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Kayla Bloom W1EMV
Editor

Published by
Wayne Green, W2NSD/1

Cover

K6MIO Dishes up a measured 16.9 dB with his 12.5 foot antenna at the Fresno VHF Antenna Measuring contest. He won the contest.

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Editorial Liberties

Recently, on TV, there has been a series of ads put out by the Cancer and Heart Associations showing how children learn from their parents and tend to imitate their actions. These ads all end with the question, "Do you smoke?". Now, I am not going to give you any lectures on smoking, since I use the filthy weed myself. I merely use this to illustrate a problem we have in ham radio.

About a month ago, I was at a luncheon meeting where an ARRL Division Director loudly complained about the terrible operating habits of the newcomers to ham radio. He droned on and on about how the newcomers were ruining our chances for frequency allocations and are to blame for all our troubles in amateur radio today.

I can't help thinking that as the child learns from his parents, so the newcomer learns from the old-timers. Incidentally, the definition of an "Old Timer" is anyone who has been licensed longer than you have. It is the obligation of each ham to see that his operation on the air is courteous, legal, and within the bounds of good manners. This is not too difficult, but we should all remember that someone new will be learning from us.

My dictionary defines the word "communicate" as: An exchange of ideas by speech, writing or signals. Note that it says *ideas*. Listening to the average QSO on the air, I get the feeling that there is little communication going on. There is an exchange of *information* such as the kind of rig, the signal report, names, addresses, and a FB OM, CUL ends the contact.

There is no set formula for getting a QSO going on an exchange of ideas, but we should try to toss out some tidbit to begin a stimulating exchange. Granted, there are some who are not interested in communicating and nothing you will say gain more than "By the way, what's the rig on that end". However, with the majority a leading question like "What is your occupation?" will usually draw a response and will be countered with a question which will give you something to go on and thereby begins a *communication.*

The exchange of ideas is especially rewarding in a QSO with a station from another country. Granted, Rag-Chewing with "rare" DX is frowned upon, unfortunately, and in these cases all you can hope for is an exchange of information, *not* ideas. But the less exotic DX is usually not only willing, but eager to talk, not only about rigs and antennas, but about themselves and their families. They will answer questions you may have about their way of life, and furnish the opportunity to travel while sitting in the ham shack. The most rewarding part of this kind of communication is the friendships which often develop and grow over many years. Try communicating once in a while and your enjoyment of ham radio may increase.

Having spent the past month searching the files to see just what interested articles are available for future issues, I would like to call for authors to produce. For the past year, there has been a lax policy about prompt payment of authors. I was shocked to find that there were dozens of authors who's articles had been accepted, but who had not been paid on acceptance. As of now, this has been rectified and all payments are current. *They will remain so!* The payment policy is payment on acceptance. The system goes like this: You send in an article for our consideration. If, in my judgment, it is suitable for 73, I will write you a letter accepting it and telling you how much your payment will be. As soon as you accept my offer of payment, a check will be sent to you and your article will be processed for publication as quickly as possible.

At the moment we need VHF articles. The magazine has neglected the VHF angle for the past year and the files are bare. Of most interest would be construction articles using ICs. No conversions or modifications of commercial gear, please, unless they are really unusual and have the approval of the manufacturer. Commercial equipment reviews will usually be rejected unless you are well known to us and have done writing for us before. However, if you

(*Continued on Page* 84)

de W2NSD

never say die

The latest issue of Interadio, the International Telecommunications Union publications, has some sobering words for amateurs. We have our amateur radio frequencies not, as so many amateurs believe, as a gift from the FCC, but as the result of the ITU agreement between 133 countries. And if we lose our frequencies they will not be lost at Washington, but in Geneva.

Few amateurs in the U.S. realize just how precarious our position really is. Most of those 133 ITU member countries are on record as being officially in favor of cutting our amateur bands and, if they are ever given the chance, it is quite likely that we will come out of the conference badly pruned.

Time is on our side. Technical developments will eventually relieve the pressure on our bands as other services change over to cables and satellite communications. This may be in the near future here in our country, but it is still further off than most other countries can see. So, in the meanwhile, we will continue to exist as long as a new ITU conference can be stalled off.

Amateur radio has friends in high places in the ITU and in many foreign governments. An understanding of the long range benefits of amateur radio is gradually becoming more evident in many countries. They are beginning more and more to realize that amateur radio is much more than a hobby for the wealthy, it is a primary training ground for electronic technicians and, frequently, one amateur station can reach more of a listening audience than millions of dollars spent on short wave broadcasting.

The Interadio editorial says, "There is one thing going on in the amateur world today that bids fair to cancel out all our attempts to popularize and publicize amateur radio with the world's radio Administrations. Some amateurs, on DXpeditions, have been using call signs that they themselves invented for the purpose and which are registered nowhere officially. To quote No. 735 of, the Radio Regulations, Geneva, 1959—these are the international regulations governing radiocommunications of all kinds—'Transmissions without identification or with false identification are prohibited.' Now that is clear and unambiguous, and that writ runs in the 133 Administrations of the world that are members of the ITU. We all know that a stiff fight is ahead for us to save the amateur bands, and so it is the height of folly for any amateurs to be so thoughtless as to present the opponents of amateur radio with a first-class, legal, and unanswerable case that radio amateurs are using their bands irresponsibly."

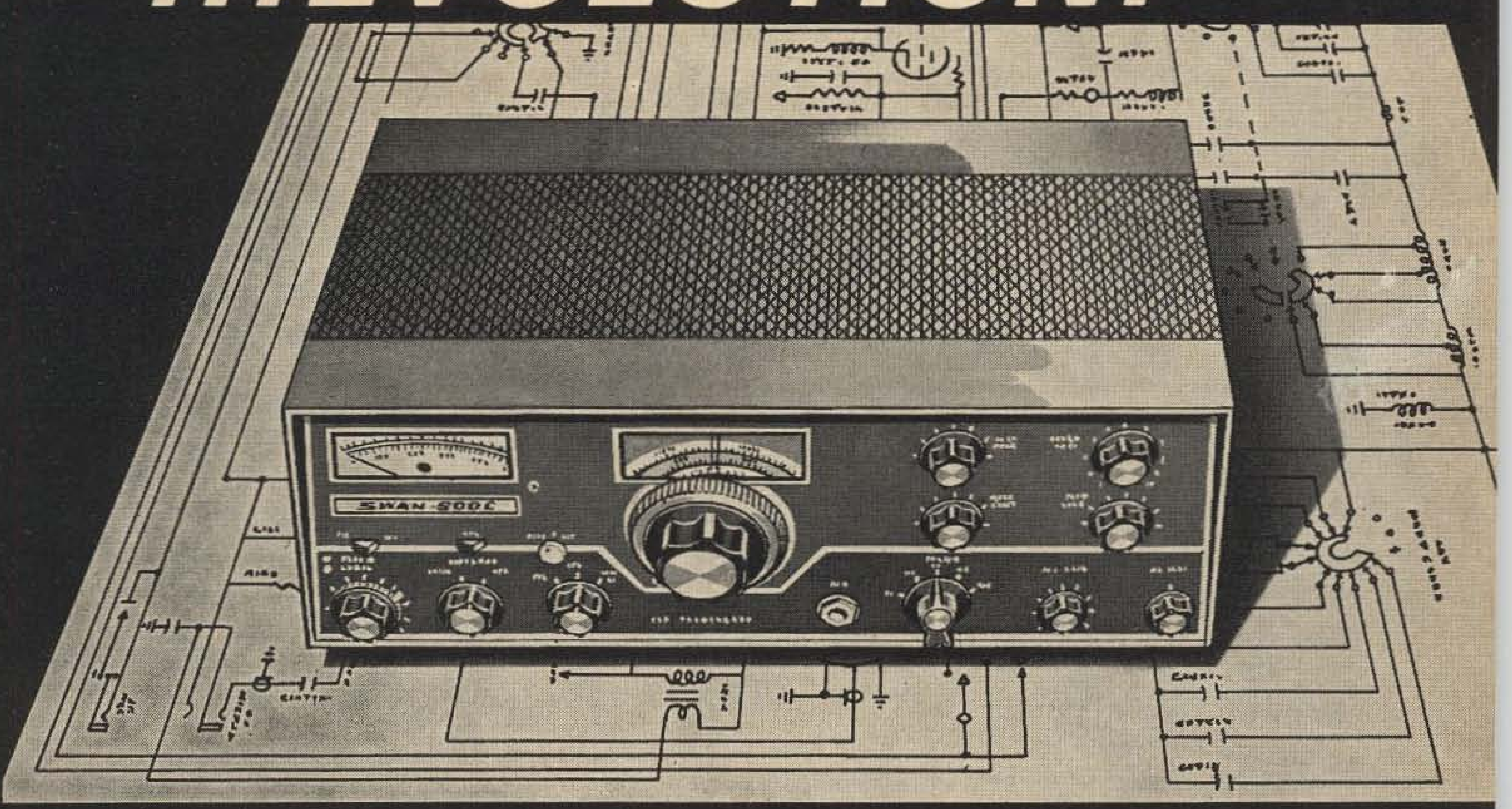
The "they" in this case seems to be Don Miller and his self-appointed prefixes such as 1S9, 1M4, 1G4, etc. These prefixes are absolutely illegal and I am surprised that the FCC has not taken action to reprimand Miller for his flagrant breaking of international law. I am also disappointed in the ARRL for giving credit for some of the operations using these illegal call signs. It wouldn't surprise me if the ARRL were to reconsider their earlier hasty decision in this manner and delete DXCC credits accordingly.

Perhaps CQ will also reconsider their decision to champion this man who is such an international disgrace to amateur radio. Perhaps they will also name a new winner for their DX contest, which Miller supposedly won from Minerva Reef using the made up 1M4 call. Those of you who enjoy doing a little research will be interested in comparing the Miller pictures and description of Minerva Reef with the book Minerva Reef by Olaf Ruhen published in 1964 by Little, Brown. After reading the book one wonders just what Minerva Reef Miller visited.

Well, enough about Miller, I think he has been grounded by the DX fraternity. The harm that he has done is incalculable. This means that all of us are going to have to work that much harder if we are going to see amateur radio through the hard days ahead. And there is much that we can do. . . every one of us can help.

While not many of us are in the position where we can go traveling around the world talking with the radio Administrations in the foreign countries, selling the benefits of amateur radio to them, we are in a position to get on the air and see that amateur radio puts its best foot forward to the world. All of us have a clear responsibility to keep our bands as clean as we can. When you hear someone on the air making an ass out of himself you should delegate your-

...EVOLUTION!



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Narrow Band Frequency Modulation

Introduction

The NBF Modulator to be described has been designed around a component known as a Voltage Variable Capacitor and is being sold under the tradenames of Varicap by TRW Semiconductors Inc. and Semicap by the International Rectifier Co. The writer has found no appreciable difference, performance wise, but local availability has sometimes dictated choice.

Electrically they are diodes, have polarity, are fairly unaffected by heat, are voltage sensitive and are usually reverse biased with a low dc voltage when used as a Narrow Band Frequency Modulator. They are the simplest, least costly frequency modulating device available and are capable of providing 100 percent modulation for a kilowatt transmitter at full CW rating at a cost of less than $5.00 for the modulator and a stage of microphone pre-amplification.

Physically, they are the size of a quarter watt carbon resistor for the Varicap and a top hat rectifier look a-like for the Semicap. In spite of their small size, they are capable of performing functions normally requiring tubes or bulky mechanical equipment. We have in mind mechanical sweep mechanism, or saturated choke inductors such as are used in sweep signal generators or similar instruments calling for frequency modulation.

Used as a NBF modulator, the Voltage Variable Capacitor, hereafter referred to as V.V.C., will change capacity with application of any voltage across it's terminals, and the resulting change will be nearly linear for a comparatively large change.

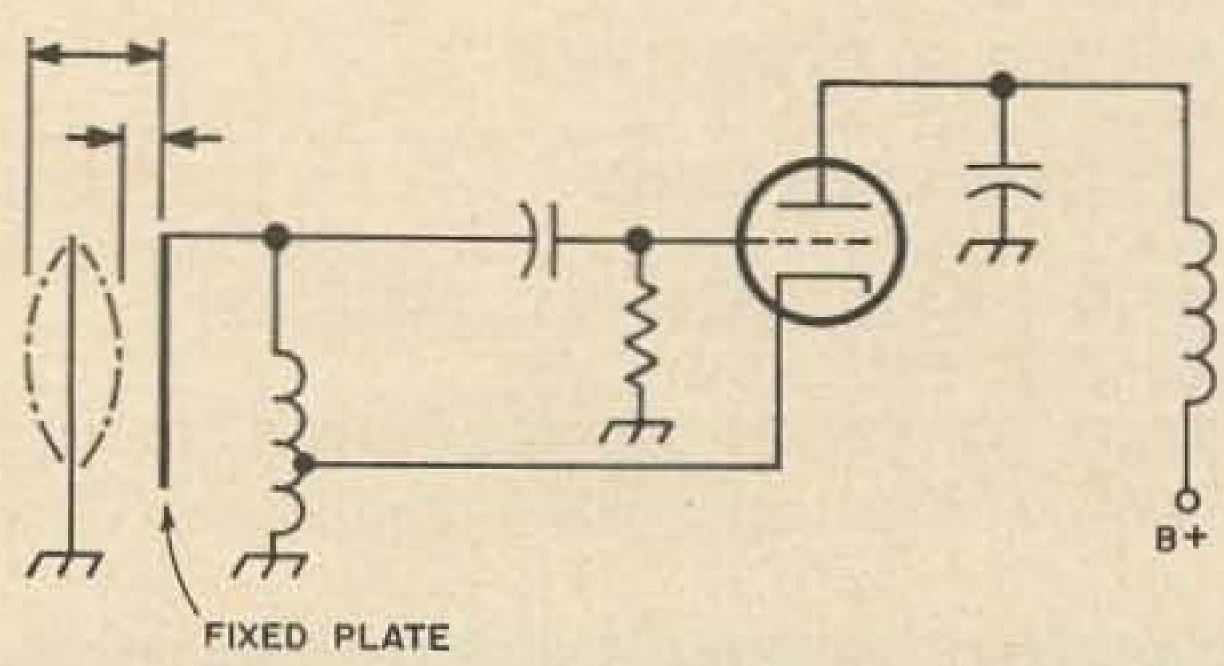

Fig. 1. Capacitor microphone frequency modulator.

See **Fig. 3.** Since the V.V.C. as a frequency modulator becomes part of the oscillators tuned circuit, any fraction of audio voltage across it's terminals will cause the V.V.C. to change capacity in step with the applied, audio voltage, thereby producing almost perfect *direct* frequency modulation. The frequency change, due to the audio voltage, appears to be linear over a fairly wide frequency deviation from resting or center frequency.

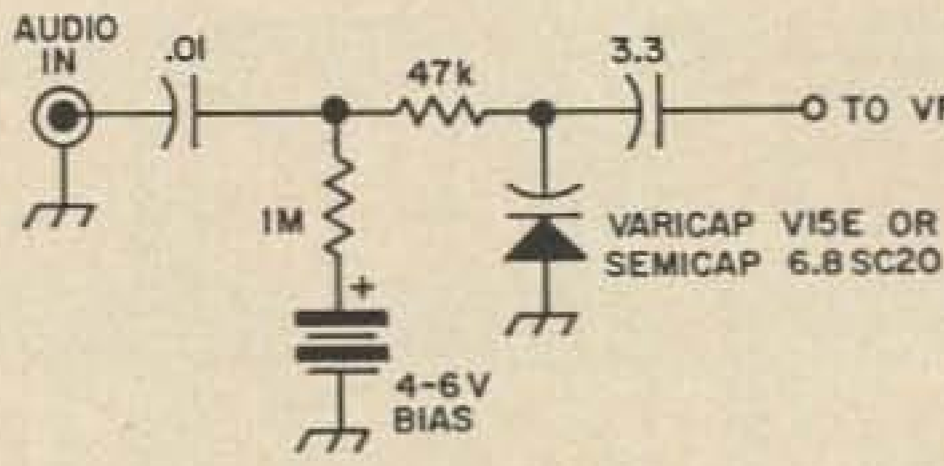

Fig. 2. Basic varicap frequency modulator.

Frequency modulating systems:

The V.V.C. as a modulator is possibly the nearest thing to the classical example so often described in textbooks; wherein the tank coil of an oscillator is shunted with a capacitor microphone; and where the minute capacity variations of the microphone, when spoken into, add to or subtract from the total static capacity across the oscillator's tank coil and in this manner produces Direct frequency modulation. A seemingly simple idea which never did work out well in practice. One of the main reasons was of course the required use of the highly special and costly microphone, since no other microphone available could provide the necessary capacity variations.

The only restriction a V.V.C. imposes upon an oscillator to be frequency modulated, is that the oscillator is not of the extreme stability type. Crystal controlled and some high C/L type of oscillators do not lend themselves very readily to the *direct* type of frequency modulation. Crystal controlled frequency modulated transmitters usually employ the *indirect* or phase modulation method, in which modulation is introduced into a

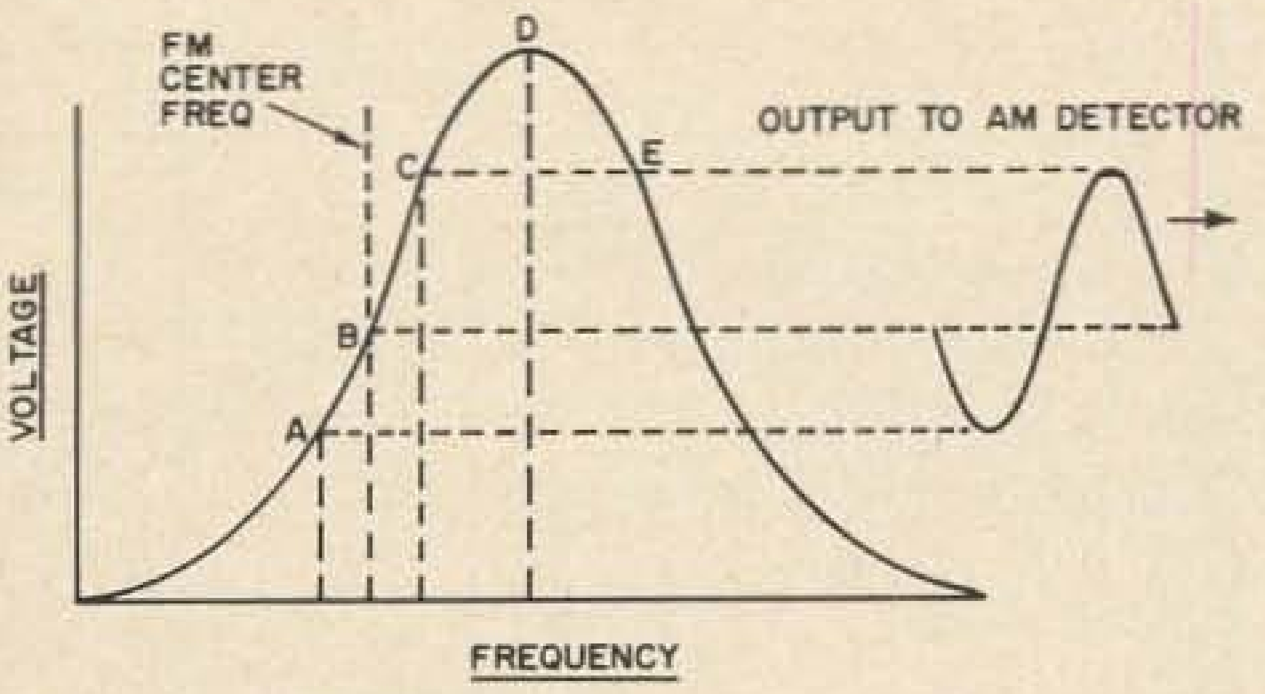

Fig. 4. Slope detection.

the transmitter, in this case, is set at a lower level than normally is used, in order to match the bandwidth of a possibly very selective receiver. If all conditions are right, the only indication a receiving station may experience, is a low S meter reading with considerable audio.

For a better understanding of the slope detection method, **Fig. 4** and the following, should be helpful. Admittedly, slope detection is not the most desirable way to receive an FM signal. For amateur use of NBFM, where the total bandwidth is usually less than 5 kHz, slope detection can, and will, produce a pretty good audio signal at the receiver's output. For the ultimate in FM reception and to do full justice to a still very fine mode of communication, with it's many advantages over AM and even, under certain conditions, the SSB mode of operation, a receiver of the limiter-discriminator, limiter-ratio detector or quadrature detector type is a must. In spite of it's seeming shortcomings, slope detections permits the owner of an AM receiver to copy NBFM signals in pretty good style. That is something which could not be done with the same receiver trying to copy SSB without the benefit of a product detector and/or a BFO.

When the carrier of an NBFM signal falls on the sloping side of the rf response curve (See **Fig. 4**) in an AM receiver, the frequency variations of the FM carrier are converted into equivalent amplitude variations. This conversion results from the unequal response above and below the carriers center frequency at point B on the curve. Consequently, when the incoming signal is **less** than center frequency at point A, the output voltage is at it's minimum or negative value and when the signal swings to point C on the curve, the output voltage is at it's maximum or positive value. This available voltage can be fed to the regular AM detector where the original FM audio will be recovered. The obvious nonlinearity of the response curve would be detrimental to wide band FM reception using the slope detection method, since the most linear portion of the response curve has a limited frequency response. With NBFM, where the required frequency response is limited to voice frequencies of approximately 3000 Hz maximum, the undistorted output voltage available can provide a fairly good audio quality from an NBFM signal.

Finally, if the NBFM center frequency is permitted to fall on point D of the rf curve, the maximum frequency swings would fall between points C and E, and, because of the relative flatness of the curve, there would be no effective output signal. Under actual receiving conditions, this would manifest itself as a big carrier indication on the S meter with practically no audio, and the receiving station would report the NBFM transmitters signal in these terms.

Those wishing to take full advantage of NBFM operation, are handy with simple tools and are familiar with FM circuitry, won't find it too difficult to add a small ratio detector or quadrature strip to their present receiver. Hints and circuits can be found in the ARRL handbook in the chapter on specialized communication systems. To the readers who may question the effectiveness of slope detection, it can be stated that the signal strength thus received is about one quarter of an equivalent AM signal. It should be remembered however, that the FM signal in nearly all cases is received at a 100 percent modulation level, especially if the FM signal bandwidth matches the receivers.

Adding the NBF modulator to the VFO.

Fig. 6 shows a complete and practical NBFM—VFO circuit, which incidently happens to be a copy of the writers own 2 meter rig, and the tube version in **Fig. 7** for the 6 meter transmitter. The battery operation in **Fig. 4** has been replaced by the power source circuitry in **Fig. 5** after giving excellent service for over two years. Where desirable, battery operation is practical and economical, since current requirements are low for the circuit in **Fig. 6.**

It should be remembered that, when installing a V.V.C., the nominal capacity of the V.V.C. (which is determined by the bias voltage) is in series with the small coupling capacitor (3.3 pF in **Fig. 2.**) and shunted across the total tuning capacity of the oscillator. The result is, of course, a stage following the oscillator, thereby permitting the transmitter to be fully modulated and still retain the stability advantages of crystal control. Phase modulation is not within the scope of this article and was mentioned solely for the benefit of those who may be tempted to try frequency modulating a crystal controlled oscillator by the *direct* method.

Cost of NBFM

For the "home brewer" with a limited budget, NBFM is a real money saver. The cost of a good AM modulator for a kilowatt rig could be prohibitive for a fellow with a thin pocketbook. The price of complete NBF modulator including a microphone amplifier need not be more than the price of a single medium power AM modulator tube. Although very low in cost, the NBF modulator has the built-in capability to produce 100 percent modulation for any transmitter from 1 to a thousand watts and at full CW ratings as previously stated.

The total space required for the NBF modulator and pre-amp as shown in **Fig. 6** is less than a matchbox and the total weight less than 3 ounces with no power wasting or heat producing components in its circuitry. Amateurs with outboard VFO's should find it particularly easy to add NBFM operation to their transmitter, without having to give up their AM mode, by installing a NBF modulator and pre-amp in the VFO and by disabling the AM modulator, which in many cases requires only to switch to CW, where this provision is available. To acquaint those readers who may have had little or no experience with frequency modulation of the *direct* type, a basic V.V.C. circuit is shown in **Fig. 2.** The oscillator to be frequency modulated may be of any standard design and the V.V.C. should be connected to the oscillator with the shortest leads possible. The more affluent members of the amateur fraternity who may be fortunate enough to own a P & H, or similar, compression amplifier may, with a few minor changes recommended by the manufacturer and shown in his instruction sheet, use the compression amplifier instead of microphone pre-amplifier shown in either **Fig. 6** or **7.** With the recommended changes the P & H will deliver slightly more than 1 volt of audio with approximately 10 to 15 mV, input which is more than needed to produce frequency deviation to the full

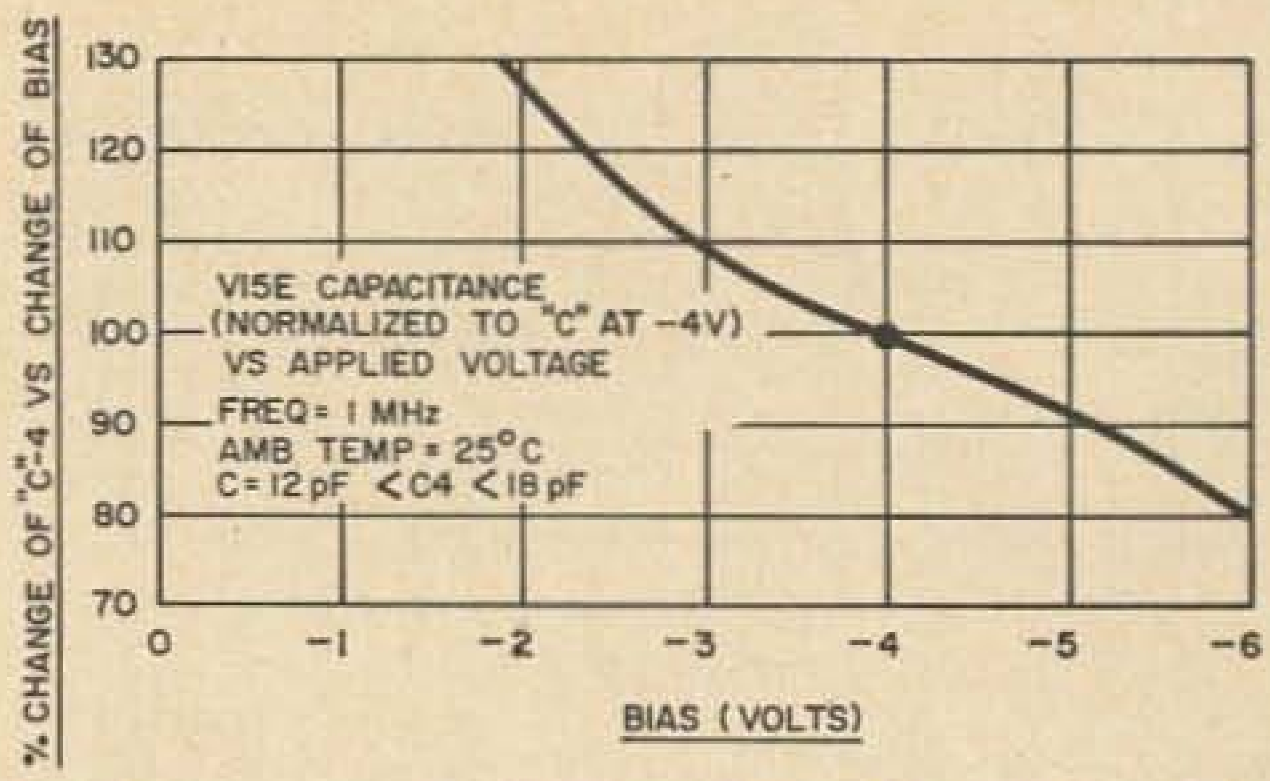

Fig. 3. Frequency variation at 1 MHz with a Pacific Semiconductor VO15E voltage-variable capacitor. Typical capacity (25° C) is 12 pF.

legal limit at the transmitter's output frequency at 6 meters. The compression amplifier is simply connected between the microphone and the audio input terminal of the modulator, best shown in **Fig. 2.**

Receiving NBFM signals

Receiving NBFM signals should pose no great problems, since almost any AM receiver, with the possible exception of the Heath Sixer, can receive NBFM signals using the slope detection method, which requires nothing more than a slight detuning from the NBFM carrier's center frequency. The amount of detuning required depends a great deal upon the rf response curve of the individual receiver. Audio quality obtainable from an AM receiver using the slope detection method, is mainly a function of the receivers bandwidth to match the deviation width of the NBFM signal. Receivers with a 5 to 8 kHz bandwidth should have absolutely no trouble receiving an NBFM signal with a deviation level of 4 to 5 kHz. The more selective receivers with a 2.1 to 4 kHz bandwidth can easily be accommodated by reducing the deviation width at the transmitter.

The writer has had many fine QSOs with stations having some very selective receivers with bandwidths around the 2 kHz mark and has had some very good audio reports at that. In some cases the receiver's owner was not even aware of the fact that he was listening to an NBFM signal. This however, can happen only if the listeners receiver *and* transmitter are tuned to the same frequency. The FM transmitter is then tuned to the listeners frequency and finally backed off slightly from this frequency, which is reality is nothing more than slope tuning in reverse, and is done at the transmitter instead of at the receiver. Frequency deviation at

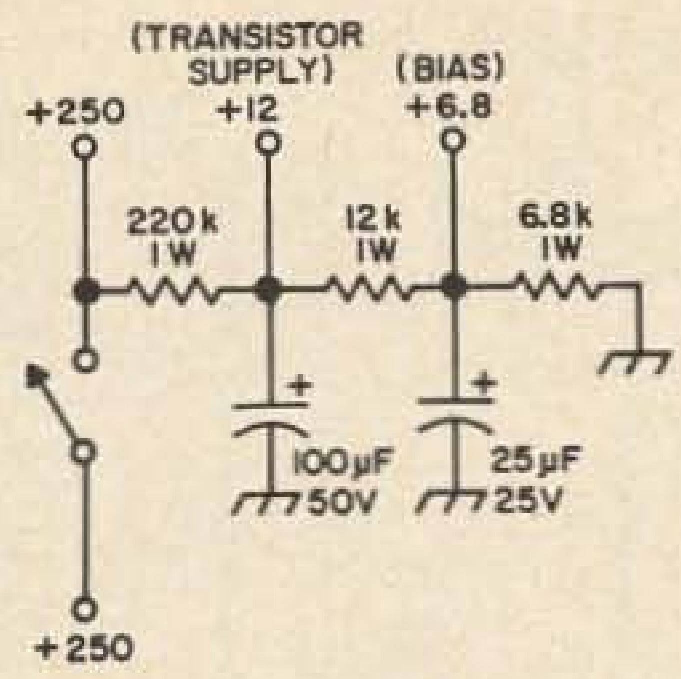

Fig. 5. Alternate transistor supply and bias source for Fig. 6.

small shift in the VFO's dial calibration. With VFO's having 100 or 500 kHz calibration points, this effect will be negligible. Those who own a precision calibrated frequency meter type of VFO, can easily restore the original dial calibration by a very small internal trimmer adjustment, or, if provided, a small tuning slug adjustment of the VFO's tank coil.

With no audio exitation from the microphone, the NBFM modified VFO will deliver a steady rf signal. This is why a NBFM-VFO with no audio input can still be used as the VFO for the original AM mode. Since many of the popular VFO's for the six meter band operate at fundamental frequencies of 8 to 9 MHz and are using the transmitters multiplier stages, with a multiplication faction of six to obtain output frequencies of 50 to 54 MHz, the actual frequency deviation at the VFO's fundamental frequencies is very small, percentage wise. To be more specific; the proper deviation for NBFM is about 2000 Hz based upon an upper audio frequency limit of 3000 Hz with a deviation ratio of approximately .7 at the *output* frequency. This deflection is about equal to 100 percent modulation on voice peaks, and since the accepted deviation for NBFM is 2000 Hz, the required deviation at the VFO's fundamental frequencies would be (taking into account the transmitters multiplication factor of six) . . . ⅙ of 2000 Hz or roughly 333 Hz. It may be interesting to know, that the total capacity change required to cause a 333 Hz deviation is *less* than 1 pF, and it takes less than 1 volt of audio to produce this frequency swing.

A good rule to remember when using any V.V.C. as a frequency modulator, is not to exceed the V.V.C. operating voltage, and that for proper NBFM operation, the bias voltage for the V.V.C. must be set high enough to prevent the sum of all voltages, dc, peak rf, and peak audio, from driving the V.V.C. into it's forward or conducting region.

In the circuit shown in **Fig. 6**, the output from the one stage of audio and a high impedance microphone is more than enough to fully modulate any transmitter. It should have become clear from the above given figures that it is rather easy to overdeviate or modulate any NBFM transmitter. A word of caution to the home brewer who may be building his own favorite VFO. A carelessly built VFO can actually produce frequency modulation without the aid of an V.V.C., but it will be of the incidental or illegal kind, frowned upon by the powers that be. The writer has copied many AM stations with a strong FM content on their carrier and can often read considerable frequency deviation of the AM carrier on his deviation meter. A clean AM signal is dead, audio wise, on it's center frequency, when received with a properly operating FM receiver.

Before leaving the NBFM—VFO subject, the writer would like to say, that he is fully aware of the many types of silicon diodes available on the surplus market which may be suitable for application as a V.V.C. However, the audio requirements of these surplus diodes may be more demanding than the simple, single stage of preamplification shown in **Fig. 6** and **7** can provide, thereby offsetting, quite possibly, the price advantage of a surplus diode of unknown performance.

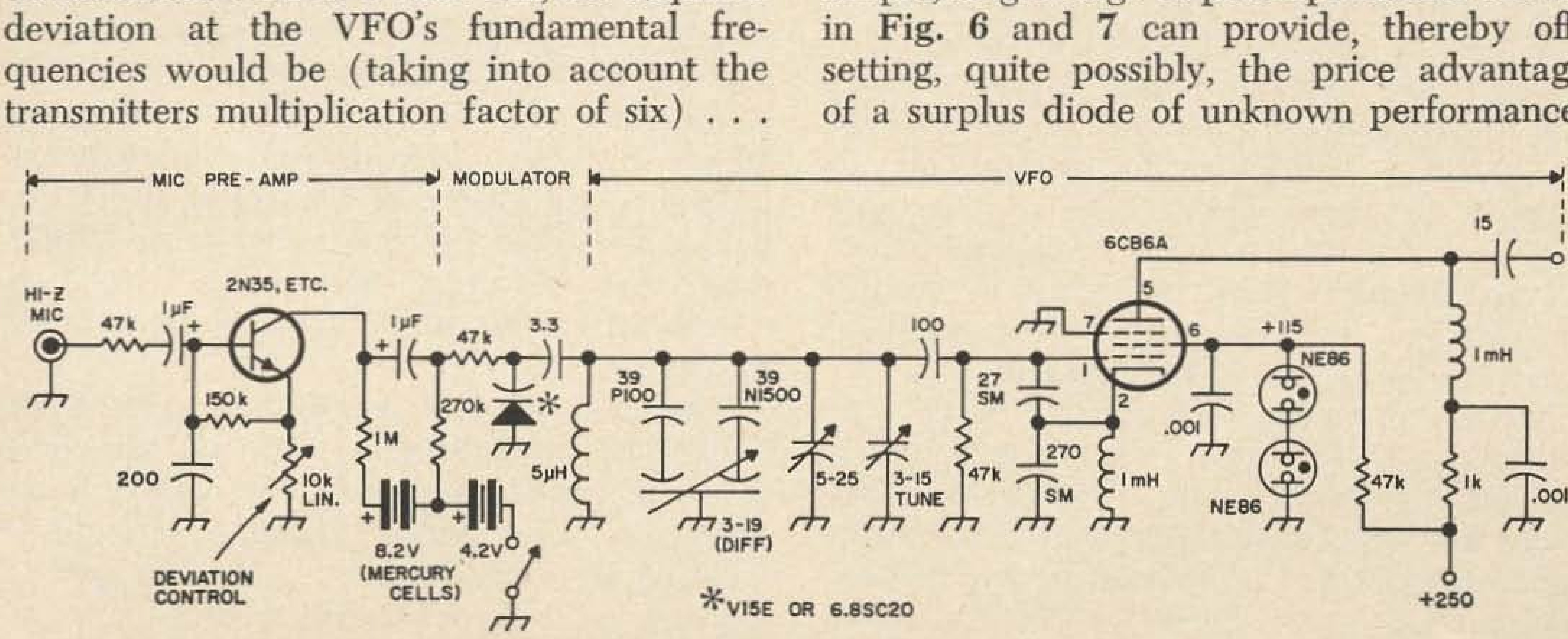

Fig. 6. Practical 8 MHz direct frequency-modulated VFO with battery operated transistor pre-amplifier.

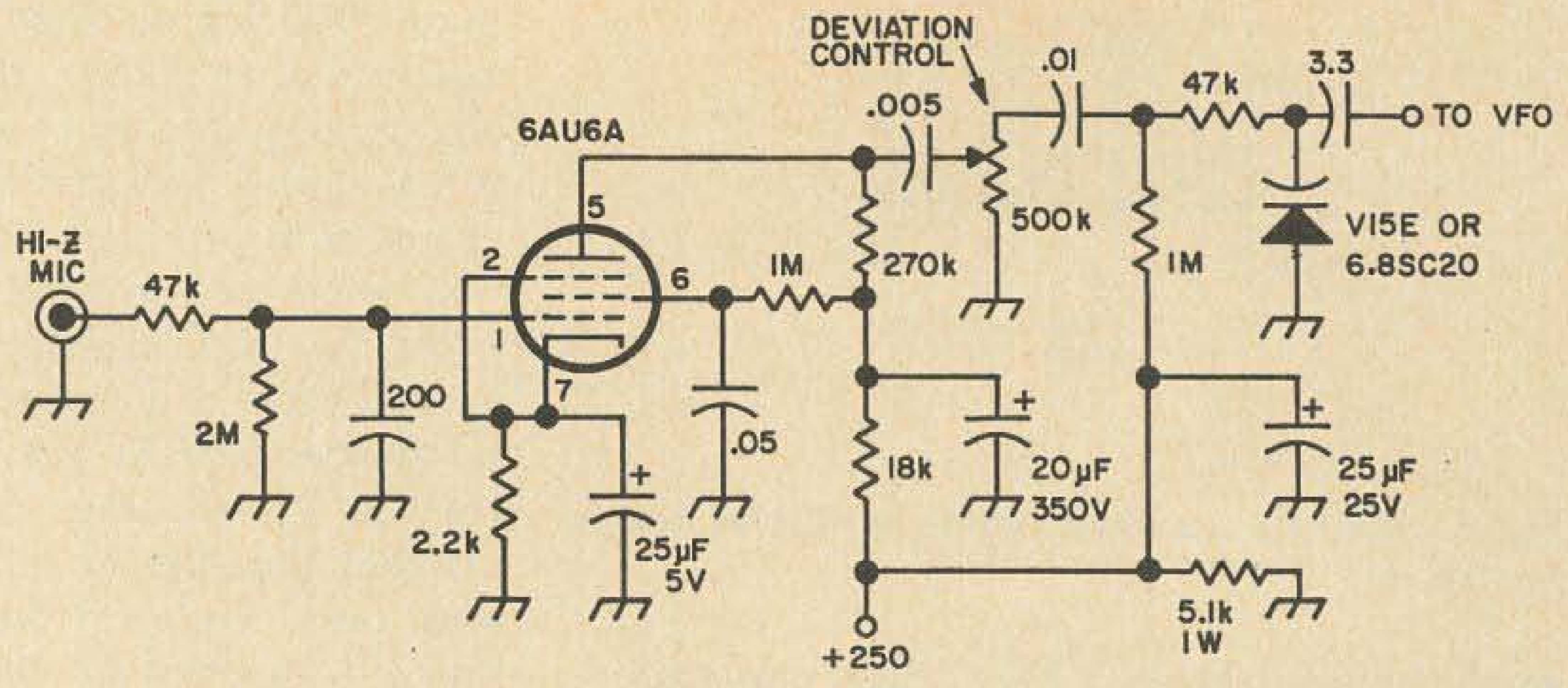

Fig. 7. Vacuum tube version or Fig. 6.

Conclusion

Up to now, the writer has deliberately refrained from making any direct comparisons between the various modes of communications and is fully aware that the next lines will bring forth some very strong disagreements, especially from the SSB addicts. The writer, having been around FM longer than he cares to remember, believes that; CW is more efficient than either AM, FM and SSB and that SSB is more efficient than AM and that FM is better than either AM or SSB, . . . *up to a point.* The definition or location of this point is not too difficult, especially on 6 meters, since the 6 meter band has not been a spectacular DX band, skip conditions excluded, and ground wave reception, even when conditions are favorable, do not extend regularly for thousands of miles, therefore a six meter NBFM signal can fall easily within this "point". There is nothing mysterious about this point, it is simply the distance in miles from the NBFM transmitter, where the signal produces the "threshold of improvement effect," or in plain words, where the signal is strong enough to provide adequate limiting in the FM receiver. At this point, FM is better than AM, as good as SSB, and at points closer to the transmitter, where heavy limiting occurs at the receiver, FM comes up with a distinct advantage over either AM or SSB. There are several ways to substantiate these claims. One of the more easy to understand is the S/N vs. Pathloss in dB application where, by means of graphs, the efficiency of either mode of communication can be readily demonstrated.

With a properly operating FM system of transmitter and receiver, and a signal within the limiting range of the receiver, there are many advantages available that can be obtained with either the AM or SSB mode of operation. The great drawbacks of AM (like random noise, ignition noise and co-channel interference), are practically absent with the NBFM mode. With AM, an interfering signal on the same channel may require an input signal to 20 to 35 dB above the interfering signal for an acceptable S/N ratio, while the FM mode requires only 6 dB or two times the signal strength of the interfering signal, because the FM receiver responds to frequency variations and limits amplitude variations caused by noise or other unwanted signals. Again, let us remind the reader that the described advantages are *not* obtainable with the use of slope detection.

Unfortunately, very little information on NBFM has appeared in print recently, at least not in print available to the average amateur and many of the younger amateurs in age and term of license are, in the writers opinion, convinced that the FM mode of operation went out of use with the cats whisker and crystal set era. Many do not realize that Governmental Agencies, Armed Forces Services, Business Band Operators and not to forget the big Commercial Tropo Scatter Stations, where reliability is a prime requisite; *all of them* use FM.

Some time ago the writer ran across an advertisement of a prominent manufacturer of amateur and business band gear who had this to say about his new line of NBFM transceivers, Quote, "rugged, with capture effect reception, overcomes interference, immunity to ignition noise" and here comes the punch line "The FM mode results in greater range than AM units." Interesting, . . . when it comes from an outfit that lays it's cash on the line.

The readers who are still with us, even those who may disagree with us, may find a few interesting points in our closing lines. Amateurs, for example, living in an apartment house in greater New York City, operating six and two meter AM phone, have, at one time or another, had their share of

"Indian" warfare, although their transmitter like ours was perfectly clean. Demonstrating an interference free TV receiver operating in the shadow of the transmitting antenna means absolutely nothing to a person having TVI and who does not want to be helped. Explanations, advice, and even the offer of a free $4.00 high pass filter makes no impression.

I have listened to many six meter heroes shouting their battle cry of "co-operate *but* operate." With few exceptions they moved up to two meters or wound up with self imposed silent hours when the "Indian" pressure become too great. We are lucky to hear them working the midnight shift now-a-days.

The writer and a group of fellow amateurs decided some four years ago to avoid all this aggravation on six meters and "switched rather than fight" to the NBFM mode of operation and all in our group are now operating our six and two meter rigs any day, any hour with no TVI complaints whatsoever. Since possibly the majority of TVI complaints are of the audio rectification type, that's where they copy your call and location, as it was in our case, switching to NBFM eliminated all further complaints.

It is true, our maximum power into the antenna is only 40 watts. It is likewise true that our transmitting antenna sits right in the middle of a forest of TV antennas on top of a six story building housing 67 families. Some of our fellow amateurs run their NBFM modified Zeus transmitters at 180 with no TVI complaints, while operating the same transmitter on AM practically causes an uprising in their immediate neighborhood. While FM has many advantages, it can not perform miracles and in the case where TVI is caused by the transmitter's carrier, resulting in a severe front-end overload at the TV receiver, there is nothing that NBFM can do to eliminate this condition, at least not at the transmitter, because FM like AM does have a carrier. However, where modulation bars on the TV screen and audible interference are the complaints, NBFM will resolve these complaints, almost 100 percent, in practically all cases.

