstats, 7½A type 116B $14 each—1st cashiers check or postal money order received—pastage extra—K1ABE, 130 Bishop Ave., Rumford, R.I. 02916.

FOR SALE—Heath HW-12A with xtal calib. A-1 cond. $105 plus shipping. Getting SB-101. Laurence B. Smith W7FOM, 441 Minnesota Ave., Rte. 4, Missoula, Mont. 59801.

TRI-EX 88' tower, $150. 85' 50 ohm coax, $25. Will deliver within 100 miles of Reno, Nevada. Paul Etcheberry, WA7GHQ, 1220 S. Marsh Ave. 89502.

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SALE: Adventurer $30.00. Heathkits: VF-1 $10.00, QF-1 $4.00, AR-3 $14.00. Morrow 5BR-1 Converter $35.00. Worked 106/60 countries with listed gear. Hallicrafters S-40A $35.00. Zenith S-700 Novice receiver, hardly used, $45.00. K9WVJ, Box 3679, Air Force Academy, Colorado 80840.

WANTED: Record, tape, or lyrics of the song "Gloomy Sunday" from the early 1930 era. WØHJL, P. O. Box 224, Dublin, N.H. 03444.

TRADE: New Wheatstone Perforator; DAVCO DR-30 receiver; RCA SSB-30M transceiver; Mite TT-299 teleprinter; National 200 transceiver. Roy Brougher, W4RRU, 3743 Wesley Drive, Montgomery, Ala. 36111.

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P&H LA400C—$89, DX60A $49, HG10B $29, HW32 $89, HP13 $39, H. brew AC for HW32 $25, HW29 Sixer with GP11 DC supply $35, presentation Vibroplex & case $19, Heath AT-1 $19, Navy RBM4 200kc 21 mc—2 recvrs & AC supply $35 all working with manuals. D. Goetcheus W2QH, 92 Genesee St., Greene, N.Y. 607-656-8083.

TELETYPE TEST SET I-193C. Brand new surplus. Tests RTTY transmitters, converters, relays, $24.95, F.O.B. Harrisburg, Pa. Telemethods International, P. O. Box 18161, Cleveland, Ohio 44118.

GEARFINDER: What gear do you need? What gear do you have to sell or swap? Send list to: Gearfinder, 8848 East End Ave., Chicago, Illinois 60617.

ARC-3: SELL two ARC-3 xmtrs, one ARC-3 rcvr, all three complete with tubes for $40. Mann, 4404 Judith Lane, Apt. 1-a, Huntsville, Alabama 35805.

FOR SALE: HRO-60 communications receiver, good cond., with speaker, xtal calibrator and CE Sideband Slicer, $200. HT-32 xmtr, xlnt cond., $200. 4-1000A bandswitching 10-80m. GG linear amplifier with 4,000 vdc power supply, $300. W6KW, 11422 Zelzah Avenue, Granada Hills, Calif. 91344.

WANTED—Serviceable FM communications equipment such as General Electric or Motorola, for use in six and two meter ham bands. Please include model, type, condition, price, and quantity in first letter. K5ZEG, 14221 Sommermeyer, Houston, Texas 77040.

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SBE-33 135 watt 80-15 ssb xcvr—$180; Heath SWR meter — $9; Shure 444 Dynamic mike — $13; WB2VTP, Don Nausbaum, 167 Loines, Merrick, New York 516-Ma 3-5808.

WANTED: TEST EQUIPMENT, laboratory quality such as Hewlett-Packard, General Radio, Tektronix, etc. Electronicraft, Box 13, Binghamton, N.Y. 13902. Phone: (607) 724-5785.

PANDORAS BOX transceiver wanted. Write Hemly WA4UQQ, Savannah, Ga. 31402.

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COMMUNICATIONS SPECIALISTS Transmitters-receivers repaired—Kits wired, tested—Custom building—Product detectors added—Receivers updated—By Licensed Engineer—Lab equipment. J-J Electronics, Canterbury, Conn.