We would like to conclude with the following: if going NBFM eliminates or at least greatly reduces certain types of TVI, then that feature alone recommends it's use, *especially,* if in doing so, *peace* is restored on the *"reservation."* . . . WB2CPG

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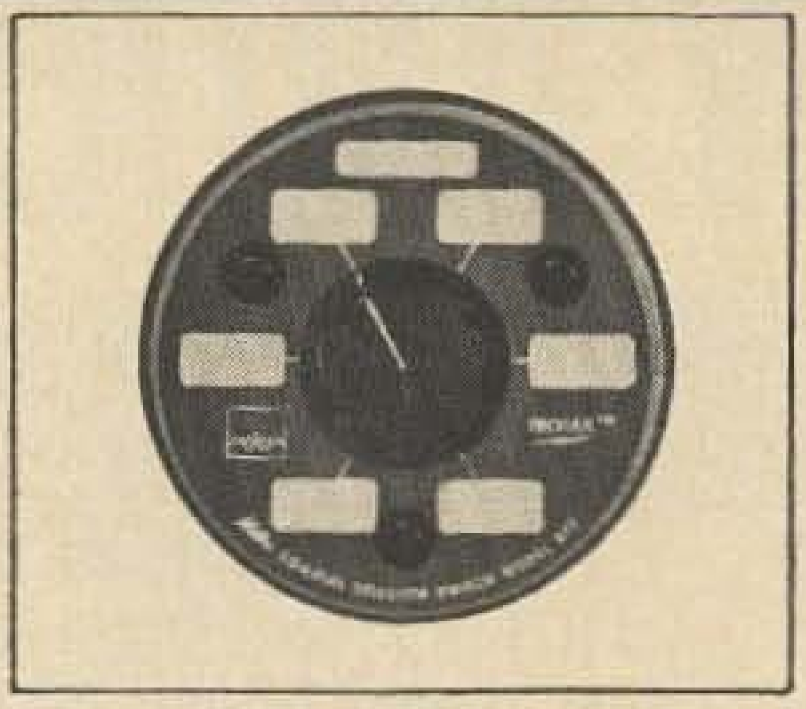

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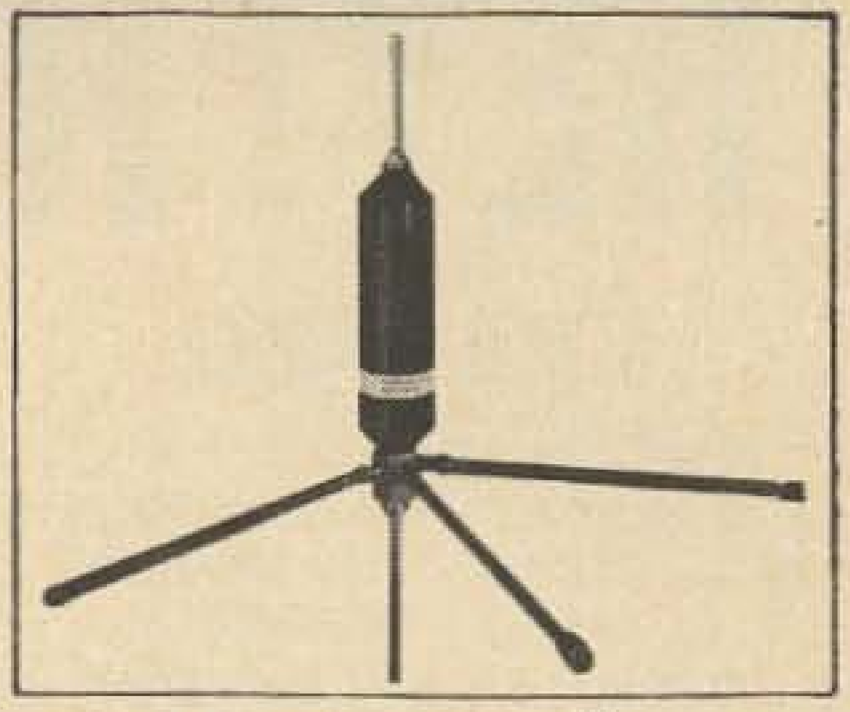

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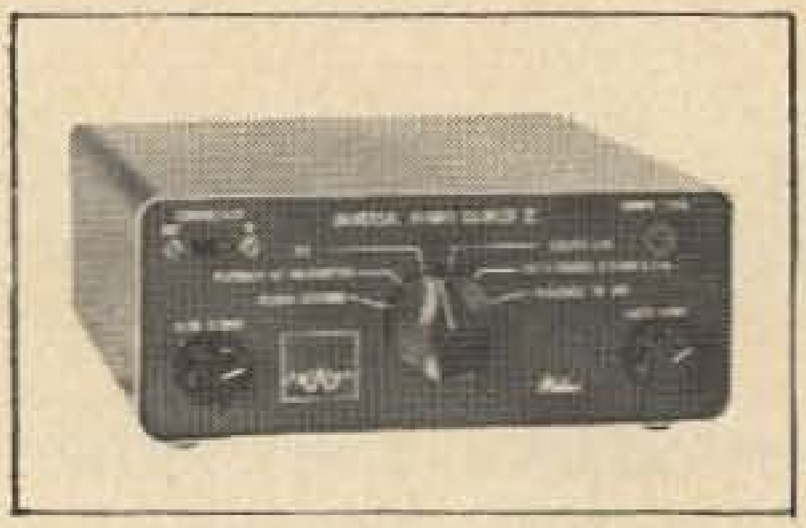

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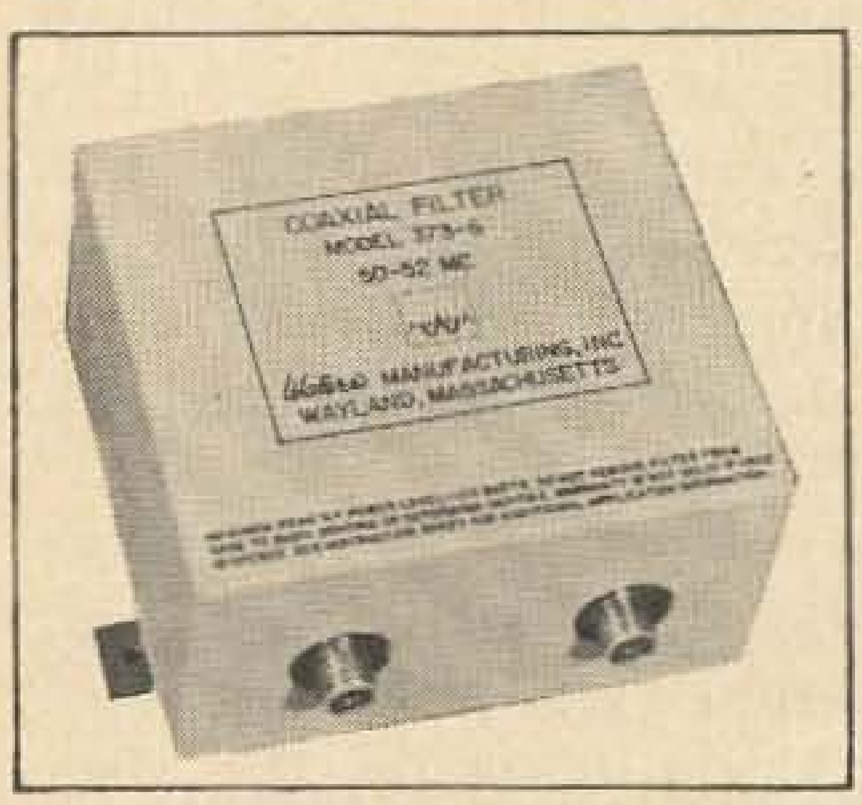

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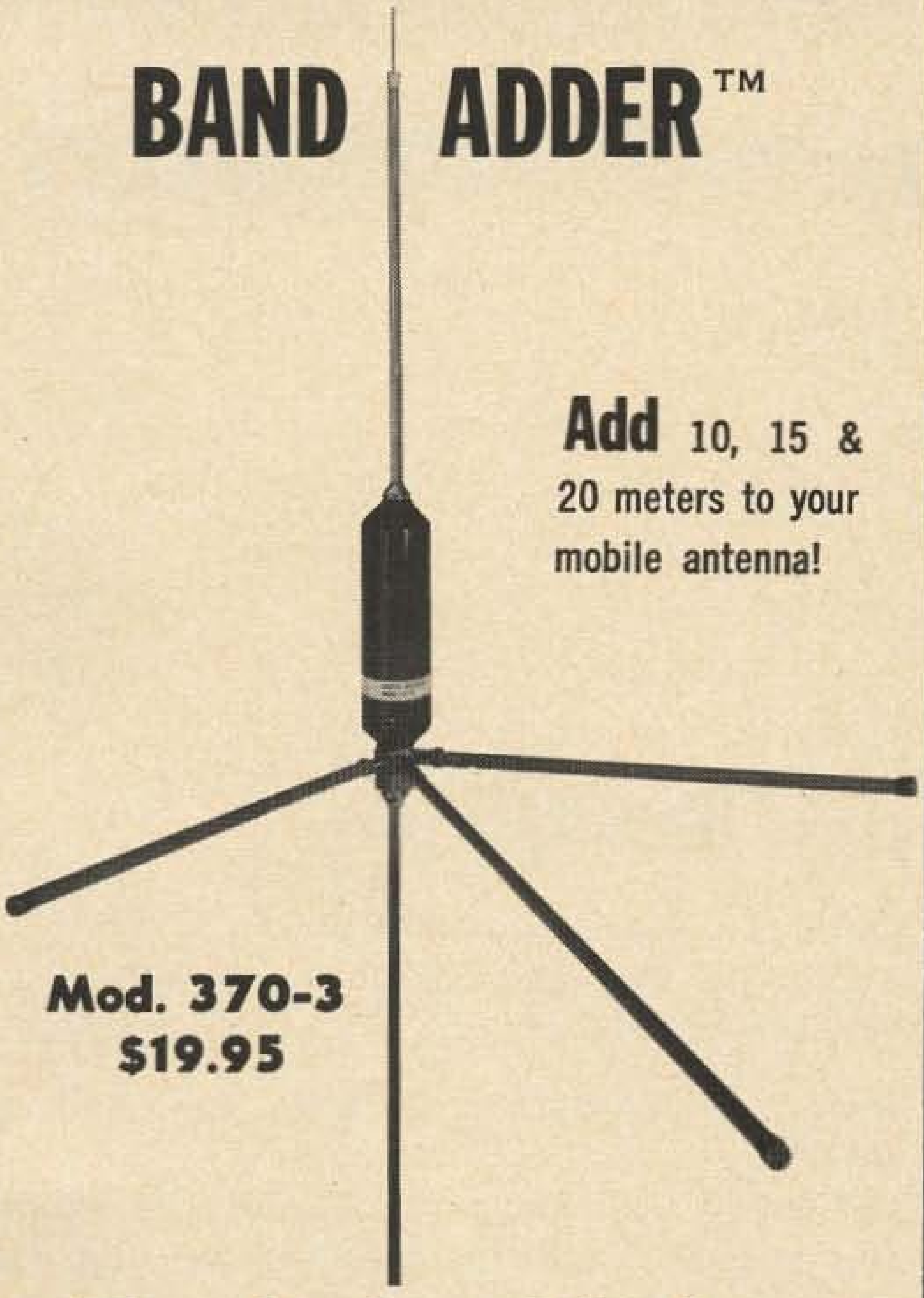

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Harley Gabrielson W6HEK
1150 Polk Ave.
Sunnyvale, California 94086

Transmitter Keying—with Transistors

The most common method of keying a CW transmitter is the simple operation of opening and closing the cathode return circuit(s) of one or more stages in the transmitter. This mode of operation is effective, but it turns out to be uncomfortable, if not downright dangerous, due to the high dc voltage which appears across the terminals of the key. The problem is often solved by the use of a keying relay. It is also possible to accomplish cathode keying by the use of a transistor (or transistors).

What are the requirements for a transistor to do this switching job? First, it should be an NPN transistor so that it can be used with the positive collector voltage that appears at the cathode of the tube circuit which is to be keyed. Second, it should be capable of withstanding the open-circuit cathode voltage from collector to emitter (V_{ceo}) during key-up conditions. And third, it should be capable of carrying the plate current of the keyed stage continuously during the key down condition.

In the early days of transistors, their voltage ratings were severely limited, and it was rare (and expensive) to find one with a V_{ceo} rating above 100 volts. More recently, several manufacturers have announced units with voltage ratings in the 300 to 400 volt region. These same transistors will handle currents of 100 ma or more and have collector dissipation ratings in excess of 1 watt. The RCA 40264 has a V_{ceo} of 300 volts, a maximum collector current rating of 100 mA collector dissipation of 1 watt and sells for $1.21.

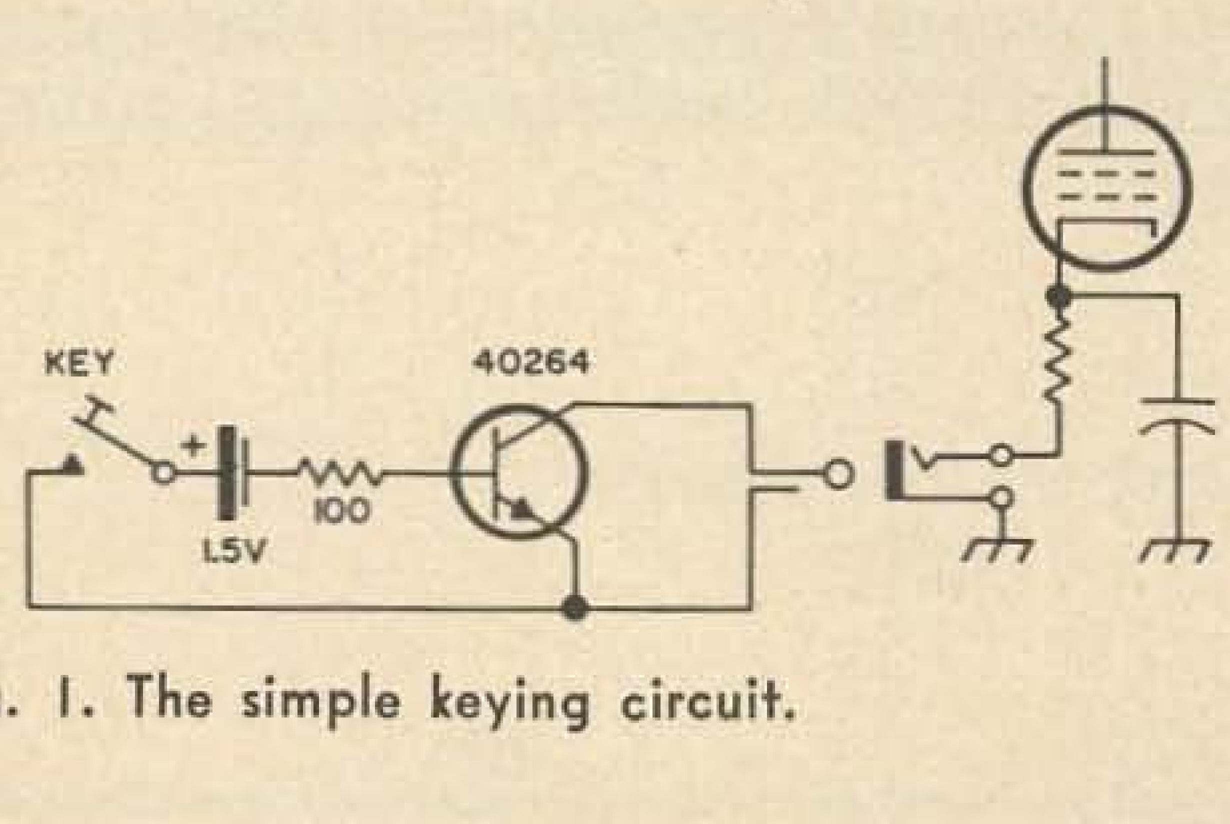


Fig. 1. The simple keying circuit.

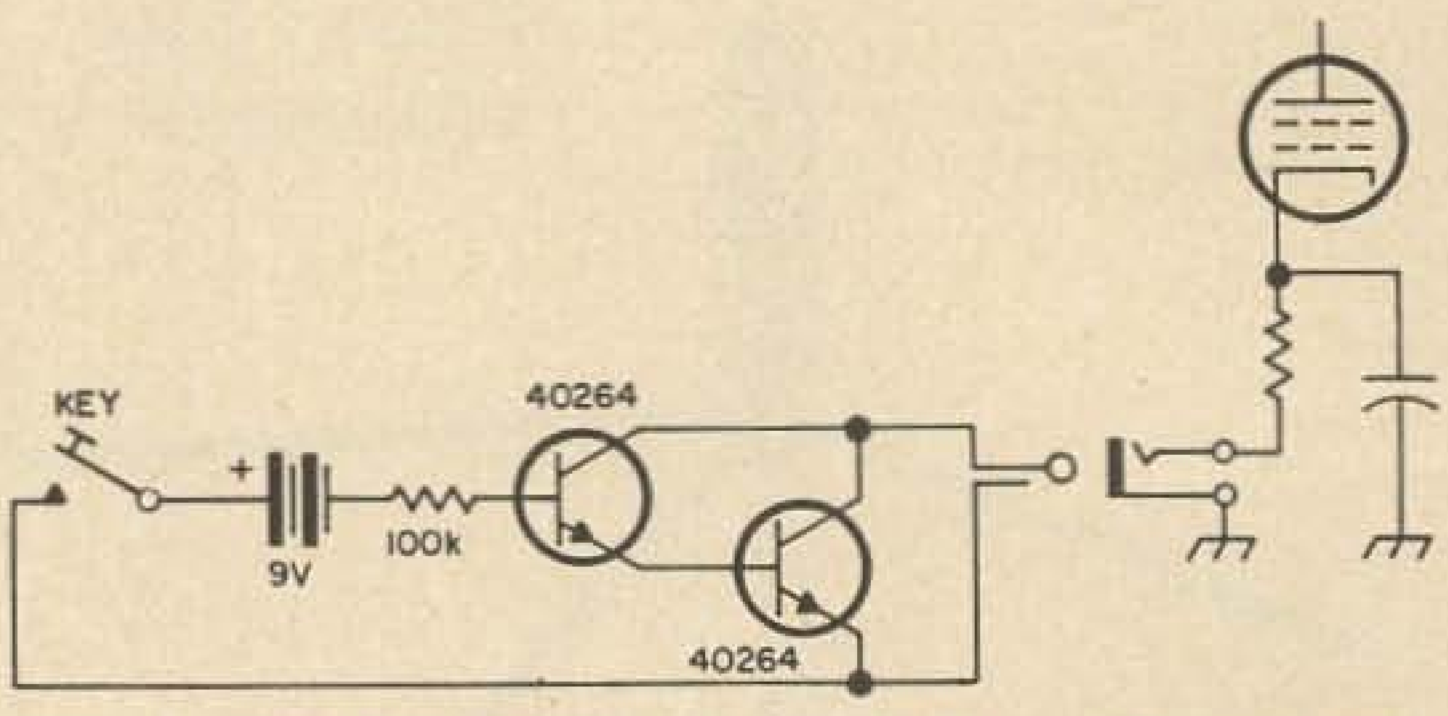


Fig. 2. The Darlington circuit further reduces battery current drain.

During key down conditions, the switching transistor will be operating at high currents, but the terminal voltage will be very low so that the collector power dissipation will be less than half a watt. In addition to keeping the power dissipation low, this low collector voltage during key down conditions minimizes the effect on the bias voltage for the keyed stage of the transmitter. The saturation voltage under these operating conditions should be less than 5 volts.

The keying circuit turns out to be very simple in practice—**Fig. 1.** The bias battery voltage and associated resister are selected to cause the keyer transistor to draw saturation current under key down conditions. Current drain from the bias battery can be further reduced by using the Darlington circuit shown in **Fig. 2.** Both transistors in the Darlington circuit must be capable of withstanding the open circuit cathode voltage of the transmitter. In checking your transmitter, make sure that you use a high impedance voltmeter (preferably a VTVM) when measuring the key up voltage.

As a typical example, the Seneca transmitter shows 250 volts across the open key contacts, and it draws 90 mA when the key is closed. An RCA 40264 transistor was used in the keying circuit shown in **Fig. 1.** A 1½ volt battery and a 100 ohm resister

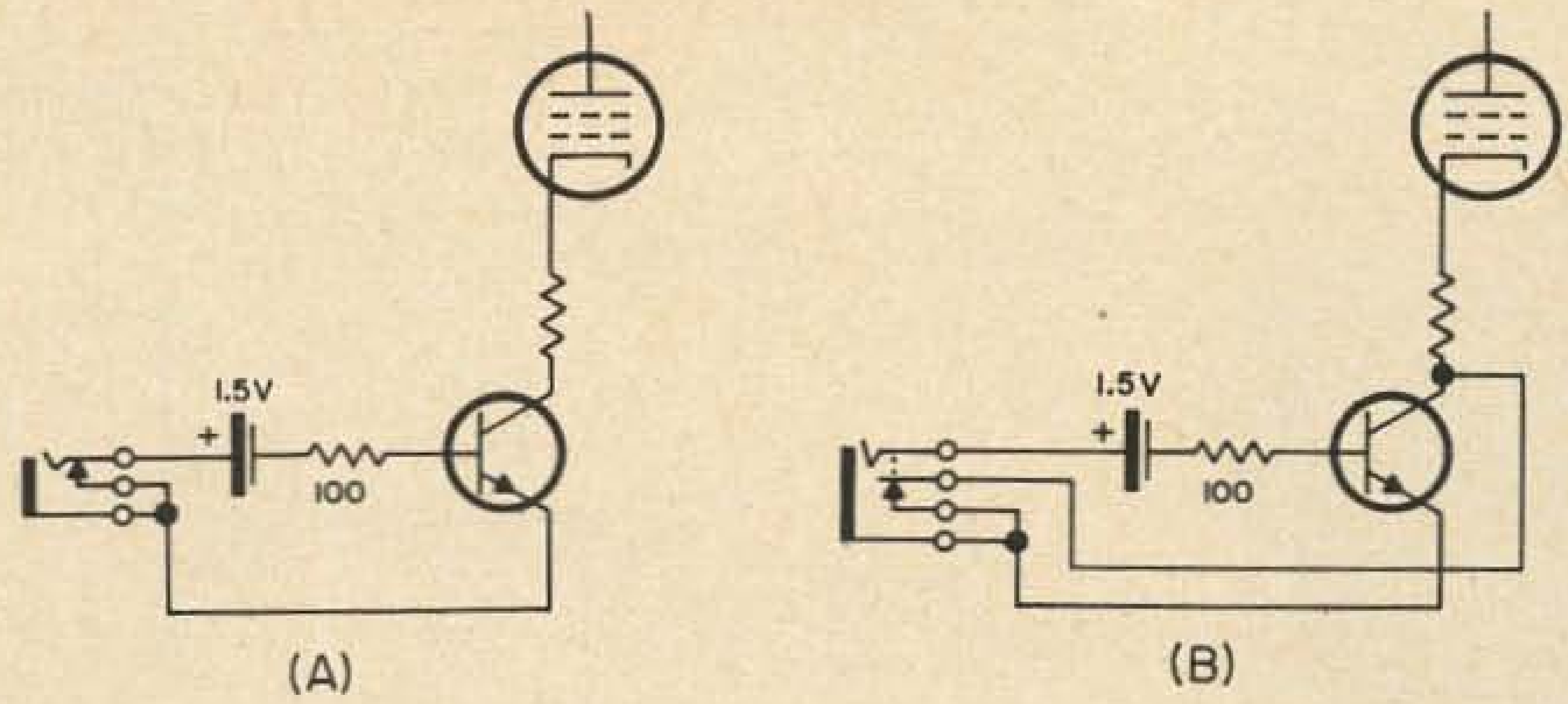


Fig. 3. Replacement key jack which has a separate pair of switch contacts which close when the key plug is withdrawn.

draw 4 mA at the base of the transistor and this is sufficient to drop the collector voltage from 250 volts (key up) to 3 volts with the key closed. The same transmitter was used in the circuit of **Fig. 2** with a 9 volt transistor radio battery and a 100,000 ohm resister. For these conditions, the base current is 70 microamps and the collector voltage drops to 2 volts with the key down. Take your pick.

A transistor keying circuit can be built into the transmitter as an installed modification. When doing this, the keying jack should be replaced. Most keying circuits use a jack which has a grounding contact to short out the keyed circuit when the key plug is pulled out. This type of jack, **Fig. 3A**, will work with the transistor keyer, but it will leave the battery connected and drawing current continuously. It is recommended that the regular key jack be replaced by one which has a separate pair of switch contacts that close when the key plug is withdrawn. **(Fig. 3B).**

As an alternative to modifying the transmitter, the transistor keyer circuit can be built into the key, or into a small unit which can be plugged into the normal key jack of the transmitter. The key can then be plugged into this sub-assembly to key the transmitter. These unit arrangements external to the transmitter have the advantage that they can be used with other transmitters as long as the voltage and current ratings of the keyer are not exceeded.

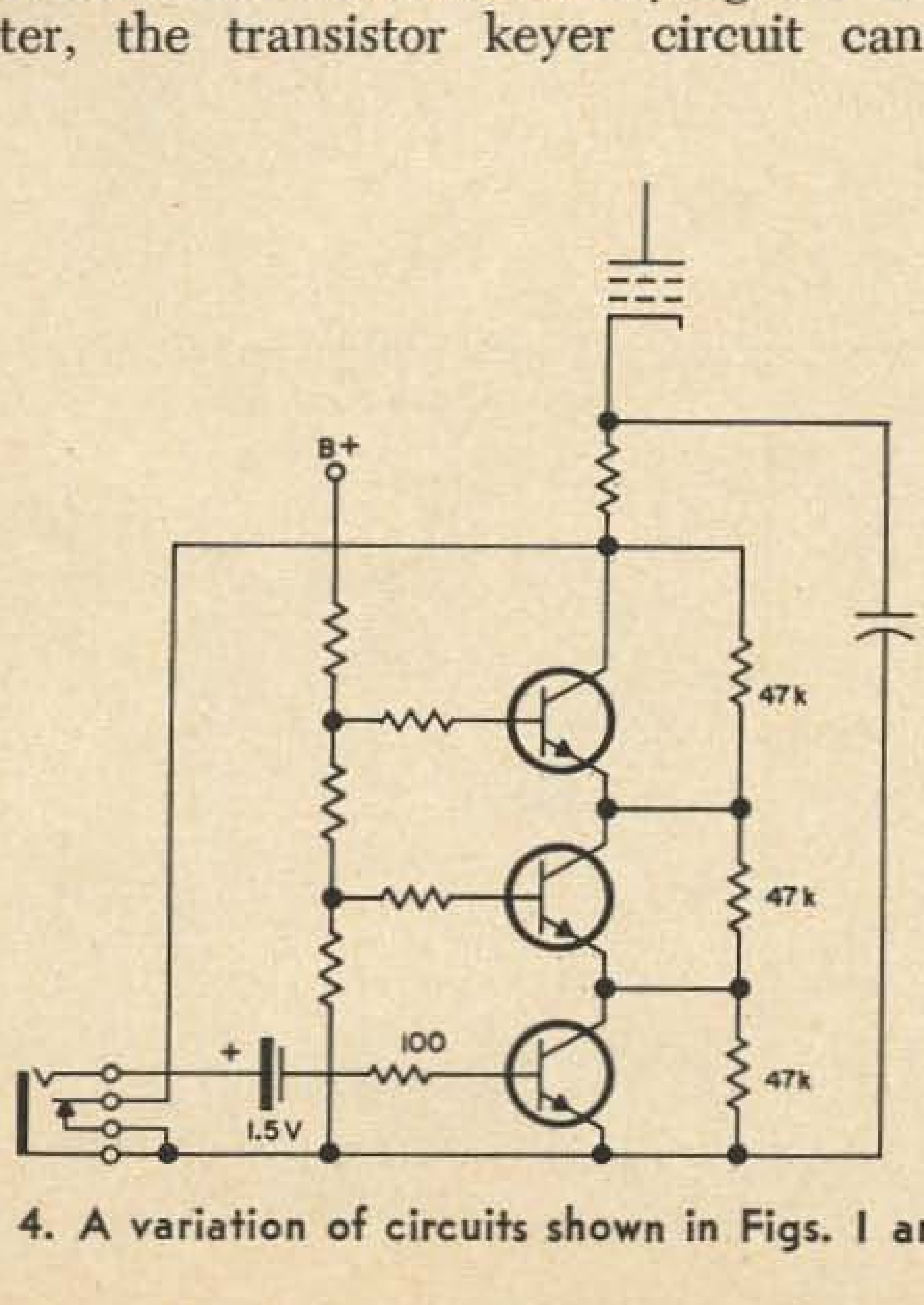


Fig. 4. A variation of circuits shown in Figs. 1 and 2.

The circuits shown in **Fig. 1** and **2** are great, if the cathode voltage does not go higher than the voltage rating of the available transistors. The circuit of **Fig. 4** is a variation which can be used to increase the maximum voltage level which can be keyed. In this circuit, the voltage applied to the keyer transistors is divided across the series string by the resistive divider in the collector circuit. A similar resistor divider is connected in the base circuit to bias the upper transistors off during the key up condition. The supply for this divider should be the B+ for the keyed stage and the tap voltages should be just slightly lower than the corresponding emitter voltages. The resister in series with each base should be set to limit the base current to the level required for saturation (about 3 to 5 mA) when the key is closed.

Several transistors can be used in series to key 1000 volts or more. There would be no trick in keying your final amplifier with this arrangement, but remember that the transistors must be rated to carry the total key down current of the keyed stage.

It is also possible to combine a sidetone keying monitor with a transistor to key the cathode circuit of a transmitter. An audio oscillator may be keyed, the output tone rectified, and the resulting dc signal used to provide the base drive for a keyer transistor. **Fig. 5.** This circuit also lends itself to use with tape recorded signals. The recorded information can be played directly into the tone rectifier for keying the transmitter.

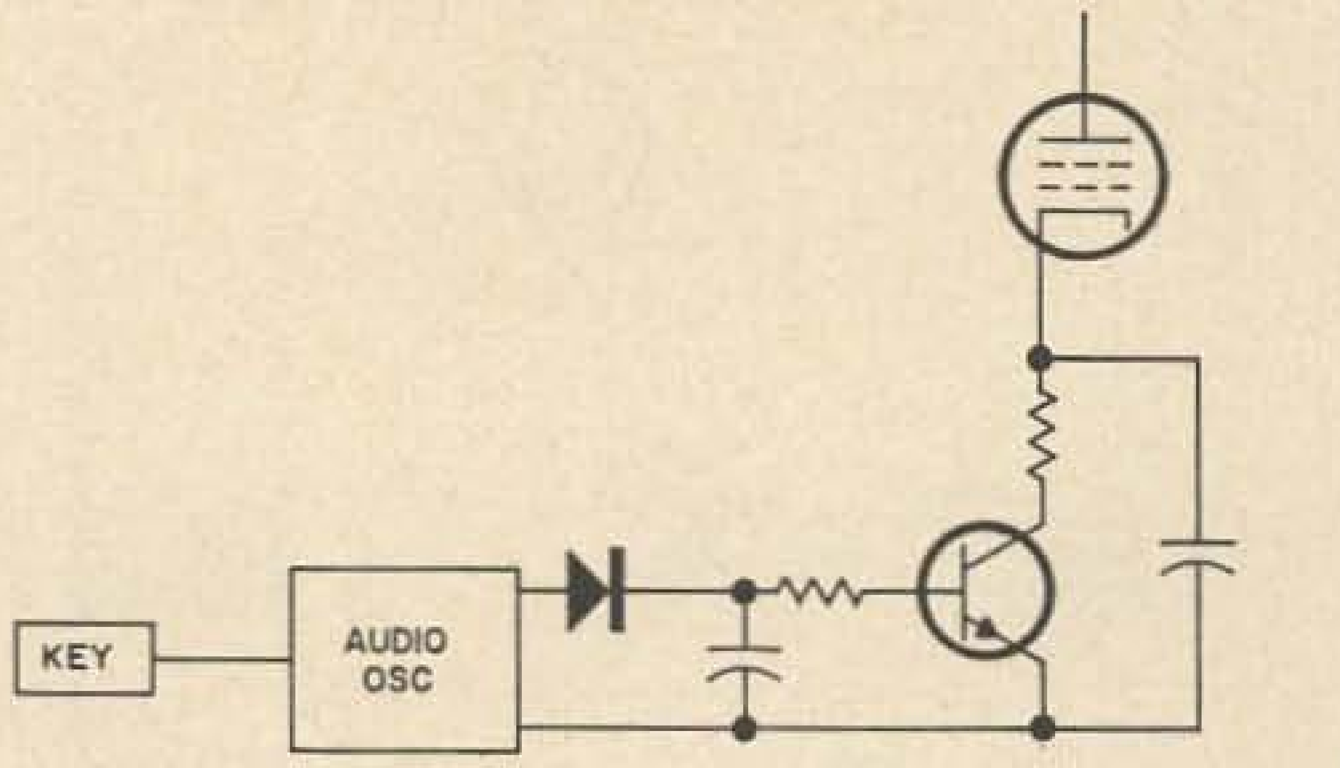


Fig. 5. Keying an audio oscillator to provide drive for a keyer transistor.

One caution with applying transistorized transmitter keying. Make sure that your transmitter is keyed to the cathode circuit. If your transmitter has blocked-grid keying, the keying voltage will be negative and you could lose a transistor in a hurry if you plug an NPN transistor into it. If you want to transistorize the keying with a blocked-grid keyer you will have to adapt these circuits to the use of PNP transistors.

If your transmitter is cathode keyed, then here is your cure for that nippy key and the sparking contacts.

. . . W6HEK

Howard S. Pyle W7OE
3434—74th Ave., S. E.
Mercer Island, Washington 98040

Mini-Mitter; The Ultimate in Miniatures!

World's smallest HF Transmitter?

Well, maybe not *the* smallest but a pretty darned good runner-up! Now that we've apparently succeeded in 'mini-mizing' everything else from automobiles to skirts and now to electronic components, maybe it's time we tossed a few minis together into a compact 'talk-box'. The "Mini-mitter" does just that; a completely self-contained CW transmitter with integral power supply, all housed in a 2" x 2" x 2½" minibox . . . much less than half the size of the popular walkie-talkie. And, is "Mini-mitter" limited to a range of a few city blocks? Not by a long shot; her debut was made her first day on the air by chalking up a 300-mile contact in broad daylight with a readable signal reported! And she's been behaving just as well ever since.

Her 'heart' is an OX crystal oscillator recently introduced by the International Crystal Manufacturing Company. This little gadget, with all components and a beautiful little etched circuit board only 1½ inches square, is sold as a kit for a mere $2.35 postpaid! Everything is included; transistor and socket, crystal socket, all resistors and capacitors and the specially-built inductance. Mounting screws, spacers, nuts and lock washers . . . they're all there! All it takes to get on the air is the 20 to 30 minutes to put it together plus a key, a 6- or 9-volt battery and a crystal of whatever frequency you choose between 3000 and 6000 kHz. Use your own crystal, or preferably, one of International's EX crystals around which this oscillator was designed—just a few pennies more from your piggy bank. If you use your own rock you may have to whip up a little adapter if your crystal pins and spacing vary from the socket provided; this is no trick however—ten minutes will do it.

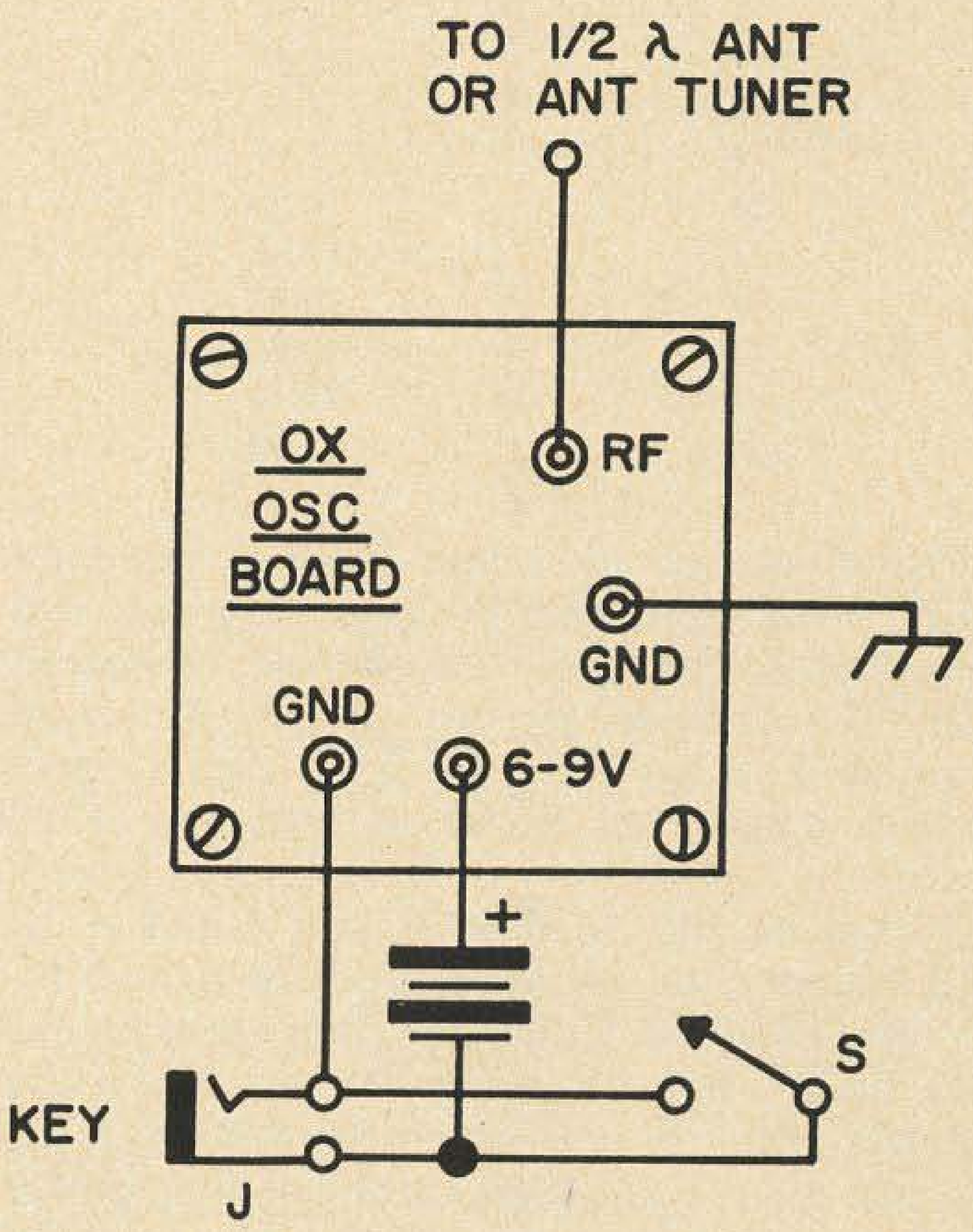
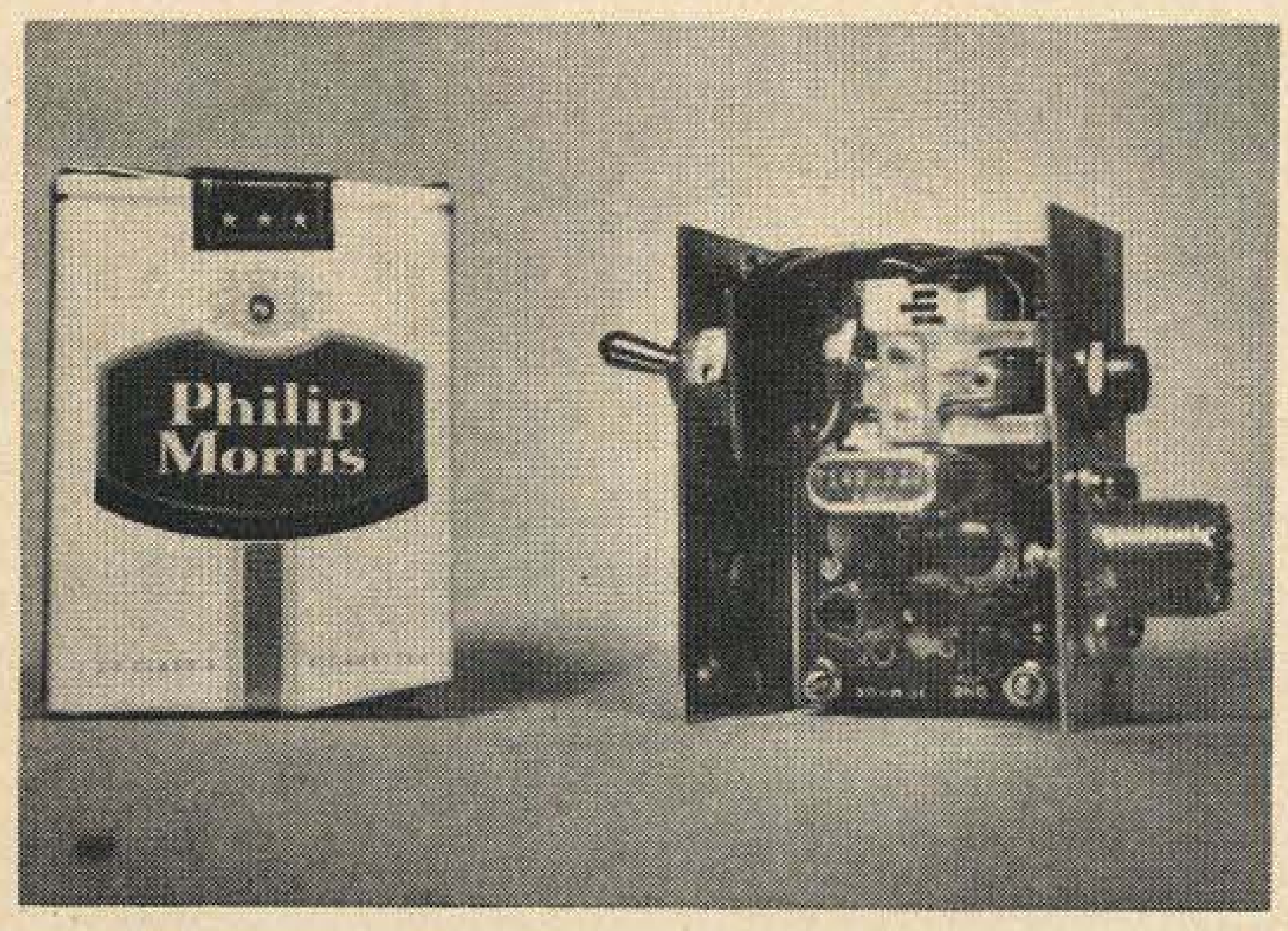


Fig. 1. External connections to the International Crystal OX oscillator for operation as a low-power transmitter.



Mini-Mitter proudly exposes her innards.

Aside from the little oscillator assembly, we have added a coax connector (use a phono plug if you prefer), key jack and a SPST toggle switch. This latter may be omitted if you like; it is simply connected across the key and serves to keep the circuit oscillating should you want both hands free to set spot

DB—A Curious Animal

One of the most talked about, and least understood, facts of radio, is that of dB gain. Below is a simple table of dB vs Power Gain

Decibels	Power Gain
1	1.26
2	1.58
3	1.99
4	2.51
5	3.16
6	3.98
7	5.01
8	6.31
9	7.94
10	10.00
11	12.60
12	15.80
13	19.90
14	25.10
15	31.60

Now lets say that you have an antenna with 6 dB gain, and by increasing the size one way or another, you eke out one more dB. By looking at the table, you have increased from 3.98 to 5.01 power gain which figures out to be an increase of 26 percent.

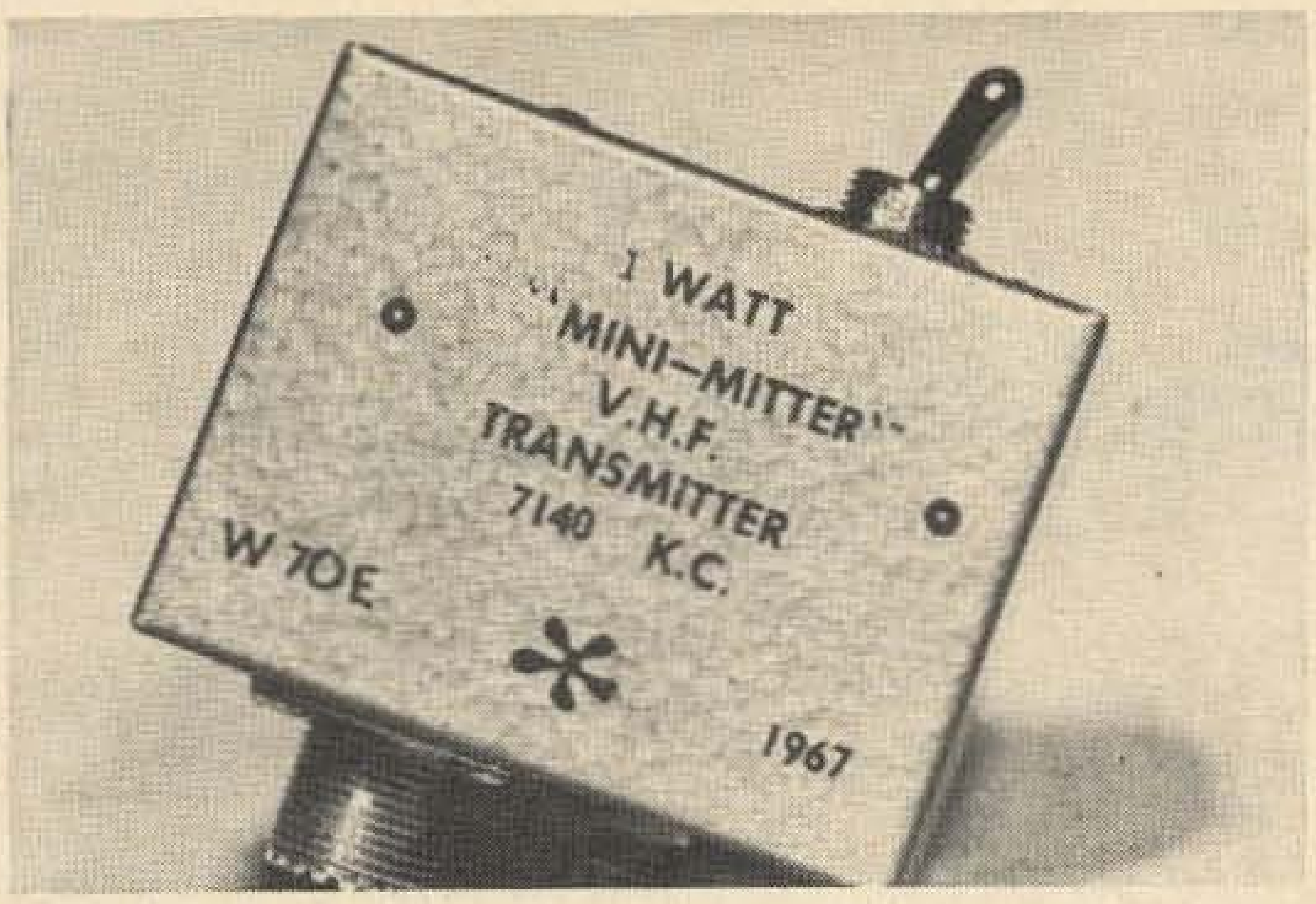
Carrying this further, if you raised a 13 dB antenna to 14 dB gain, you would increase 19.90 to 25.10, or 26 percent mathematically. But, assuming you have 100 watts at the antenna, increasing from 6 to 7 dB would raise your theoretical antenna power from 3.98 to 5.01 times 100 watts, or 398 watts to 501 watts; an increase of 103 watts.

Now lets take the other instance—we have raised the power from 19.90 to 25.10 watts—or an equivalent of 1990 watts to 2510 watts. This time you have gained 520 watts. Obviously while the 103 watts is not to be taken lightly, it is obvious that when you get into the high gain antennas, squeezing out one more dB is a very much worth while thing.

You can immediately see that stacking an antenna with a gain of 10 dB you would, as they say, "double the power" (or from the table increase it 1.99 times). This would become 19.9 against 10.0. You have increased your 100 watts to an equavalent of 199 watts (assuming no stacking loss).

A stacked antenna certainly is cheaper than doubling your transmitter power.

W. Roberts W9HOV



Completely self contained, including power supply, the "Mini-Mitter" can be nestled in the palm of your hand!

frequency on your receiver for example. As this is an untuned circuit, no tuning controls are provided or required; to change frequencies, simply plug in the appropriate crystal and you've got it made . . . what could be simpler?

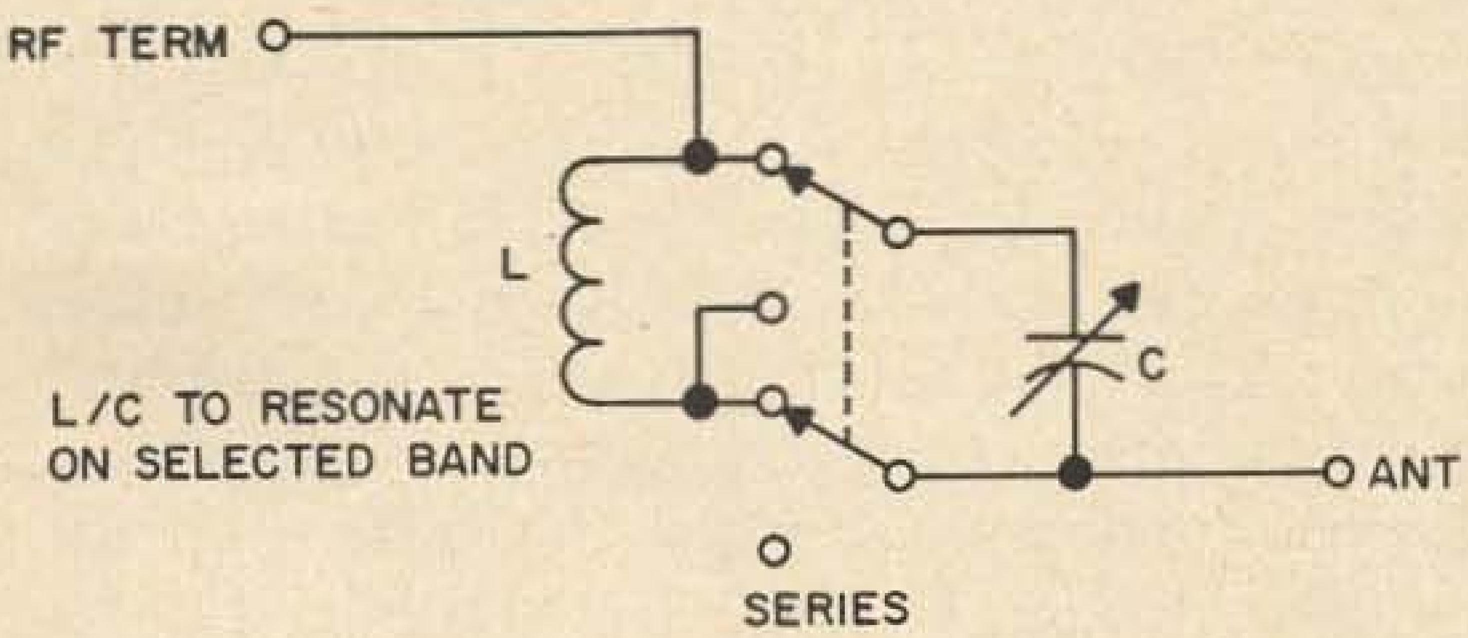
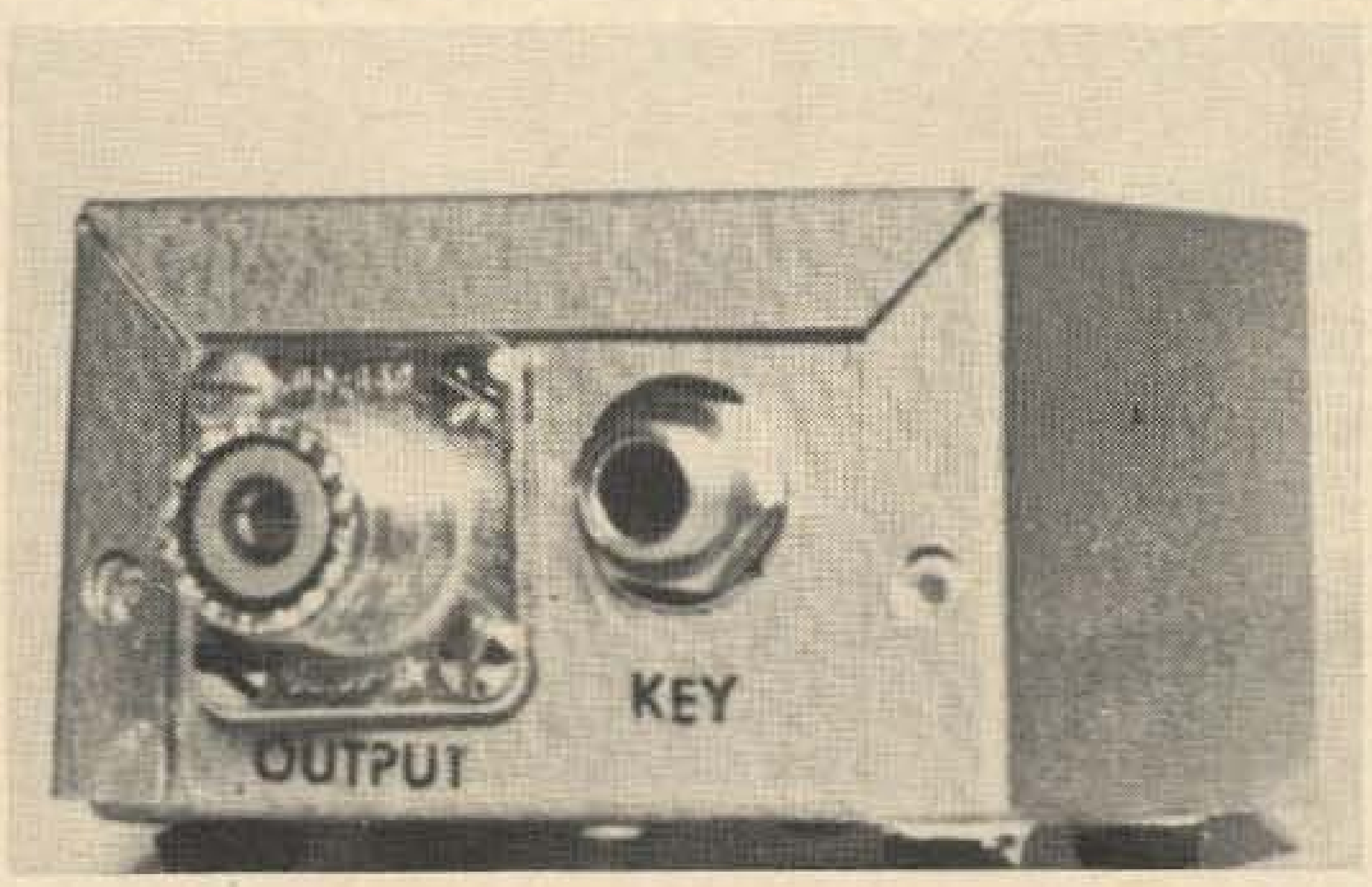
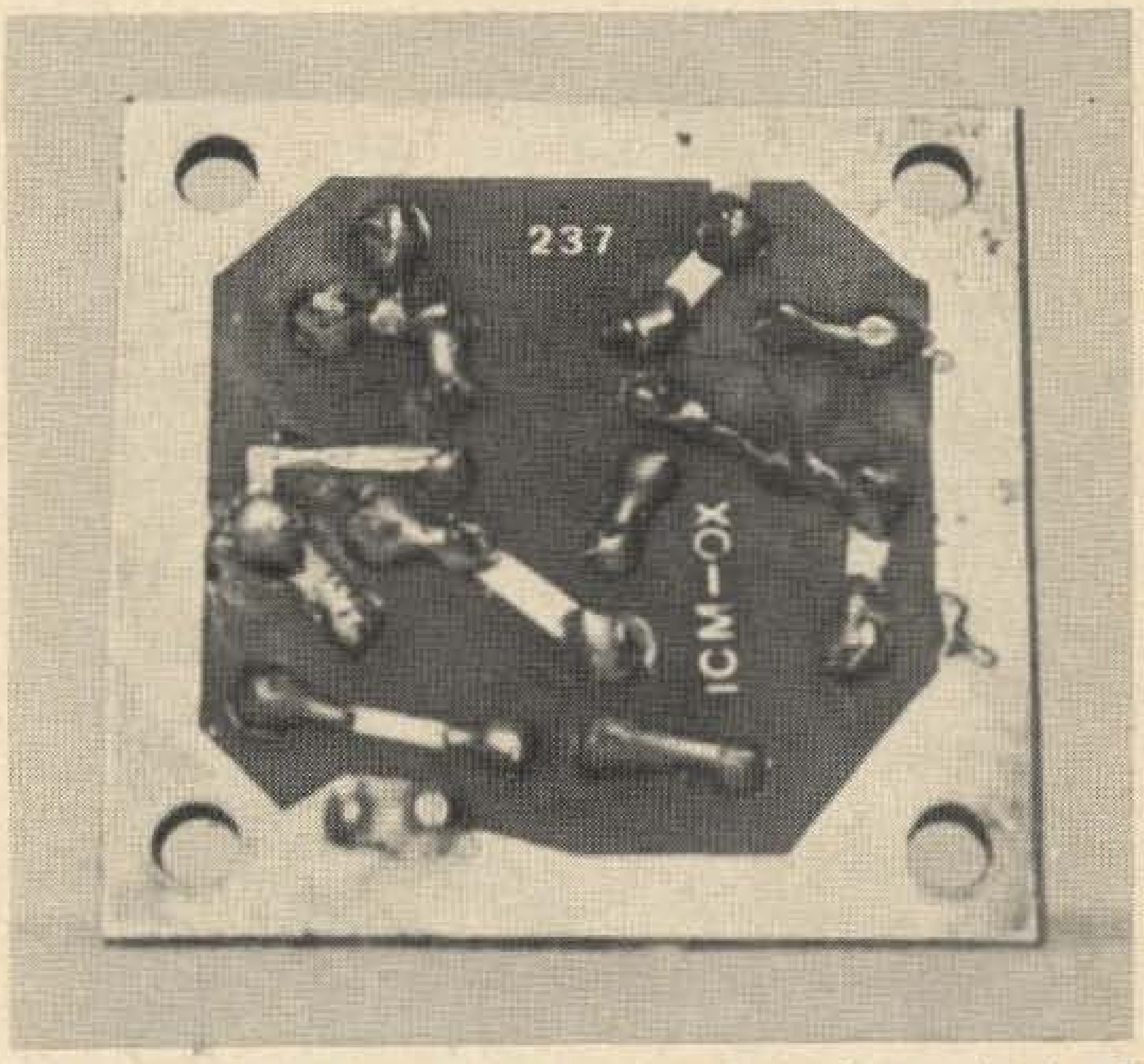


Fig. 2. An auxiliary antenna tuner for loading the mini-mitter into a random length wire. The L/C ratio is selected to resonate on the desired band.

With only milliwatts output, a *good* antenna is a *must* if you hope to work reasonable distances. If you have a half-wave dipole or equivalent frequency conscious antenna, simply plug the coax feeder from the antenna into the connector on the "Mini-mitter" . . . no trick antenna tuners or other gadgets to bleed off energy. However, if you propose to use the little rig with a random length wire for portable operation, for instance, you *may* have to rig up a 'mini-tuner' for it. This too, is no trick; you can get a suitable coil and variable capacitor in a matching 'Mini-box' and a conventional L/C circuit will fill the bill. Should you want to go whole hog, add a DPDT toggle switch to change the antenna capacitor to 'series' or 'parallel' as desired. Such a tuner is shown in the schematic which, together with the "Mini-mitter" will give you a very flexible antenna choice. Assembly instructions and schematic for the oscillator board accompany the kit so we are simply showing the connections which are *external* to the board. The terminals are plainly marked as shown.



The only external connections required are to the antenna and key!



Underside of the printed circuit board on which all components were installed in twenty minutes!

While this little oscillator was designed and built by International with apparently no thought of its communication capabilities, but more as a test oscillator, it occurred to us to hook it to a sky wire on a hunch. We were dumbfounded! Is 300 miles on 40 meters with 1.2 watts inputs bad? This, with a six volt battery; in the final assembly we found that we could just squeeze in an RCA #VS323 9-volt transistor battery (or equivalent) which raised the input power to 1.8 watts.

Drop a small handful of nickels and dimes into this little project and put it on the air. It will surprise and amaze you and you'll have no end of fun!

. . . W7OE

Frank Jones W6AJF
850 Donner Avenue
Sonoma, California 95476

Receiver Front End Protection

The first transistor in a radio receiver is very likely to take too much overload voltage when a medium or high powered transmitter is being used. Back-to-back diodes connected across the coaxial input jack to the receiver or converter offer considerable protection, but still enough signal gets through to sometimes cause a deterioration of the first transistor and an increase of noise figure. Ordinary 1N100 low forward resistance germanium diodes seem to be desirable for this back-to-back connection. This type has very low shunt capacitance and can be used up through 432 MHz.

One quick way to damage a transistor, or even a tube front end, is to use antenna and power relay switching without a timed sequence system. If the power relay turns the transmitter on before the antenna relay transfers the antenna to the transmitter, this is bad! Even worse, if the antenna relay switches to receive at the same time as the power relay turns off, arcing will occur and the receiver gets a terrible voltage input surge.

The power supplies have capacitors and filter chokes which tend to keep some voltage on the transmitter tubes for a short period after the ac line is opened. This produces rf output and an arc in the antenna relay contacts as it switches from transmit to receive, unless this relay operation is delayed a fraction of a second. It is also better to have the reverse take place when switching to transmit. This procedure is called timed-sequence relay switching. It can be accomplished by using a dc supply for the relays through power diodes and RC networks. One form is shown in **Fig. 1**, which someone developed quite a few years ago. It has been in service at W6AJF/AF6AJF for several years, dating back to 6J6 rf tube failures with high powered 144 MHz transmitters.

From time to time a check is made on the capacitance of the electrolytic capacitors because the values shown in **Fig. 1** are near the minimum permissible for good protection. The 10-watt resistors get pretty warm and these were finally mounted outboard from the main small chassis in order to not affect the electrolytic capacitors. A recent change was the addition of a double-pole toggle switch S, in **Fig. 1.** This permits the use of a 200 mA field antenna relay which had superior isolation characteristics at 432 MHz. Regular "115V ac" relays usually require about 100 mA at 50 volts from a dc supply, so the main components were chosen for these types of power and antenna relays. A small 50 volt, 15 mA relay was added to the circuit years ago for receiver muting purposes, so there are three main branches fed from the 120 volt dc supply in **Fig. 1.** Each branch operates in the proper sequence due to the power diodes, resistors and capacitors in each relay circuit.

If one operates in the VHF or UHF regions, antenna relay feed-thru can be a major headache. Some types of coaxial relays do not offer enough isolation between the contacts as the frequency goes up. A relay that is satisfactory at 7 or 14 MHz may be pretty poor at 144, and dreadful at 432 MHz. An old relay that has gotten out of proper alignment can be a lethal device for a transistor receiver. Even some new relays are not suitable for VHF service. Any antenna relay should have more than 60 dB of attenuation between the send and receive positions. If a person operates at full legal power, the antenna relay had better be of the 70 to 80 dB isolation type at the frequency of operation. Some relays have a very low SWR rating into the UHF regions but lack enough isolation attenuation to protect a receiver. The poor back-to-back diodes in the receiver front are then taxed beyond their protective capabilities and the

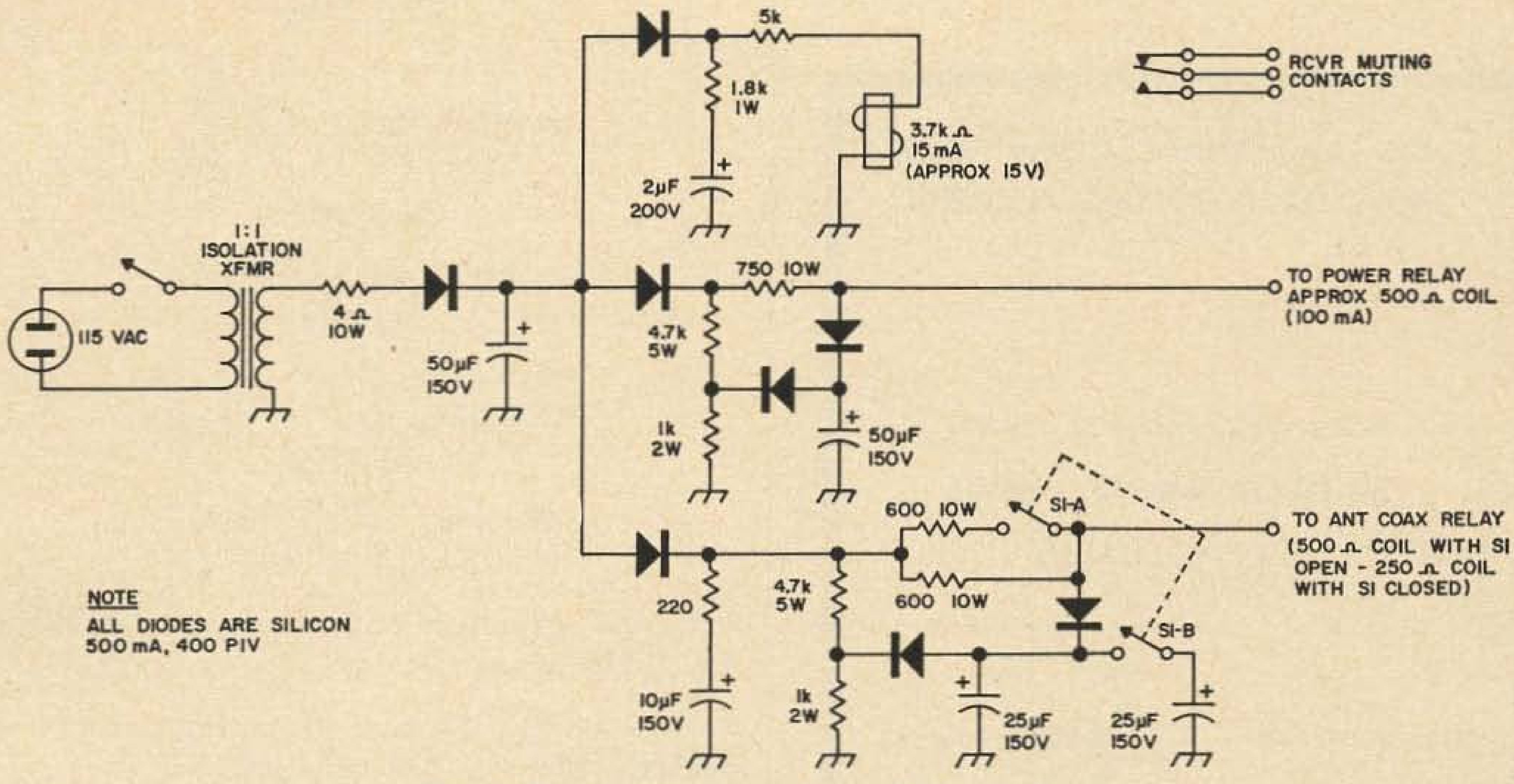


Fig. 1. Timed sequence relay switching system.

front end transistor may develop a poor noise figure. Weak signal reception then becomes a thing of the past and local contacts are all that are left.

At least five coaxial relays are in service at W6AJF for different bands of operation up thru 432 MHz. The writer finally got around to making some attenuation tests since some of these relays had been used for 10 to 15 years. The results were pretty horrifying in some cases and a program of adjustment and relay replacement was undertaken.

The method of relay testing was to connect a signal generator to the "antenna" side of the relay and a 50 ohm termination to the "transmitter" connector. The receiver was connected to the "receiver" side. The signal generators available had good calibrated attenuators in terms of microvolts from 1. to 100,000. Additional 20 dB coaxial attenuators (10 to 1 voltage attenuation) were available for checks on the generator attenuator accuracy at each frequency. The microvolt reading direct thru the relay into the receiver was then set to give a reference S-meter reading, such as 2 microvolts for an S6 reading. The relay was then energized to the "transmit" position and the signal generator output increased until the same S6 reading was obtained. If the generator read 200 microvolts, the relay has 40 dB of attenuation or isolation. 2000 microvolts would mean 60 dB and 20,000 would be 80 dB.

The accuracy depends upon the receiver or converter input impedance which should be 50 ohms. Since most receivers have a better signal-to-noise ratio if somewhat mismatched, a 6 dB pad was connected in series with the coax lead to the receiver front end. The receiver was being used only as a sensitive rf voltmeter with no calibration being necessary except for a constant S-meter reading.

If E_1 is the direct input microvolt reading and E_2 is the second reading with the relay energized to the transmit position, then $dB = 20 \log E_2/E_1$. If the signal generator has its attenuator calibrated in dB, then no slide rule work is needed, only the subtraction of one reading from the other.

Tests were made on a number of relays over the range of from 28 to 432 MHz. If the relay showed at least 60 dB isolation for the band it was operating in, and the transmitter power input was normally less than 500 watts, it was left in service. For the 500 to 1000 watt transmitters, no relay with less than 70 dB isolation was left in service.

The isolation readings obtained at first are listed below for 432 MHz. It was found that the Dow-key relays could be adjusted for contact spacing by loosening the lock nuts on the transmitter and receiver coax fittings and rotating the fittings in or out of the relay case. These adjustments seemed to be very critical, since too large a gap prevented contact and too small a gap prevented the Dow leaf shield inside the relay from functioning as an isolation shield.

Advance relay #1 = 28 dB
Advance relay #2 = 43 dB
Dow relay #1 = 55 dB
Dow relay #2 = 31 dB
Dow relay #3 = 26 dB

Small FEC #CS300 (100 watt relay) = 66 dB

Transco relay (type N fittings) = 75 dB

The two Advance relays were of different types and were not suitable for 432 MHz. They were retired to the "dc" bands below 30 MHz. The Dow-key relays were carefully adjusted and provided 75, 65 and 75 dB isolation respectively at 432 MHz. This isolation was sufficient at 432 MHz, but due to the UHF fittings versus "N" fittings, the SWR was not as good as with the Transco relay. The latter appeared to be better mechanically and not subject to maladjustment.

Next, tests were made at other frequencies with some of the results listed here:

220 MHz

Dow #1 = 70 dB
Dow #2 = 66 dB
Dow #3 = 75 dB

144 MHz

Dow #1 = 78 dB

50 MHz

Advance #1 = 44 dB
Advance #2 = 71 dB

28 MHz

Advance #1 = 60 dB

432 MHz

Large old *radar* relay with type N fittings = 40 dB

An example or two of voltages to be expected with 60 dB isolation will be given. Take a high powered SSB signal of 2kW PEP with perhaps 1400 watts peak output. If the antenna is 50 ohms at the antenna relay, $E^2 = RP = 50 \times 1400 = 70{,}000$. E = 264 volts at the relay contacts. Therefore, 264/1000 = 0.264 volts at the receiver contacts for 60 dB isolation; 264/3150 = 0.084 volts for 70 dB isolation. The latter would impose no strain on the front end of the receiver, but the first case would be marginal.

A 100 watt AM signal input might have a 200 watt peak output; therefore, from above, 50 x 200 = 10,000; E = 10000 = 100 volts.

100/1000 for 60 db isolation = 0.1 volt across receiver which would be a safe value. With other than 1:1 SWR, the voltages could be higher or lower.

The back-to-back diodes are mainly for protection in case of large static discharges across a lightning arrestor from a nearby thunder storm. These diodes on the receiver input will reduce several volts of rf from ¼ to ½ volt, thus reducing the number of replacements of transistors which might be inconvenient, time consuming, and expensive. A good antenna relay, with lots of isolation between transmit and receive, is the best insurance against transmitter overloading of the receiver. Timed sequence relay switching not only stops antenna relay arcing and point wear, but eliminates tremendous peak voltages from getting into the receiver. All three forms of protection should be used, especially with transistor converters or receivers.

. . . W6AJF

E. R. Lamprecht W5NPD
Rt. 3, Box 207
Victoria, Texas 77901

A Regulated DC Voltage Divider

A means of reducing a regulated or storage battery source of voltage while maintaining good regulation.

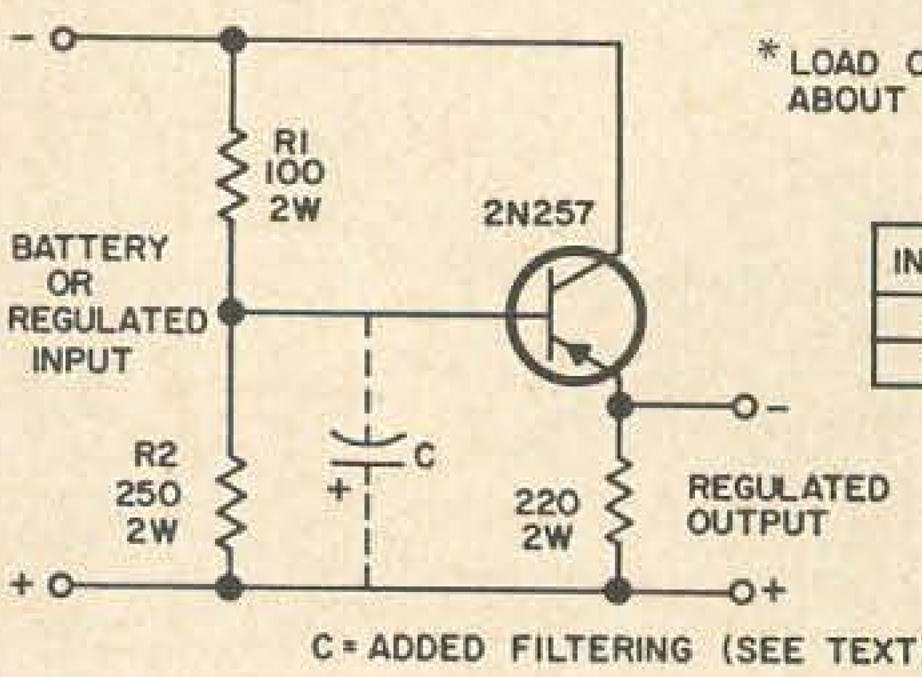
Many of the integrated circuit units on the market are designed for 3.6 or 6 volt operation. Transistor circuits of the "old" type are generally designed around somewhat higher voltages and therefore existing supplies often do not go down to the IC voltages. Current requirements of the IC's are rather high and variable and in most cases do not allow the use of dropping resistors or voltage dividers. A J-K flip-flop IC will draw 25 mA or so and if you want to divide by ten, you use four of these at around 100 mA. A crystal oscillator and buffer plus a Schmitt trigger to drive the flip-flops will raise the current some more. So it's not unusual to need a couple of hundred milliamps at 3.6 V.

The unit described here will permit the use of an existing regulated and filtered supply or storage battery to furnish voltage for these units. Furthermore, it can supply additional filtering if needed by adding a filter capacitor where it does lots of good.

In the circuits shown, R1 and R2 constitute a voltage divider across an already regulated source. If they are chosen so that the current through them is high compared to the current needs of the base of the transistor, then variations in the base current will cause only small variations in the voltage at the junction of the resistors. Thus this voltage can be used as a reference for the standard voltage regulator circuit which describes the rest of the circuit. If the input voltage is from a variable source, the output voltage can be varied by the existing voltage control. If the input is from a fixed source, such as a storage battery, the circuit of **Fig. 2** can be used and R2 will vary the output voltage. R1 in this case limits the voltage. In practice, if the current through R1 and R2 is 30 to 40 mA, and the maximum base current of the transistor about 2 mA, then adequate regulation will result. The transistor can be any audio output PNP device of two watts or more at 40 volts collector to base rating such as the 2N257. For higher voltage drops and currents which result in more transistor dissipation, a unit such as the 2N441 or 2N442 will work nicely in the circuit. The transistors should have adequate heat-sinks and resistors of good quality and ratings of two watts or more should be used so that a breakdown and change in output voltage will not damage the IC's.

An electrolytic filter capacitor connected as shown will increase the filtering if needed. The more capacity, the better at a voltage rating about that of the input supply. The effect of capacity at this point is amplified by the transistor and a 100 μf or so will have the effect of many hundreds of μf across the output.

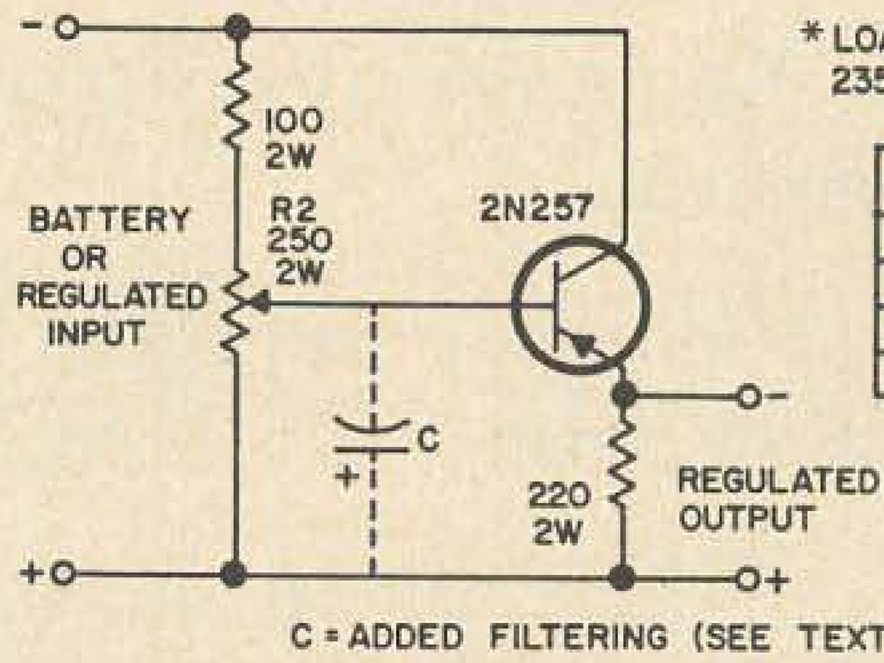
. . . W5NPD



* LOAD ON 7.6V SUPPLY
ABOUT 235 mA

INPUT V	OUTPUT mA	OUTPUT V
7.6	0	3.8
7.6	*180	3.6

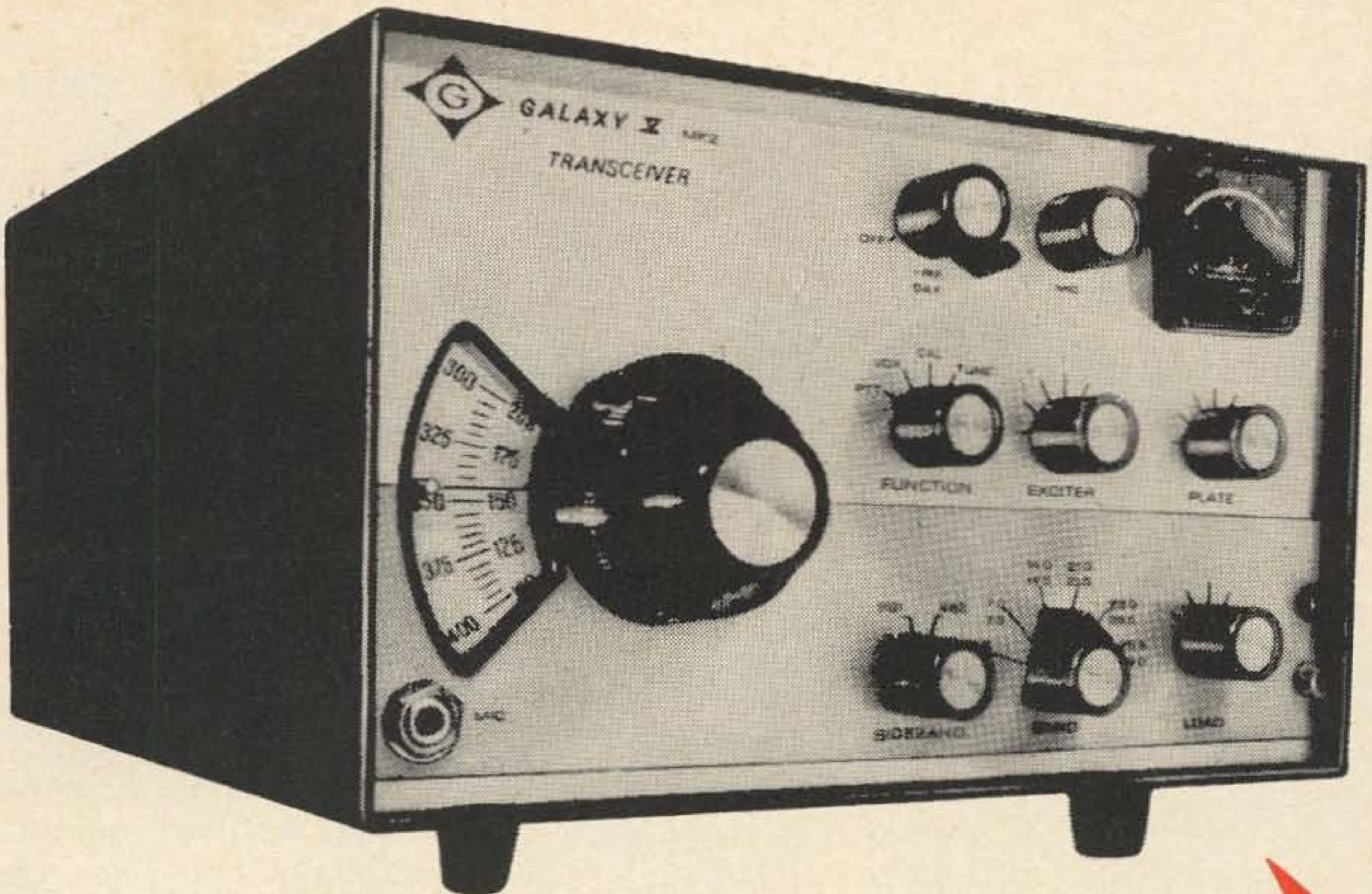
Fig. 1. Circuit for regulated DC voltage divider.

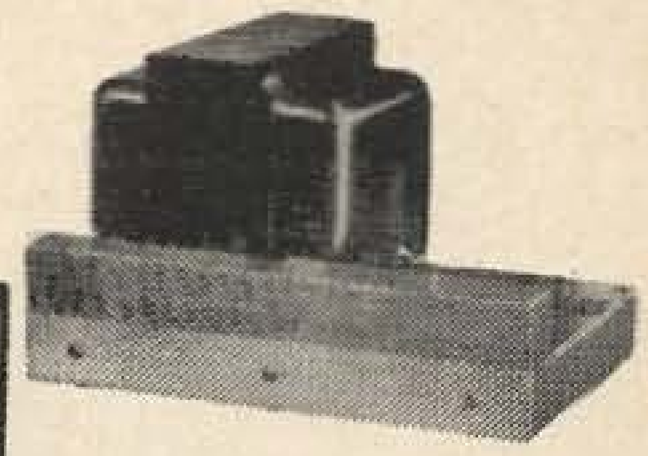


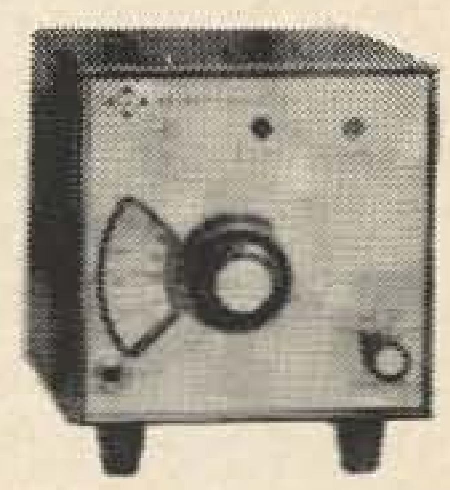
* LOAD ON 12.6V SUPPLY
235 TO 245 mA

INPUT V	OUTPUT mA	OUTPUT V
12.6	0	6.1
12.6	*180	6.0
12.6	0	3.8
12.6	*180	3.6

Fig. 2. Circuit used if the input is from a fixed source such as a storage battery.







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Gay E. Milius, Jr. W4NJF
421 Saddle Rock Rd.
Norfolk, Virginia 23502

The QSL Manager

My Postman came to the door the other day to ask why I suddenly became so popular that he was having to carry an extra load addressed to me. He remembered when I impatiently waited for him, looking for the occasional foreign envelope or card. Now, I was swamped with them—or he was. How could I explain to him that I had taken on the QSL chores for several rare DX stations? And then not long ago I was asked on the air what advantage did a QSL manager offer to a DX station? The questioner apparently had just started chasing DX, but I could frame an explanation for him far easier than to my postman.

A QSL manager at the outset gives a DX station more time to operate by relieving him of the arduous task of answering hundreds of QSLs. A QSL manager also saves money for many US and other amateurs by saving them expensive airmail charges connected with sending a card or envelope to, and getting a reply from some spot on the globe where mail may be delivered only once a month. It also speeds up delivery of QSL cards to those who impatiently want them for certain awards.

The job of a QSL manager—in my opinion and not that of very many other people—is quite interesting. I enjoy handling piles of QSLs for the same reason that I enjoy trimming the hedge around my house, although the neighbors think I am "Nuts". Perhaps I am. I said it!

I can always say that I took up QSL managering because of my ultruistic attitude: I have received so many cards from various other managers that I believed I should return the favor. Maybe that is true, but on the other hand I was interested in learning first hand what a QSL manager received, the different comments on the cards, what a DX log looked like, and I must admit it does sound good to hear a rare DX station tell the world to QSL via W4NJF. Only my postman suffers.

They ask how do you get started in this business? Of course, the first thing is to hook up with a DX station and make arrangements with him either by mail or on the air. Usually the DX station is one to whom you speak frequently or one to whom you have a consistently good signal so that you can maintain a regular schedule with him. He must also want a manager, as many prefer to QSL personally. It is also advantageous to have a working contact with a QSL printer whereby you can have QSLs printed at reasonable cost and within a short time. If you have to wait around for a printer to produce you can get all fouled up. Then there are financial arrangements to complete. If the QSL manager is going to do all the work he shouldn't be obliged to foot the bill as well. DX stations realize this and make elaborate preparations to reimburse expenditures. However, it is difficult to obtain US dollars in foreign countries and it can be complicated.

When you have set up the arrangements with your DX friend, and you are definitely engaged as QSL manager, you can drop a postal card to the various publications which print DX information, including QST. (Rod Newkirk), *CQ* (John Attaway), *DX Magazine* (Gus Browning), and any others you can think of. However, certain of the weekly bulletins do not want QSL manager information and I have been informed of that in no uncertain terms. Hence there is no need wasting postage in that direction. Nevertheless, when your man gets on the air, anybody interested will hear him announce your call as his manager. You'll get no better publicity.

There is one item which is rather important in making the announcement of your appointment. Be certain to state the date on which your tenure commences, the date after which you will accept cards. If you do not do so, you will receive a bundle of mail for past QSOs for which you will have no logs. If it has been cleared with your principle it will also be essential for you to include in your announcements that every card must be accompanied by a self-addressed stamped envelope (sase) or International Reply Coupons (IRC) as this venture is not a philanthropic one. Many uniformed amateurs, used to exchanging cards with US stations only, merely send you a card asking for one in return. Naturally, the QSL manager does not have funds to reply to all comers when the tally can amount to thousands of QSLs. So, be specific if your DX friend directs you to answer only cards with proper return postage. Of course, if he wants to do otherwise and will reimburse you, then that is a different question.

Once your call is promulgated it is not long before the postman arrives laden with correspondence. At this stage all you can do is to arrange the cards in their return envelopes in date/time order as you patiently await the logs. I have been successful in circumventing this waiting, knowing that many DXers are impatient for their cards. I QSO my DX stations and confirm their cards over the air one by one. I also, when I have time enough, and can hear him, monitor his QSOs and log them myself. This saves time and prevents a large stack of cards from accumulating.

Finally along come his logs. Then I suggest that you obtain a large mailing manila envelope (11½" X 8"½) in which to store them and the cards awaiting reply.

Mark the envelope plainly on the flap with a red marker pencil. (This way you can see it from top as well as sides.) Next you can devise your own method of checking each call in the log after you have sent out the corresponding card. I always put "X" after the station call to indicate that it has been answered. I use a red ball-point pen and make another X in the upper right corner of the card which has been answered. Then I file all the answered cards in a shoe box.

You will discover that despite your admonitions many amateurs continue to send QSLs without SASE etc. Many QSL managers have told me they merely consign those to the circular file. I try to answer them by sending the reply through a bureau—stacking them for months until I have enough to send them along third class mail. It costs only 4 cents with open envelope to send 2 ounces of cards to US bureaus and to overseas stations it costs 6 cents for the same weight. I can get about 14 cards in a regular envelope at these prices. (I always admonish senders not to send a QSL manager cards without sase.)

Another problem is replying to SWL cards. This depends upon the policy of your DX station. He may not care for you to use cards or time to reply to SWLs or he may want specific information before sending a card. Many SWLs drop a card in the mail saying "I heard you on such and such a date—such and such a time and you were 59 working W4XXX." This is all right but it is absolutely useless to the DX station and is hardly an indication that he heard the DX station or just the W working the DX station. So I have a habit of procrastinating my reply to the SWL cards until I have no other cards to handle. Then I start seeing if their information fits the logs.

Most real DXers know how to make out a card and do so correctly. It is the newcomers who cause the trouble. They neglect to use GMT, they get the date a day or so off, they write so poorly that I can not make out their information.

There is one thing I think should be emphasized when it comes to QSLs. I am against QSL cards with the information I need on the reverse side. I strongly feel that ALL information should be on the front of the card. However, if this is impossible then the senders should at least have his call on the reverse side with the other information.

Imagine yourself with logs piled in front of you and cards stacked beside you trying to find a call somewhere in the logs. The time and date is on the back of the fellow's card but you have to reverse the card to find the call sign. Then you have to go back to the reverse side and get the information. Furthermore, cards with information on the reverse side must be mailed only when they are inserted in an envelope because nine times out of ten the postmark obliterates the information which is needed most. The post office can not fail to mess it up because of the size of the standard cancellation.

Hints for the QSL sender: always put your call letters on the front of the return envelope, put the QSL manager's address in the upper left corner of the return envelope, and remember to put on the cover envelope the station's call for which the enclosed QSL is sent. A QSL manager with

several DX stations in his "farm" can sort the mail much easier in this fashion.

More Notes: I wonder how many people realize that IRCs can be exchanged between hams like "due bills?" Every day I receive IRCs which have travelled across the seas several times. However, U.S. IRCs are only good to DX stations and can only be used here to send to DX stations themselves for their QSLs. They can be sold, of course, to other amateurs in the U.S. under their face value if the QSL manager has a large pile of them. At the post office, foreign IRCs (except those of Mexico and Canada) can be exchanged for 13 cents worth of stamps. Thus they are worth a great deal of money when you obtain a sufficient number. If you have any Mexican or Canadian IRCs send them out of U.S. The odd value of airmail postage accounts for the QSL manager receiving extra IRCs; airmail to Europe is 20c per ½ ounce so it takes 2 IRCs to cover that, but at the post office you can receive in return 6c worth of stamps; other places where postage is 25c per ½ ounce IRCs will cover the expense but will return only 1c. I usually use the extra stamps to pay for overseas cards which come without IRCs or to pay for postage to send cards to the various bureaus around the world. Which brings up another point. This country has NO outgoing QSL bureau. The ARRL is looking into the feasibility of setting up such a thing. Accordingly, it costs quite a bit of money to send envelopes to the many countries which have their own bureaus. Private QSL bureaus are operating but that expense is too great when at present one can send about 14 cards to a foreign QSL bureau for 6 cents if the envelope is left open and marked "Printed Matter Only". The hams in the Norfolk area have been meeting every month to pool their cards going to the world bureaus.

One other bit of information to have when you become QSL Manager is that your own QSL bureau here in the U.S. will receive a flood of cards for your DX station addressed via your call. You must expect this and let your bureau know, so that they understand where to send the cards. You must also furnish your bureau with extra envelopes because the volume mounts up ferociously. It is the reply to cards received through your bureau that makes up the best part of the volume you will have to send out through the world bureaus.

In conclusion, when your DX station finally leaves his DX location and closes down, you will still receive cards for him. I have been receiving for one station as far back as two years. I do not know what goes on in the ham's mind but some move very slowly. Therefore, be sure to retain the logs or Xerox them before you send them back to the operator.

. . . W4NJF

19th Annual DX Club Meeting in California

The Southern California DX Club wishes to announce that the Nineteenth annual joint meeting of the Northern and Southern California DX Clubs will be held on the 27th and 28th of January, 1968 at the Del Webb Towne House in Fresno, California. In recent years the joint meeting of our two clubs has blossomed into *the* yearly West Coast DX Convention. Last year's attendance of 200 included most of the prominent DX'ers on the West Coast, many distinguished visitors from the East, and a top line of guest speakers and convention events.

As sponsors of this years event, the Southern California DX Club extends a cordial invitation to all DXers to attend the January 27-28 meeting this year.

All room reservations should be made directly with the Del Webb Towne House, Tulare St., Fresno, California. The convention will start at 12 noon on Saturday, and will end at 12 noon on Sunday. Further notices on the availability of tickets, preregistration, etc., will be mailed in mid December to members of West Coast DX clubs for which a mailing list is available. All interested individuals throughout the country may obtain such a notice upon request. Further inquiries should be addressed to:

W6AOA Frank Cuevas
General Convention Chairman
14919 Yukon Ave.
Hawthorne, Calif.
90250

or

Larry Brockman WA6EPQ
Publicity Chairman
30927 Rue Valois
Palos Verdes Penn., Calif.
90274

Fred R. Herr W3WPV
330 Vintage Way
Pittsburgh, Pa. 15232

160 Meter Flat Top

Not all of us are blessed with large, rambling estates. In fact, most of us are short on real estate and do not have room to erect a full size antenna. This was my problem at one time, and I believe many more hams are faced with the same perplexity. This article describes a long antenna for use on a short lot.

For many years I have had transmitters and receivers with 160 Meter coverage. Due to the limited size of my lot I was unable to erect a suitable antenna to allow full use of the equipment. My lot measured 150 feet by 50 feet, and, according to the formula, $\frac{468}{f\ \text{MHz}}$, I needed a wire 260 feet long.

Desperately wanting to operate on 160 Meter band, I gave the problem considerable thought. Before running out of ideas, I remembered the old 'flat top' antenna used in the days of 'wireless' and decided to do some experimenting.

The experimental antenna, as constructed, consisted of three wires, each 66′8″ long, spaced about 16″ apart, and supported by two end spreaders. The three wires were connected in series to make a length of 200 feet. One free end was connected to a 60 foot lead-in which gave a total length of 260 feet. In making the series connections, one end of the center wire was connected, with a jumper, to the end of one outside wire, and the other end connected in similar fashion to the other outside wire. Essentially, the antenna is a wire 260 feet long with part of it folded back on itself two times. The details of construction are given in **Fig. 1.** If a longer or shorter lead-in is required, the length of each of the three wires should be altered accordingly.

As an alternate, the wire could be folded back on itself three times instead of two to obtain a still shorter antenna. This arrangement was not tried, however.

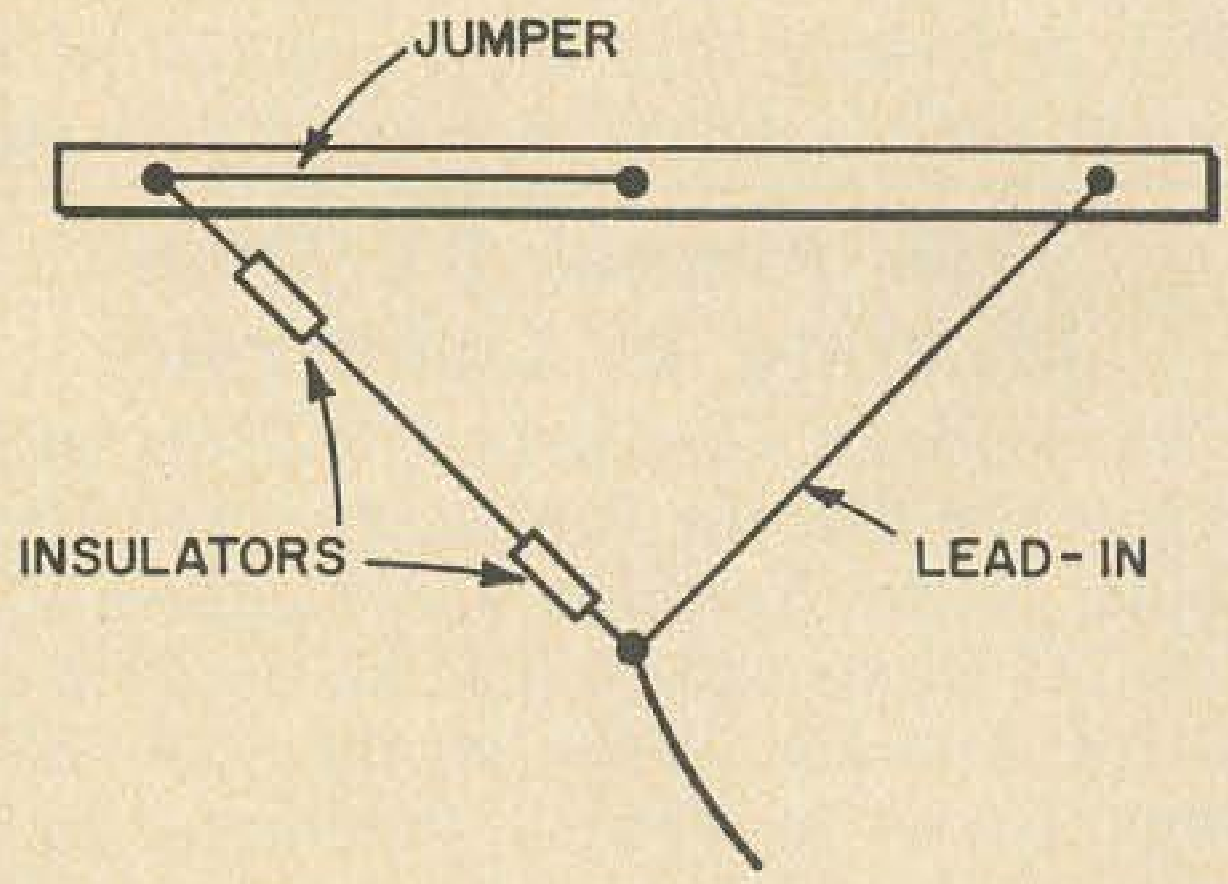
The wire used in the project was No. 23 cotton covered wire. The use of No. 12, 14, or 16 bare wire, solid or stranded, would undoubtedly have given much better results.

The construction of the antenna was quite simple and the results were very gratifying. Using about 65 watts on phone, solid contacts were made (from my former QTH in Philadelphia) with stations in Michigan, Ohio, and Vermont, as well as with many local stations.

If you have a similar real estate problem, try this antenna. If your results equal mine you will be well pleased.

I have a new problem. My present lot is less than 50 feet long. What do I do now?

. . . W3WPV



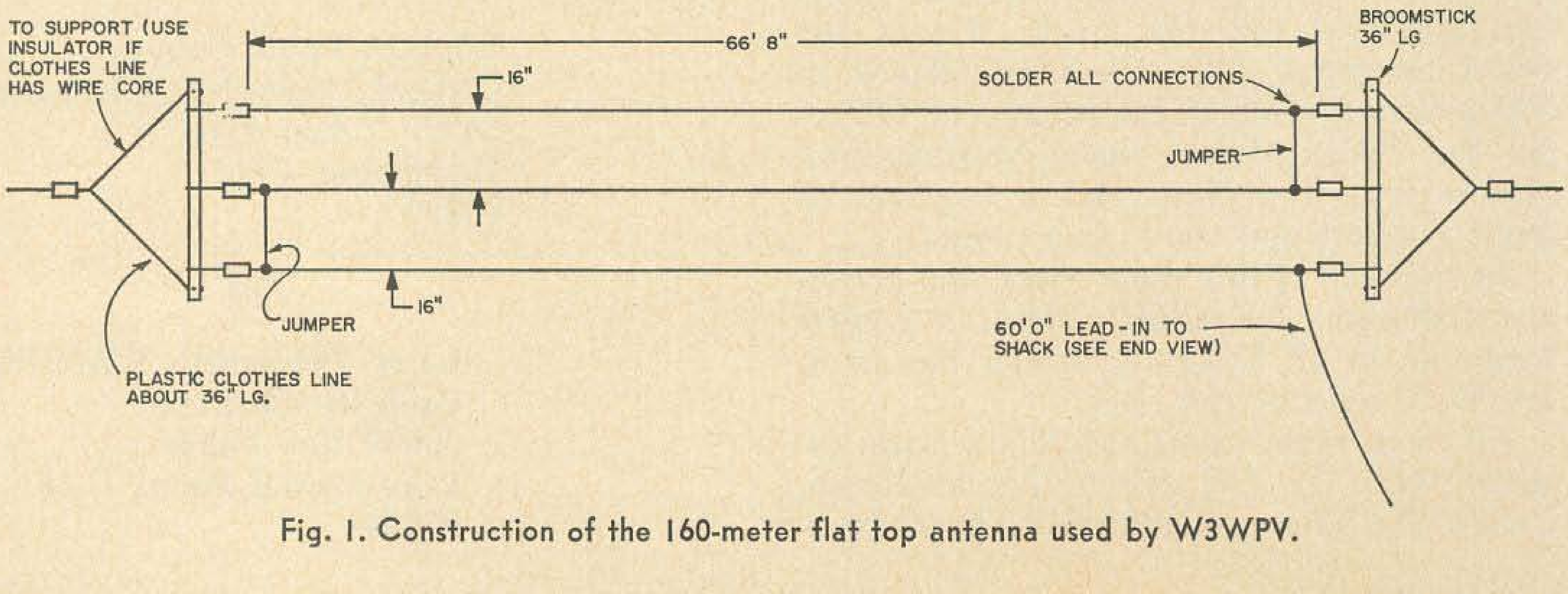


Fig. 1. Construction of the 160-meter flat top antenna used by W3WPV.