APACHE & SB-10, very clean, all manuals, cables and coax relay included. $140 or best offer. Jim Moorman WAØDIC, 1223 Ninth, Ames, Iowa 50010.

SELL: AN/SRT-14 Ø-275 RFO units, AN/FGC-29 NBFSK filters, SASE for list. Need manuals for AN/SR-14 Ø-275 RFO. L. P. Siggen, WØHLT, 512 McDonald Rd., Leavenworth, Kansas 66048.

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SB1-VOX for SBE-33. Operates fine. Came with used SBE-33, and I don't use VOX. Make offer. Will ship post-paid. Miller, 182 Stribling, Charlottesville, Virginia 22903.

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TRADE, new boxed solid state Ameco .54 to 54MC receiver, performance will surprise you. Need government surplus and tubes. Send swap list. Slep Electronics, Highway 301, Ellenton, Florida 33532.

LAWTON-FORT SILL HAMFEST—February 11, 1968. Contact David R. Tancig WA9FRE/5, 1923 Kinyon, Lawton, Oklahoma 73501.

HAMMARLUND HQ170A. Perfect, original carton, manual. First $235 takes. Failed exam! Theo. B. Younger, 913 St. Marys Ave., Janesville, Wis. 53545.

WHEATON COMMUNITY RADIO AMATEURS (WCRA) will hold the sixth annual Mid-Winter Swap and Shop on Sunday, Feb. 18, at the DuPage County Fairgrounds, Wheaton, Illinois. Hours—9 AM to 5 PM. $1.00 donation at the door. Refreshments and unlimited parking. Free coffee and doughnuts 9-10 AM. Contact K9GHR, Ken Bourne, 305 Maple St., Glen Ellyn, Ill. 60137.

HAMVENTION will be held Saturday, Feb. 17, 1968, by the Utah Council of Amateur Radio Clubs at the Utah Technical College in Provo, Utah. VHF, DX, ARPSC, MARS, and other group discussions. Special program for the ladies and entertainment for the kids. Contact Bryce K. Anderson K7SAI for registration information. 445 North 300 East, Pleasant Grove, Utah 84062.

MUST SELL: NCX-3 Xcvr and NCXA ac P/S, both excellent $250 or best cash offer (or offers). Gordon Olson, 708 E. 7th, Duluth, Minn. 55805.

HF-VHF-UHF communication and instrumentation products for amateurs. Catalog 25¢ refundable with first order. Mailing list. Radiation Devices Company, Box 8450, Baltimore, Md. 21234.

MOTOROLA new miniature seven tube 455 kc if amplified discriminator with circuit diagram. Complete at $2.50 each plus postage 50¢ each unit. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

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• Tube Cartons: 6AU6 etc. size, $1.75 per 100. 6SN7 etc. size, $2.10 per 100. 5U3GB size, $2.50 per 100. 5U4G size, .03c each.
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• 10 Flangeless Rectifiers, 1 amp, 400 to 1000 p.i.v. Cat. #RS10, $2.98.
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• 2 Silicon Controlled Rectifiers, 1 amp, general purpose units with instructions. Cat. #SCR 1, $1.00.
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32-S3, $525; 516-F2, $75; 75S3, $400; 312-B4, $125; SB-200 linear $175; HO-10 monitor scope $50. 10% off on package deal. K1VCB, Fern Belanger, 61 Lafayette St., Fall River, Mass. 02823.

NATIONAL INCENTIVE LISENSING POLL: Tnx to all who voted. QRM to many who did not. Poll submitted to FCC as you read this. Vast majority against incentive licensing. Final figures soon. Seems hams have not been faithfully represented by any organization. WA2NOD, Box 685, Moravia, N.Y. 13118.

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3	.40	.50	.60	.85
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** 18	1.50	Query	Query	Query
45	2.25	2.70	3.15	4.00
160	5.75	7.50	Query	Query
240	14.40	19.80	23.40	Query

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