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CB & 10 meter	273 X	26.9 - 30 mhz	1500 kc	
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GO AHEAD! RUN AWAY TO SEA

Ever long to see the world while on someone's payroll? Ever wonder what it is like to be on the other end of a QSO with a maritime mobile station? Do you ever long for an "eye-ball QSO" with some of the DX hams you have worked or to know if the port cities of the Far East are really as intriguing as you have heard? Then what you need is to ship out and find out for yourself.

At the present time, due to retirement of regular operators, generous vacation plans (60-120 days a year), and the activation of over a hundred moth-balled ships for the Viet Nam war, there has developed an acute shortage of merchant marine radio officers. Conditions are now so critical that qualified men get ship assignments in a matter of hours (compared to weeks or months a few years ago) and frequently a ship is unable to sail due to a lack of a radio officer—they can sail without the 'ol man but not without "sparks". This has resulted in calling pensioned operators back for a few trips and delaying vacations for presently assigned operators but it still is not enough. Now is the time for prospective operators to enter the field, either on a permanent basis or whenever they can scrape together a couple months for a "relief" trip—usually one trip while the regular operator is on vacation, etc. Relief sailing is especially attractive to those with shore professions (such as teachers and students) as the peak relief-sailing months are during the Summers. In return for this type of sport, the pay and fringe benefits are excellent since you will be classed as a ship's officer. However, if you are an "operator" only and not able to repair and improvise, perhaps you'd better think twice before packing your seabag because most of the equipment on U. S. ships is over 20 years old and you can imagine what 20 years exposure to salt air can do to it. But, assuming you're still game, let's push on with the task of shipping out.

The first, and most important (and difficult), requirement is to obtain a second class (or first class if you're good enough) radiotelegraph license from the Federal Communications Commission. After obtaining this, you must get a "Z-card", (USCG radio officers license), and a vaccination or "shot" record (only if you're going on a foreign voyage and showing a small pox vaccination within the past three years—this can be obtained after you're assigned to a ship so don't worry about it now). Also, if you plan to make a foreign voyage—and who wouldn't since you have to go foreign in order to see the world, etc. etc.—not a requirement but a good idea is a standard, tourist-type passport as it will open many normally closed doors in some foreign lands.

To get the second class radiotelegraph license you need three things. First, you must pass a code test of 16 W.P.M. code groups (5-letters per group) and 20 W.P.M. plain language. Secondly, you must pass a comprehensive written examination, and thirdly, you've got to cough up $4.00 for the tests.

The written portion of the test consists of four parts. Element one is 20 multiple-choice questions on basic radio laws, international treaties, and regulations to which the U.S. is a party. Element two consists of 20 multiple-choice questions on basic operating practice and procedures for radiotelephone (most ships have voice ship-to-shore equipment). The third part is FCC element five which consists of 50 multiple-choice questions on radiotelegraph operating practice. The final part is element six which consists of 100 multiple-choice questions on advanced radiotelegraph pertaining to technical topics, message format and routing, and marine radio navigation. For those of you who enjoy examinations, it is to your decided advantage to also take the test for the "radar endorsement" which is composed of 50 questions pertaining to the theory, operation, and maintenance of shipboard radar equipment.

Now, for those of us who feel the above is a little too much to tackle in one bite, a sneaky (and easier) way to do it is to first get a third-class radiotelegraph license which involves only the code test and elements one, two, and five. When this is obtained, cramming is concentrated on the more difficult element six since credit is given for the elements already passed in obtaining the third-class license. After obtaining the second-class license, preparation is then made for the radar endorsement.

Being careful not to smear the still-wet ink, take your shiny, new second class telegraph license in your hot little hands and rush down to the nearest Coast Guard Office of Marine Inspection and get things started on the next two requirements.

The next requirement is to obtain a "U.S. Merchant Mariner's Document" popularily known as a "Z-Card" because of the letter "Z" prefixing the seaman's identification number. This is a plastic, laminated ID card, issued by the Coast Guard, and shows the positions in which you are qualified to serve. In our case, you want it to show qualifications for at least "radio officer" (It is suggested you also apply for endorsements as "ordinary seaman", "wiper", and "food handler" since they cost nothing and you may need to sail in one of these capacities someday). In order to obtain a Z-card, you must have proof of citizenship (not necessarily U.S.), a social security card, and a "letter of commitment". This letter or job-promise requirement may, at first, appear to be an insurmountable obstruction because "you can't get a job without the Z-card and you can't get a Z-card without a job" but this is where the letter of commitment comes in. In our case, probably the easiest way around this is to write to the nearest radio officers union (in most major ports), tell them your aims and that you have a second class radiotelegraph license, and in most cases they can fix you up with the required letter. In the case of those who are Navy or Coast Guard veterans with sea service, a letter requesting a "transcript of sea service" sent to General Services Administration, Navy Branch, Military Personnel Records Center, 9700 Page Blvd., St. Louis, Missouri 63132 will do the trick.

The next requirement is the radio officers license, also issued by the Coast Guard. To qualify for this requires a minimum age of 19, a first or second class radiotelegraph license, a letter of commitment (same as above), passing a physical examination, passing an examination on the "Ships Medicine Chest and First Aid at Sea", and the patience of Job because you will spend many hours completing forms, assembling records, letters of character reference, photographs, fingerprint cards, security questionaires, and then waiting for 2-4 months for it to be issued.

Now, several months later, you've got all the necessary documents. You hear foghorns blowing on the damp, on-shore wind, and you decide its time to start thinking about getting a ship and getting underway. On U.S. ships, in order to sail as the only operator on board, you will need an endorsement on your FCC license stating that you have served at least six-months as an operator on U.S. ships. Since freighters and tankers carry only one operator, job possibilities are severely limited without this endorsement. Those of you who have served as radiomen on board ships in the Navy or Coast Guard are already qualified for this endorsement. While not suggesting a hitch in the Navy to obtain this endorsement, some other ways to get it is to sail on a passenger ship as an assistant radio officer (these jobs are assigned through the unions) or to enter the Radio Officers Union apprenticeship program. Other ways are to work on various U.S. government ships as a radio operator, such as with the Military Sea Transportation Service, the U.S. Coast and Geodetic Survey, or on a research vessel belonging to the several oceanographic institutes. These jobs are filled through application to the individual agency concerned while almost all jobs on freighters and tankers are assigned through the two radio officers unions (American Radio Association and the Radio Officers Union). Those with the six-months endorsement can also apply to tankers companies such as Texaco, Humble, and Sun Oil, etc. for direct employment as a radio officer.

Now that you're all set to go, pack your seabag early and get your affairs on shore squared away because when called to a ship, you're usually phoned one day for a ship which is sailing the next day. Newcomers usually do not have much choice of the areas to which they will sail, but when you're new, the whole world is yet to be seen. Bon Voyage.

. . . K4UDP

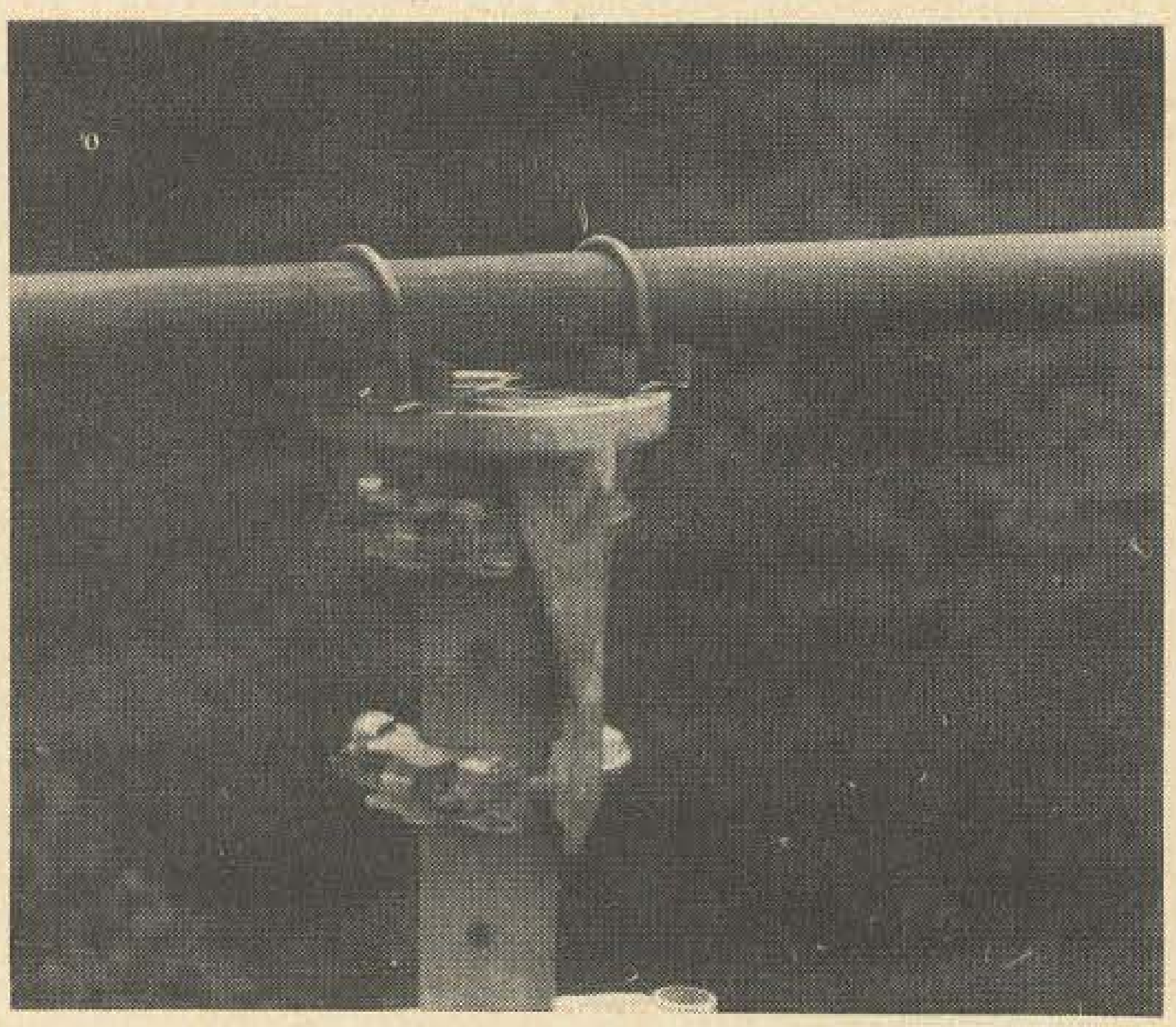
References

American Radio Association, 270 Madison Avenue, New York, N. Y.

Radio Officers Union, Room 1315, 225 West 34th St., New York, N. Y.

Military Sea Transportation Service, 58th St. & 1st. Ave., Brooklyn, N. Y.

"Study Guide and Reference Material for Commercial Radio Operator Examinations" U.S. Government Printing Office, Washington, D. C. 20402, $0.75.



A Sturdy Boom Clamp

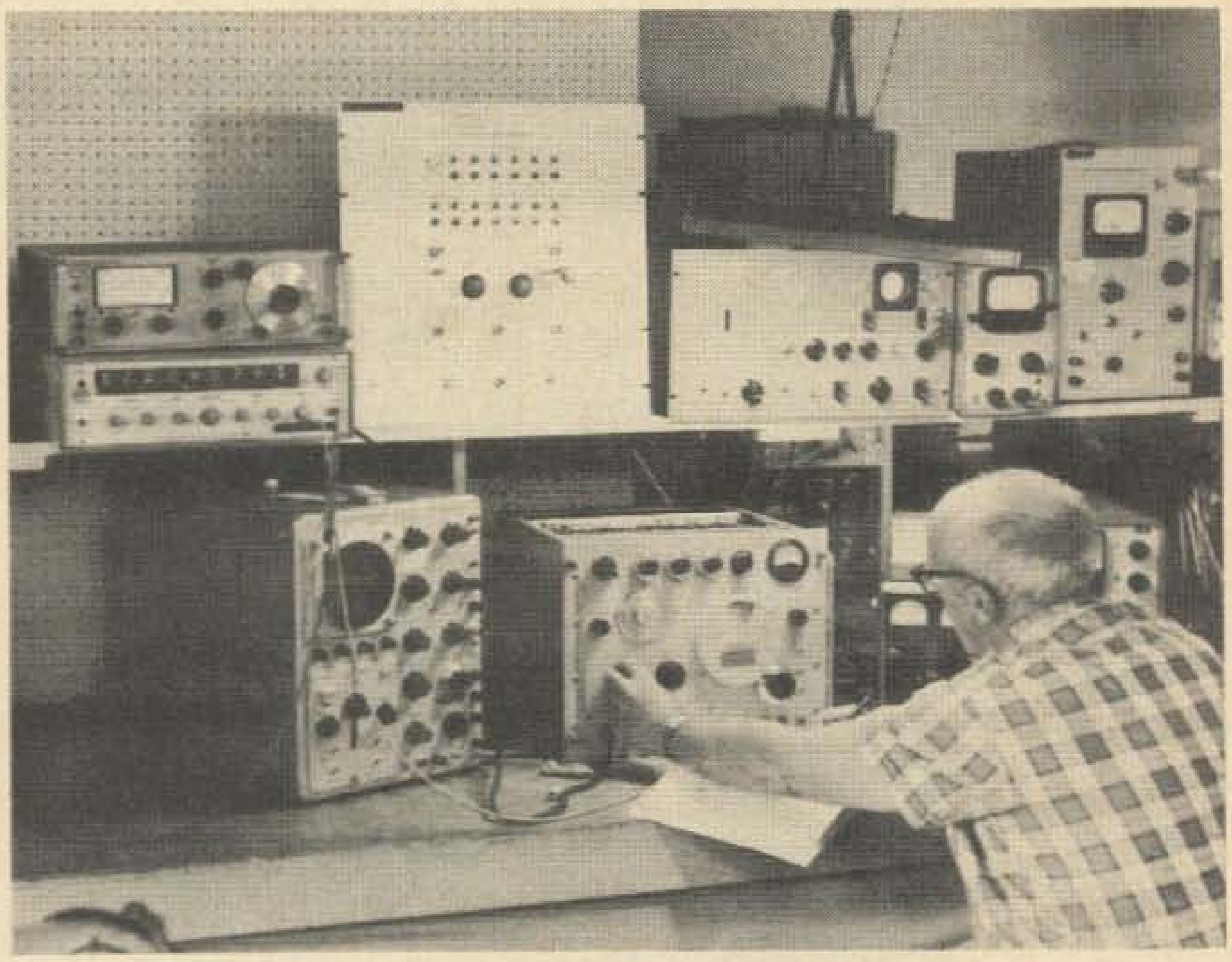
Don't throw away the bottom section of your C.D. rotator when you mount it in a tower. Shown in the photograph is the lower section of an AR 22 rotator used to connect the boom to the mast of a 20 meter 2 element quad installed at W6BKX.

Drill four holes in the flat section to fit the boom clamps, tighten it up and you have yourself a very stable connector. Boom length is 10 feet long here.

Old TV telescoping masts are useful for beam parts. The mast at W6BKX is the outside 2 inch section and the boom is the next smaller size. Just right for the clamps which were part of a Gotham quad kit.

The smallest inside diameter pipe in the TV masts should be discarded. They are not to be trusted for even the smallest of 20 meter beams. Mine twisted off in very moderate weather.

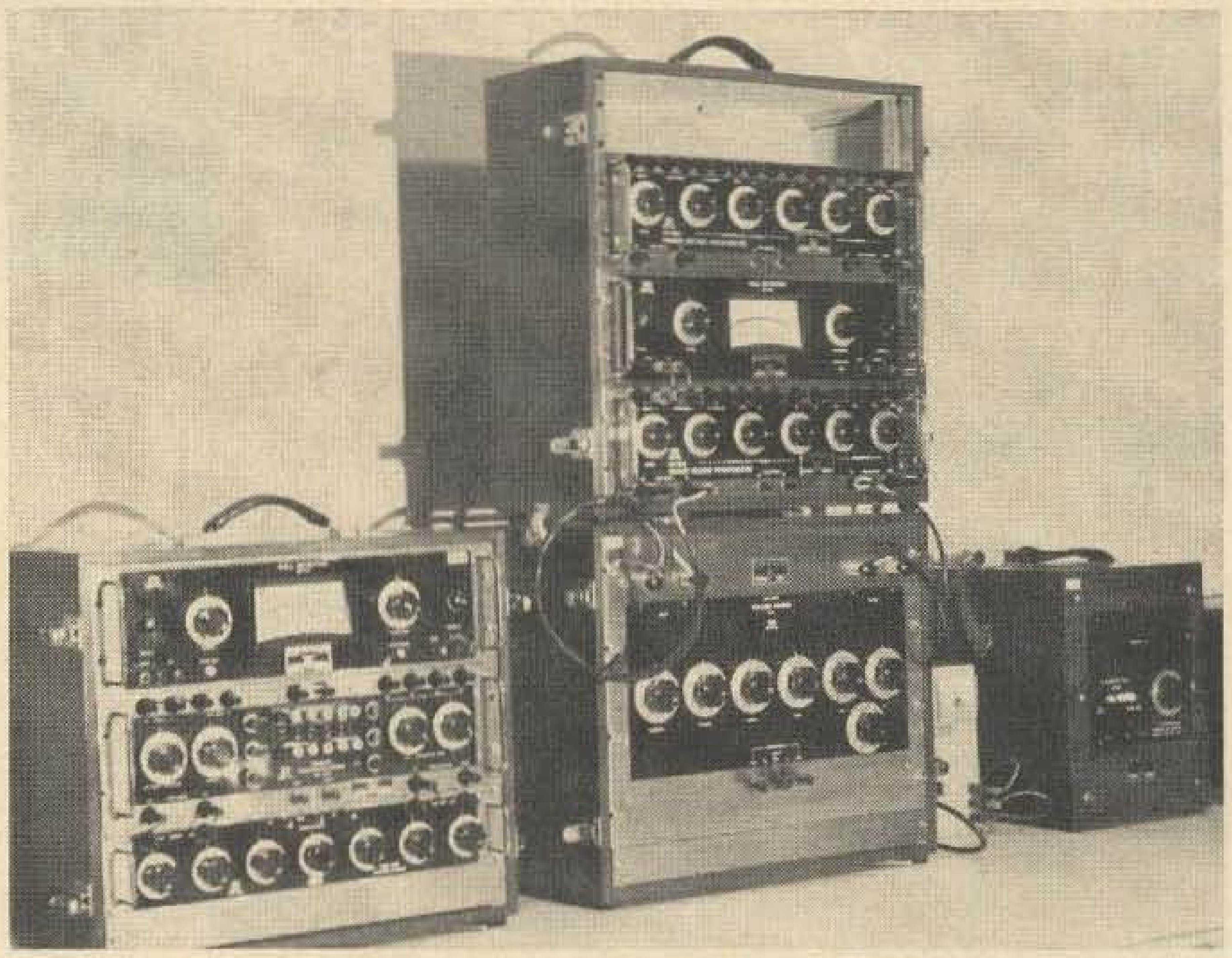
Paul A. White W6BKX



Here is one of our technicians using an **Eldorado** 951 counter to calibrate a Hewlett-Packard 618B signal generator. The **Eldorado** is reading out the frequency of the 618B to nine places at 5220 gc!

This fast counter can be used for quickly calibrating transmitters and receivers too.

Most ham measurements don't require the n'th degree of accuracy, but we are set up to calibrate and service the latest and most advanced equipment, so we have to be able to get right down to NBS standards in as many measurements as possible.



Here is a bridge used to measure resistance with an accuracy to five parts per million. Engineers will appreciate that this bridge is by **Julie** and that it reads $0\text{-}10^{12}$ ohms with .0005% accuracy.

In the middle is a **Julie** dc measuring system. **Julie** represents the most accurate dc current and voltage measuring system commercially available. It allows us to calibrate all dc instrumentation with part per million accuracy.

On the right is one of a bank of saturated cells in a constant temperature regulated bath. This is a "house" primary standard and is periodically sent to NBS for certification.

One of our technicians is shown here using another Eldorado 951 counter to certify a working standard.

Ralph Steinberg, K6GKX,
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Operations Deep Freeze...1957-1967

The saga of ten years amateur radio in the Antarctic.

"Vast expanses of ice and drifting snow"! "Temperatures from 50 to 100 degrees below zero"! "Winter darkness and isolation"! These were some of the conditions at Little America V in Antarctica during Operations Deep Freeze III, from 1957 to 1958, the International Geophysical Year.

The history of Operations Deep Freeze III and the International Geophysical Year has been published in many magazines and books but little has been told about the momentous part amateur radio accomplished during this operation and still continues to do today. This immeasurable service to the lonesome and isolated men in the Antarctic should go into the records of achievements along with other public services the radio amateur has contributed.

To relate the story about Operations Deep Freeze III at Little America V, where our story begins, some description of how all the radio amateur activity started. Little America V, the fifth station to bear that name, was begun in early 1955, by Operation Deep Freeze I, with construction continuing through Deep Freeze III. In early 1957, operations were under way for the International Geophysical Year, with 352 men setting up housekeeping for the vital job to come. The ice breakers USS Glacier and Atka had the job of clearing through the ice pack so the ships could unload their cargo of supplies and equipment before the heavy snows fell. It was slow and tedious work chipping away at the ten foot thick ice barrier. With time becoming increasingly important, helicopters began shuttling cargo ashore and it was work around the clock for the men as temperatures of minus 50 fanned by 40 knot winds were constant. By the time unloading operations were completed the temperature had dropped to minus 70 degrees. With these conditions prevailing outside, work began on the inside of

Ice breaker USCG GLACIER clearing a channel in the Ross Sea so that the Navy supply ships can unload cargo at McMurdo Station.

the buildings sorting equipment and supplies. While some of the men worked on this task, others got the 19 house city called Little America conpleted with an interlocking tunnel, made of chicken wire and burlap, connecting every building. This work was finished none too soon as the buildings were snowed under so that the radar, radio and ground control antennas were all that showed above the snow.

With the buildings completed and the Naval communications center in operation, it was time to install the radio equipment for KC4USA. Under the guidance of Lt. Comdr. T. N. Thompson, officer-in-charge of Little America, the amateur radio equipment was installed and on the air in a very short time. Contacts to stateside were good and before long KC4USA became a choice DX station for the radio amateurs. There was always a pile-up of stations waiting for a contact and, under favorable conditions, KC4USA could be heard in most any part of the United States. DX contacts were fine but these isolated and lonesome men were anxious to talk to their loved ones at home. Knowing the great value of morale, Lt.

Comdr. Thompson made sure that phone patching was the order of the day, and under favorable conditions many happy voices could be heard on the 20 meter band.

There was drama and humor in those phone patches. As you know a phone patch is nothing private especially when you are sitting at the rig with a shack full of fellows at one end talking across thousands of miles to the other end, from Little America. For humor, there was one incident on a phone patch, where a fellow at Little America who had a German wife who every now and then would hit him with a bit of German in her conversation. The fellow was limited on his German and he would ask for a repeat here and there and sometimes would ask for an English version of it. Sometimes she would not give it to him in English and he would still be trying to figure it out for days later. On the dramatic side, there was a phone patch which helped save the life of a mother of one of the men at Little America. The mother was to have major surgery and her wish was to talk to her son before the operation. The patch was made and the doctors said after the operation that the mother, by talking to

After making connections with a ham in the states, Glenn K. Doebler, Jr. and John R. Haugh attempt to locate McMurdo personnel who desire a phone patch into the States. *Official U.S. Navy Photograph.*

Ice cave. Great place for a ham shack

her son, came through with flying colors. There were many more humorous and dramatic phone patches but it would take a separate book to tell them all. A few common questions from the folks at home were, "Is it cold down there?" "When will you be home?" "Did you get the goodies I sent you?"

It was not easy to keep phone patches going through in bad weather. Antennas would blow down from the constant gale winds of the Antarctic. An idea and ambition came to the men at Little America to make a cubical quad antenna which was to improve their operation, both transmitting and receiving. Bamboo for the cross members was plentiful, so with a little welding, a few bolts, etc, not to mention some pure Navy talk, it was completed. It was intended to do wonders on 10-15 and 20 meters. This was mounted on the end of a 5 inch pipe which extended about 20 feet above the snow on the radio shack roof. On the lower end, about 4 feet from the floor, were a couple of steel rods mounted horizontal on the pipe, making the set-up look like a rusty periscope. The idea was to be able to rotate this whole lashup simply by a bit of pressure on the steel rods. It was a good antenna, but within a week, the end of the 5 inch pipe above the roof had become solidly frozen to the Ross Ice Shelf. Needless to say, it was not rotated until the temperature got warmer and then it went round and round like a windmill, when the gale winds came up.

Several months after Little America V was in operation, KC4USV at Mc Murdo station started their amateur radio activities with KC4USW at Ellsworth, KC4USH at Hallet, KC4USK at Wilkes, KC4USB at Byrd and KC4USN at the South Pole following a short time later. These outpost IGY bases were built to take scientific observations during the International Geophysical Year. With the increase of more scientists and Navy men to man these stations, the population in Antarctica had grown to 4200 men in support of Operations Deep Freeze III. This increase in population made the Antarctic look like the "Gay White Way" in New York City. Bright lights on the long winter snows glistened like jewels and the wastelands of the Antarctic became alive with men and machines. Phone patching and traffic increased with the growing population, and more state side stations volunteered to handle the phone patching and traffic. Traffic nets were organized especially to operate to and from the Antarctica stations.

There was one more amateur radio station in Antarctica during the winter of 1957-58 which was not at an IGY base. Father Daniel Linehan W1HWK, operated KC4USC at a reconnaisance base near the present site of the Mc Murdo station. Father Dan with a group of U. S. Naval Construction Battalion men (SeaBees) was engaged in special studies of camp sites for the Navy.

Father Daniel Linehan WIHWK at the mike with Paul Blum W2KCR in Paul's shack.

The camp being a temporary one, no heavy amateur radio equipment was used and Father Dan brought his personal amateur gear with him. With 40 watts on AM phone and 50 watts CW, he had a lot of fun running messages for the personnel at the camp. At one tine, KC4USV, at Mc Murdo was out of operation due to trouble with their equipment, so Father Dan at KC4USC had to handle most of the traffic for them and send it back and forth by helicopter. Some of these messages were happy ones and

Antarctica's great white way.

some were very tragic and it was difficult at times to determine which end of the message was the more lonesome. On one occasion, a Navy helicopter pilot called Father Dan from the 'copter on the ship-to-shore radio, when he was five hundred miles from the base to see if Father Dan at KC4USC could get some news about his wife who had been in an auto accident in Kansas City, Missouri. The Lieutenant had tried through other channels to get in contact with his wife but was unable to do so. KC4-USC went into action and contacted an amateur in New Jersey who put the phone call through to the pilot's brother-in-law in Kansas City, who gave a full story of the condition of the wife and child who was also in the accident. At the time of the phone call, the wife was still on the danger list at the hospital but the baby was unharmed. With the 'copter still many miles away, the pilot got the report of his wife's condition from Father Dan. A week later, the pilot was aboard a ship about ten miles from the camp and again contacted KC4USC to ask, if he came ashore, would he be able to talk to his brother-in-law in Kansas City once again. With a prearranged schedule, a Syracuse station was contacted and the pilot came ashore with the ship's doctor and captain. The ship's doctor was able to talk to the doctor in Kansas City and, with a few moments conference, the news came that the wife was out of danger. The pilot was so overcome he was unable to speak to his brother-in-law or the doctor. Needless to say, amateur radio had helped another man's morale that day in the Antarctic.

Besides handling traffic and phone patches, there were other services that the radio amateurs offered to the isolated men in Antarctica. At Little America V, a newspaper was published called the Penguin which had the national and international news as soon as it happened. From the station of W2KCR in North Syracuse, New York, Paul Blum with four members of the Radio Amateurs of Greater Syracuse (RAGS) transmitted the first newspaper page by facsimile to Little America V, on May 5th, 1957. The transmission consisted of a cartoon, two pictures, news stories and a greeting. This was so successful that a one page newspaper sheet was transmitted twice a week, which now included more photos of people in the news, sports and of course, cheesecake (the girls usually wearing fur coats). About May 30th another news project was started called, "Operations Baby Face". Pictures of the new born babies were sent with each edition of the newspaper. Many happy fathers had their morale lifted by the picture of his new born child. One father received a picture of his son 18 hours after being born. This facsimile operation became so popular with the men at Little America, they gave it the title of "W2KCR Family Album".

Operation "Baby Face" with photo of new born baby.

A bit of humor was also included in these facsimile operations. In the fall of 1958, the Miss America Beauty Contest was being held in Atlantic City so Paul, W2KCR, conceived an idea, as a morale builder, to stage a beauty contest at Little America and call it the Miss Little America Beauty Contest. The only difference between the two contests was that in the one at Little America the winner would be selected from the pictures instead of in the flesh. Pictures of the various state winners were transmitted to Little America and, as they were received, they were hung on a large bulletin board with


Miss Little America beauty contest

statistics of each of the Miss America contestants. To keep the selection of the winner completely impartial, the contestants were identified only by number. After heated voting in 67 below zero weather, Miss Massachusetts (36"-24"-36") was picked as Miss Little America of 1958. It was a close race with a hazeleyed blond from Tennessee but Miss Massachusetts won in the runoff. The winner was awarded a silver penguin which was paid for by the "residents" of Little America. All the news services carried the photograph of the Miss Little America winner and it hit the front pages of many newspapers throughout the United States.

In 1959, Little America V was closed, but Mc Murdo, Byrd and the South Pole stations were designated as permanent scientific observation stations. Mc Murdo Station became the hub of all communication activities both Navy and amateur radio. With Mc Murdo Station as the communications center, amateur radio activities also became a center of communications at KC4USV. In the summer months, the arrival of scientists from all parts of the world made Mc Murdo station look like some large city hotel with a "full house". Each night there was "standing room only" in the ham shack, waiting for phone patches to stateside. KC4-USV operated around the clock, with two or more operators on a shift ,to take care of this peak load of traffic and phone patches. As the summer months came to an end, the scientists returned to their homes and the "wintering-over" Navy personnel settled down for a long hard winter ahead. Antennas and equipment had to be checked before 100 knot gales with snow whip into the Antarctic. Even with the best of care,

KC4USV . . These call letters are beamed from the Navy ham station at McMurdo over 6,000 times a year. The steel cables over the ham shack are needed to hold it down during frequent Antarctic gales. *Official U.S. Navy Photograph.*

very often the antennas were damaged by severe storms.

From 1960 to 1962, Mc Murdo, Byrd and the South Pole stations took on a new look with a modernization program of antennas and equipment. At Mc Murdo station, a nuclear atom electric power plant replaced the fuel burning generators which had been in use since the IGY year. A new tower and a new Mosley TA 33 beam was installed and in the ham shack the complete 32 S Line (Collins) took the place of older equipment. With this work finished at Mc Murdo station, new antennas and equipment were installed at the South Pole, Byrd and Hallet stations. Highly directional conical monipole and uhf antennas were part of the antenna replacements at Byrd station. Upon completion of this modernization program, the capability of these stations improved considerably.

Through the years from 1962, Navy personnel were relieved of duties and others came to take their places. Amateur radio activities were much the same until this present year when Operations Deep Freeze 1968 got under way. With the summer season here again, operations at the Antartica stations are again at high peak. At KC4USV, amateur radio activity is increasing and some facts just received from there might give you a picture of their amateur radio operations. An average of 19.7 phone patches a day are put through to the United States and the world. The record number of phone patches for this summer season is 56 patches in eight hours. From October to March (the summer support season) approximately 3,000 patches are made. During the winter season, March through September, a total of 2800 patches were completed. An average of fifteen states are covered each week in the patching. A years total in phone patches averages about 6,000. Emergency phone patches are received and transmitted at any time as there are six regular ham operators at Mc Murdo. "Marathon" phone patch transmissions are held on major holidays; beginning on the holiday (Mc Murdo time) and ending at Midnight the next day. Besides all this phone patch activity, Mc Murdo station is also a member of the Navy MARS network with the call, NØICE. They operate with the east coast from 0100 to 0300 Zulu time. The midwest from 0300 to 0430 Zulu and the west coast from 0430 to 530 Zulu. Several thousand MARSGRAMS are transmitted and received each month. The outpost stations, KC4USB at Byrd and KC4USN at the South Pole, although staffed with smaller crews, participate in these amateur radio activities as well.

There are many radio amateurs to be commended for their participation in handling all the traffic and phone patches from and to the isolated men in the Antarctica. Some have participated in this dedicated work for more than ten years. Space does not allow a complete list of everyone who has had any part of the communication link between the men in the Antarctica and their loved ones at home. We will however list several of the radio amateurs who have been mentioned in the letters we received from the men who are now in the Antarctic or from those who have done duty there in past years. Topping the list (ladies first!) is Betty Gillies, W6QPI, who for the past ten years has seldom missed a schedule with the Antarctic stations to pick up traffic and phone patches. Her record of phone patches and hamgrams, during these years, total

Betty Gillies W6QPI picking up traffic from one of the Antarctic stations.

several thousands. Betty is also a member of Navy MARS and her call is NØAYT. Kayla Bloom, W1EMV, formerly WØHJL and KH6CKO, just happens to be the new editor of 73. Besides being editor, Kayla has done a lot ot traffic handling with the men at the South Pole station, KC4USN. When she lived in Kailua, Oahu, many hours were spent in this work but now being editor of 73 keeps her busy into the wee hours of the morning. There is also Captain Haud Gillis, W4UEL, pilot for Pan American Airways, who has, for the past ten years, been one of the regular scheduled stations picking up phone patches and traffic from all the Antarctica stations when not flying. W2KCR/W1CED, Paul Blum, mentioned earlier in this story, still does a lot of phone patching for the men in the Antarctica. W7ARS, Walter Nettles has had RTTY skeds with Mc Murdo and Byrd stations for some several years. Also on RTTY skeds with Byrd and Mc Murdo stations are K1TWK, Kenneth Nokes and John Terry, KL7DRZ. Kenneth Nokes is QSL manager for Byrd and South Pole stations. His address is Island Park Road, Ipswich, Mass. Charles Morgan, K1GZL does considerable phone patching for the men at Byrd station, during the winter months. Again to all amateurs contributing to this dedicated work, the men in the Antarctic "Thank You"!

It is now the middle of the summer season in the Antarctic and this brings more radio amateur activity. Scientific parties in remote areas are accompanied by ham gear. Picket ships and research vessels, USCG ice breakers and supply ships all have ham stations aboard. The call letters of these and the other Antarctic stations may be useful for reference in traffic handling and we list them as follows:

KC4USV . . Mc Murdo
KC4USX . . Williams Field, Mc Murdo
KC4USB . . Byrd
KC4USN . . South Pole
KC4USJ . . Plateau
KC4USH . . Hallet
KC4USP . . Palmer
KC4USL . . Little Brockton
KC4USG . . USCG Glacier
KC4USD . . Burton Island (USCG)
KC4AAA . . Research Vessel Eltonin
KC4USS . . Picket Ship USS Mills
KC4USO . . Picket Ship Thos. J. Gary
KC4USC . . Army Helicopter Squadron
KC4USM . . Satelite near Byrd Station
KC4AAO . . Byrd Satellite, long wire

Some of these stations are closed during the "wintering-over" period and the USCG ice breakers return to their home ports in the states.

Before we bring this story to an end, we wish to relate a human interest story of a radio amateur who has spent a good part of his life in the Antartica. Julian P. Gudmunson, KØOEE/NØANU, now stationed at Mc Murdo station, has recently returned for his fifth tour of duty in the Antarctic and looking forward to his sixth, next year. Julian arrived the first time at Little America in 1956 and wintered-over till 1957. He was one of the operators at KC4USA that year. In 1960-61 and 1961-62, Julian was one of the operators at KC4USV Mc Murdo and operated KC4USX at Williams Field. During the wintering-over period 1962-63, he was one of the operators at KC4USN at South Pole Station and also operated at KC4USB that year. In January, 1967, the National Science Foundation honored Julian Gudmunson by naming a mountain in Antarctica, Mount Gudmundson.

Through the years anateur radio and the radio amateur have contributed willingly to science and public service and a recent letter from Rear Admiral Robert H. Weeks, ass't. Chief of Naval Operations (communications) expresses the importance of amateur radio to the morale of Navy personnel, "The contributions which amateur radio makes to the morale of Navy personnel throughout the world are numerous and varied. Unfortunately, many incidents involving amateur radio have been lost to history because of documentation. There is a definite story to tell regarding the importance of amateur radio to personnel connected with naval operations in remote areas such as those in Antartica."

This is the story, in a brief way, about Operations Deep Freeze and the radio amateurs who participated in it. To those men of the Antarctic who are part of this story, we hope it has been a little insight of the many hours of happiness which amateur radio has brought to them.

I wish to thank Betty Gillies, W6QPI, Paul Blum, W2KCR, Julian Gudmundson, KØOEE, Father Daniel Linehan, W1HWK, Commander T. N. Thompson and all the Navy personnel who helped make this story possible.

. . . K6GKX

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The Crystal Shopping List

The ham who enjoys building gear usually has a number of projects in mind at any one time which require crystals. Hamfest and surplus store prices are attractive, but it is wearisome going through box after box only to come home and realize that you passed up a crystal which would triple onto the wanted frequency while hunting for one which would double. Moreover, the buck fever of bargain hunting does not improve one's arithmetic on the spot. The answer, of course is a list, but the trick is to prepare a list in such a way that the alternative frequencies which might be used are easily compared while the total list is in serial order to facilitate a quick search. Here is how this can be done.

Say you want to build six pieces of gear, a low frequency marker oscillator, a 21 MHz converter with two ranges (for cw and phone) feeding a Q5er, a 28MHz converter, a 50-MHz converter, and a 14MHz and 28MHz SSB exciter. Sounds complicated? Well, it takes more than crystals, but hunting all these crystals ot the next hamfest is easy, if you set up your list as shown in **Fig. 1.**

The two low frequency crystals are so different that they hardly complicate life. The rest fall in serial order by columns with alternates appearing in rows across the page. Now if you find a 6866, for instance, you know immediately that you have finished with that row and can strike off 5150, 6866, 10,300 and 20,600, all of which were possible alternates for the CW range on the 21MHz converter. If you wonder how all trese are so readily interchangeable, I recommend that you investigate the Robert Dollar oscillator as one of the best for overtone and harmonic generation. Just don't get ahead of me at the crystal table at the next hamfest!

. . . WA4UZM

MARKER	100 500 (Channel 70 or 360)								
28 SSB		6433				9650		19300	
21 CONV	5150	6866				10300		20600	
14 SSB	5200								
21 CONV	5225	6966				10450		20900	
50 CONV				8300			16600	24900	49800
28 CONV			7050 or 7075		9400 or 9433	14100 or 14150		28200 or 28300	

Fig. 1. The crystal shopping list.

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Witching for Better Grounds

This article is written with the idea that antenna performance can be improved by proper location of radials and/or ground rods being driven into more favorable earth locations. Low resistance grounds also improve reception by effectively lowering the power line noises at the receiver input, which in turn improves the signal to noise ratio of the received signal.

The basis for this article is the fact that some people have the ability to locate underground objects, pipes and water streams by so called witching methods. I don't believe that anyone has come up with an explanation of this phenomenon of witching, but the fact remains that it *is* being done—and with surprising accuracy. After talking with persons who have this ability, I have come to the conclusion that the ability must be partially hereditary. But first and foremost, the person making use of this ability has to believe in it himself. It only follows that there will be many non-believers. You can't convince some of them even after they have seen the results. As an example, I recently had the occasion of watching a so called "witcher" demonstrate his ability to a couple of "non-believers". They were making fun of him while trying to locate some buried water pipes. He made the statement that he could find a lot smaller objects than pipes. One of them said, "How about me burying a nickel in the dirt and you find it"? As it happened the witcher had shortly before, been practicing on small coins, so he suggested that one of the non-believers bury 3 nickels close together along a track recently left by a tractor wheel. This particular track was plainly visible for a distance of about fifty feet. In short order, the witcher, using two rods made from coat hangers located the 3 coins. The non-believers again hid the coins and again in 2 or 3 minutes the witcher had located the coins. You can imagine the disgust which showed on the faces of the non-believers. They simply walked away, mumbling, "I still don't believe it's possible".

There seems to be various methods used by various people in locating buried objects. I was recently told of a man in Alaska who used an ordinary crow bar for locating buried water streams. He was in great demand to locate spots on which to drill for water wells. When using the crow bar he would balance the bar in his hand and when he passed over the source of water, the bar would dip downward. From experience he could get some idea of the depth of the proposed well.

I have seen other persons use willow branches, rods made of brass, copper or iron. My Uncle showed me how to witch for water when I was about 16 years old. He was following a buried stream by crossing back and forth over it as it passed under our front yard. He told me the pull was very strong and that it was impossible for him to hold the willow horizontal when he passed over any large body of water. In order to convince me, he told me to hold the end of the willow on one end with a pair of pliers. To my amazement, the willow twisted off in the grip of the pliers. He also told me at this particular time that the water would be about 12 feet deep. From the direction that he was indicating the underground stream was following, I scoffed at the idea, since it appeared to me that any water only 12 feet deep would have to rise more than that to get onto this small plateau on which he was witching. Well to make a short story shorter, I took my Father's post hole auger and made some extensions for it. I augered down at the spot indicated by my Uncle. Lo and behold, I found water at eleven feet. That made a believer out of me, but quick.

While I don't claim to have excellent sensitivity for locating buried objects, I have never-the-less located many water pipes, buried electrical cables, junction boxes etc. I have shown other persons how to do it, and many of them, it turns out, have better sensitivity than I do. For instance I was never able to locate the 3 nickels in the dirt. I have noticed one thing, though, that early in the morning, when my power of concentration is highest, that I do have more sensitivity than late in the day, especially if I've had a trying day at work. Up to this point the reader is probably wondering why I don't get to the point and tell him how to do it!

Making the rods

Simple but effective divining rods can be made from a pair of metal coat hangars. It is only necessary to cut the hook off of the coat hangar and bend the metal in the shape of an "L". The short side of the "L" should be about 5 or 6 inches long and the long side of the "L" should be 12 to 15 inches long. Smooth out any bends in the metal.

Using the rods

Hold the rods, one in each hand as shown in the picture. During "actual operating conditions", the rods are gripped loosely. I repeat, loosely. The hands will be separated about 24 inches apart, and the long side of the rod will be extended directly out in front of you. It is quite important to hold the rods horizontal, or in the words of the scientist or mathematician—approximately 90° from the forces of gravity. Actually the tips of the rods should be down perhaps 1/8 inch from the horizontal. This will assure that they will stay pointed straight ahead unless influenced by external forces. Remember though, if they tilt down too far, the tips of the rods will have to overcome gravity to turn in your hand. This will decrease the sensitivity. With the rods pointed straight out ahead of you, and with your hands about 24 inches apart, start walking slowly forward. As you pass over a buried water pipe, or underground stream, or other object, the rods will turn inward, and will come together. Walk up several times to the point where the rods turned in, to get the feel of things. Then walk up to the same point from the opposite direction.

You will probably find that the two points are separated by several feet. The pipe or water stream will be directly below the midpoint of the two spots where the rods turned in. The deeper the pipe or water stream, the farther apart will be the two spots where the rods turned in. You can move laterally 6 or 8 feet and repeat the process. In this manner you can trace the pipe or water stream all the way across your property. If you move laterally and cannot get another indication, it may be that the pipe made a bend. You will have to change your direction of walking so as to cross the pipe at an angle.

Now that you have mastered the art of witching, suppose we get back to the original purpose of this article, which I remember was to try and find a more favorable location for your radials or to find a wet-earth ground.

I am assuming that you have located and marked with stakes all of the buried pipes that cross your property. If you have a septic tank or cesspool in your backyard it might be a good idea to locate this and mark it so as not to locate an antenna post directly over it. If you are fortunate enough to have a large yard with water pipes underground, you can locate that new vertical antenna directly over one of the pipes. This will allow you to place two of the radials 180° apart and directly over a water pipe. I would also suggest that you run parallel wires for the radials which are directly over the pipe. This will increase the capacitive effect between the radials and the buried pipe. Radials can be easily buried in a lawn by simply drawing an axe through the grass to a depth of about 4 inches. Lay the copper radial in the slit made by the axe and tramp down the sod on either side. In a week or so you won't be able to find where you had cut the slit in the grass.

It may be worth your time, if the water pipe is not too deep, to dig down and fasten a ground clamp on the pipe directly below that new vertical antenna location. This will increase the effectiveness of the grounding system.

Now then, suppose you know that there are no water pipes in the area, but that you have located an underground stream. You can drive ground rods down into the stream and this will give you a wet-ground. Most of these underground streams run the year around, but even if they don't, the dirt will remain moist near the sand or gravel in which the stream was flowing. In any case a moist ground is better than a ground rod driven into dry dirt, which is almost 100% ineffective. One way to check to see if your ground system is effective is to make use of the commercial power. I am assuming now that the power company has their neutral grounded in various spots throughout the city. Generally this is done at the distribution transformer. If the power company uses a grounded neutral system, then you can connect a 100 watt bulb between your new ground system and the power company's hot side of the line. The bulb should light to near full brilliance if it is a "good" ground. If it doesn't light, try a 10 watt bulb. If the 10 watt bulb doesn't light at all, your new ground system is not going to be very effective. Remember, however that unless the Power Company's neutral is grounded, this system of checking won't reveal anything. A *word of caution*—110V can be dangerous. Connect the bulb and ground wire prior to connecting the hot wire. Make sure you are insulated from the hot wire.

Here is hoping that you will be lucky enough to locate a "wet ground" right outside of your ham shack window. If you were not successful in this venture, but you located an underground stream over in the corner of your property, you have not wasted your time. Drive a sand point down into the underground stream and use the water to irrigate your garden. You might even use the water to form a "wet counterpoise", that is, by sprinkling, keep the earth wet around your radials at all times. HAPPY WITCHING!

. . . W7CJB

Bee Line Audio Filter

That little audio filter advertised by Ham Buerger caught our eye and we decided this might be something well worth a try. We were right.

The AJ-1 is a variable audio filter for use with receivers or transceivers. It plugs into the output of the receiver, processes the flow of audio, and presents it to a 4-ohm speaker output or earphones.

The AJ-1 is designed primarily for CW work, but it does an appreciable job of cutting down on the QRM when listening to AM or SSB. The selectivity of the filter can be adjusted to drop out that annoying voice from the next higher channel.

There is a slight insertion loss of about 5 dB for the filter. The real loss is where you want it, above 3000 Hertz, those frequencies which interfere, but don't help communications. At 2000 Hz the filter gives you from 15-dB attenuation at minimum to about 45 dB at maximum. At 1000 Hz the filter gives a minimum of about 5 dB and a maximum of about 25 dB attenuation. There is little effect below 300 Hertz.

So, as you can see, the AJ-1 is quite a handy device. Not a bad deal for $7.95 at all. And once you get used to using it you just never switch it out of the circuit . . . everything is so much less noisy this way. On CW you can almost completely eliminate a signal just a few hundred cycles higher up the band. The CW bands being as vacant as they are these days, perhaps this is not important to you? ■

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The Ham

I met him, I liked him, I loved him. A month later he told me he was a ham. "Never mind, Dear" I said comfortingly, "You must be good at something, everybody is".

"No, you don't understand", he answered, "come home with me and I'll introduce you to the rig".

I had visions of a boat or a tent in the garden. I was totally unprepared for the room full of wires, metal boxes, switches, meters and other strange things that met my gaze.

"Mind yourself on the soldering iron", he said. He was to be saying it for the next 30 years or so.

"What is it all?" I whispered.

"It's my rig". A world of pride was in his voice and I knew in that moment that I'd met something to be reckoned with.

My mind switched to the new, but very small, flat we had chosen, and I murmured some words about perhaps managing to get rid . . . .

"Get rid?", he bellowed. The only time in the 30 odd years that have followed, as it happened, that he ever bellowed. So, I knew from that moment that this "thing" had to be lived with, and that I'd better make friends with it.

I got to know it well. Its' whistles, its' shrieks, its' howls, and from time to time its' effect on the neighbors, when it interfered with television. Even a night when his voice was heard coming over radios, and for some reason, a record player.

Yes, of course, he would see to it at once, but the band was open at the moment and the DX was marvelous. The Sun Spots had just taken hold and we were on our way out of the trough. Wasn't it just his luck the neighbors should complain *now*.

One by one, our three children arrived. They survived the nights of metal bashing as if it were sweet music. QSL cards ranged the walls. Government surplus became a household word.

I got used to people knocking on the door asking if G3GAD was in the "shack". So long as the kettle was always boiling for the endless cups of tea, things went on smoothly.

The walls of our now much larger house became covered with certificates, curling at the edges. DXCC, WAZ, WPX, and many others that were meaningless to me. A very high pole was as necessary to the garden as the roses. Indeed, wherever we moved, it went up first.

Field days were special dates, ringed in red in kitchen and shack on the calendars. Until *the* Field Day. He got a blast from some faulty equipment and was suddenly stone deaf. After innumerable tests at the hospital, he was told that nothing could be done.

The house was quiet. The whistles, groans, and metal bashing stopped. It was a sad silence. I would have done anything in the world to be able to hear all those horrible, but familiar, noises again.

Six months passed. The heap of metal and wires that had driven me crazy over the years, lay unused and covered in dust.

He sat up in bed one morning and smiled. "I think I'll just call CQ and see if anyone's about", he said. His hearing had returned. My Ham was back in his beloved headphones again. ■

**Wife of G3GAD*

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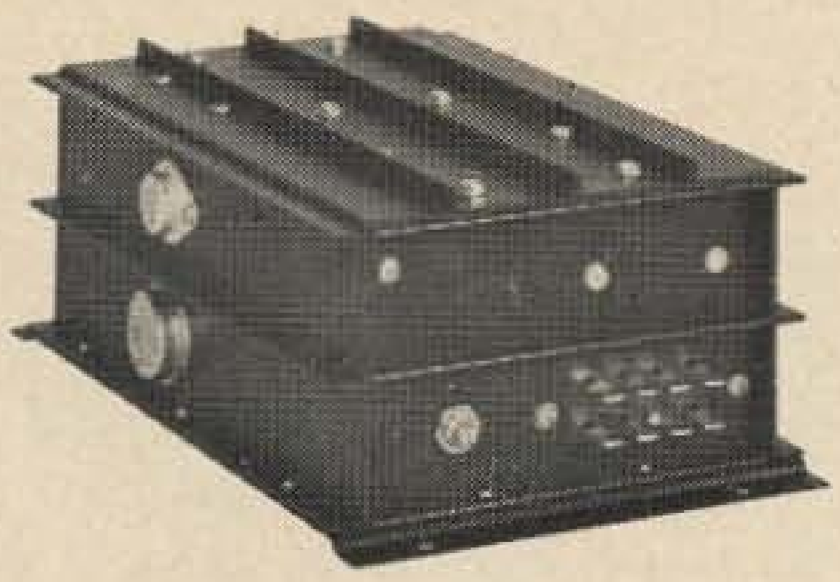

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CENTURY CABLING INFORMATION

CENTURY 400-12 Pin # Wire Size	CENTURY 500-12 Cables	FUNCTION	SW 350 SW 500	SW 240	SW 400	TR-3 TR-4	NC-200 NCX-3 NCX-5	KWM-1	KWM-2	SR 400 SR 160 SR 500	GALAXY 300	GALAXY III V
1 & 2	#8 Red	12v Battery										
3 #22	#22 Yellow	Bias	3	3	3	9	3	4	4	4	9	9
4 #22	#22 Green	Low Voltage	10	10	10	11	9	1	1	2	3	3
5 #22	#22 Red	High Voltage	8	8	8	10	11	2	2	1	1	1
6 #22	#22 Black	Starter	1	7	7	2	1	7	5	5	4	12
7 #8	#8 Brown #16 Black	Ground —12v Battery	2 & 6	6 & 9	6 & 9	1 & 6 & 7	2 & 5 & 6	3 & 9 & 10	3 & 7 & 10	3 & 6	10 & 11	7 & 11
8 #16	#16 White	12v Filament	4 & 5	N/C	N/C	4	4	12	11	7	5 & 6	5 & 6
Inter-connect					2 & 4 & 5							
Ext. Spkr. to Ground			12	12		12	7				12	
12 Volts to Switch				2	1							

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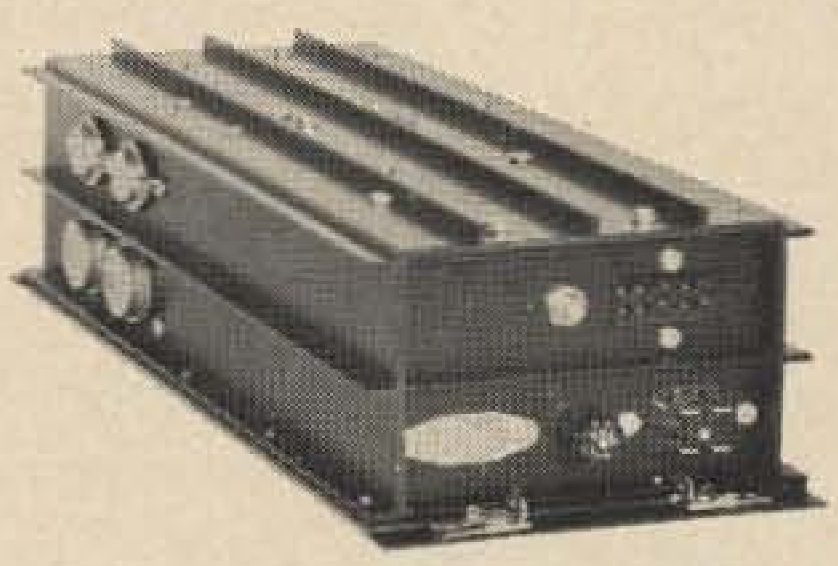

COMMANDER CABLING INFORMATION

COMMANDER Pin # and Wire Color	FUNCTION	SW 350 SW 500	SW 240 SW 400	TR-3 TR-4	NC-200 NCX-3 NCX-5	KWM-1	KWM-2	SR 160 SR 400 SR 500	GALAXY 300	GALAXY III V
1 Green	+275 Volts	10	9	11	9	1	1	2	3	3
2 Red	+800 Volts	8	8	10	11	2	2	1	1	1
3 Black	Ground									
4 Yellow	Bias - 0 - 125 Volts	3	3	9	3	4	4	4	9	9
5 White	Switch	1	1	1	1	7	5	5	4	12
7 Purple	Switch	2	2	2	2	9	7	6	11	11
8 Orange	+12 Volts	5	5	N/C	N/C	N/C	N/C	N/C	5	5
9 Blue Brown	12 Volts A.C.	4	4	4	4	12	11	7	6	6
10 Black	Ground	6	6	6	5 & 6	3, 10, 14	3 & 10	3 & 9	10	7
	Ext Speaker	12	12	12	7					12
14 - 16 Red	+12 Volts	Battery	D.C. Input Cable							
13 - 15	—12 Volts	Battery	D.C. Input Cable							

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Getting the Most out of Link Coupling

Most of the VHF transmitter designs in the handbooks, and other amateur publications, use coupling links to transfer energy either between stages, or from the output tank, to an antenna of some sort. These links might either be loops around the output tank or linear networks if the tank uses lines. There are good reasons for using a link, including better harmonic rejection because of the lack of capacitive coupling that will pass everything, and maximum power transfer between stages. The added features of better harmonic rejection can be appreciated when we think of the horrors of a good case of TVI (and what that entails in the way of personal diplomacy to quiet the neighbors). Since we all work for the biggest signal we can squeeze out of any one circuit, we don't care to leave part of it in the tank. With so common a circuit in use, it might be nice to know more about it, so you can snow the hams who aren't informed.

What is a link? Basically a link is an impedance transforming device which takes the high output impedance of your driving stage and either transforms it to the impedance of your following grid, or transforms it to an impedance which will match the relatively low impedance at which most antennas operate. Since the transformer has been analyzed rather thoroughly in the past, it might be well to take this information and transfer it to the high-frequency realm of VHF.

A transformer is a magnetically coupled circuit consisting of two conductors in close enough proximity to each other so the magnetic field of one cuts the other. A varying current in either conductor will induce a current in the other. For maximum coupling efficiency, power transformers are wound on a core. Because of frequency considerations at two meters and up, the link can be just a single piece or wire near the high current portion of the plate lines. They both work in the same manner.

The theory and construction of linear plate lines has been well covered in past issues of 73,[1,2] but the proper method of tuning and setting up the output link has been left to chance. For the purposes of this article, I'll assume the link in the transmitter which you have built is proportioned properly and just go through the ways to make it operate.

Let's draw an equivalent circuit of a link: In this diagram the generator represents the voltage induced in the link through the transformer action caused by the proximity of the output link to the plate lines. R1 represents the series ac resistance of the link, R2 is the load, and the capacitor and inductor represent the series reactances of the loop. According to Kirchoff's voltage law, the sum of the voltage drops across the passive elements in the loop must equal the generator voltage. To get maximum power into the load R2 we have to maximize the voltage across it, since $P = \frac{V_2}{R}$.

Depending upon how you have the link tuned, you might have either series inductive reactance below resonance, or series capacitive reactance above resonance with its accompanying voltage drop. A portion of the remainder of the voltage is dropped across R1, and the rest is across R2. It is an easy matter to get rid of the reactance by making the inductor-capacitor combination series resonant at the operating frequency. We can make the drop across R1 as small as possible by increasing the Q of the network. At higher frequencies rf tends to travel on the surface of a conductor, the familiar skin effect. We have to make the surface area larger, and the easiest way to do this is to go to some sort of strap line for the link inductance. Silver plating is also a help, but if you use copper and polish it so that it is shiny and smooth, then coat it with Krylon, or something similar, so that it won't corrode, you will never notice the difference.

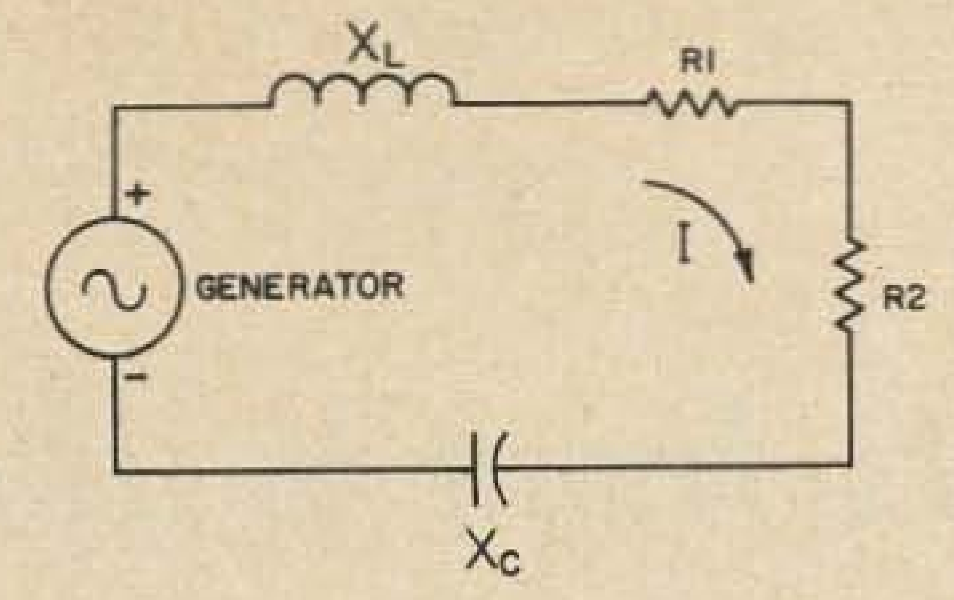

Fig. 1. Getting the most out of link coupling.

You will notice that I drew the antenna impedance as a resistor. It will act like a resistor if your SWR is 1:1, as it should be if you've been doing your homework and getting your antennas matched. However, most antennas aren't too broad, and will exhibit some reactance before you move too far from the frequency at which you tuned the antenna. No problem, since your link capacitor is variable and you can diddle with it until the link is series resonant again.

Some rigs don't use a series capacitor to tune the output link, but depend on stray circuit capacitance to resonate the affair. This is fine, for one frequency. Unless you have some way to retune the antenna, or use an external antenna tuner, you won't be able to move far from one frequency without loss of power. Witness the trials and tribulations of WB2HAL.[3] If you want to spend a little time, you can put in a capacitor, but you probably will have to pull a turn or two off the coil to bring the tuning range of the circuit back into line again. Let's explore the subject a little more.

The maximum power transfer theorem states that, for maximum power transfer to occur, the impedance of the load has to equal the impedance of the generator output; in our case the driving stage. However, if the load is reactive, then the generator has to have a component of reactance equal in magnitude but opposite in phase; i.e., if your load is inductive then the generator has to look capacitive and vice versa. You can still get power into your antenna, but to peak the power output you have to detune your plate circuit a little from resonance to again cancel the combined reactance. This gives your output tube a less than ideal load, and the extra current required for off-resonance operation does a nice job of heating your output stage.

Now, let's see how you tune your transbitter up the right way. If your link is fixed, it's a little harder than if it is moveable (the old guys with their seven-foot high, fifty watters had a good thing going for them). Put your SWR bridge in the forward position, or if you really can't borrow one, whip up some sort of field-strength meter and put it where you can see it while you are tuning up. Energize your rig and resonate the plate; now, peak the output while keeping the plate dipped with your plate meter. If you find that this loads the rig too heavily, *kill the power* and reach inside and pull the link away a little bit from the lines and then go through the routine again. If you do this carefully, you will find that your output peaks at the minimum plate current position. Try detuning the plate circuit a little to see if the power comes up. If it does, it means you still have a little reactance from the link side reflected back to the plate lines. Retune the link a little and try again. Assuming that the lines present a proper load to your output tubes, you will never have to say that "maximum power output occurs just a little off resonance." When you change frequency, just repeak your link and reresonate the plate to keep efficiency up.

A little hint for users of 4X150 series tubes; if your screen current is negative after this peaking process, your link is too big; go to a smaller link and increase your capacity a little.

. . . K1GBF

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More on More Contacts from Within

In the urban society of 1967, more and more amateur operators are finding themselves cornered in the big city. Massive apartment complexes soar on all sides. The only grass in sight is the ground-up kind sprinkled onto pies in pizza parlors.

Since 73 published my do-it-yourself Joystick article in May, 1966, I have received over 100 letters and cards from hams across the States. They were all hungry for more on the apartment dweller's antenna system.

The correspondents asked questions, the answers to which are of value to any ham forced to use a miniaturized radiating system.

There are at least 50,000 hams boxed in, in urban areas, today. These fellows use some highly unorthodox structures to transmit from apartment buildings and other housing projects.

Super-thin wire is dangled from a twentieth-floor window after dark. TV, 300-ohm, lead-in wire is strung from corner to corner, across a spare bedroom. Insulated wire is run around a floor, under the rug.

In my system, as described in 73, poles with spring-loaded end pieces, such as those used in modern "tree" or "pole" lamps were used.

Loaded dipoles, base-loaded verticals, and center-loaded verticals using home-brew coils were shown.

Many readers' questions referred to coil dimensions for particular antennas.

Virtually every apartment-ham shack is different. Every antenna, even when constructed from similar home-brew materials, is different. An indoor radiator, such as the Joystick, is very sensitive to variations.

The location of the antenna in the rooms of an apartment and the construction materials used in building the apartment are major factors when the operator sets out to resonate his antenna at a desired frequency.

But, for a start, try winding coils of a heavy, rubber covered, solid, copper wire—such as electricians use to wire homes. Get a size that will hold shape well, yet be flexible enough to bend easily during winding.

Use the center cardboard from a bathroom tissue roll as a form for the coil. Take the cardboard out after construction and tuning of the coil—if the wire will hold its shape.

There is no way to get the coil circuit to resonate at the desired frequency without using a grid-dip meter, or similar instrument. Build the antenna with a guess-work coil in the circuit. Then use the grid-dipper while pruning the coil to desired frequency. Be sure to guess a coil size larger than the finished product so you can trim it down to size. Squeezing the loops of the coil, or pulling them apart, aids in the search for the frequency, too.

As with the most efficient outdoor antenna, an antenna-tuning matchbox is desireable. And, a matchbox is nearly useless without an SWR bridge so the operator can see just how efficiently the antenna is working.

Well-built outdoor antennas, fed from a matchbox following the transmitter, can be used with surprising efficiency at an end of the ham band far from the frequency at which the radiator was originally built.

Indoor antennas are not as flexible and their efficiency is less, but the matchbox will give the indoor antenna operator the flexibility to move some distance up or down the band from the antenna's cut frequency.

On occasion I have used an outdoor, half-wave dipole which was cut for 7100 kHz, at frequencies above 7200 kHz in the 40 meter phone band. I have been able to tune the SWR down to less than 1.5:1, even though the antenna cut frequency was 100 to 200 kHz away.

With the super-compact indoor antennas, the frequency is critical. It is sometimes difficult to get a low SWR on the antenna's cut frequency, let alone one far up or down the band.

It is not always possible to get that 1:1

ratio on the cut frequency. It has always been easy to get an SWR in the range of 2:1 or less. That range is not harmful to most transmitters.

The lower the frequency, the longer the wavelength, and the more the indoor radiator is compressed. Therefore the antennas are more efficient at higher frequencies.

With sunspot activity nearing optimum for this cycle, a 10-meter vertical indoors would give good results. Diligent construction and fine tuning of the system would be necessary as always. But it would be reasonable to assume QSO's with many foreign countries within range of a city-dweller's apartment.

. . . K3RXK

Somehow I don't think this marriage is going to work.

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S-9-Manship

The Art Of Achieving 40 dB Gain While Putting Your Contact 40 dB Down

". . . and turning it over to CEØXYZ on *Easter Island*."

Easter Island? Of course the CEØ was on Easter Island. And he knew that he was. Why then did that W7 mention his location?

For a long time, the significance of this apparent redundancy escaped me. Then one day it hit me—like hot solder dropped on bare toes. The W7 had mentioned the DX station's location for *my* benefit. He wanted me to be sure that I knew exactly how important was his feat. He intuitively knew that everyone listening would think well of him, admire his rig, and envy his operating technique if they fully appreciated the importance of what he was doing. He had wanted to impress me and he had succeeded.

This chance discovery was the turning point in my ham life. And in time I developed a whole new philosophy of amateur radio which in many ways negated the accepted and honorable standards of ham radio and raised—or threw down—the gauntlet. I'll never forget the day I opened my ARRL Handbook to "The Amateur's Code" and said, "Oh, yeah?"

You see, I had found that the real pleasures of ham radio are derived when one—regardless of rig, antenna, conditions, or operating technique—*comes out on top*.

Am I going too fast? Let me explain further. The joy of radio comes not so much from the working of DX, but with the satisfaction of knowing that others cannot work it. It is less the thrill of receiving an S-9 report than in *giving* a 4-6. . .especially to a brassy chap with a kilowatt and a beam. It is not the happiness felt when a kind ham comments on your good audio. It is the spine-tingling sensation you enjoy when you suggest that *his* audio needs a thorough going over.

I'm getting to you now, am I not? You smile, perhaps a little bitterly, at the audacity of these statements. But deep down you know I've touched a sensitive area. Just as the average man laughs at the fat man who slips on a banana peel, we delight in imagining that rich ham down the street turning on his rig and blowing every fuse in the house.

Now that we understand ourselves, let's see how we can use this knowledge to gain a certain status in hamdom that we probably do not deserve. Here, then, are the secrets and techniques of "S–9–manship".

The rig

The basic aim in this gambit is to appear to do a slightly better job than the other fellow. Run as much power as you can, but *never* acknowledge that you have anything but a 20-watt rig. *Always* ask for a signal report before giving one. If he reports your signal at 5 & 9, tell him he's doing a nice job despite the fact the meter shows only S-3. If he gives you anything less than S-8, don't bother to go back to him. Instead, respond to an imaginary break from a UAØ and carry on a one-sided conversation for several minutes.

The antenna

There may have been a time when the other fellow could be impressed if you suggested that you were using a giant multi-element beam or quad, but today it's not so. Why, you'd hardly receive an acknowledgement if you said you were using a beam *and* a quad simultaneously. No, the secret of coming out on top with regard to antennas is to announce that you are using an obviously inferior system-and getting remarkable results. I often casually reveal that I'm loading the aluminum siding on my house. And when stunned silence greets me I offer to put the "antenna" on him a little better—by opening the garage door.

DX

Don't worry about DX. Don't even bother to work it. Just *call* it. Cleverly. For example, tune up on 10 meters when short skip or *no* skip can be heard. Call CQ, then, "QRZ the VU2." You might then do something like the following. "Oh, it's you, Sarvapali. Didn't expect to hear you coming in *again today*. You're booming in. Easily 20 over 9. Yes, we'll be there for the tennis matches in Bombay. Thanks so much for offering the guest house *again this year*." Who could fail to be impressed after hearing this? And remember, even on a "dead" band, h u n d r e d s, perhaps thousands, *are* listening. Just imagine them twisting their dials, cursing their antennas and tearing their hair as you—not they—apparently work a bit of exotic DX.

The ham club

Participate in club activities, but do the things that will help set you apart from the ordinary. Try strolling up when the gang is going over the schematic of a new rig and off-handedly (and just audibly) say, "I'm sure that .003 should be .004." Then, quickly walk away. Find a way to remark about the warmth of *Australian* wool. And the first time you get a puzzled look, say "Tim, down there in Perth, and I have been exchanging gifts for years. *I* gave *him* a 75S-3B for Christmas.

You might do as I do with the "screw driver gambit." I like to pull a small screw driver out of my pocket and when someone is operating the club station make a brief *if* adjustment in the receiver. Of course, you must be careful. Once I stuck my screw driver in a chassis, smiled mysteriously, mumbled something about the *if* being a little off, and remember (just before I lost consciousness) seeing my screw driver melt in my hand as it shorted the B plus to ground.

What has all of this gained me? And what can it do for you? It has made me the envy of my friends and it can do the same for you. How do I know? Little things tell me. When I attend club meetings now, the other members stare at me with awe and disbelief—obviously aware of their shortcomings and too shy to match knowledge or experience with me. On the air, it's much the same. After a transmission or two—after I've used my "S-9-manship"—they often plead QRM or a previous schedule and sign off quickly. And even in the ham magazines, my techniques have received considerable comment—usually in the letters-to-the-editor section. Most of the writers try to hide their envy and appreciation behind some accusation such as "kook" and "jerk." But I know what they *really* mean.

Looking for a way to gain a unique position in the ranks of amateur radio? Try "S-9-manship." I guarantee that as soon as you do, former friends will rush to get out of your way and every ham—even the one you're working—will clear the channel!

. . . W6DFT

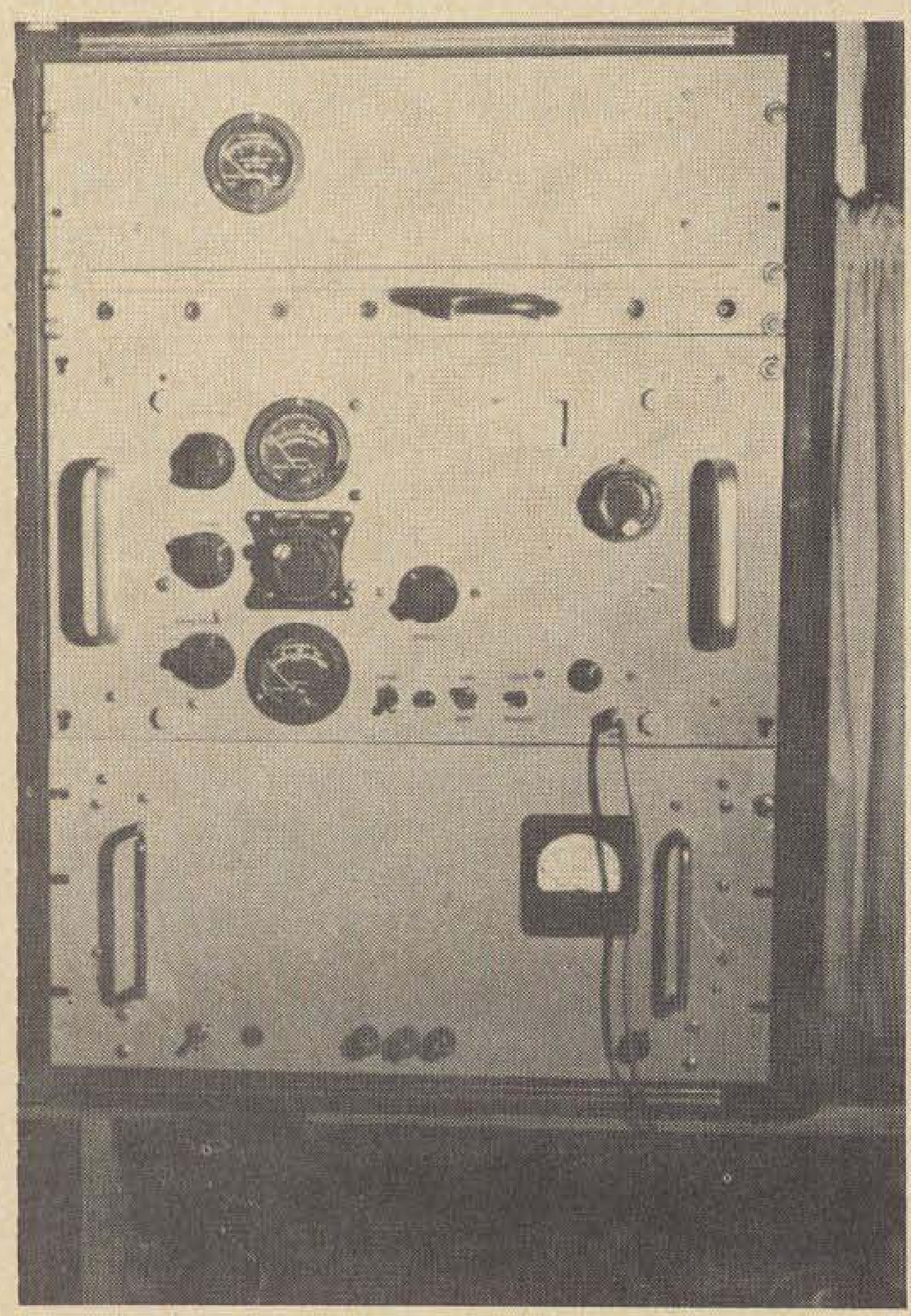
Sam Kelly W6JTT
12811 Owen Street
Garden Grove, California 92641

The RF Patch

A New Solution to an Old Problem

Mention the term"patch" to an old timer and he will probably think of the days when the only meter in the shack was mounted in a black bakelite panel and patched to the meter circuits by means of a phone plug on a long cable!

Modern day telemetry system patching components are a far cry from the early ham radio approach. The telemetry svstems designer has had a wide variety of high quality video patching components manufactured by such firms as Vitro, Trompeter and Whistler electronics. These components were of little interest to the radio amateur due to their power and frequency limitations. Of course, rf patches were built, but for the most part they were very cumbersome and expensive.

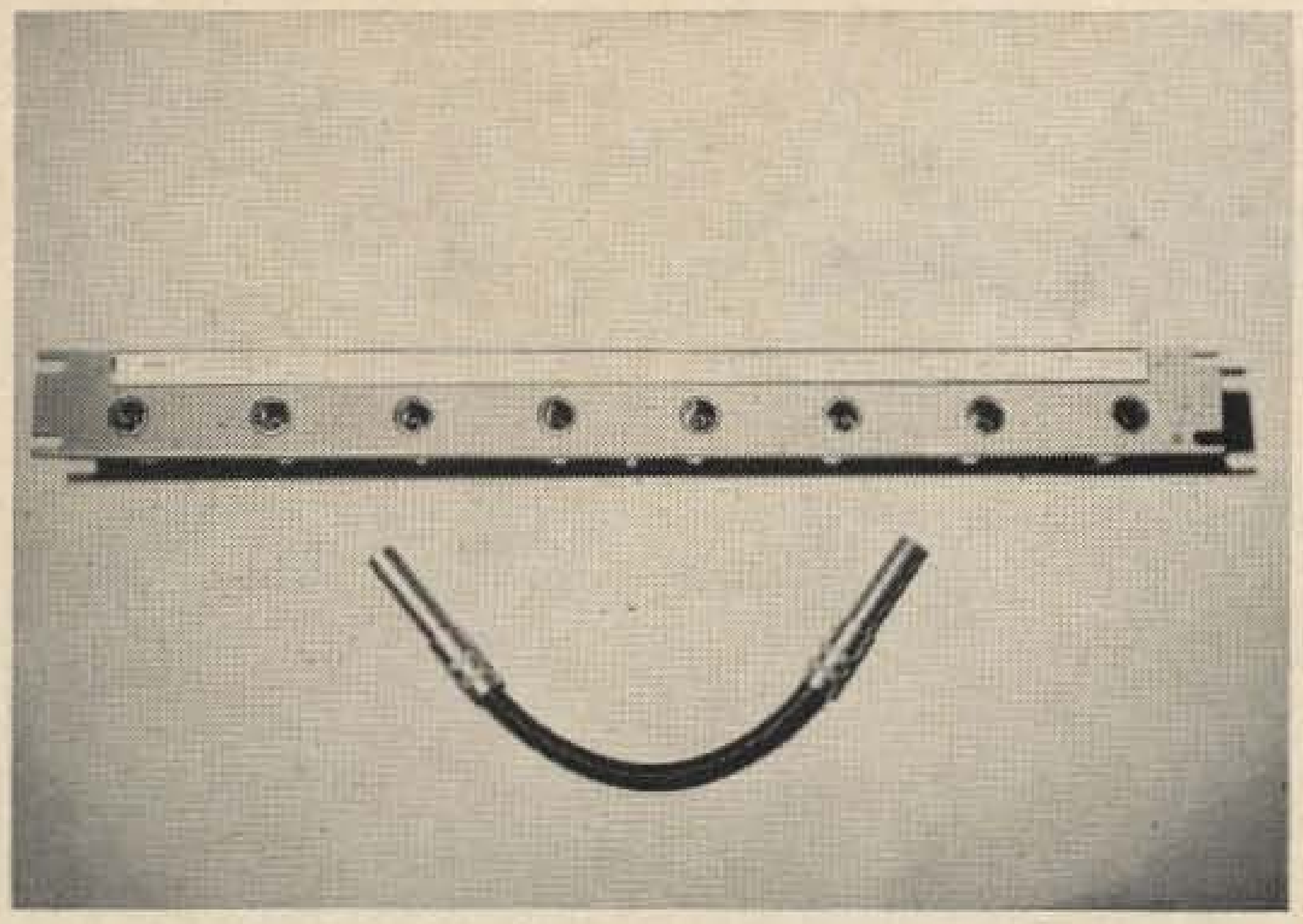

The eight cell panel installed in a rack.

Recently there has been a break through in the field of rf patching components that is of considerable interest to the radio Amateur. This is a series of components manufactured by Whistler Electronics for their "large patching systems." The original design was primarily for patching transmitting and receiving equipment operating in the newly activated 2.4 GHz telemetry band. The components are compatable with all amateur frequencies from the 160 meter band through 10 GHz.

The patching systems consist of a patch panel containing from 8 to 36 jacks. The jacks have a type N connector on one end (just the thing for that surplus co-ax) and accept a special plug at the other end. The jack will handle anything that RG-8 cable will. In fact, I tested them to 15 KV for insulation break down.

The WR-7 jacks are available mounted in a standard 19" relay rack panel. The antennas, receivers, and transmitters are terminated at the rear of the panel. Any cell can be patched to any other cell by means of a WC3-5-1 patch cord, or if the cells are adjacent by using a WBPN-5 looping plug. The plugs are not threaded but simply slide in and out. Their design is such that positive contact is assured. 50 ohm impedance is maintained throughout the system. Using a little ingenuity, the cell assignments can be made so that all normal patching is done using looping plugs, keeping patch cords to a minimum.

The rf patch is a much needed accessory in the sophisticated shack which contains a variety of receivers, transmitters and antennas. It sure beats crawling behind equipment to unscrew connectors when changing receivers or bands. I have found it very convenient in my shop as I am constantly changing antennas to test out various pieces of home brew equipment. For this purpose, a WP-3 plug on a test cable provides for rapid connection to any cell.



An eight cell rf patch capable of handling a KW. A typical patch cord is shown below the panel.

Cost of a home built system is fairly reasonably. The individual jacks cost about \$7.50 each. More detailed information on the components and systems can be obtained by writing Harvey Hunt, Whistler Electronics 18718 Bryant Street, Northridge, California.

. . . W6JTT

New books from Sams

Fundamentals of Digital Magnetic-Tape Units, by the Univac Division of Sperry Rand Corp., was written originally for use by it's own organization. It has proved so successful that it has been published for general use. This book presents a thorough background for understanding magnetic-tape units which are coming into wide use for information storage. It presents basic facts about magnetism and magnetic fields and shows their application in magnetic-tape recording. The book contains many illustrations and operators, programmers, troubleshooters, and maintenance technicians will find it helpful. Catalog No. 20580 List Price \$2.25.

Know Your Sweep Generators, by Robert G. Middleton, is the latest in the Sams "Know Your" series. This book provides a handy reference and guide for the experienced technician, and is also a textbook for students in technical institutes and junior colleges. It provides a detailed background on the basic principles of sweep alignment, methods of FM test-signal generation, and the operation of beat-frequency generators and associated instruments. Catalog No. 20593 List Price \$3.25.
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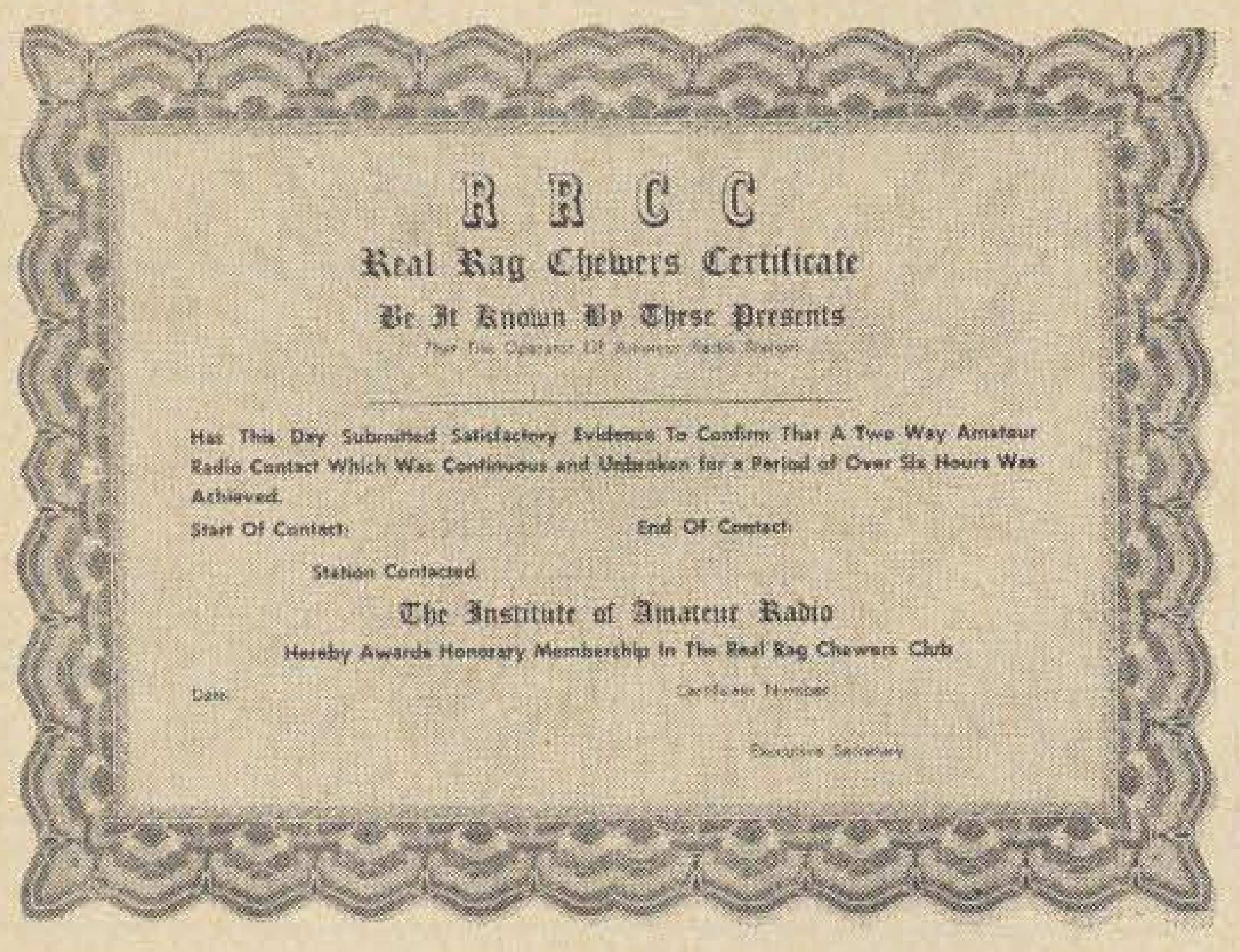
73 Certificates

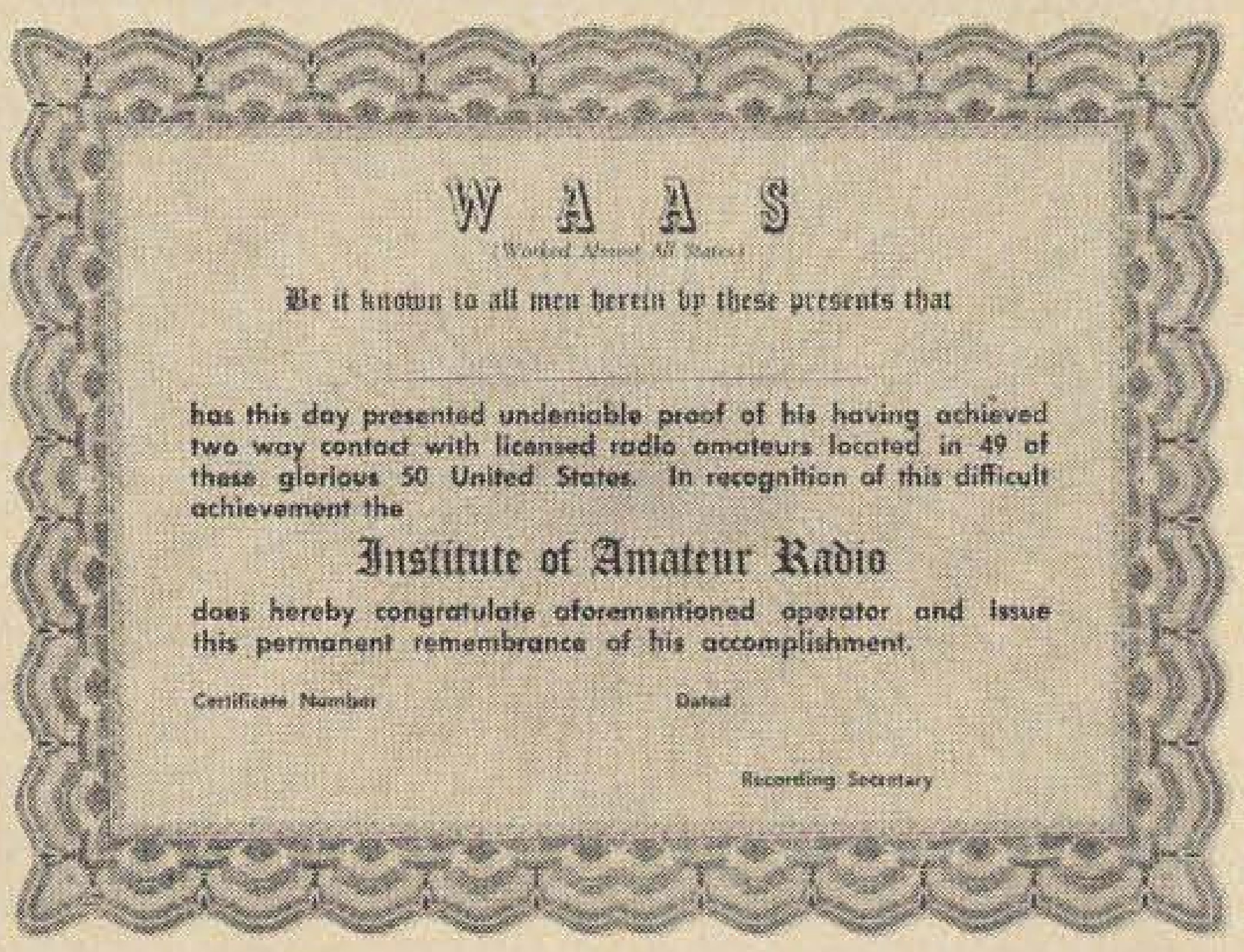
Since a recent article (*The Longest QSO*, 73 November 1967) mentioned a certificate issued by 73, we have had numerous requests for information on the R.R.C.C. (Real Rag Chewers Certificate). Since it has been several years since we have publicized our certificate program, the rules for all 73 certificates (except WTW) follows:


R R C C
Real Rag Chewers Certificate
Be It Known By These Presents
Has This Day Submitted Satisfactory Evidence To Confirm That A Two Way Amateur Radio Contact Which Was Continuous and Unbroken for a Period of Over Six Hours Was Achieved.
Start Of Contact: End Of Contact:
Station Contacted:
The Institute of Amateur Radio
Hereby Awards Honorary Membership In The Real Rag Chewers Club
Date: Certificate Number
Executive Secretary

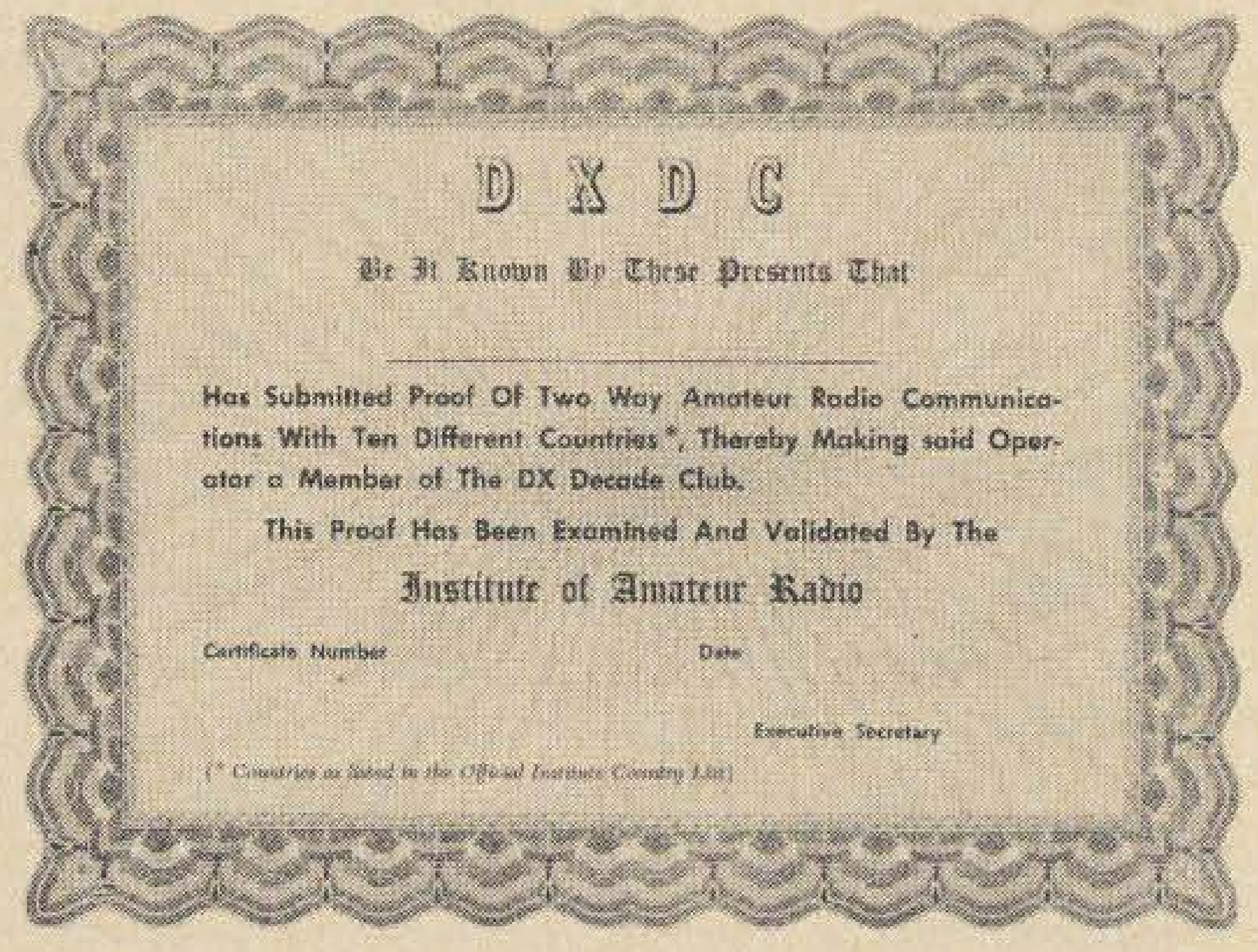
R.R.C.C. This certificate will be awarded upon satisfactory evidence of a QSO between two (only) amateurs which lasted more than 6 hours. The contact must have been continuous and unbroken.


Institute of Amateur Radio
WAZP

W.A.Z.P. (Worked All Zones Promised): Any amateur who shows evidence to the awards committee that he is *intent* upon establishing two way amateur radio contact with each and every one of the forty amateur radio zones into which the world has been arbitrarily divided, is eligible for this award.

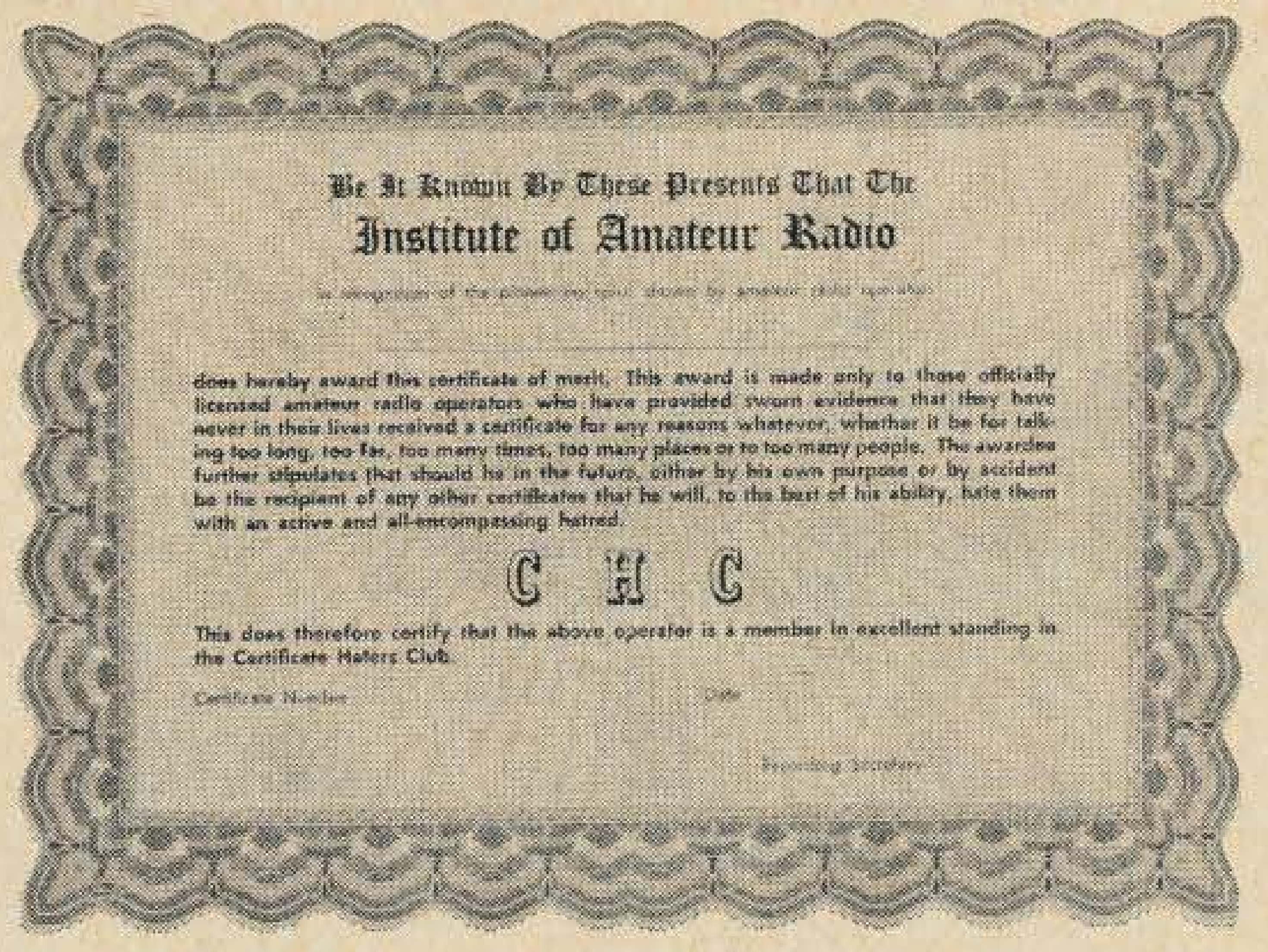

W A A S
(Worked Almost All States)
Be it known to all men herein by these presents that
has this day presented undeniable proof of his having achieved two way contact with licensed radio amateurs located in 49 of these glorious 50 United States. In recognition of this difficult achievement the
Institute of Amateur Radio
does hereby congratulate aforementioned operator and issue this permanent remembrance of his accomplishment.
Certificate Number Dated
Recording Secretary

W.A.A.S. (Worked Almost All States): This certificate is awarded to any amateur who submits undeniable proof of two way communication with 49 of the 50 states.


D X D C
Be It Known By These Presents That
Has Submitted Proof Of Two Way Amateur Radio Communications With Ten Different Countries*, Thereby Making said Operator a Member of The DX Decade Club.
This Proof Has Been Examined And Validated By The
Institute of Amateur Radio
Certificate Number Date
Executive Secretary

D.X.D.C. (DX Decade Club): Any amateur who submits proof of two way amateur radio communications with ten different countries is eligible to become a full member of the DX Decade Club and will receive this handsome award.

C.H.C. (Certificate Haters Club): This award is made only to those officially licensed amateur radio operators who have provided sworn evidence that they have never in their lives received a certificate for any reasons whatsoever, whether it be for talking too long, too far, too many times, too many places or to too many people. The awardee must also stipulate that should he in the future, either by his own purpose or by


Be It Known By These Presents That The
Institute of Amateur Radio

does hereby award this certificate of merit. This award is made only to those officially licensed amateur radio operators who have provided sworn evidence that they have never in their lives received a certificate for any reasons whatever, whether it be for talking too long, too far, too many times, too many places or to too many people. The awardee further stipulates that should he in the future, either by his own purpose or by accident be the recipient of any other certificates that he will, to the best of his ability, hate them with an active and all-encompassing hatred.

C H C

This does therefore certify that the above operator is a member in excellent standing in the Certificate Haters Club.

Certificate Number   Date

accident be the recipient of any other certificate, that he will, to the best of his ability, hate them with an active and all-encompassing hatred.

A fee of $1.00 to cover handling and mailing shall accompany all requests for each certificate.

Note: These certificates are *not* recognized by the Certificate Hunters Club, and may jeopardize your standing in that organization.

Bill Hayward WØPEM
3408 Monterey
St. Joseph, Missouri 64507

TUBE Abuse in SSB Gear

Upon making a trip to one of the area radio stores and talking with one of the servicemen there, he showed me what was left of a pair of 6HF5's. The glass bulb was just like someone had put his thumb through it, while the glass was being made. Why this abuse of tubes, I thought? Maybe we all need an education on the use of all these new type tubes (at least new to the ham field).

In this day of 6JB6's, 6HF5's, 6GJ5's, 6DQ5's that are used in present day SSB transmitters and transceivers, you find that it takes a bit more care in antenna matching, tune up and key down condition. Most all of this tube abuse could be eliminated if hams would only take time to read and understand their instruction manuals. But, not seeing this happening in the foreseeable future, what then is the answer? I would suggest that persons using new type SSB transceivers, transmitters confine their tune up to not longer than 20 seconds at one time with a cooling off period of at least 5 minutes.

The good old days of the 807, 813, 6146, etc., when you could turn the plate switch on and walk away from the rig for a half a day at a time, and come back and still have a tube left, are gone. These new type tubes just won't take that kind of treatment. Most of these tubes are horizonal oscillator for color TV sets and as such have no rating for rf power. But, the peak power used in SSB transmission is only micro seconds, so these tubes work wonders when used this way.

Why then do manufacturers use them? Because, they will do the job on the SSB and CW modes (this is one reason that you don't find AM on the rigs today), cost less (6GJ5A cost $2.74 while a 6146 cost $5.20), are smaller to use and are more readily available on the open market for replacement purposes.

What can you do about using these new type tubes? Well, first, on most SSB transceivers you can peak up the receiver and the transmitter section will be fairly close to tuned up. Second, have a good match to your antenna. Third, when in the tune mode, tune up quickly and don't let it stay in this mode for more than 15 or 20 seconds, or good bye tubes. Fourth, you don't have to run your audio up to where it is pinning the meter (such as in the days of the big modulators).

Again *read* your instruction manual for correct tune up procedure. If you don't have a manual you can get one from the company which makes the gear you are using for around $2.00. So, lets all stop this tube abuse and see how many hours you can out of your tubes.

. . . WØPEM

Dick Lehrbaum WA2APT
51 Harvey Avenue
Lincroft, New Jersey 07738

Transceiving With an Outboard Receiver

Although transceivers are very widely used today, many hams would be extremely pleased if they could combine some of the features of their station receiver with their transceiver; noise limiting, variable passband, Q-multiplier and added audio circuitry are just a few of the things that are desirable. The addition of these few devices would greatly improve reception. This article describes how the station communications receiver may be modified to transceive with a SSB transceiver.

In this application, the station receiver is actually used as an elaborate *if* strip. After determining the fixed *if* frequency of the transceiver (the center frequency of the crystal filter), the outboard receiver is tuned to that frequency and connected to the *if* of the transceiver. Some experimentation may be needed in choosing the proper tap point, but some of the following hints may be helpful.

The transceiver connection should be as early as possible in the chain of the transceiver's receiver section. Since each stage of amplification introduces a certain amount of noise, hooking in near the front-end will preserve the signal-to-noise ratio of the set. Also, you have to decide whether to tap before or after the crystal filter. In most cases the best tap point is in the *if* strip—after the crystal filter. This approach provides added filtering and image rejection before the signal is fed into the outboard receiver, and results in excellent gain and selectivity. As a rule of thumb, best results will usually be obtained by hooking on to the plate of the second *if* stage.

The cable which feeds the transceiver signal to the outboard receiver can be of any convenient length, and should be connected to the transceiver through a 10 pF capacitor of suitable voltage rating. Do not tap directly on the input or output of the crystal filter, as this will detune it and alter the passband on transmit; do not tap a stage common to both receive and transmit, because this may steal power from the exciter, and probably reduce drive on transmit. Also, do not tap too near the product detector, for this will introduce a strong BFO signal which may override the desired signals in the outboard receiver.

The author is presently using the above system with a Drake 2B receiver and an Eico 753 transceiver. The transceiver *if* frequency is 5.2 MHz; in order to put the Drake 2B on that frequency, a 9.0 MHz accessory crystal is used in bandswitch position "B". To lock the receiver onto the transceiver, the receiver is tuned around 5.2 MHz until the signals from the transceiver receiver are heard. At this frequency, the transceiver BFO signal is found and *zero beated;* this results in proper transceiving.

Naturally, provision must be made to mute the receiver on transmit. Most transceivers have spare contacts for controling a linear, and these can usually be connected directly to the receiver's mute terminals.

Suggested connections

Transceiver . . .	IF Frequency . . .	Tap plate of . . .
EICO-753	5.2002 MC	V5
HEATH SB-100	3.395 MC	V4
SWAN-350	5.1728 MC	V8
NATIONAL NCX-3	5.2000 MC	V11
DRAKE TR-4	9.0000 MC	V12
HALLICRAFTERS SR-150	1.6500 MC	V5

Table I. Suggested tap points for various transceivers for use with outboard receiver operation.

One final word: to return the transceiver to normal, simply turn off the outboard receiver and turn up the transceiver audio!

. . . WA2APT

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A Hams Shack Is His Castle

Or so it should be. But when your life is shared with a female, nothing is sacred. Now don't get me wrong. I think my XYL is tops and if she wants our living quarters neat and orderly that's all right with me. But she doesn't stop there. She's forever nagging me to clean up that "death-trap of a shack". It's a little old building across from the patio and looks all right on the outside so why should she care how the inside looks? If my goodies are strewn over the floor it's because I like them that way—when a part is needed I know just what pile to paw through. Another thing, with a mess like that—no one else dare enter for fear of breaking a leg.

But men stronger than I have conceded under constant condemnation so when our town conducted its annual "Clean Sweep" campaign (the motto being: "Paint it, Repair it or Throw it out"), I decided to do my part. Besides, those participating were entitled to free trash pick-up and what dedicated ham would resist anything free.

Disposing of acquired treasures was not easy to contemplate, let alone do, especially when some of it dates back to sub-teen years. But my mind was made up (for me) so, with stiff upper lip, closed mind and eye, I discarded.

Obsolete, moldy and rusty items went first. Next ageless tangled, piles of sticky-coated zip cord, then literally miles of useless coax, various lengths of frayed twin lead, and old chassis ended on the monstrous junk heap in the driveway.

My XYL is blessed with an unusual amount of false pride, so to hide the mess, she'd park the car sideways in front of it. Having it exposed to full view of the world was more than she could take.

Until—her sister came by one day and gasped this remark, "You aren't sending that stuff to the dump? Why? It's worth cash. Strip that wire—segregate that aluminum, brass and copper. The foundry pays good money for that kind of junk".

Well the XYL's ears perked up, dollar signs flashed in her eyes and her attitude took an about face.

In the following two weeks she learned more about what went into making ham radio tick than she had in all the years of tolerating my hobby. Donned in shorts and halter, she'd sit in an old lawn chair, in the middle of that mess, working at an improvised tool-strewn bench, sunbathing, stripping and destroying hour after hour. Transformers were dismantled in record time. The evening hours were spent in front of the TV unwinding the copper threads. The flipping noise of wire against paper was distressing but it made for a nice family sit in, so I said nothing.

The junky driveway didn't bother her anymore, in fact, the mess she made was ten times worse than mine with boxes and piles of stuff all over the place.

The biggest pile was the zip cord and coax which she stuffed into an old oil drum to burn. When lit, the entire neighborhood was engulfed in a great pall of black, billowing smoke. Flustered and embarrassed she explained to the firemen that she didn't realize it would smoke so much. Polite but obviously annoyed they departed with the comment, "Next time either warn us in advance or burn less at a time".

Undiscouraged, she was soon back on the job stripping twin lead by the yard. It got so she could tell, at a glance, what component had a coil hidden in its confines. She learned all about wire and could tell the difference between pure copper and other metals. She saw the painstaking intricate work that went into every piece of gear I had built, as she tore into project after project with screwdriver and pliers. The cutters flew as she salvaged every last inch of connecting wires.

I began to get uneasy, as her work neared an end, for fear she might rummage around the shack while I was out earning a living. She added to my apprehension when she kiddingly remarked, "By the way, I found a real good piece of wire hanging from your antenna this morning".

She may have been kidding but I sighed with relief when she announced that tomorrow was the big day—she was taking her loot to the foundry. Just to be on the safe side I took a moonlight inventory and sure enough there in a box was my supply of p.c. boards.

She did pretty well, got $32.10 for the lot. Who else but a person dedicated to destruction would work for fifty cents an hour. True to her gender she spent twice that amount but her explanation was simple, "I bought only things I needed and look what I saved by salvaging all that junk". I understood, and no further comment was necessary.

She was happy—the shack was clean and orderly—but somehow things wern't the same. The soldering iron no longer beckoned. Could be I was afraid to start something for fear the needed parts would be among the missing. The place didn't even sound the same.

My melancholy was short lived. After pawing through my remaining goodies and dumping some of them back on the floor I added some parts discarded, under similar pressures, by a buddy, purchased more from the surplus store and in no time at all I had my castle looking and sounding just about normal again. It was private and disorderly and no one dared enter for fear of breaking a leg.

. . . W6LNG

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International OX Crystal Oscillator Kits

If you're like most experimenters, at one time or another you've had some serious trouble with transistor crystal oscillators—instability, frequency jumping or spurious outputs. Don't fret any more—International Crystal has come out with a unit that will solve all your problems. The new OX Oscillator kit is a broad-tuned one-transistor circuit which provides oscillation over a range of frequencies by merely inserting the desired crystal.

Although the OX was designed specifically for the new EX (EXperimenters') line of International Crystals, it works quite well with all the crystals that I have tried. Since the crystal-controlled signal will be within 0.02% of the nominal frequency with an EX crystal installed, it is intended primarily for general purpose applications where precision is not required. For experimenters, it is ideal.

There are two OX kits available—the OX-L (low frequency) for 3000 to 19,999 kHz and the OX-H (high frequency) for 20 to 60 MHz. The price on each of these units is $2.35, and when I saw what came in the kit I was astounded. Getting out my latest catalog, I priced out the parts—it came to $3.40 and I hadn't even counted the printed-circuit board. With the cost of the board thrown in, the total value would be pretty close to $4.00. So, not only do you get an oscillator that works well, you get one that you couldn't build with all new parts for the same price!

The OX circuit is extremely compact, so it will fit into almost any application you have. Power consumption is low and it requires a power supply of six volts. Power output is on the order of 1 milliwatt so it is ideal for service as a local oscillator or crystal-controlled signal generator.

My first application for the unit was a small 50-MHz converter with the local oscillator at 36 MHz. It turned out to be one of the simpliest and fastest converters I have ever put together. No detectable birdies from surplus oscillator products—you put the crystal in and you're right where you want to be. The converter worked so well that I added a couple more transistor stages and a diode mixer and came up with a transmitting converter on the same chassis—three by five inches. No problems here either. With my 50 milliwatts out on six I was able to work three sections during the June VHF contest.

The next project, if you want to call it that, was a two-meter band edge marker. A single transistor tripled with a tuned output at 144 MHz was link coupled to the OX oscillator—in about ten minutes I had a crystal controlled marker. Plenty of output too. Next step—432. A 1N82A tripler into a 432 tank circuit provided a strong marker for that band. Not bad for one hour's work.

If you really want to go QRP, the OX oscillator kit is a natural. W70E has managed to chalk up some pretty good DX with the OX Oscillator Transmitter which he describes on page 111. Although he used CW in his experiments, you can modulate the oscillator without any difficulty at all.

If you do any experimenting at all, you're missing a good bet if you're passing up the OX oscillator and the EX crystal. The problems and money you will save are only your own. ■

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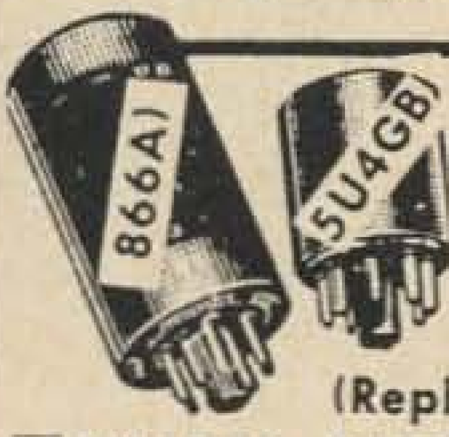

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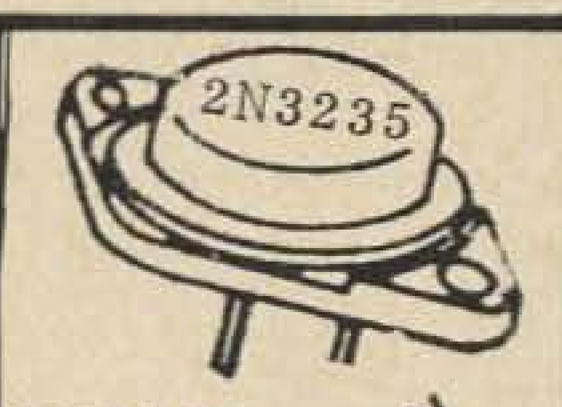

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BV_{CBO} 100

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PIV	3A	6A	12A	55A
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200	□ .09	□ .30	□ .39	□ 1.25
400	□ .16	□ .40	□ .50	□ 1.50
600	□ .20	□ .55	□ .75	□ 1.80
800	□ .30	□ .75	□ .90	□ 2.30
1000	□ .40	□ .90	□ 1.15	□ 2.70

SOLITRON DEVICES, 5 AMP Epoxy Rectifiers

PIV	Sale	PIV	Sale
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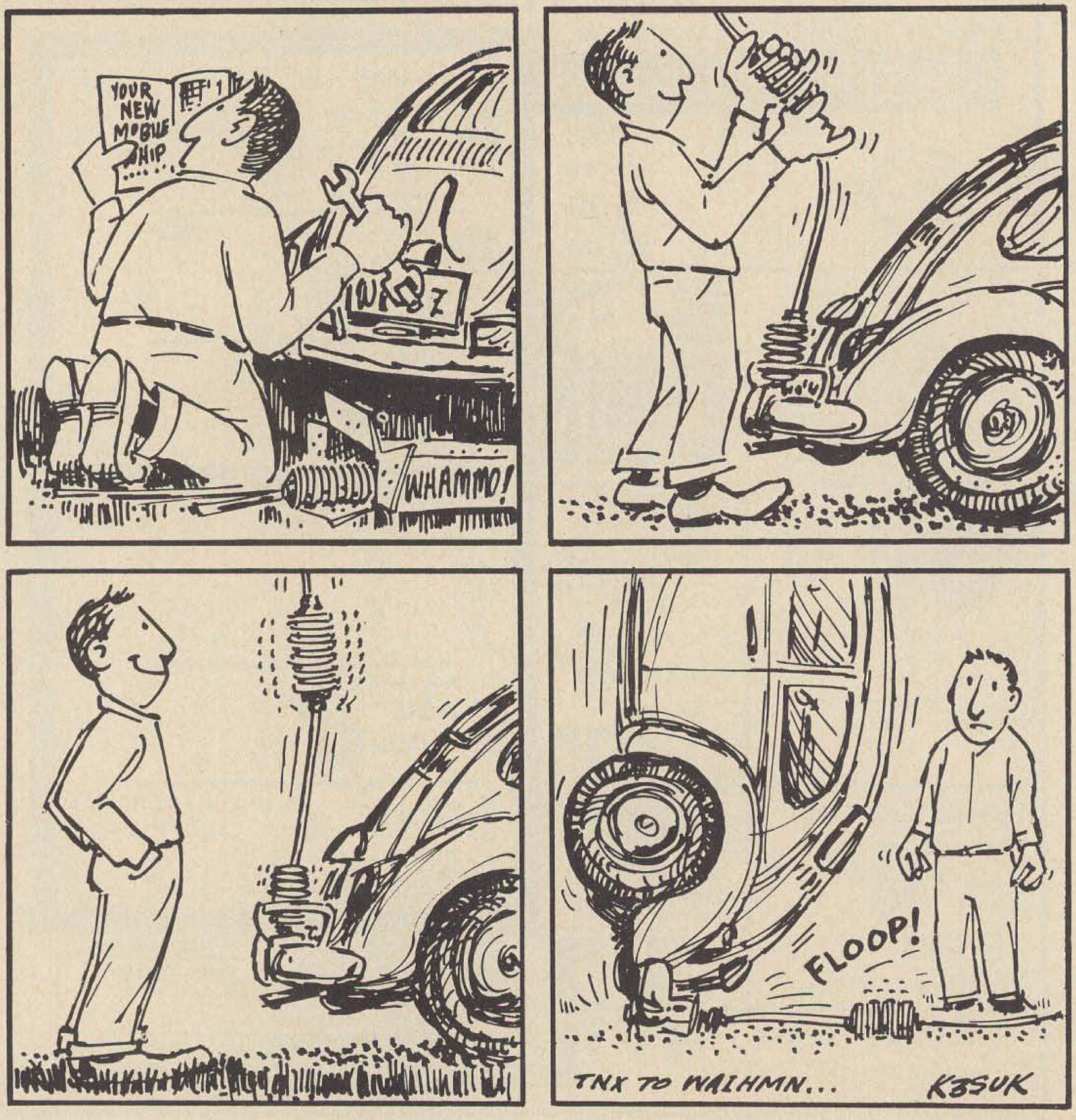
The New Whip



A Report on the WTW

Not enough "extra" cards sent in yet to start our "Honor Roll". See The November issue of 73 for the new rules of submitting less than multiples of 100 for your Honor Roll listing. Send them in fellows so we can start our Honor Roll next month.

To date we have issued a total of 67 WTW Certificates. Broken down like this:

43 WTW-100 14MHz phone
9 WTW-200 14MHz phone
7 WTW-100 21MHz phone
3 WTW-100 28MHz phone
3 WTW-100 7MHz CW
2 WTW-100 21MHz CW

This is not too bad for a new DX Award. The interest is growing by leaps and bounds.

There is still Number *ONE* Certificate QRX for WTW-100 on 28 MHz CW

" " " " " WTW-100 on 7 MHz Phone
" " " " " WTW-100 on 3.5 MHz CW
" " " " " WTW-100 on 75 phone

and both CW and phone on 160 meters, even 6 meters if anyone ever qualifies! When we say PHONE we mean just that—it can be either SSB, AM, FM, PM etc.

I ask everyone to always place their full address with ZIP CODE on every form they send me, this means the address of the stations that qualify even when they submit their cards to a Certification Club. This will save me a lot of time in looking up addresses with the chance of having an address incorrect.

Have had a little trouble with fellows sending cards for the wrong band or wrong mode a few with both wrong on the cards. PLEASE POLICE your cards carefully fellows because YOU DON'T QUALIFY UNTIL I HAVE the right number of cards with the mode and band agreeing. With me its FIRST COME with the serial numbers on Certificates.

Don't send me cards, SEND THEM TO YOUR CERTIFICATION CLUB, if you don't know who that is an SASE will put one in your hands. We have almost every district covered now EXCEPT THE FIRST, SECOND AND ZERO DISTRICTS OF THE USA. STILL NEED AFRICA & ASIA.

At the moment I am not 100% sure of South America because the forms I sent them many months ago were returned to me. So to be on the safe side those of you in South America please send your cards direct to me—(Gus Browning, W4BPD, Route 1, Box 161-A, Cordova, S.C. 29039 U.S.A.) Will let you know about South America when I find out about them. In the meantime I am looking for a good DX club down there to act as Certification Club, the same goes for ASIA and AFRICA.

Read the new rules in the November issue (1967) very carefully and start sending in those "extra" cards for our Honor Roll.

In the W T W we have a good thing and I suggest you all jump in, the waters fine!

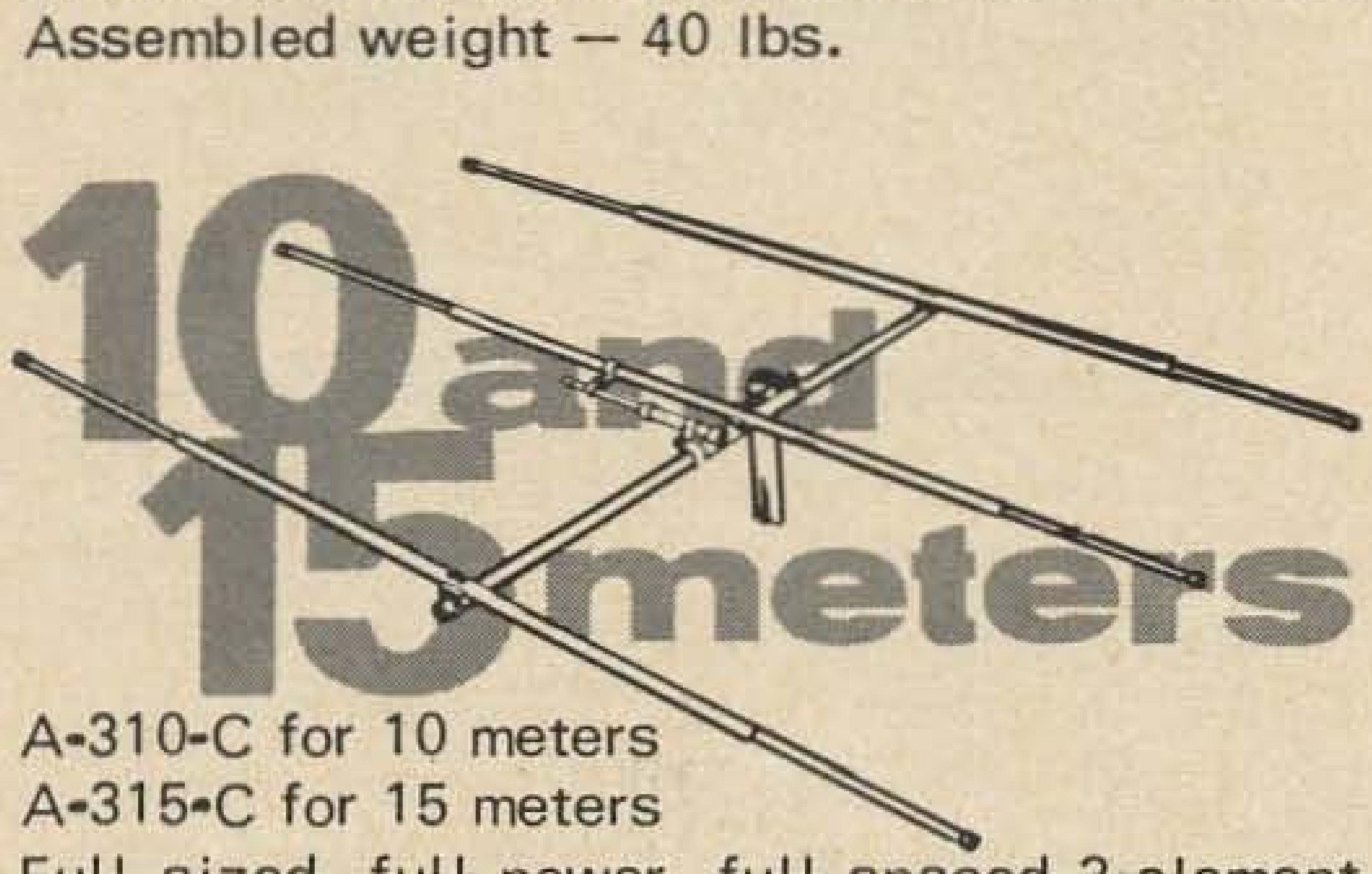
Gus Browning-W4BPD

When hams discuss 'OPTIMUM SPACING' in single band beams . . .

. . . . The subject turns to Mosley

20 meters

Amateurs punch through the QRM on 20 meters with Mosley's A-203-C, an optimum spaced 20 meter antenna designed for full power. The outstanding, maximum gain performance excells most four to six element arrays. This clean-line rugged beam incorporates a special type of element design that virtually eliminates element flutter and boom vibration. Wide spaced; gamma matched for 52 ohm line with a boom length of 24 feet and elements of 37 feet. Turning radius is 22 feet. Assembled weight — 40 lbs.



10 and 15 meters

A-310-C for 10 meters
A-315-C for 15 meters
Full sized, full power, full spaced 3-element arrays. 100% rustproof all stainless steel hardware; low SWR over entire bandwidth; Max. Gain; Gamma matched for 52 ohm line.

40 meters

S-402 for 40 meters
Top signal and unexcelled forward gain - a 2-element optimum spaced beam. 100% weatherproof. Low SWR. Heavy duty construction. Link coupling results in excellent match over full bandwidth.

For detailed specifications and performance data, write Dept 157A.

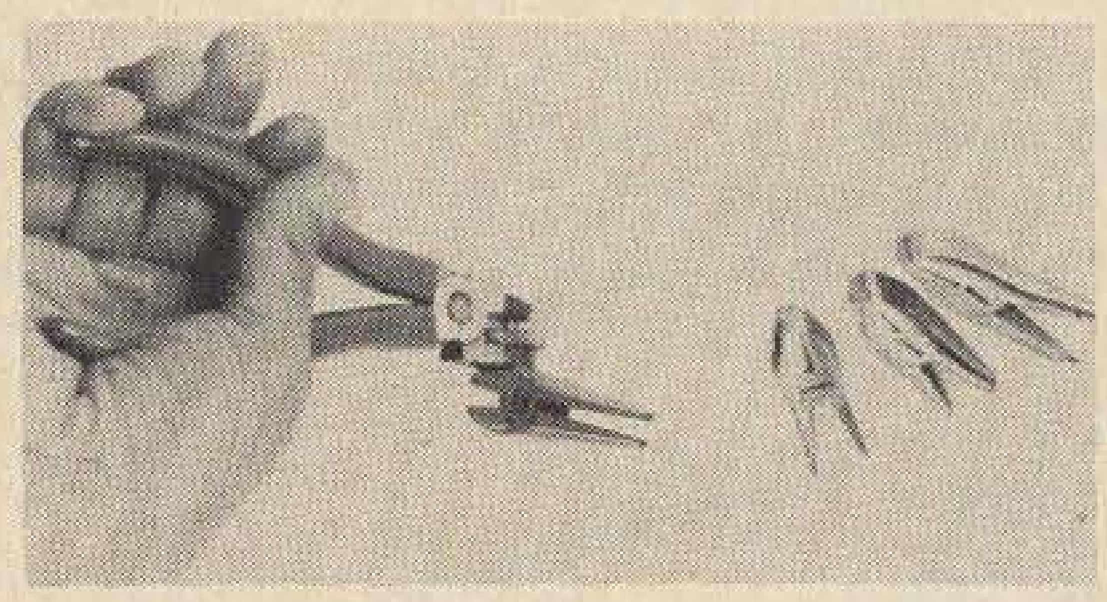
Mosley Electronics, Inc. 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042

NEW PRODUCTS

Knight-Kit T-175

The new Knight-Kit 6-and-10/11 meter linear amplifier delivers plate power input of up to 300 watts PEP on SSB, 120 watts AM, and 150 Watts CW.

Attractively designed, the T-175 Linear Amplifier is only 5½" high, 13⅜" wide, and 11" deep. The coils are supplied for 26.960-29.700 MHz and 50-54 MHz. The price is $99.95. Sold by Allied Radio Corporation, 100 N. Western, Chicago, Illinois 60680.



Jensen Swivel-Head Plier Set

A versatile new plier with interchangeable heads which rotate 360° has been announced by Jensen Tools and Alloys.

Using this new tool, the operator can reach easily into inaccessible areas, around corners, into blind spots which cannot even be seen. Eight locking positions are provided at 45° intervals. The new Swivel Head plier thus functions as a straight standard plier and as an angled plier with a choice of eight separate angles to match the work. The set consists of a long nose head with serrations on the gripping surfaces, a shorter duck-bill head with serrations, a duck-bill head without serrations, and a retainer-ring head with pins at the extreme ends. The complete set is furnished in a compact vinyl case and is priced below $15. Catalog number 23C450. Further details may be obtained from Jensen Tools and Alloys, 3630 E. Indian School Rd., Phoenix, Arizona 85018.

Motorola Transistor Selection Guide

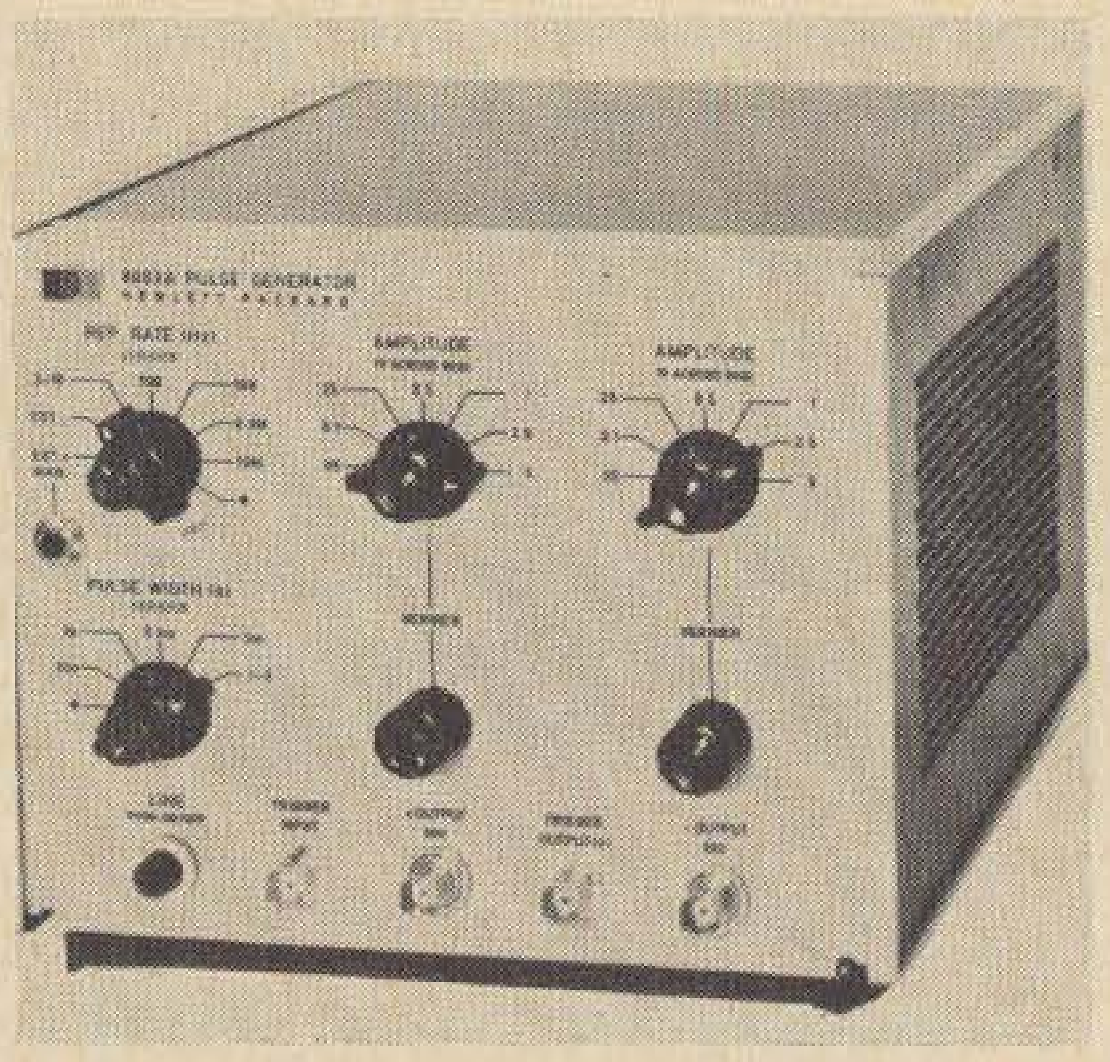
A new complete selection guide for plastic transistors has been published by Motorola Semiconductor Products Inc. The guide covers Motorola's Unibloc silicon annular transistors which have been developed for industrial applications. The guide groups transistor types by application categories and one section of the brochure is devoted to an illustrated description of the Unibloc plastic package. Both NPN and PNP device types are included in this 6 page selector guide. For a copy of the Motorola Selector Guide for Unibloc Plastic Small-Signal Transistors, write Motorola Semiconductor Products Inc., Box 13408, Phoenix, Arizona 85002.

Motorola Thyristor Guide

A handy Thyristor Selector Guide offers an easy to use key to more than 300 different Motorola devices now available for today's modern stepless power control designs. Also included is data on plastic and metal unijunction transistors, plastic bilateral triggers, fast switching SCR's diodes 4-layer diodes and Motorola's practical how-to-do-it thyristor applications guide: the new "Power Control Circuits Library". Copies may be obtained from any Motorola district office, franchised distributor or by writing Motorola Semiconductor Products, Inc., P.O. Box 955, Phoenix, Arizona 85001.

Ameco Model "PT"

The Ameco Model "PT" Radio Frequency Pre-Amplifier, covering the range of 6 through 160 meters, has been specifically designed for use with ham transceivers in this frequency range. Ingenuis control circuitry allows the "PT" to be added to virtually any transceiver without modification. The fundamental requirement is that the transceiver have control circuitry built in for use with an external linear amplifier. The "PT" also contains circuitry to feed and mute a second receiver. It sells for $49.95, complete with built in power supply and connecting cables. Further information is available from the Ameco Division of Aerotron, Inc., Raleigh, North Carolina.

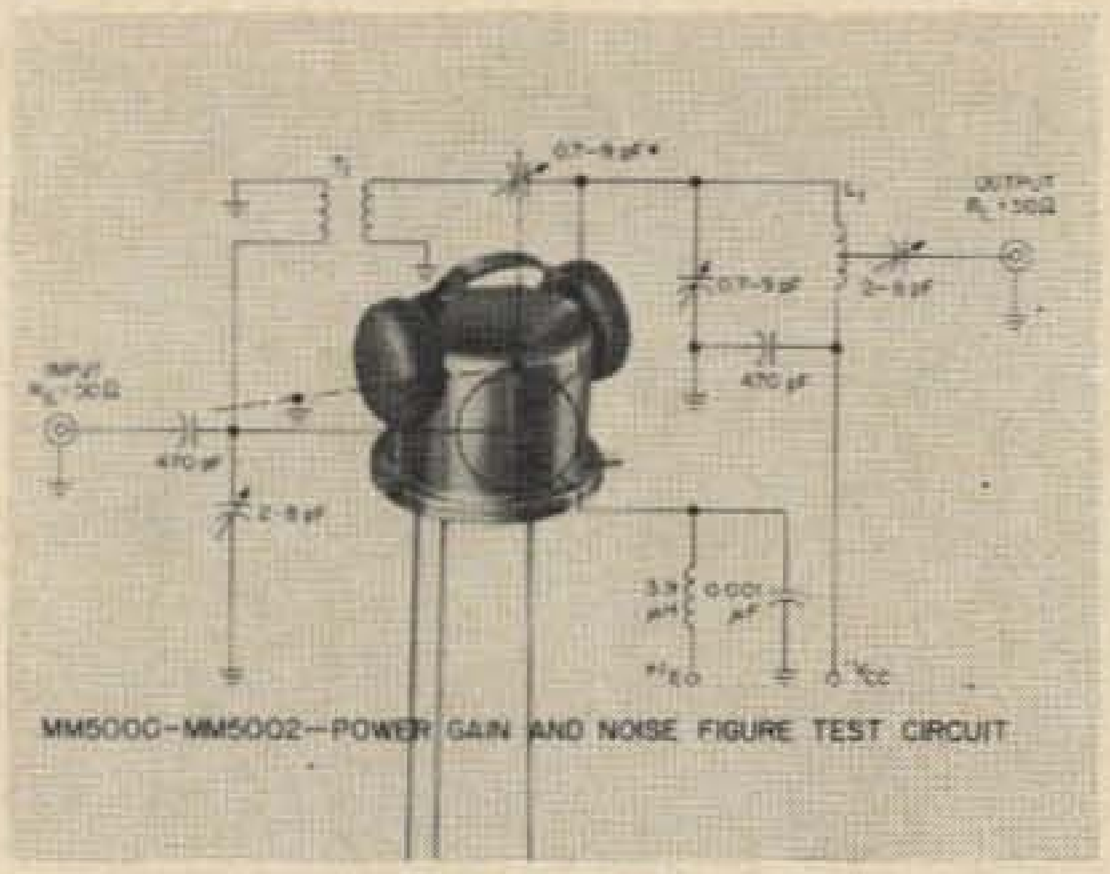


Hewlett-Packard Pulse Generator

This compact, multi-purpose Pulse Generator Model 8003A combines fast risetime (5 Ns) with long pulses (to 3 seconds) useful for testing wideband analog devices such as filters and amplifiers. At the same time, its short pulses (down to 30 ns) and high repetition rate (to 10 MHz) make it well suited for fast switching applications. Optional programmability adapts it to automated test systems as well as serving for lab applications. The price is $470. For further information contact Hewlett-Packard, 1501 Page Mill Road, Palo Alto, Calif. 94304.

Motorola Semiconductors

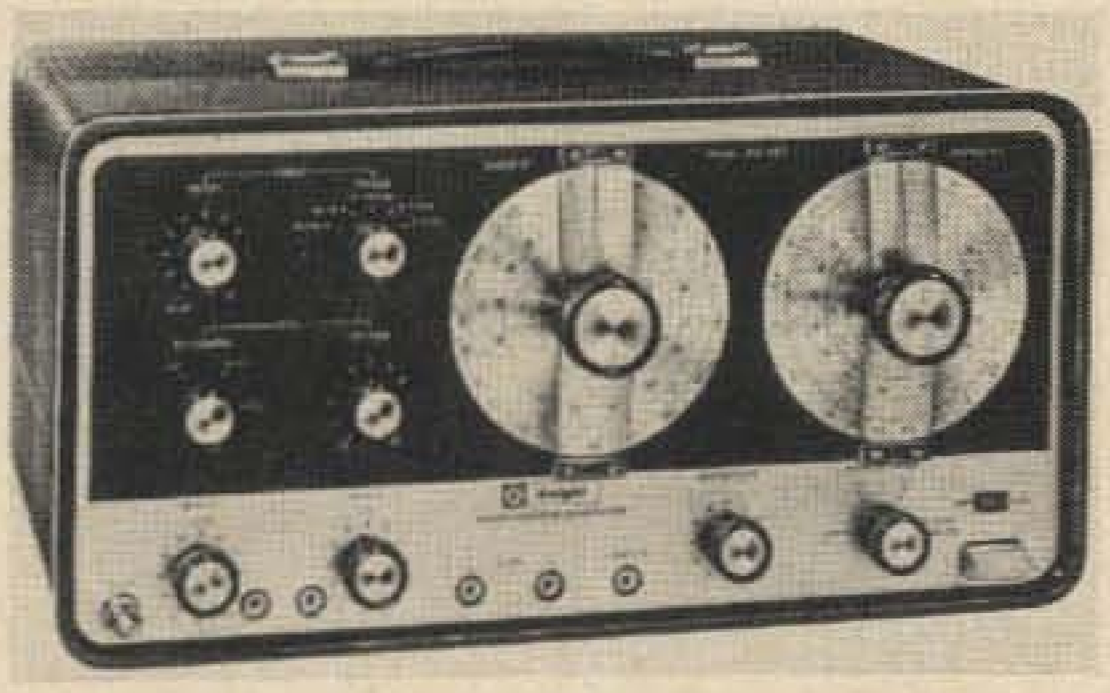
Low noise, low cost, high power gain germanium transistor solves rf front end needs. The new Motorola MM5000 and MM5002 germanium SME transistors are priced as low as $1.50 and furnish up to 24 db minimum power gain at 200 MHz. Higher frequency, and lower noise performance is obtainable due to complete freedom of transistor geometry and much better definition and closer spacing of emitter/base areas to gain optimum device performance.



TABLE

Type	Low Noise @ 200 MHz	Power Gain @ 200 MHz	Price (100-up)
MM5000	1.6 dB max	24 dB min	$2.95
MM5001	2.0 dB max	22 dB min	2.10
MM5002	2.2 dB max	20 dB min	1.50

Additional information may be obtained through P.O. Box 955, Phoenix, Arizona 85001.



Knight Solid-State Sweep/Marker Generator

The 1968 model Knight KG-687 Sweep/Marker Generator is designed with laboratory quality specifications and covers all TV and FM, *if* and TV-VHF frequencies. It permits complete alignment for Stereo FM, black and white, or color TV, front ends and *if's*. This is a fine instrument for design work, production and testing, maintenance and servicing.

The KG-687 provides an all-electronic sweep up to 18 MHz wide at the highest center frequency. It has a built in crystal controlled and variable post-injected marker for non-distorting markers.

It is a solid-state circuit using all silicon transistors to minimize drift and provide maximum reliability.

The model KG-687 is priced at $120 in kit form, $185 assembled. It is available from Allied Radio Corp., 100 N. Western, Chicago, Illinois 60680.

Knight-Kit Inverter/Charger

One of the most useful of electronic devices is a unit that permits operation of standard AC appliances from a 12 volt battery. Allied Radio now has made available a compact Knight-Kit Solid-State Inverter/Charger, 1968 Model KG-666 which converts 12 volts dc to 110-130 volts ac. It operates ac appliances (radios, TV, transceivers, power tools, lights, shavers, soldering iron, test equipment, etc.) in cars, boats and trailers. It can be used by campers, sportsmen, hobbyists, farmers, explorers—almost everyone, especially since it also charges 12-volt batteries.

The kit is designed for easy assembly and is supplied with complete step-by-step wiring instructions and solder. It is priced at $44.95 and is available from Allied Radio Corporation, 100 N. Western, Chicago, Ill. 60680.

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Motorola Zener Diode Guides

Easy, quick identification and selection of virtually any Zener or temperature-compensated reference diode is possible with these newly released publications from Motorola Semiconductor Products, Inc.

The 40 page cross-reference guide covers the widest offering of devices in the industry. All Motorola zener, temperature compensated and precision reference diodes, assemblies, current regulators, reference amplifiers, high power transient suppressors, Meg-a-Life, and mil-type units are covered.

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Copies are available from any Motorola district office, franchised distributor or from P.O. Box 955, Phoenix, Arizona 85001.

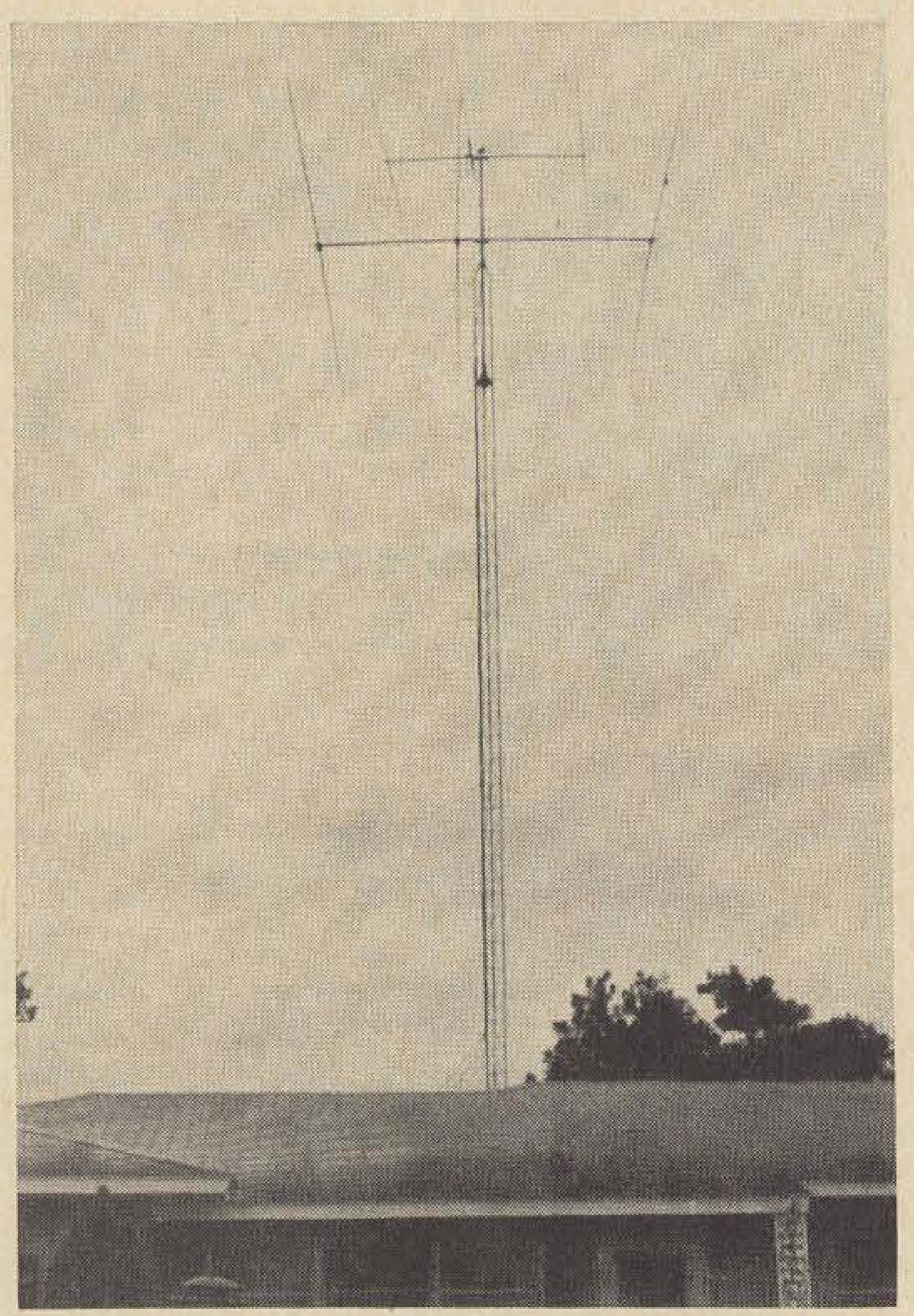
MOVING?

Every day we get a handful of wrappers back from the post office with either a change of address on them or a note that the subscriber has moved and left no address. The magazines are thrown out and just the wrapper returned. Please don't expect us to send you another copy if you forget to let us know about your new address. And remember that in this day of the extra rapid computer it takes six weeks to make an address change instead of the few days it used to when we worked slowly and by hand.

John A. Attaway, K4IIF
and James E. Fredericks, K4ELB
P.O. Box 205
Winter Haven, Fla. 33881

Converting The TA-33 Jr to Full-Power 15 Meter Beam

And It's Use In A Real Crazy Triband Array



During the past sunspot minimum hauling down the old tribander became common practice, particularly among DXers, as first 10 and then 15 meters deteriorated and gave up the ghost. Up the pole in its place went such things as 20 meter monobanders, 40-20 meter duobanders, and even 40 meter monobanders as propagation hit rock bottom. The serious DXers who were not already using linear amplifiers found that high power also became a virtual necessity.

More recently, however, as the sunspot number climbs, 15 meters has begun to regain its old punch, and occasional flurries of 10 meter activity into the southern hemisphere are being experienced. As a consequence, the DXer who ignores 15 is taking a chance on missing some good ones.

This thought was very prevalent while cleaning out the garage a few months ago, when what should turn up but the old TA-33 Jr. It was a good standby antenna and great for field day, but it just wasn't made to handle high power. For those unfamiliar with this beam, it is a lightweight trap tribander of the Mosley family. Its size and weight permit it to be easily rotated by the AR-22 TV antenna rotator. It is rated to 300 watts maximum power input, and consequently is fine for use with Valiants, HT-37s, and most of the SSB transceivers.

The little beam brought back pleasant memories of past contests during the favorable portion of the sunspot cycle. Many times the best single band score was on 15 meters while using the TA-33 Jr for 10, 15, and 20. It seemed to be an unusually good antenna for the 21 MHz band, so for curiosities sake we pulled out the Mosley poop sheet and checked the beam's exact dimensions. The boom was approximately 12 feet in length. When set for fone operation the driven element was 23 ft. 10 and ½ inches, the director 22 ft. 10 and ½ inches, and the reflector 25 ft. 9 and ½ inches. These lengths of course included the traps. It was evident that these dimensions were very close to those of a 15 meter monobander. To verify this we checked the lightweight 21 MHz, 3-element beam described in the ARRL antenna handbook[1]. This beam uses a 15 ft. boom, a 23 ft. radiator, a 22 ft. director, and a 25 ft. reflector. The only difference of consequence between it and the TA-33 Jr was the longer boom on the monobander.

[1]The ARRL Antenna Book, 8th Edition, pg. 253

Other significant measurements on the TA-33 Jr included the 5 foot spacing between the radiator and the director, and the 7 foot spacing between the radiator and the 0.16λ, respectively. According to the ARRL graph relating element lengths and spacing, Fig. 9-24, page 254[1], the director for a 15 meter beam with this spacing should be 464/21.4 or about 21 ft. 2 and ½ in. for operation on 21.4 MHz. From this same graph, the reflector was calculated at 495/21.4 or about 23 ft. 1 and ½ in. while the driven element was 475/21.4 or about 22 ft. 2 and 1.2 in.

Consequently, all that is required in converting a TA-33 Jr to a 15 meter monobander is first the removal of the traps and substitution of aluminum tubing of the appropriate lengths. This is easily accomplished as the traps are mounted on ½ in. aluminum tubing, readily available, and can be taken off by removing only one sheet metal screw. Then a short piece of ½ in. tubing is used to join the two halves of the driven element, and a gamma match is installed. The gamma match used in this particular instance was of a unique design developed by K4ELB and will be described in a later article.

The converted tribander can be easily restored to its original function by reversing the above procedure. The gamma match, radiator connector, and aluminum tubing can be removed and the traps replaced in a matter of 5 minutes time and the TA-33 Jr will again be in service.

The new monobander was placed on a low tower for preliminary testing. It was found to load satisfactorily, and preparations were begun to hoist it up the high tower for stacking over the 20 meter beam. However, at this point it was decided that some provision should be made for 10 meters. After all, the sunspot cycle was definitely on the way up. Unfortunately, there weren't anymore spare beams in the garage, but a 102 inch whip complete with mobile mount was found, and it was r e a s o n e d if it were installed above the 15 meter beam, which would be at 73 feet, a pretty fair country antenna for 10 meters would result. Accordingly, the whip was attached to the mast above the beam and installed at the top of the tower. The braid of the 10 meter coaxial feed line was soldered to the boom of the 21 MHz beam so that the latter could act as a ground plane. This gave us a 10 meter ground plane extending to near 80 feet above the earth, a 3-element 15 meter beam at 73 feet, and a 3-element 20 meter beam at 66 feet. The 20 meter beam consisted of the elements from a Hy-Gain monobander mounted on a 20 foot piece of 2 inch aluminum irrigation pipe for the boom. A greater separation between the beams might be desirable, but the lengths of the mast did not permit a wider spacing. The finished product viewed from the ground is shown on Fig. 1. The whip can be seen faintly as the vertical line above the upper beam. The array is rotated by a Ham-M Rotor mounted inside the tower.

Standing Wave Ratios were determined using a Heathkit Reflected Power and Standing Wave Ratiometer. The 15 meter beam varied from a minimum of 1.3:1 to a maximum of 2.5:1 at the extreme band edge. The 10 meter ground plane varied from 1.7:1 to 2.5:1, while the 20 meter beam was 1.0:1 at 14250 and 2.0:1 at 14.001 kHz.

It is difficult to evaluate the effectiveness of the array through comparative signal reports because of such factors as QRM and band conditions. However, the 15 meter beam has received 5/9 reports from as far east as VS9, VQ9, ET3, etc., and as far west as VK and ZL lands. The 10 meter ground plane regularly received 5/9 + reports from South America and also has a 5/9 from as far away as KS6 land. The 20 meter beam has been used for QSOs with 8F3, XZ2, 1S9, etc., while in phase with the 15 meter beam, so if interaction is occuring between the two bands, it is not serious. Interestingly enough, while the above mentioned contacts were made while running 700 watts power, the 20 meter beam was recently used for a SSB contact with VK2ADY/VKØ on Heard Island while using only the HT-37 barefoot, about 140 watts PEP. This was considered a remarkable achievement in light of the great demand for Heard by DXers, and the poor propagation conditions prevalent during the DXpedition.

. . . K4IIF & K4ELB

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The Scientific Method

Hate filled the room. It seeped, like a thing alive, from the young woman who sat at the desk studying. It crept over the *Radio Engineer's Handbook*, curled around *The Principles of Radio*, eddied about the open *Radio Amateur's Handbook*, dripped past *Basic Mathematics For Engineers* and flowed remorselessly to the floor, where it seethed in murky pools just beyond the small circle of lamplight.

There was a creaking from the chair as the beautiful girl pushed back with a sigh. She put down the slide rule and lifted her eyes to the ceiling to rest. How she hated her husband! She thought for a moment of their wedding day, six years ago, bright with hope. She thought with contempt of how she had been a typical bride, radiant, with stars in her eyes. She had been in love with love itself. Her husband . . . how handsome! What a lovely couple, people had said. How right they were for each other. If ever a marriage was certain to succeed, this was it.

People, she snorted! They didn't know about amateur radio operators. Hams, they called themselves. Pigs would be more like the truth. Dirty, filthy, lazy swine, who wallowed in their welter of tubes, coils of wire, beam antennas, day after day, to the absolute exclusion of all else. How she had tried to interest him in herself, in her own lovely world of knitting, embroidery and flowers. It was a short honeymoon, she mused. It was very likely one of the shortest on record. He'd jumped up, one evening, looking at his watch, exclaiming, "I've got a sked on ten in W2 land!"

After that she'd seen little of him. He had taken to coming home from work night after night and disappearing almost at once into his transmitter room. She'd learned early that hams liked to refer to the rooms where they kept their equipment as "shacks". She thought, with a curl of her lip, how thoroughly right and fitting the term was.

It was difficult to pin down with any degree of exactitude when she'd first thought of murder. It may have started that night when he'd ignored her carefully planned living room, with the dimmed lights and soft, romantic music. He'd then spent the next four hours frantically chasing an elusive radio contact, nearly at the antipodes. Or was it the night she'd met that handsome man at one of her friend's dinner parties? As usual, her husband was in his shack, working with his radio. She'd been forced to attend the party alone, where her hostess had paired her off with a charming attentive man. Perhaps it was then she had first realized with crystal clarity that her husband must go. That which she had to offer the world, her youth and beauty, were still highly negotiable assets, and if her husband didn't appreciate these qualities, here was one man who obviously did. Of course, she realized, one cannot just go around murdering people. The trick is to get away with it. For that matter, murder would not even be necessary if her husband would only listen to reason. He'd made it quite clear that he did not believe in divorce, and would never, under any circumstances, even consider it. Have it your own way, she'd thought grimly, and begun to ponder a suitable method. Just any old way would not work. This would definitely require what her husband fondly called the scientific method.

She'd started to study radio, sneaking his books when he was away, at first, burrowing, probing into the mysteries of electronics. Radio involved electricity, and that was dangerous, wasn't it? After all, didn't they execute murderers by electrocution? There must be some way to safely eliminate her ham of a husband; some scientific method hidden in those weighty tomes. He'd actually delighted when he'd first come upon her with her nose in the *Handbook* and had been most helpful. There had followed weeks and months of study, and at last she'd found the answer! Not that there was a chapter carefully labelled, "How to Murder Your Husband", but just the same, the information was there.

She dropped her eyes once more to the open textbook before her, smiled faintly, and then, closing the books, piled them neatly. She snapped off the student's lamp and walked into the kitchen and began to brew some coffee.

She went carefully over her plan as the water heated. She took delight in her new ability to think in technical terms. Without the bleeder resistor across the output of the high voltage power supply, there would be nothing to remove the death dealing voltage from the final filter capacitor following its shutdown. If her husband could be caused to turn on a unit defective in this manner, and then it off again. . .

With infinite care, she had fashioned the trap. The bleeder resistor, with its open circuit, made to look like a natural break; the open cathode lead on the power amplifier; the faulty ground rod; and the last critical link in the plan, provided by her husband himself. The train of events was predictable. He'd tune up the transmitter on high power. He would see plenty of drive on the final grid, with no plate current. He would shut down the transmitter, give the final plate a hasty swipe with the defective grounding rod, and then grab the plate cap of the final stage with his hand. The loaded capacitor would do its job. The plan was good. Nodding thoughtfully, she was satisfied.

Her head lifted as she heard the car turn into the driveway, and she began to pour two cups of coffee, finishing just as the kitchen door burst open, and her husband strode into the room. There followed a hasty peck at her cheek, as he grabbed some coffee on his way to the shack. The wife sat down and waited. Suddenly the house echoed to a crackling WHAP!, a queer choked yell that ended even as it began, and the heavy thud of a 160 pound body hitting the floor. The widow smiled.

The crackle of static filled the room, as the girl leaned back in her chair for a moment. She lifted her eyes past the short wave receiver, swept by the exciter, passed briefly over the kilowatt amplifier, and rested near the ceiling where the black snake of a coax cable went through the wall. Her memory drifted back over the past year. How solicitous her friends had been. She'd made a lovely widow, playing to perfection the part of the bereaved spouse of a man electrocuted by his own transmitter. After a decent interval, she'd begun to accept invitations. It was at one of these affairs that she'd met the handsome, attentive man again. She'd been right; he was interested. So interested, in fact, that he was at this moment sitting in the living room as her new husband. Strange, she thought with an inner chucke, but her studies of radio had born fruit in another, totally unexpected manner. She'd felt her curiosity touched and had gone on to obtain her own license. She leaned forward and began to make delicate adjustments to the transmitting apparatus.

In the living room, her new husband sighed as he turned to page 37 of the *Radio Engineer's Handbook.* There were dark thoughts of murder in his heart. ■

W1EMV from Page 2

are reviewing a piece of equipment with which a member of the staff is familiar, it may be acceptable. The reason for this is that a review in 73 gives our approval to the equipment and if it turns out to be a poorly designed device, we get caught in the middle. I would be interested in hearing from anyone who is doing work with multiplex. This is obviously the next breakthrough in use of frequencies, and should be examined.

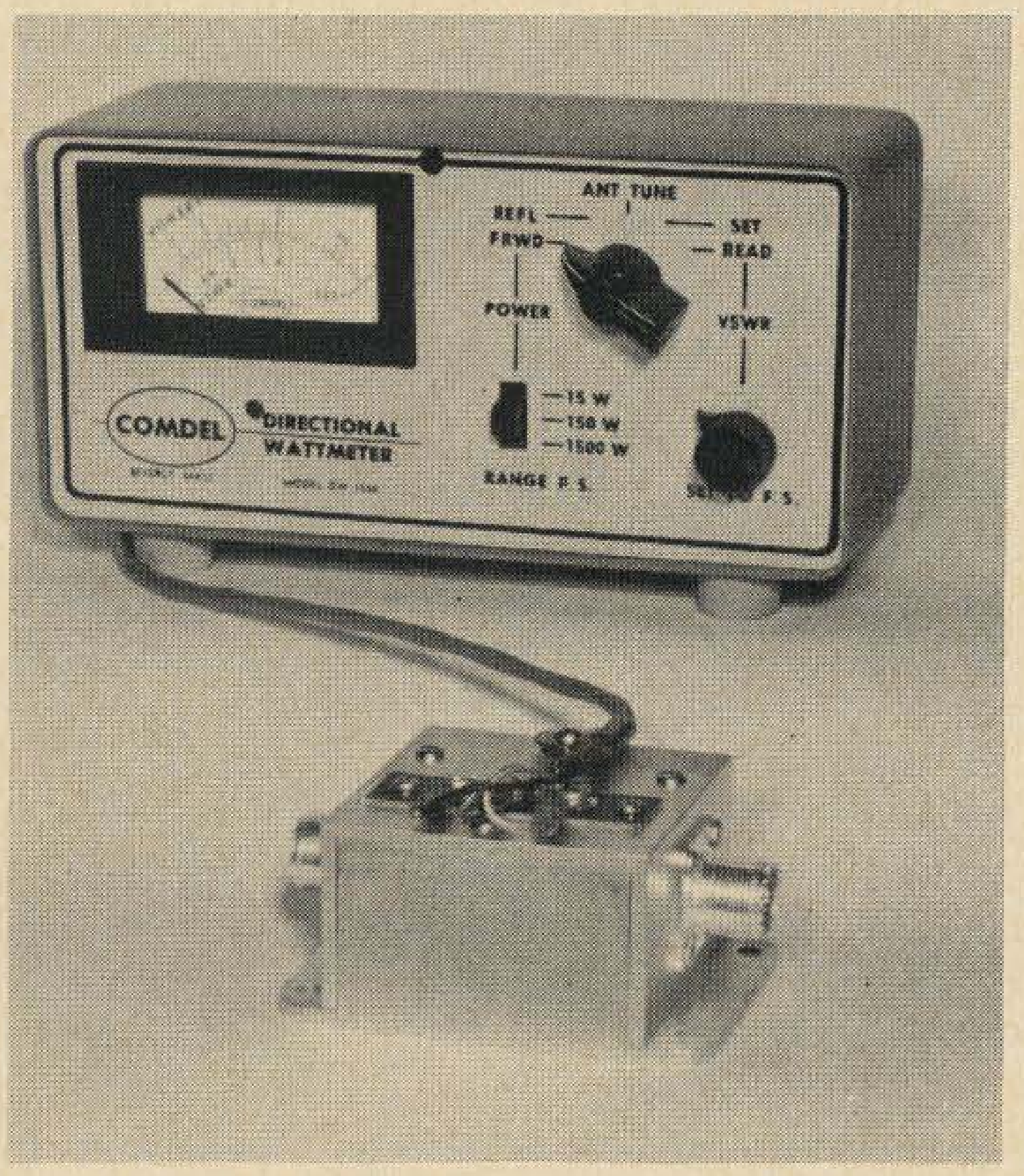
Fiction, humor, and the "Look what happened to me" type of article is the least in demand. If it makes *me* laugh, I'll buy it, but I'm hard to please. Satire on some of the foibles of ham radio is good (see S-9-Manship on page 56) and can be used to deliver a message.

The important thing is, if you have recently built a new piece of gear and have it working on the air, let the rest of the world know about your project. Photos and diagrams are a must. An article without them is dull and readers often pass them up. You don't have to be an artist, though. We have a fine draftsman who will redraw all your diagrams to our specifications.

I'll be waiting to hear from you. Reading manuscripts is my favorite pastime in the evenings . . . well, maybe not my *favorite* . . . but it is better than TV.

. . .W1EMV

Comdel Wattmeter DW 1550



Recently, I had the opportunity to try out Comdel's new wattmeter and was impressed with its versatility and accuracy. Like other devices of the same kind, it is an "In-Line" instrument, which consists of two separate parts; an rf coupler and a meter unit. The coupler is inserted in the outgoing transmission line, while the meter unit which contains all controls, may be placed in any position suitable to the operator. A three conductor cable, furnished by the supplier, interconnects the two units. Provision is made to bolt the two units together to form a single entity, for those who find this more convenient.

In contrast to simple SWR indicators, the Comdel instrument measures true power up to 1.5 kW, over the frequency range of 1.5 to 60 MHZ. A range selector permits full-scale deflections of the meter for outputs of 15, 150, and 1500 watts. Forward and reflected power are measured, as selected on the function switch, and the absolute power output is, of course, the difference between the two. When the system SWR is less than 2:1 the reflected power can be ignored

The Comdel unit doubles as a VSWR bridge. The use of charts based on forward and reflected power is eliminated by two more positions on the function switch, SET and READ, and a separate VSWR scale on the meter. A separate control knob enables the user to set the meter to full scale in the usual manner. This control is out of circuit when power measurements are being made.

A very useful feature is provided when the function selector is placed in its center position, labelled ANT. TUNE. If you have been tuning external antenna couplers for minimum VSWR, you may on occassions have ended up, as I frequently have, with zero reflection but also with no output. This condition is not exactly good for your equipment. The danger is completely eliminated when the Comdel instrument is used in the ANT. TUNE position. The meter indicates the combination of forward and reflected powers, and the antenna tuner is simply adjusted to give maximum meter deflection.

The meter unit is attractively styled and measures 7½" long by 4" high and 3½" deep. The coupler is of rugged construction and features mounting holes for permanent attachment to bulkheads or any convenient surface. The price is $95.00 postpaid in the U.S.A. ■

Comdel Inc., Beverly Airport, Beverly, Massachusetts 01915.

DW 1550 Specifications

Frequency range:	1.5 to 60 MHz.
Power range:	0.2 to 1500 watts.
Power accuracy:	± 1 dB.
Impedance:	51 ohms nominal.
VSWR range:	1.0 to 4.0:1.
VSWR residual error:	1.1:1 maximum from 1.5 to 60 MHz. 1.05:1 maximum from 2.5 to 30 MHz. Negligible from 3.5 to 25 MHz.
Insertion loss:	Negligible.
Size and weight:	7-9/16" x 4" x 4-1/4". 20 oz.
Price:	$95.00.

YOUR CALL

Please check your address label and make sure that it is correct. In cases where no call letters has been furnished we have had to make one up. If you find that your label has an EE3*&* on it that means we don't know your call and would appreciate having it.

W2NSD from Page 4

self as a committee of one to try and correct him. Explain to him that America already has enough problems with our image abroad without his reinforcing the idea that we are inconsiderate and immature. Be as nice as you can about it and be ready to hold your temper because the other chap will probably get mad. Almost all of us get mad when we are wrong and it is pointed out. It is much easier to get mad than to face the thought that we have been guilty of acting stupidly or childishly.

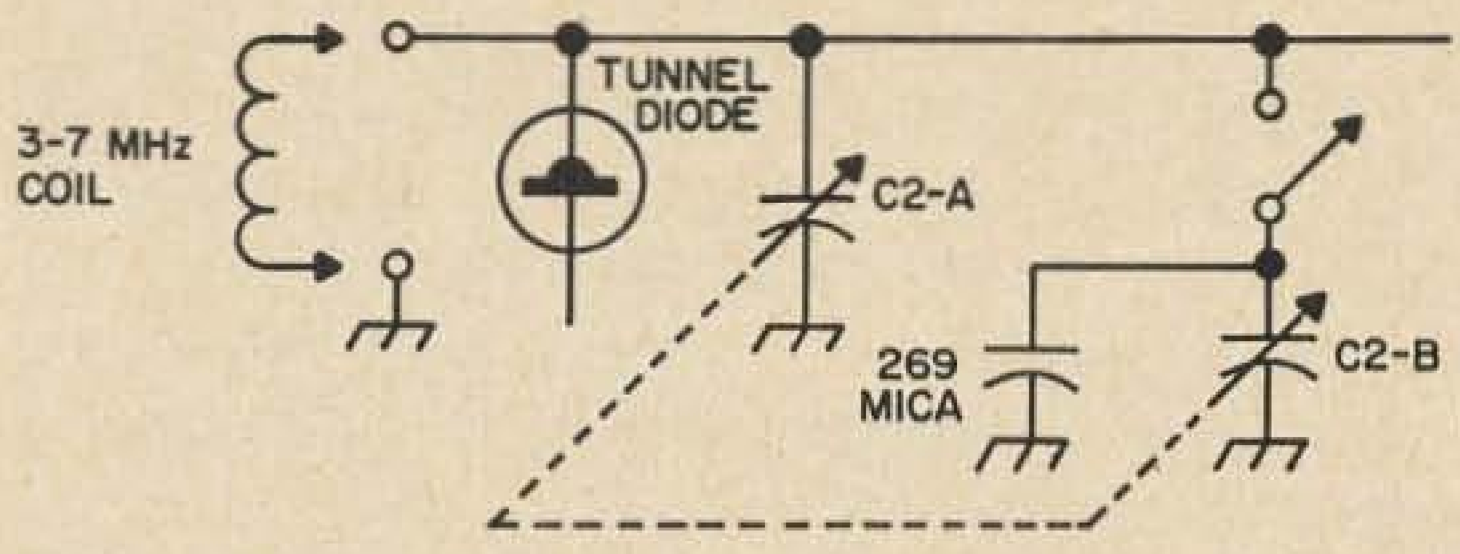
Knowing that the way of the reformer is a hard one, it is a lot easier to not become involved. If you keep quiet all you have to face is your own conscience, and that has taken such a beating already that another black mark won't show. Right? Those of you with consciences that are still reasonably intact have a mandate, I believe, to help clean up our bands. Even the hardened cases of ego bordering on insanity that manifest themselves will, in time change. Fortunately, most of our troubles stem from thoughtlessness rather than deep-seated neurosis and just a few verbal slaps on the wrist will bring long range benefits.

Well, if anyone goes along with that idea, we may be on our way toward a long range improvement in amateur radio, not only for ourselves, but in the image we project to foreign amateurs and to radio Administrations around the world. I hope that the idea takes hold enough so that our next problem is to find a way to protect ourselves from the self-appointed protectors of our image.

Our DX bands are badly crowded at times and it is normal for there to be some abrasion. Rare DX hunting can be very abrasive. There is no point in trying to explain to the fellow who has been calling a rare station for three hours that it is of no possible signifiance in the long run whether he gets through or not. Reasoning with a DXer on the scream is about as fruitful as reasoning with a pit full of vipers. But we can get our 2c in with the chap who calls CQ on a net having neglected to find out if the channel is busy. We can try to calm down some of the more excited fellows who are sounding off. We can ask that blue material be kept off the air. There are lots of things to talk about without getting down to dirty jokes and thinly disguised innuendo.

. . . Wayne—

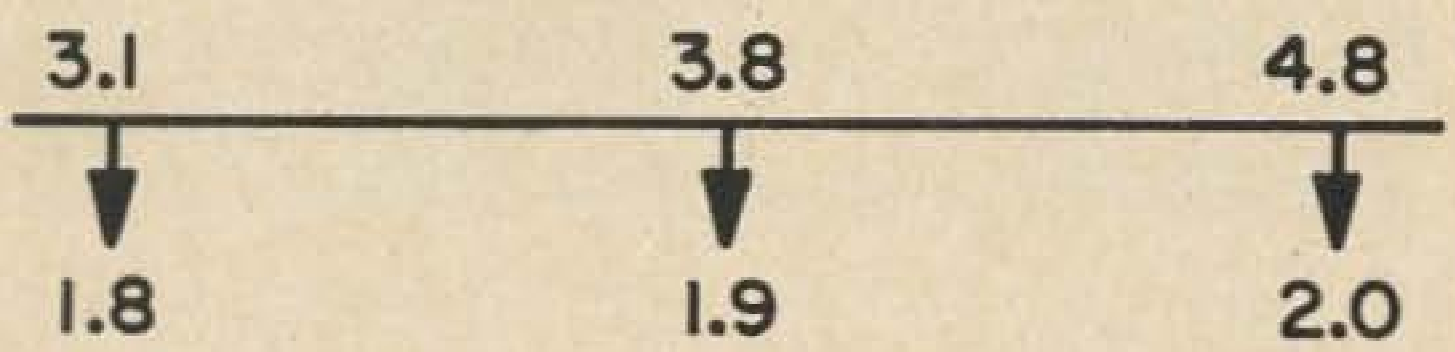
Tunnel Dipper on 160



The Health Tunnel Dipper has been a very useful piece of test gear in building home-brew projects, but the frequency range does not extend low enough for coverage of the 160 meter band. An attempt to lower the range by increasing the inductance ended in erratic operation before 2 MHz was reached.

Operation on the 160 meter band can be accomplished by adding 267 pF of capacitance from the variable capacitor, C2B, to ground, when using the 3 to 7 MHz coil. This capacitor should be a silver mica as disc types cause severe frequency drift. The capacitor may be stored in the coil rack and soldered into the circuit when 2 MHz coverage is needed. An approximate scale conversion when using the 3 to 7 MHz coil and the additional 267 pF is as follows:

For convenience the new 160 meter scale may be pencilled in on the bottom of the 3 to 7 MHz scale.



Carl D. Pleasant, W5MPX/5
218 John Wayne Dr.
Lafayette, La. 70501

Questionnaire

We don't like things to be static at 73, so, although the magazine gets few complaints, except for occasional circulation problems and some of the opinions expressed in the editorials, we are always thinking about improvements that might be made.

You can help a lot with this, if you will. Just tear out the questionnaire below and send it to us, suitably marked.

For instance, do you find the propogation charts of value and do you think we should continue them? These are expensive to prepare and take up a half page every month so if you don't really want them we could publish just that many more articles.

How about the placing of the advertising? We try to spread it through the magazine to give the best opportunity for you to see what is being advertised rather than jamming it all up in a solid bunch the way QST does. CQ used to do that too, but they have changed over somewhat to our system now and have spread the ads out a bit.

What about color? We can easily put full color pictures on our covers if you like them . . . and if you send in pictures for us to use. Do you think we should run a second color all through the magazine the way CQ is doing now? This would be simple for us to do, but we have refrained because we think it looks junky and cheap . . . what do you think?

And what do you think about unsigned editorials such as CQ has been running? How do you feel about unsigned editorials? Shall we?

Now that QST has suddenly discovered transistors perhaps we are giving you too much transistor dope? Would you like more of as emphasis on tubes or should we continue to stay ahead of the other magazines with new transistor info?

A few readers complain, though I'm not sure they are serious, that it takes too long every month to read all the articles in 73. Of course we do run more articles than the other two magazines combined as a rule. but we thought you liked that.

Tear out and return to 73 Magazine, Peterborough, N. H. 03458

	YES	NO
Do you regularly use our propogation charts?	☐	☐
Do you read the ads in the front of QST regularly?	☐	☐
Do you read the ads in the back of QST regularly?	☐	☐
Shall we continue to spread the ads through 73?	☐	☐
Would full color covers make a big difference to you?	☐	☐
Should we splash color all through 73?	☐	☐
Do you approve of unsigned editorials as in CQ and QST?	☐	☐
Would you prefer more tube circuits than transistor?	☐	☐
Should we make 73 smaller and limit advertising?	☐	☐

Field Day in Liberia

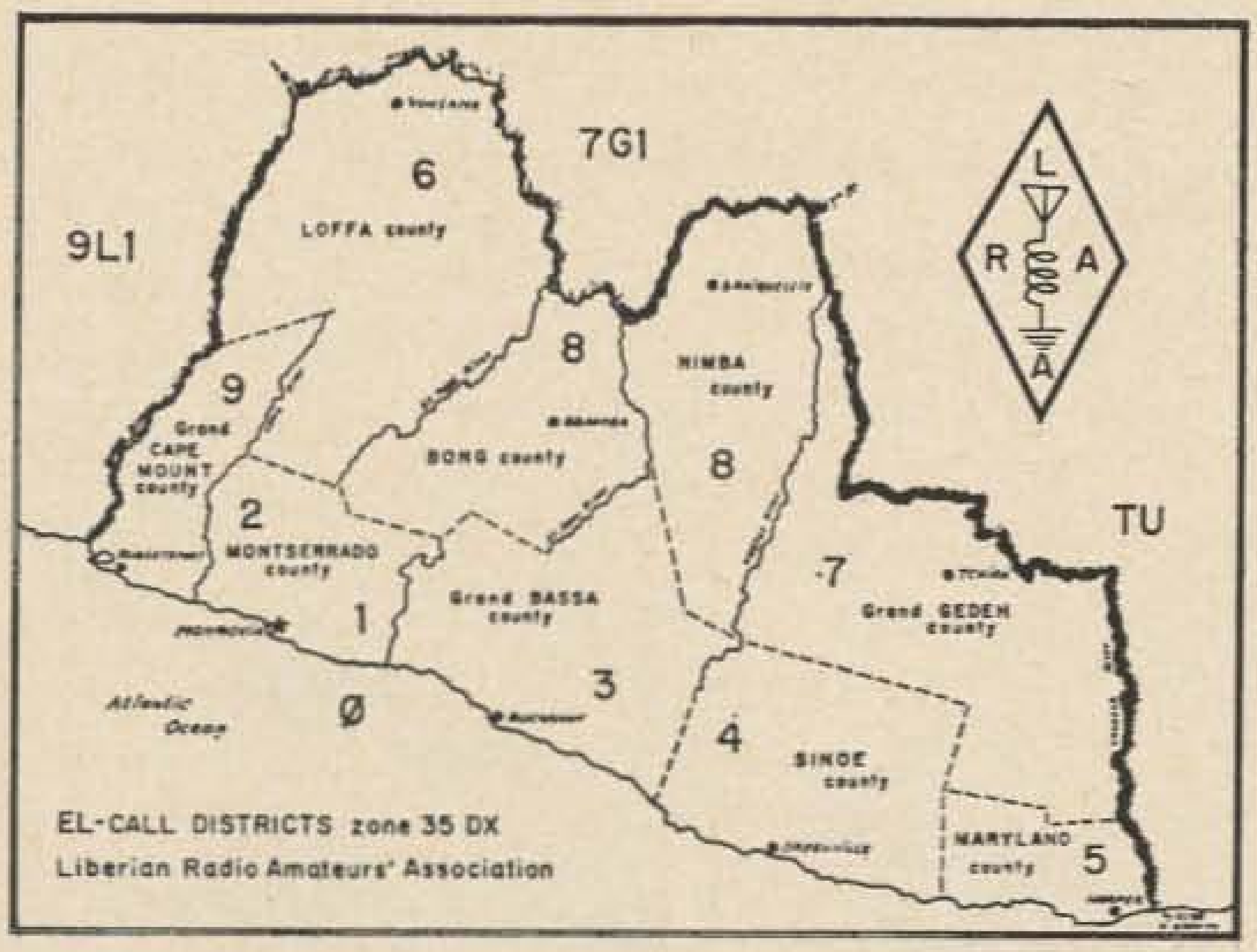
The Liberian Amateur Radio Association will hold its annual field day March 30, and 31, 1968. Plans are presently underway to make this year's Field Day the biggest and largest ever. Last year the club used the new call designation 5LAFD and caused several large pile-ups.

This year's annual field day should provide as much excitement with another special issued call, 5Z2RL. Plans are to have more equipment and operators working during the 36 hour field day which will begin at 1200 GMT March 30. A new addition this year will be the introduction of RTTY operating in the 15 and 20 meter bands. CW, and SSB Phone operation will be in 10, 15, 20 and 40 meter bands. For those persons interested in collecting rare or unusual QSL cards be sure and contact 5Z2RL on March 30 and 31.

The Liberian Amateur Association has received world-wide recognition and has received guidance, equipment and support from other amateur clubs. Equipment donated by various clubs, organizations, groups, manufacturers, and individuals is being set up in schools through-out the country. The majority of the clubs membership is made up of foreigners from many different countries.

In an effort to introduce the local population to amateur radio a country wide training program has been implemented. This training has begun to bear fruit as more and more Liberians begin to obtain licenses and show a real interest in this world-wide society.

The Liberian government has given its full suport and backing to the association. On field days the Government of Liberia has provided speakers and words of encour-



agement. In the past, the Amateur Association has provided emergency standby communications whenever the president visited remote areas of the country. At fairs and on many different occasions the association provided communication booths and equipment displays.

The association also issues a very attractive certificate to any amateur who works nine of its ten call districts. To be eligible for this certificate amateurs who have worked nine of the districts within the past three years or works them in the future must send the nine QSL cards to the Secretary of the Liberian Amateur Radio Association for verification. ■

"I don't know what you're complaining about—you already knew I was an amateur radio nut!"

73 SUBSCRIPTION BLANK

What with the devaluing of the pound, the drain on gold and the recent increase in postal rates, obviously 73 is going to have to raise the subscription rates soon. The are still the same for now.

____ $ 5 one year	____ $2 VHF Antennas
____ $ 9 two years	____ $3 Parametric Amps
____ $12 three years	____ $1 Transistor Ckts
____ $50 LIFE	____ $1 Diode Circuits
____ $ 2 HAM RTTY	____ $1.50 Index to Surplus
____ $ 3 DX Handbook	____ $3 RSGB Data Handbook

SEND MONEY & BLANK TO: 73 Magazine, Peterborough, NH 03458

Name .... Call ....
Initials Last Name

Address ....

City .... State .... Zip ....
or Country.

We don't think you can tear on the dotted line.

SOME NOTES ON OUR

REGINAIR 321 QUAD

Perhaps you too looked at the familiar "H" pattern of the conventional 3 band quad and wondered how acceptable performance could be had from such a configuration. To Larry Johnson, WA1BUN, this concept was all wrong for the electrical spacing between elements varied widely and obviously the resulting terminal impedance of the driven elements varied equally. Trying to connect one feed line to three different impedances is touchy and mechanically difficult. The outcome, it was reasoned, was a constant electrical spacing for all three bands. This was achieved in the Reginair Quad by means of a spider type design, the hub for which is illustrated here. Eight inches long, 3½ inches in diameter, and a thick ¼ inch wall give ample mechanical support to the four aluminum tubes, which in turn support the insulating dowels. This aluminum hub is drilled to accommodate up to 1¾ inch diameter masting, to which the hub is fastened with a ½ inch plated steel bolt.

Constant electrical spacing resulted in a terminal impedance on each band of 100 ohms. This is transformed down to 52 ohms by a Q section of RG11/U cut for 21 megacycles (when matching 2 to 1, a Q section works very well over the octave from 14 to 28).

The bugaboo of suck-out, caused by 10 meter radiation from the 20 meter element, has consistently plagued Quad builders, for VSWR invariably jumped on 20 meters—the very band where we wanted the flattest response. After many trials, Mr. Johnson resolved this problem by inserting a quarter wave 10 meter shorted decoupling stub made of RG8/U, within the 20 meter driven loop.

No baluns need be used with the Reginair 321 Quad. The Quad is a full wave device, not a half wave. As a result, the RF currents from both the sheath and the center conductor of the feed balance out and no balun or balancing device is needed. You can prove this with 2 RF ammeters. In other words, the Reginair Quad is self-balancing; it is, in effect, its own balun.

Previous quad design used stubs or other devices to achieve low VSWR. Our Quad needs no adjustments of any kind—no loading coils—and yet reflects less than 1.5 to 1 VSWR over the entire 10, 15, and 20 meter bands. This most important feature is obtained by making the reflector loops very slightly larger, tuned to a slightly lower frequency.

The measured gain of this Quad is 5.9 db, compared to a conventional dipole; 8.5 db as compared to an isotropic dipole. The front to back will be 25 db equivalent to an average of 4 S units on a typical receiver.

This Quad is quickly assembled from a complete package with pre-assembled driven and reflector elements. All you need do is furnish the 52 ohm feed and raise it into position. A light TV rotator, such as the AR22R ($33.95) will swing it easily. The completed Quad weighs but 35 pounds and requires 19 feet of area, or 9½ feet of radius.

The most salient feature of our Quad is its flat response. This is particularly important because most hams today use transceivers or transmitters that can accommodate only VSWR of up to 2.5 to 1 at the most. Consider your finals and the longevity of their life, and you can see why. In a typical illustration, a pair of 6HF5's are employed as finals in a transceiver with a 400 to 500 watt PEP rating. The tubes themselves are TV horizontal oscillator types, with a dissipation rating of 30 watts each. Sixty watts then is the most you can tolerate. The idling current of the finals is 50 mills times 800 volts or 40 watts. At 2.5 to 1 ten per cent of the forward power is coming back to roost. With 250 forward watts from our transceiver, 25 watts are returned. Twenty-five and forty equal 65 watts—5 more than should be considered safe. As you slide up and down in frequency, think of what is happening in your rig—unless you had the good judgment to operate at your antenna's resonant frequency, or better yet, the wisdom to use our Reginair Quad where the VSWR is guaranteed to be less than 1.5 to 1.

Remember too, a quad has more than twice the capture area of a similar rated beam. In the case of the 321, more than 350 feet of wire are used.

To you doubting Thomases, read what WØKHI had to say. "I want to add my name to the many satisfied users of your new Quad. This is the first Quad kit that I have purchased that was a 'true' kit and not simply a do it yourself bunch of quad parts to homebrew. All the parts used in your kit are of good quality and well put together; the wire used is especially appreciated for ease in Quad assembly. It does give me for the first time an SWR that pleases me; it is between 1.2/1 and 1.0/1 on all bands."

The Reginair 321 Quad is available in 3 models. The standard models sells for $79.95; the APO model is $99.95; the deluxe version is $129.95. The standard model uses hardwood (bass wood) dowels; the APO model is similar except that it is cut down so that it can be mailed via parcel post to any APO post office and is furnished with clamps and sleeves so as to restore the original length; the deluxe version is a fiber glass version, which will be available after April 1st. All the prices quoted are FOB Harvard, Massachusetts. Delivery can usually be accomplished within a week from receipt of your order.

HERBERT W. GORDON COMPANY

Woodchuck Hill Road • Harvard, Massachusetts 01451

"Helping Hams to Help Themselves"

Getting Your Higher Class License

A new approach to studying for the Advanced and Extra Class Licenses

Part I — Radio Wave Propagation

Effective last November 22, the FCC once again made available the Advanced Class license. At the same time, the examination for the Extra Class license was revised. Several sets of "study questions" covering these new examinations were released.

A number of firms are preparing study manuals based upon the new questions. If past experience is any guide, the resulting study manuals will provide specific answers to the specific questions together with just enough "general" material to permit similar questions to be answered—but won't appreciably increase the amount of generally applicable technical knowledge possessed by their readers. Such a procedure is adequate if the intent is to permit applicants to memorize enough answers to pass the examinations; it does little or nothing to raise the level of technical knowledge in general. Since the past "study questions" have included the actual questions used on the exams. memorization works.

We think, though, that the whole idea of re-structuring the ranks of ham radio was to improve the general level of technical knowledge. Memorization won't do that—understanding is required.

With this article, therefore, we're initiating a series of articles which will split the 51 "study questions" released by the FCC for the Advanced Class exam into 10 groups, each dealing with one or more general subjects. These subjects will be explored in sufficient detail to provide all the technical knowledge necessary not only to answer the specific study questions, but to make use of their content for any purpose you desire.

We *won't* give you an answer to memorize. we *will* show you how to figure out the answer for yourself. You can then handle any question on the subject. Okay?

Our choice of questions to be discussed in any single article is based on the general subject covered by the question rather than on its numeric order in the study lists. However, we're including its number as as well, so you can relate the articles to the original list if you like.

In this initial article, the subject is "radio wave propagation", which is covered by the following five questions from the study list:

6. What factors affect the state of ionization of the atmosphere?
14. Define maximum usable frequency.
35. What is meant by describing a radio wave as horizontally or vertically polarized? Which type is most suitable for sky and ground wave propagation?
36. Which amateur band is the most usable for daytime communication over a distance of about 200 miles?
47. How does the sunspot cycle affect wave propagation? What are the best frequencies to use for day and night, short and long distance communications during the cycle?

Let's get under way by substituting a group of general questions for these specific ones, and looking for the answers to our new group of general questions. If we find the answers we're looking for, then they should include the answers to these five specific questions—and much much more.

Before we can say much about the propagation of a radio wave, we need to know what a radio wave amounts to in the first place. Therefore our first general question becomes "What is a radio wave?" The second follows immediately, since our subject is the propagation of this wave: "How does a radio wave propagate?" or more compactly, "What is propagation?"

All five of the specific questions deal in some manner with the relation between the "ionization of the atmosphere" and radio wave propagation. That phrase "ionization of the atmosphere" is a bit repugnant to physicists, since the ionization layers are generally considered to be rather far above the atmosphere. The more common name for the layers about which we're going to talk is "ionosphere", and our third general question then becomes "What is the ionosphere?" while the fourth follows directly "How does the ionosphere relate to radio wave propagation?"

The fifth of our general questions is also implicit in the third but is not quite so clearly related: "What is the relation between the ionosphere and the sunspot cycle?", or more generally, "How does the sun affect the ionosphere?"

We'll move ahead only after warning you that if anyone could give absolutely accurate and definitive answers for these five general questions, he would be a greater genius than Newton and Einstein together. Any *one* of our general questions leads directly to the core of all science—the question "What is existence?" However, we'll shy clear of the attempts to reach exact details, and explore the questions only as deeply as necessary to obtain knowledge which *works*.

What Is A Radio Wave? Nobody has ever seen a radio wave, nor can anyone describe such a thing except by means of complex mathematical expressions which serve primarily to obscure the fact that no one knows what a wave is, or even if it exists. For our purposes, fortunately, we can describes a wave accurately enough by saying that it is a pair of crossed electric and magnetic fields, in motion from somewhere to somewhere else.

This naturally leads to the question "What is a field?", and if you ask a physicist you may lead rapidly to the feeling that it is just another name for half of a wave. While in the strictest sense this is true—a field cannot be measured except by the effects of the waves of which it is a part —you can visualize both electric and magnetic fields accurately enough for almost all ham radio purposes by thinking of charged capacitors and bar magnets.

A charged capacitor contains a trapped electric field. Imagine that the capacitor is perfect—no leakage—and it's not too difficult to realize that, once charged, it will retain that charge indefinitely. Unfortunately, the charge isn't of much use so long as it's being held by the capacitor; it can only do work for us if it's in motion. The HV filter capacitors in your power supply are perfectly safe—until you touch their terminals. *Then* they bite, as the trapped charge rushes out—cooking your fingers (and maybe you as well) on the way.

Similarly, a bar magnet contains a trapped magnetic field. A really good magnet will hold its magnetism almost indefinitely, just as a good capacitor will hold its charge. Like the charge in the capacitor, the magnetism of a magnet doesn't do much until it reacts with something else.

Both these examples provide images of "static" fields, which is simply physics-ese for fields which aren't going anyplace. While it's difficult to get much visual picture of a static electric field, you can see the general appearance of a static magnetic field by placing a magnet under a sheet of paper and sprinkling iron or steel filings on top. The filings align themselves with the field, something like the pattern shown in **Fig. 1**. The exact pattern will de-

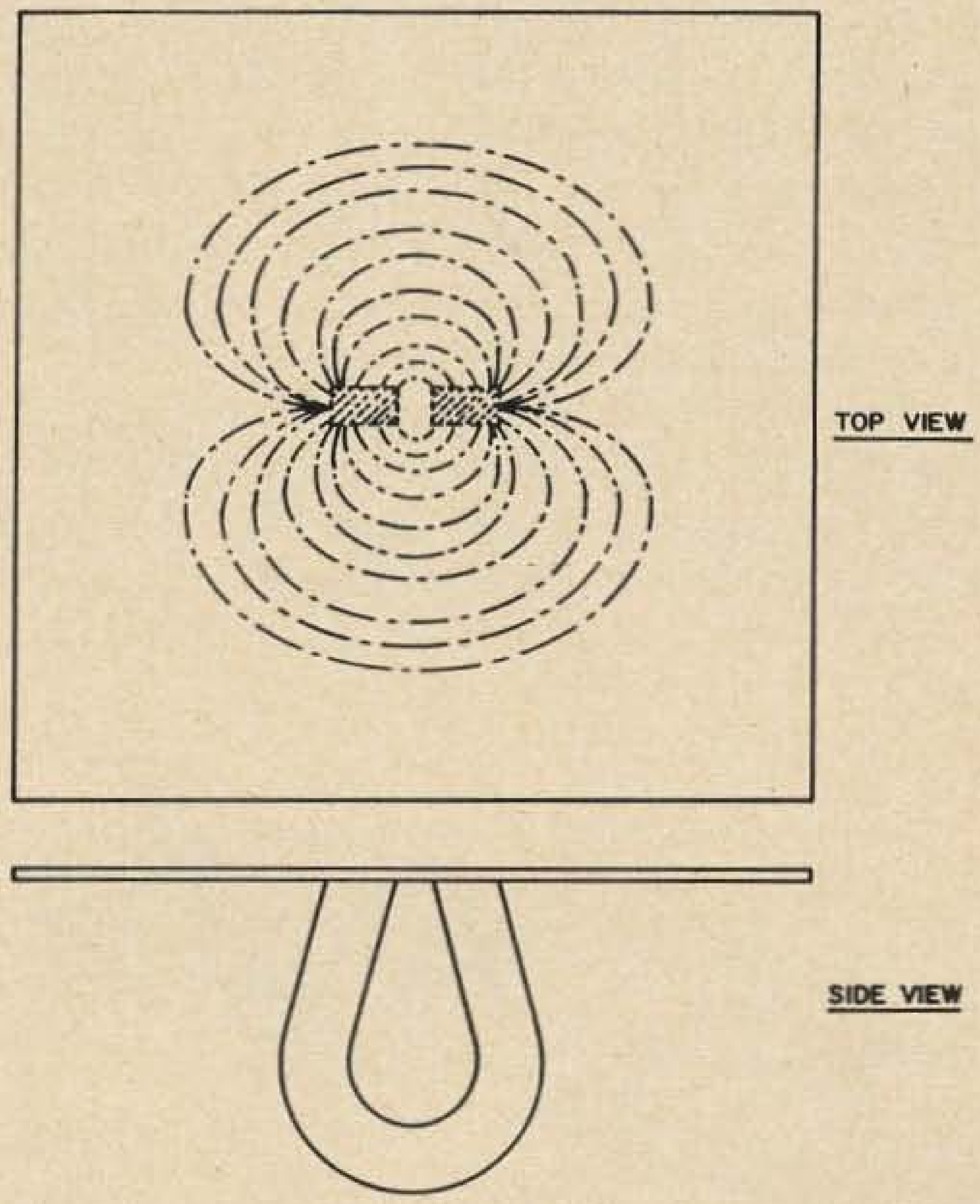


FIGURE 1. Pattern made by iron filings sprinkled on paper atop horseshoe magnet illustrates magnetic field. Electric field is similar but not so readily illustrated.

pend upon the field of your own magnet, and this depends upon the magnet's shape.

Magnetic and electric fields are similar to each other in many ways; so similar, in fact, that many physicists believe they are simply two effects of the same (unknown as yet) basic cause. A fact lending strength to this belief is that either of them, when it moves, is immediately accompanied by the other. You can prove this if you like by charging a capacitor to get a static electric field, then winding a small coil of wire around a pocket compass. Connect one end of the coil to one terminal of the capacitor and then, while watching the compass, complete the circuit with the other end of the coil. As the static electric field moves along the wire, you will see the compass needle kick; the only kind of field which can affect the compass, however, is *magnetic*.

If we have a clear enough picture of what static fields are like, and are willing to accept the idea that each of them carries the other along when it moves, we're ready to take a look at a wave.

Fig. 2 shows a highly simplified version of one way to imagine a wave. The solid curve, which represents a sine wave in the vertically-aligned plane, corresponds to the intensity and direction of the electric field at any instant. The dotted curve, which represents a sine wave in the horizontally-aligned-plane, corresponds to the intensity and direction of the magnetic field.

While a field's intensity can vary at any rate, not just as a sine wave, the only kind we're interested in *is* a sine wave.

The important things about **Fig. 2**, are that the electric field is represented by a curve in just *one* plane, and that the magnetic field is represented by a curve in a

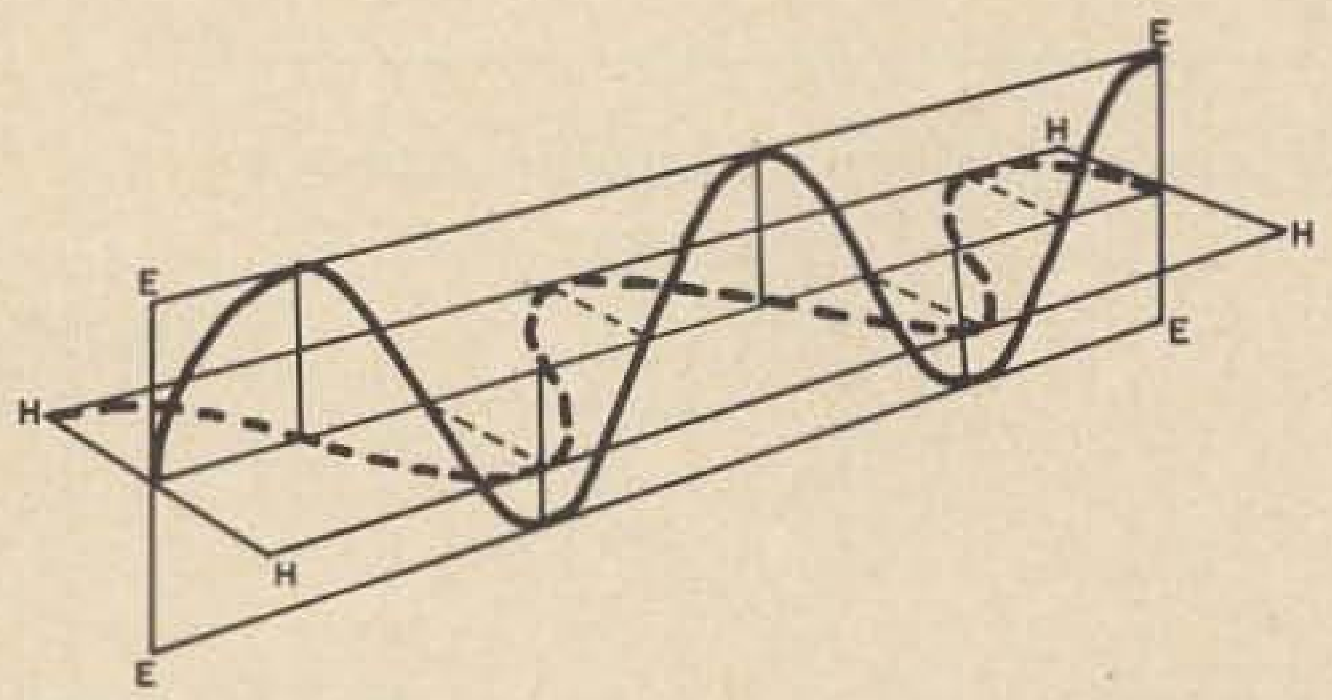


FIGURE 2. Illustration of one way to think of a radio wave. Solid line represents electric field, dotted is magnetic.

second plane which is at right angles to the first. This doesn't mean at all that the fields themselves look anything like this sketch—just that the ideas shown in the sketch have turned out to be useful in predicting how a field is going to affect anything it happens to meet!

One more thing is most important: When the electric field intensity is zero, the magnetic field is at its strongest, and vice versa. Another way of putting this is to say that the electric and magnetic fields are 90 degrees out of phase with each other. This is the characteristic of any wave *in motion*. With the relationship shown in **Fig. 2**, the wave is moving from lower left toward the upper right, or away from us.

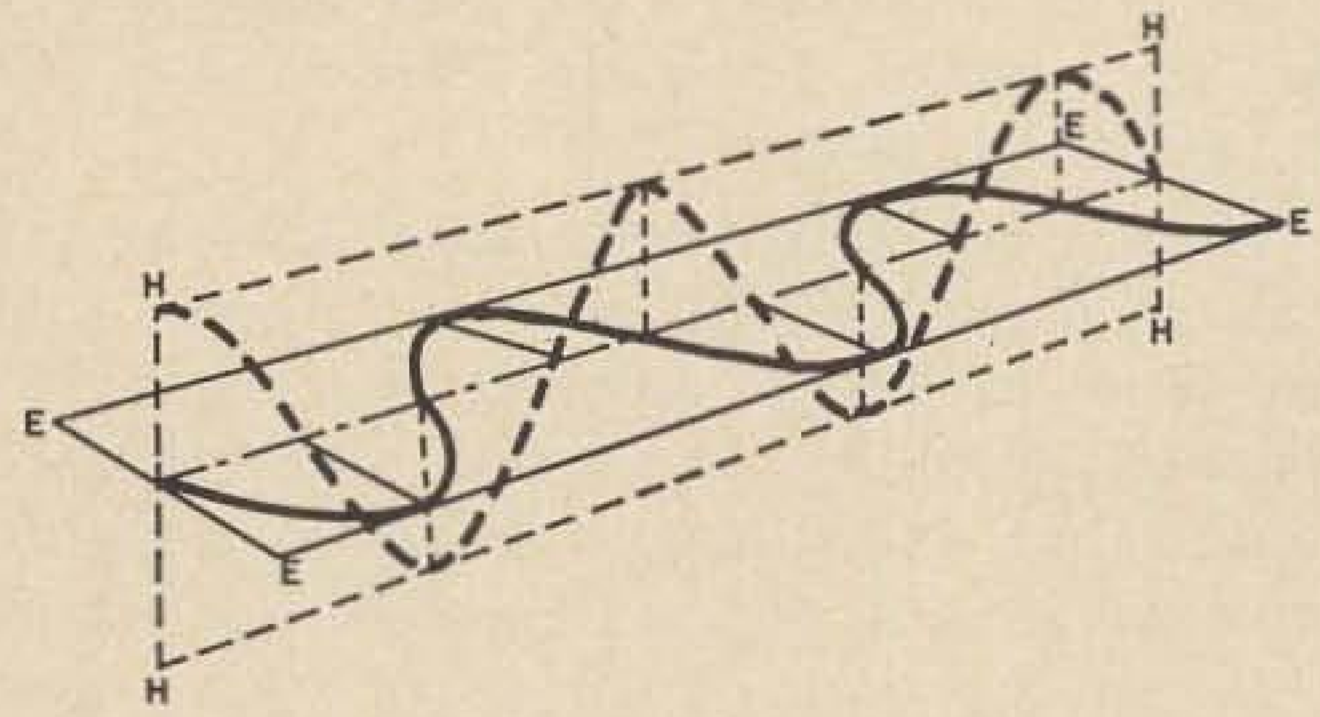


FIGURE 3. Same radio wave as shown in Fig 2, rotated 90° clockwise to change polarization from vertical to horizontal. Relationship of fields remains the same.

To generate such a wave, we could use a half-wave dipole antenna. For such an antenna, the electric field would be in the same plane as the antenna elements. Thus, the wave shown in **Fig. 2**, is a vertically polarized wave since its electric field is in the vertical plane.

This business of "polarization" is relatively simple if you just keep in mind that "polarization" refers to the plane of the electric field, and that with conventional wire or tubing antennas the wire or tubing of the antenna is always in the plane of the electric field.

To make a horizontally polarized wave out of our sample, all we need do to it is rotate it a quarter-turn to the right as shown in **Fig. 3**. Now the electric-field plane is horizontal and the magnetic is vertical—but the relative phase of the electric and magnetic fields has not been altered.

There's just one more point we need to look at to complete our examination of the radio wave itself before we go on to our second general question. That point is the manner in which the energy transfers from magnetic to electric field and vice versa as the wave travels.

First think back to our capacitor-and-magnet picture of static fields. Then replace the magnet with a coil, which concentrates the moving magnetic field into a fairly good imitation of a static field for short periods of time. Connect the coil and capacitor together as shown in **Fig. 4**, and surprise! we have a resonant circuit. In this resonant circuit, any energy originally put into the circuit is first stored in the capacitor as an electric field, then flows back through the coil which stores it as a magnetic field, and so forth until the energy all leaks out.

The same thing happens with our radio wave in motion, and that's why the electric and magnetic fields have to be 90 degrees out of phase with each other for the wave to travel. When the electric field intensity is zero, the magnetic field is at maximum. As the magnetic field starts to decrease in intensity, the electric field intensity starts to climb. When the magnetic field reaches zero, the electric field intensity is maximum.

Remember that there's only so much energy bound up in this pair of fields, and the criss-cross from magnetic to electric field and back makes a little more sense. At any one instant, the total energy in the wave remains constant. Whatever of this total is *not* in one of the fields, is in the other. **Fig. 5** shows this effect. Students of physics or mathematics might want to call the lines with arrowheads on them in this picture "vectors", but that's not what they actually are. They're just lines with arrowheads indicating the direction of the lines. The lines in the E and H planes give an indication of the fact that the energy in the wave is always the same, while the corkscrew solid line traces the tip of this energy total at every point in the wave shown. The dotted line, where the E and H planes cross, indicates the apparent location of the "center" of the wave as it travels.

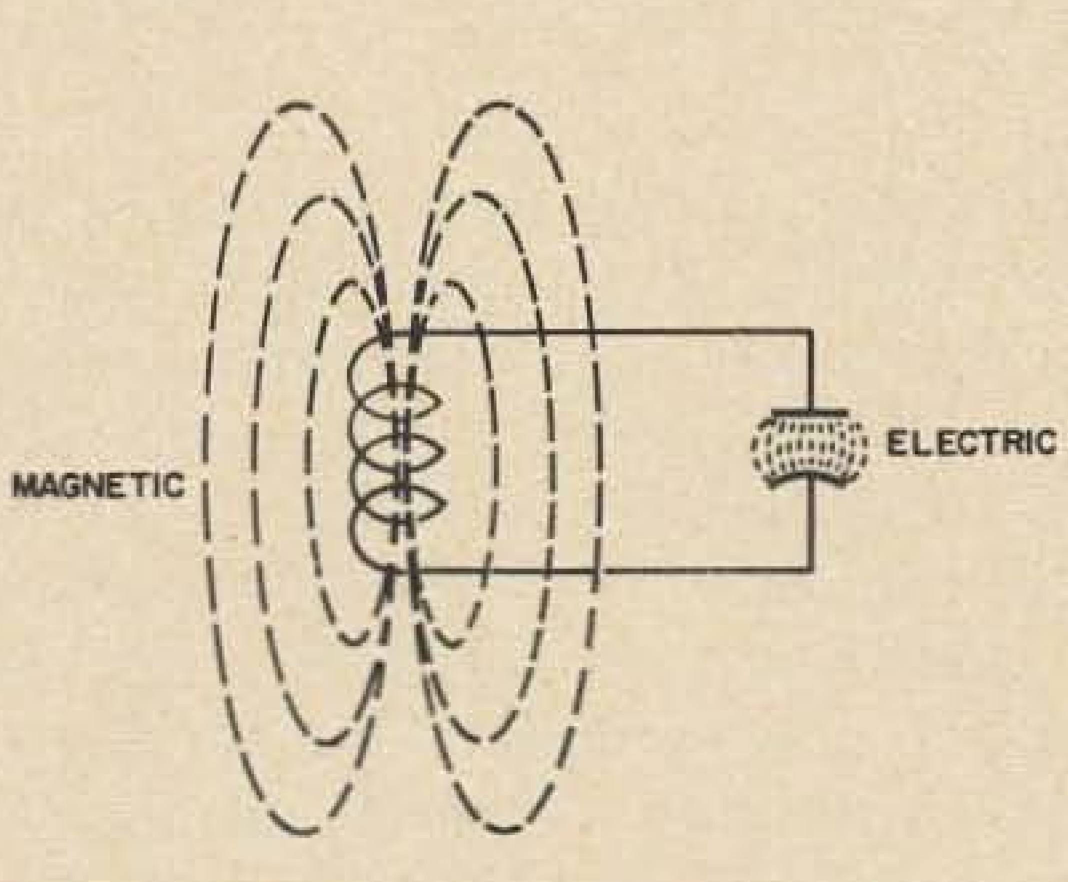


FIGURE 4. Familiar resonant circuit consisting of coil and capacitor is one example of energy swap between magnetic field (of coil) and electric field (in capacitor). Radio wave is similar, but fields are distributed throughout space rather than being concentrated by coil and capacitor.

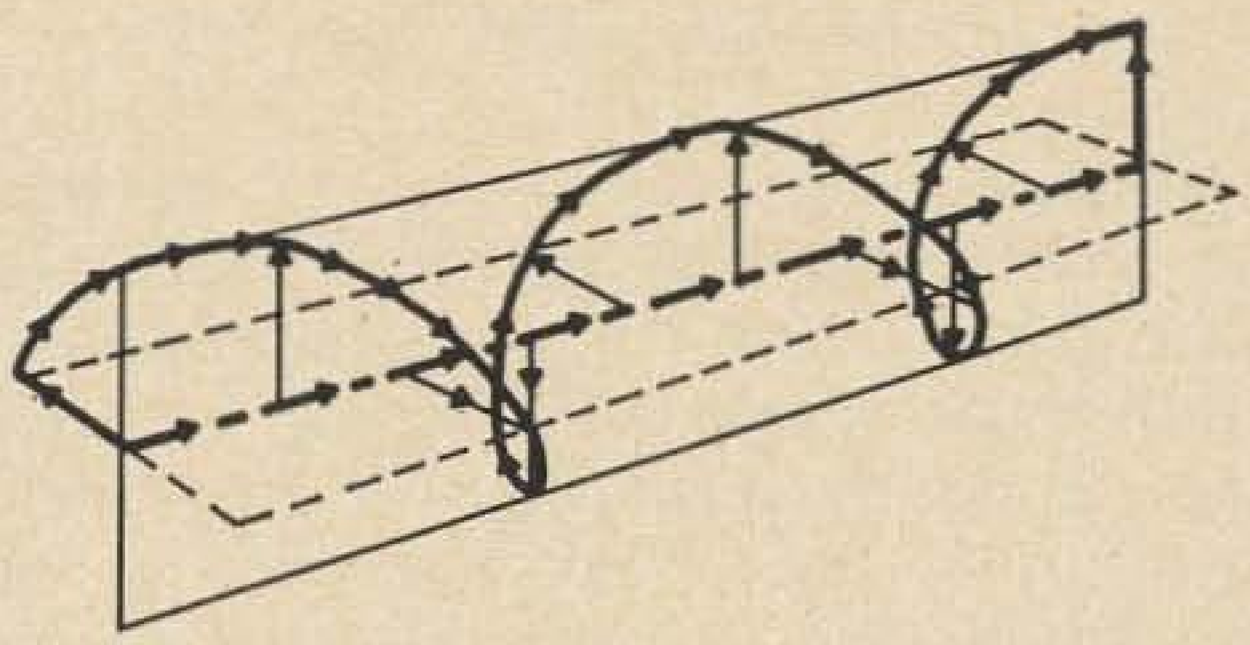


FIGURE 5. This corkscrew pattern shows swap of energy from magnetic-field plane (horizontal here) to electric-field plane (vertical) as wave travels through space. Each radio wave contains an infinite number of such swapping fields, forming an ever-expanding sphere.

All of this explanation is greatly simplified, because in practice we don't deal with just one wave. We have an infinite number of them, all overlapping each other, and every time one of the "center" lines happens to hit either a conductor or an insulator a whole new infinity of "scattered" waves is the result. For practical purposes, however, you now have as accurate a picture of a radio wave as you're ever likely to need—and more than enough for the license examinations.

What Is Propagation? A few paragraphs back when we were looking at the continual swap of energy from the magnetic to the electric field of a wave and back again, we were actually looking at the answer to this question. Since the wave itself actually consists of the effects of the two crossed fields, and its motion comes about by the swap of energy between one and the other, the energy swap itself provides the mechanism for propagation.

To get it all started, however, we must get the fields going in the first place. To do this, we normally need some type of antenna.

Amazing as it may seem, an antenna is merely a conducting surface which is large in comparison with the wavelength involved. Wavelength, incidentally, is the actual distance along the centerline or "ray" of the wave from one peak or null in field intensity to the next similar peak or null. Frequency, on the other hand, is the number of such peaks or nulls which pass a specific point in a specified period of time (usually one second). Frequency and wavelength are related only by the speed with which the wave travels. Since in most cases waves travel at very nearly the speed of light, the familiar conversion formula (wavelength = speed of light/frequency) works. If the wave is going slower or faster, though, it won't.

On such a conducting surface, any change in electric field strength (voltage) or magnetic field strength (the results of current) at one point won't be reflected instantly at all other points, but must travel along the surface. This means that a sudden change from no voltage to high voltage at the feed-point of a half-wave dipole antenna won't change the voltage at the ends instantly. The voltage change will travel from the center toward each end. If one conductor has gone positive and the other negative, the positive voltage point will be travelling out along one half of the antenna while the negative point will be travelling out along the other. Between these two points will be an electric field– and since we know that the voltage will eventually reach the tips of the antenna, this field must be in motion.

In fact, the field is approximately a sphere in this case, and is expanding like a toy balloon being blown up.

But whenever a field of one kind moves, one of the other kind immediately accompanies it. Although we apparently did nothing to cause it, a magnetic field is also in motion around our antenna.

Actually, we *did* do something to cause this magnetic field. As the voltage change moves outward toward the tips of the antenna, current must flow right along with it. The early experimenters wern't very far off base when they spoke of the "charging current" or thought of their antennas as large capacitors. This current is intimately related to the magnetic field in the same manner that chickens and eggs are related; it makes little difference which causes which so long as we admit that we can't have one without the other.

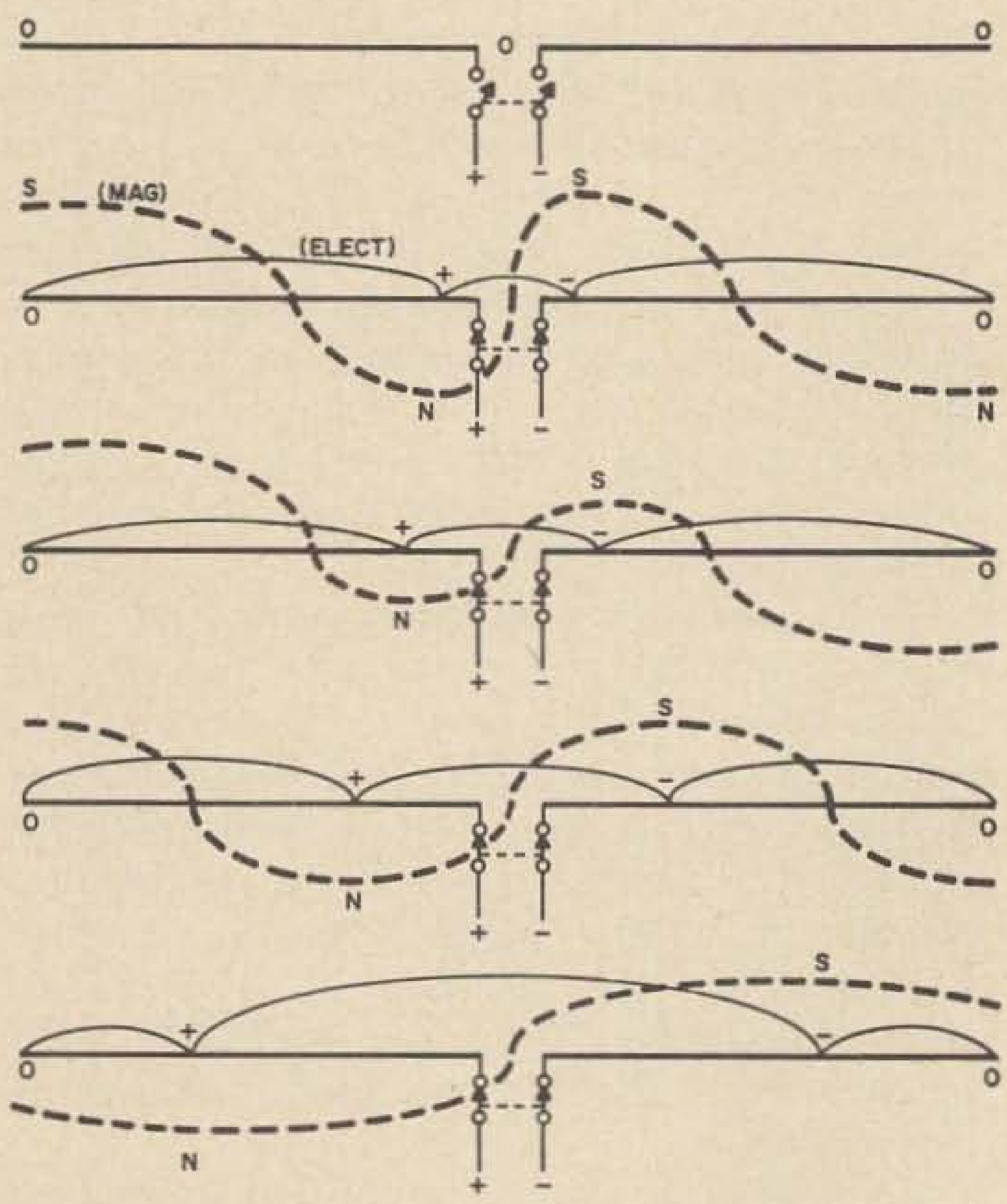


FIGURE 6. Various steps in propagation of radio wave from an antenna are shown here. At top, no fields exist around antenna because switch is open. When switch is closed, points of stongest electric fields (X) begin travelling towards ends of antenna. Solid lines show electric field intensity and dotted lines represent accompanying magnetic fields. Magnetic field lines which sweep off ends of antenna radiate outward into space. Each cycle of RF generates a new maximum-field condition which radiates.

When the voltage change reaches the tips of the antenna it has no place else to go. This halts the current flow and reduces the magnetic-field intensity to zero. However at this instant, the electric field has its greatest intensity, since the positive and negative points are at their greatest physical separation. This produces the 90-degree-out-of-phase condition required to impart motion to a *wave*; up until this time, we have had only a pair of fields changing in intensity.

All the energy is stored up in the electric field at this point; something else must now happen, and it does so. The electric field can be thought of as a sort of "stretched space" which is being stretched by the energy, and with no more push behind it, it begins to collapse.

This causes the voltage-change points to turn about and rush back down the elements toward the feed point. Since they are now going in the opposite direction, the accompanying magnetic field is reversed in polarity. When the voltage-change points each reach the feed point, the electric field is at minimum intensity. All of the energy which it contained has now been transferred to the accompanying magnetic field.

Remember that everything we've mentioned so far has been on the assumption that we simply changed the feed-point voltage suddenly from zero to a high value. If we hold this high value at the feedpoint, the voltage change points will go out to the end and bounce back as described, and this will continue several times until the ends of the wires have assumed a "steady-state" voltage. If you don't think DC can do such things, pull a spark from a 6-volt battery while listening to your receiver. You'll hear the "pop" of the waves that are generated by each spark, and it's this same process at work. You can get an even better demonstration from a mobile rig without noise suppression!

But if we feed this self-same antenna with RF voltage and adjust the antenna length so that each time the electric-field reference points reflect back to the feedpoint, they find a new "push" of just the right voltage and polarity awaiting them, then we have an oscillating pair of magnetic and electric fields around the antenna. In more conventional language, we have set up a "standing wave" on the antenna. During each cycle of RF, this standing wave launches an infinite number of travelling radio waves out into space.

Each tiny part of the antenna conductor acts like a separate antenna, and each radiates its travelling waves equally in all directions. In some directions, however, the travelling waves from the various parts of the antenna have phase relationships which cause them to cancel each other out, while in other directions the phase relationships cause them to strengthen each other. This gives rise to antenna directivity patterns—but that's part of a different article. What we're looking at right now is simply the means by which radio waves propagate.

Once launched into space, each "ray" of

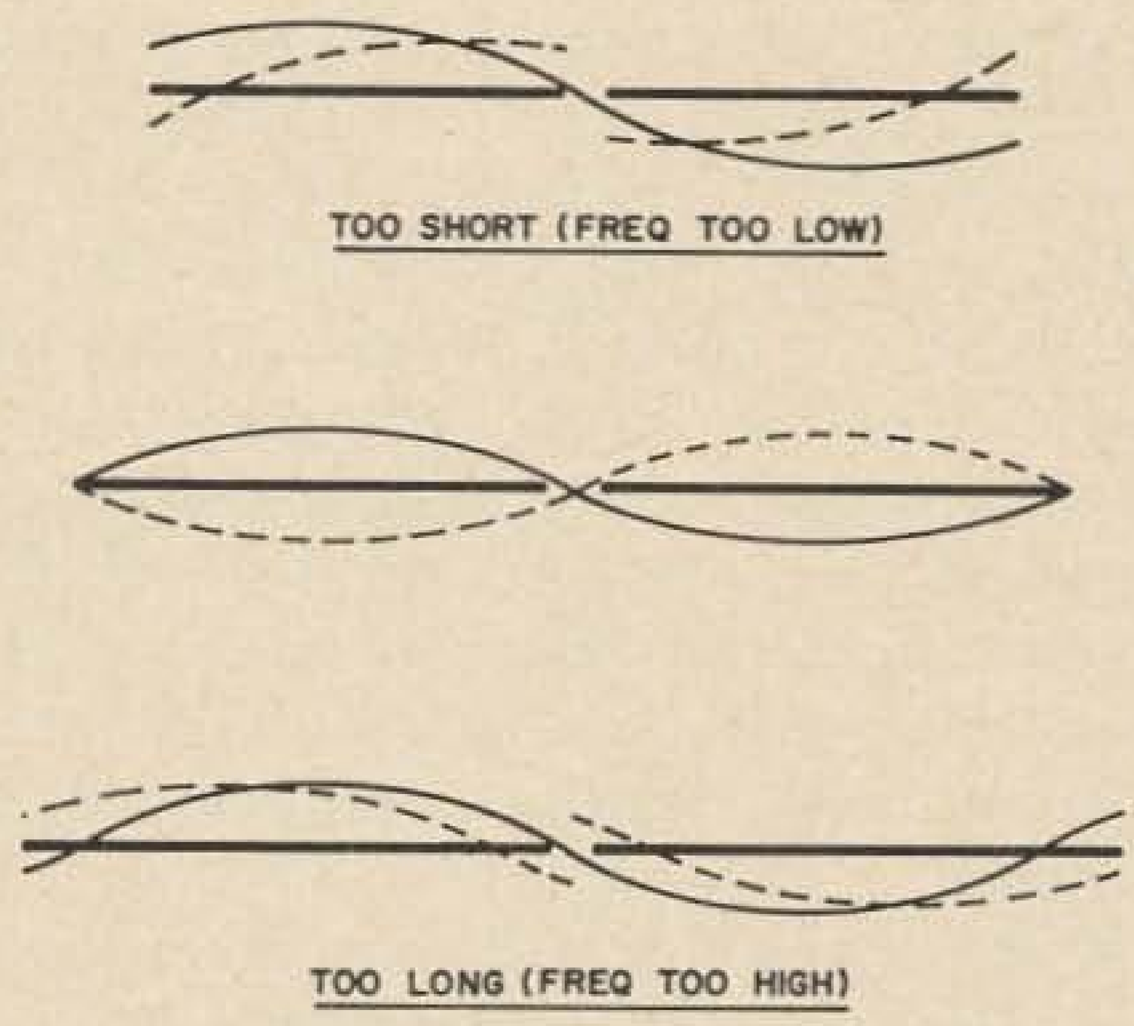


FIGURE 7. For most efficient propagation of radio wave, antenna's length must be matched to operating frequency. At top, antenna is too short (or frequency too low) and reflected electric field is out of phase with driving energy. Part of driving energy is cancelled. At bottom, antenna is too long (or frequency too high) and the same thing happens with opposite phasing. When antenna length is correct for frequency in use, center, reflected and driving fields are in proper phase and all energy goes outward.

the radio wave cannot be forgotten. It still owes its existence to the crossed magnetic and electric fields, and its motion to their phase relationships. But if the ray encounters another conducting element—such as a receiving antenna or merely a piece of wire—which happens to be aligned in the same place as the ray's electric field, the voltage difference which is the characteristic feature of that electric field will be shorted out. And in the process, a current will flow in the conductor.

The shorting out of the electric field and the resulting collapse of the accompanying magnetic field brings that particular ray to its end. However, the current flow in the conductor immediately gives birth to a new sphere of rays, each indistinguishable from the old except for the fact that the original total energy is split equally among all the new rays or waves.

Those new rays which happen to be going in the same direction as the original carry on its travel; some of the new ones, however, go off in new directions, and at least some head back for their original starting point.

If the conductor is a receiving antenna or other structure comparable in size to a wavelength, the same directional qualities already mentioned for transmitting antennas are present. However, since each individual ray is infinitesimally small (no matter how you spell it, that's mighty small; a single electron bears approximately the same size ratio to an infinitesimal as does the rest of the universe to that electron!) its electric field *can* get shorted out by some most minute particles—such as atoms which are temporarily deprived of one of their electrons.

The important point about the preceding four paragraphs, so far as the exam questions are concerned, is that the conductor must be aligned with the plane of the electric field of the wave. And the electric field, as we saw a few pages back, is what determines polarization.

Although it has nothing to do with the study questions we're examining this time, this also explains why vertical antennas and metallic masts interact with each other; the metallic mast shorts out part of the electric field from the radiated waves, and re-radiates in a somewhat unpredictable manner.

As we all know, the earth is a conductor of sorts. For this reason, horizontally polarized waves (those with their electric fields in the horizontal plane) interact with the earth more than do vertically polarized waves. This is one of many reasons why most broadcast stations (of the BCB variety) use vertical polarization. The interaction between earth and the horizontal waves tends to reflect the waves upward

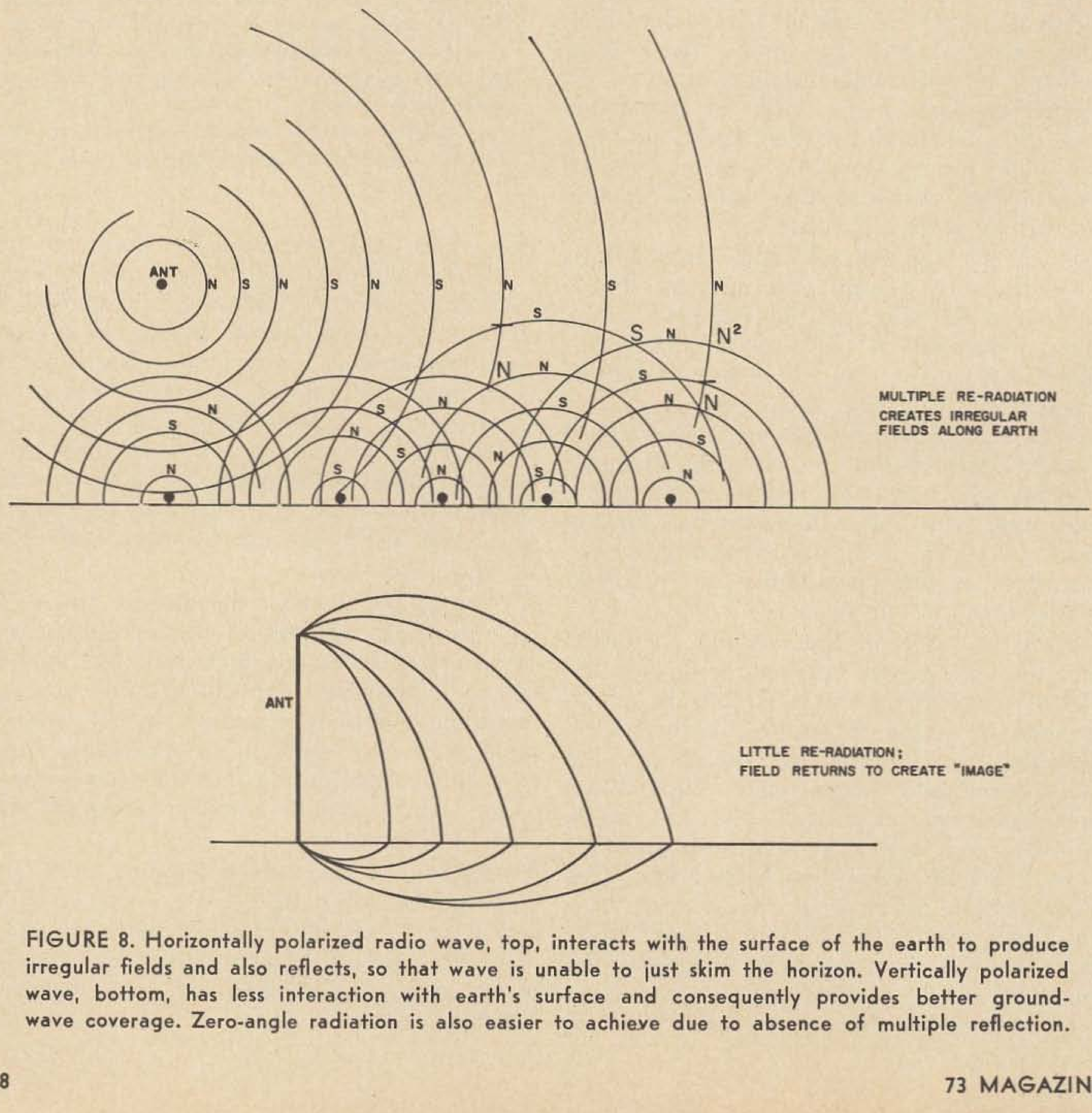


FIGURE 8. Horizontally polarized radio wave, top, interacts with the surface of the earth to produce irregular fields and also reflects, so that wave is unable to just skim the horizon. Vertically polarized wave, bottom, has less interaction with earth's surface and consequently provides better ground-wave coverage. Zero-angle radiation is also easier to achieve due to absence of multiple reflection.

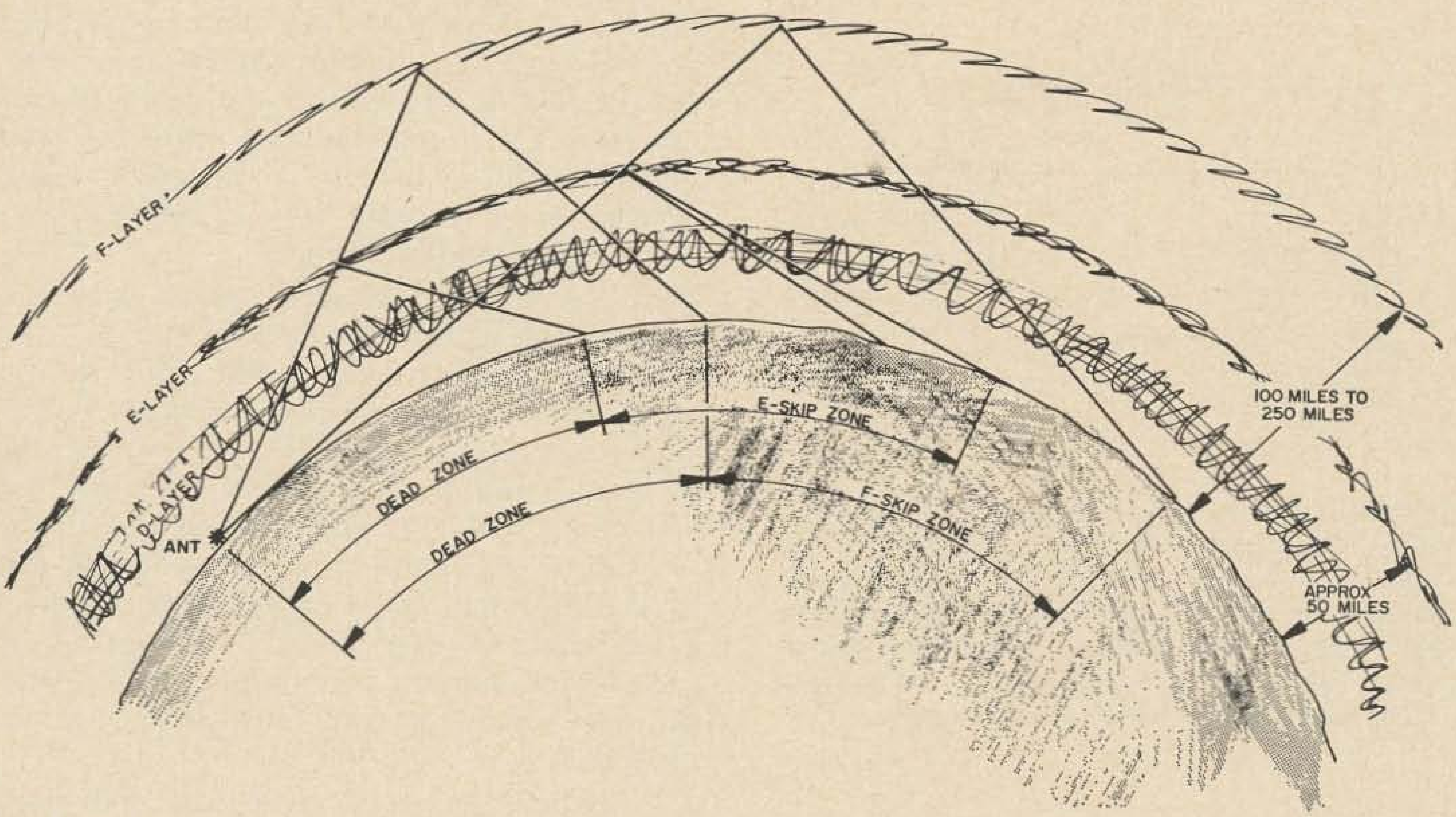


FIGURE 9. Ionized layers of atmosphere, or ionisphere, are shown here. D layer is strongest, and "shorts out" radio waves of low enough frequency to be affected by it. E layer, about 50 miles high, reflects waves which reach it. Maximum range of E-layer skip signal is about 1250 miles. F layers are highest and vary in altitude. Waves which reach them can attain ranges up to about 2500 miles; longer DX than this requires multiple reflection. However it is possible for wave to bounce from F layer and be reflected from E layer back to F, several times, and several instances of many-times-around-the-world signals with noticeable time delay have been observed.

at approximately line-of-sight distances; vertically polarized waves, on the other hand, suffer no such reflection. In fact, they even appear to "hug" the earth's surface, forming what is known to antenna engineers as a "ground wave". This is not at all the same as our normal usage of those words; the technical "ground wave" actually depends upon conduction through the earth for its electric-field return path. Waves which do not interact with either the earth surface or the ionized layers during their transit from transmitter to receiver are known as "space waves", while those which are bounced off the ionisphere are called "sky waves". Which brings us rather directly to the next question.

What Is The Ionisphere? The ionisphere has many names; the FCC study questions use the phrase "state of ionization of the atmosphere" and many persons know it as the "Kennelley-Heaviside layer". Most of us know it best by the alphabetical designations assigned to the various layers— D, E, F1 and F2. Before we go very far into what this thing is, let's pause and examine an ion itself.

An "ion" is simply a free atom of some chemical element which is temporarily missing an electron from its outer or "valence" shell. You can make a whole glassful of ions by dropping a teaspoonful of salt into a glass of water and stirring briskly. As the salt (sodium chloride) dissolves, its molecules split into ions of sodium and chlorine. These, in turn, ionize the water itself into hydrogen ions and "hydroxyl" ions composed of a single atom each of hydrogen and water.

If you now drop a pair of wires into the glass and apply some direct current, you can measure current flow through the ionized solution.

If, on the other hand, you clean out the glass quite thoroughly, then fill it with distilled water and again drop in the wires, you may be surprised to discover that water by itself is a fairly good insulator!

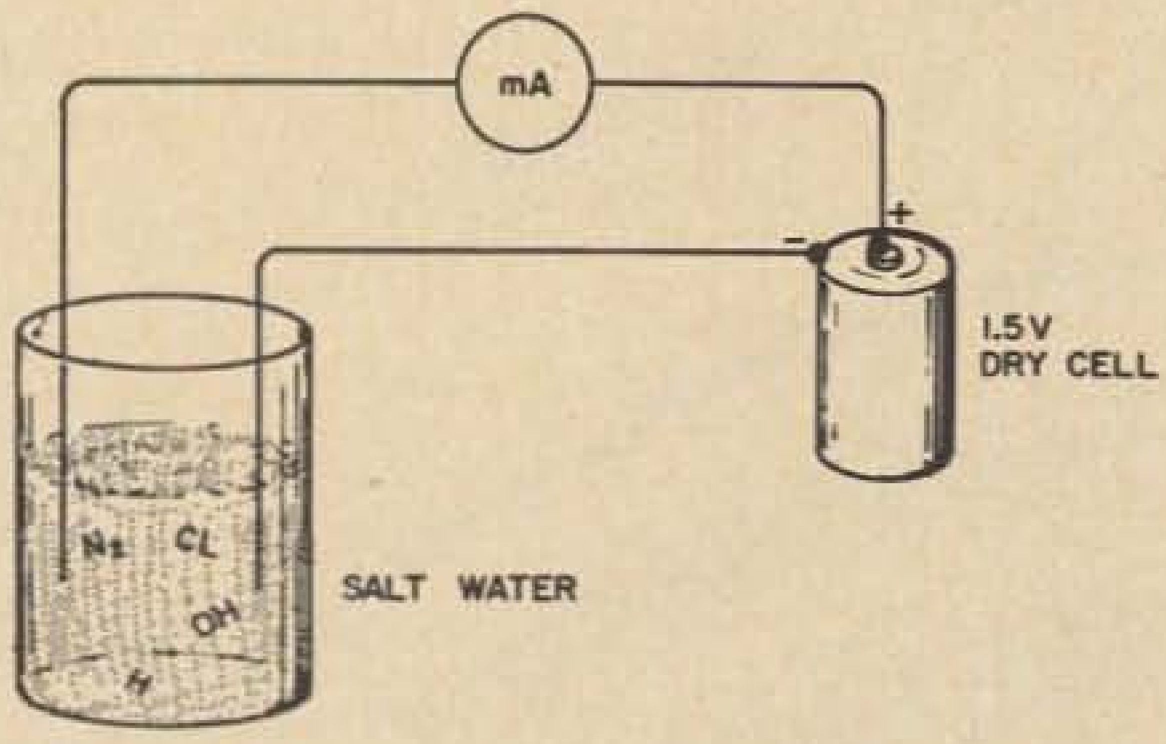


FIGURE 10. You can prove that "ions" are electrical conductors with this experiment. If the glass contains absolutely pure (distilled) water, little or no current will flow. Addition of some salt permits the water to ionize into sodium (Na), chlorine (Cl), hydrogen (H), and hydroxyl (Oh) ions, and current then flows freely.

What makes moisture so conductive is simply the fact that almost anything dissolved in water results in ionization of the water, and ions are excellent conductors.

Now for the ionisphere. The earth, of course, is surrounded by a layer of air known as the atmosphere. If you want to be strict about it, you can say that the atmosphere extends at least halfway to the moon, and for an equal distance in all other directions—but well over 99 percent of it is in a layer approximately 50 miles thick around the surface of the planet.

In that never-never land more than 50 miles straight up, radiant energy from sunlight, cosmic rays, and many other sources is able to knock electrons free from any atoms it may happen to hit, and atoms are so scarce up there (it's a better vacuum than you'll find in any tube) that it may take days for a wandering electron to come along and de-ionize the resulting ion.

As a result, the top surface of the atmospheric layer is in a relatively constant state of ionization. On that part facing the sun—the part above the daylight regions—the high energy of the sun's rays produces ionization at an altitude which is fairly low. This ionization is also rather intense. It is known as the "D" layer, and because of its intensity (and many other factors) acts as an efficient absorber of radio energy.

When the sun's light moves away, to other parts of the planet, the ions at lower altitudes (where there are more atoms and free electrons available) recombine into non-conducting atoms and the D layer disappears. The recombination process may take all night, especially if the original layer was quite intense, but a definite day-to-night variation is obvious.

At the higher altitudes, where less material is available for recombination, the ionization persists around the clock. It appears to be concentrated in two layers, known as the "E" and "F" layers, and the F layer additionally appears to move up and down with the clock, giving rise to the "F1" and "F2" names. This is probably due to the different kinds of gas atoms present at different altitudes, and to a smaller degree to the amount of energy received from the sun and other sources such as micrometeorites.

Since ions *are* good electrical conductors, they affect radio waves in the same manner as any other conductors. And since the ionized layers appear to cover the planet in the same manner as the more familiar atmosphere, they form conductors which are always large in comparison with wavelength. With these two hints, let's dive a little deeper and see specifically how the layers affect radio waves.

How Does The Ionisphere Affect Propagation? Several pages back, while examining how radio waves are propagated, we found that a large conductor in the same plane as the wave's electric field would

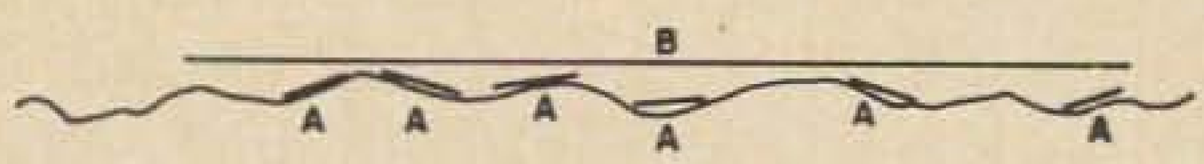


FIGURE 11. "Smoothness" of any surface depends upon the size of the measuring stick as shown here. With a short measure, A, this surface tilts in various directions and so is considered "rough"; with a long measure, B, it is level and so "smooth". This effect is what makes the ionosphere's action frequency-dependent, since the measuring stick is the length of the radio wave. For short waves, the surface is rough and "scatters" the wave; for longer waves, the same surface is smooth and so reflects them.

cause the original wave to be converted into a new sphere of wavefronts, going in all directions, by shorting out the electric field.

At that time, we didn't go into the effect very deeply. Getting a clear grasp of just how it works isn't the easiest thing in the world, because any real radio wave (as opposed to the theoretical single rays we've been looking at so far) consists of an infinite number of rays which fan out through both space and time—and the interaction between this *wavefront* and a conductor then depends not only upon the shorting of the electric field, but also upon the direction from which the wavefront approaches the conductor, the frequency of the wave, the excellence of the conductor, and a few more factors even more exotic.

For a first glance, think about what happens when light hits any surface. Unless the surface happens to be an absolutely dead matte black, some of the light is reflected off of it. A little of the reflected light goes back toward the source, but most goes in other directions. If the surface is smooth enough, at certain angles almost all of the light is *reflected* in a new direction and almost none is *scattered* in any other direction.

The major difference between light and radio waves is the frequency and/or wavelength involved; both are electromagnetic radiation. The materials we know as electrical conductors don't have exactly the right atomic characteristics to "short out" light—but virtually all conductors are opaque, so you might say that they actually do "short out" the light energy which would otherwise go right through them. And similarly, almost all good insulators are transparent. If you raise the objection that ionized water is a good conductor yet is transparent, consider that it is *less* transparent than is distilled water, and also is *not* as good a conductor as a copper or silver bar.

The ionized layers at the upper edge of the atmosphere are conductors, and frequently have surfaces which are smooth in comparison to the wavelengths involved (that's how "frequency" gets into the act—a surface is considered "smooth" if its irregularities are small in comparison with the wavelengths involved, and wavelength varies with frequency). Under these conditions, radio waves striking these surfaces at the proper angles are reflected, just as are light waves striking a glossy surface.

Since the radio waves are of much lower frequency than are light waves, the reflection process isn't as abrupt as that for light. The wave actually appears to turn, in a gentle curve; light waves do so too, but the curve's radius is related to wavelength in such a manner that the curve is undetectably small for light waves, but readily measured when radio is involved.

The major factor which determines whether a wave is *reflected* in predominantly one direction or *scattered* in all directions is the smoothness of the surface. Keep firmly in mind that at any one instant in any one spot above the atmosphere, the actual surface of the ionized layer is constant. Its actual "smoothness" or "roughness", as you might measure with a yardstick or straightedge could you go up there to see, would remain the same.

But for the radio waves, the "smoothness" is measured not by a yardstick or straightedge, but by comparison to the wavelength; and wavelength is tied directly to frequency.

For instance, if the surface had hills and valleys which ranged from 3 meters deep to 4 meters high, and were spread out in a roughly dimpled pattern with an average of 10 meters between adjacent hills or valleys, then for a 10-meter wave approaching the surface the going would be rough. The peak-to-valley distance would be 7 meters, or 70% of the wavelength, and the peak-to-peak distance would be 10 meters, or 100%.

However, a 160-meter wave approaching that same surface would find it comparatively smooth; peak to valley distance would be only 7/160 or about 4% of the wavelength, and peak-to-peak distance would be 10/160 or a little over 6%.

This is the reason that the effect of the ionisphere on propagation is frequency-dependent. A smooth surface is required for reflection, and the smoothness depends upon the frequency involved.

For the same conditions in the ionisphere, reflection is always strongest for the lowest-frequency waves. As frequency rises and wavelength decreases, the effective smoothness of the surface becomes less and reflection becomes less and less effective. As frequency continues to rise, the wavelength eventually becomes short enough that the waves appear to pass right on through, like light going through glass.

This happens first when the waves are going straight up and so meet the ionized layers "head on"; when the waves hit an an angle, they may still reflect. However, even when the waves strike the ionized layers at the sharpest possible angle (leaving the transmitter and just skimming the horizon), you'll eventually reach a frequency at which reflection ceases. The highest frequency at which reflection still occurs is known as the "maximum usable frequency" or "M.U.F.", and will naturally vary from minute to minute and hour to hour as the state of the ionized layers changes. For maximum range in DX seeking, it's best to work as near as you can to the MUF, but never right on it (even if it's in the middle of a ham band) since you are then subject to rapid and unpredictable fading.

The frequency at which reflection from straight overhead ceases, incidentally, is called the "critical frequency" and is used by propagation researchers to determine the MUF. Each of the ionized layers has its own MUF and critical frequency; the E-layer MUF is about 5 times the critical frequency while the MUF for the F2 layer is about 3 times the critical frequency. These MUF's are for maximum possible range, of some 2500 miles for F2 and 1250 miles for E-layer. Any paths over greater ranges involve multiple hops, with two or more skips from ionisphere to earth and back between transmitter and receiver.

About three paragraphs back we noted that reflection is always strongest at lower frequencies; however, signals are usually better right at the MUF. This apparent contradiction is due to the D layer of ionization which normally is present only during daylight hours. This layer is so intensely ionized that it is almost completely opaque to the lower frequencies; only the higher frequencies can survive it to reach the effective upper layers. Both the 160 and 80-meter bands are wiped out during daylight for ranges beyond 100 miles or so by this effect. The 40, 20, 15, and 10 meter bands are not so greatly affected. VHF does not suffer at all. Therefore if you want medium-range contacts during daylight, your primary choice would be between 40 meters (where the critical frequency might permit

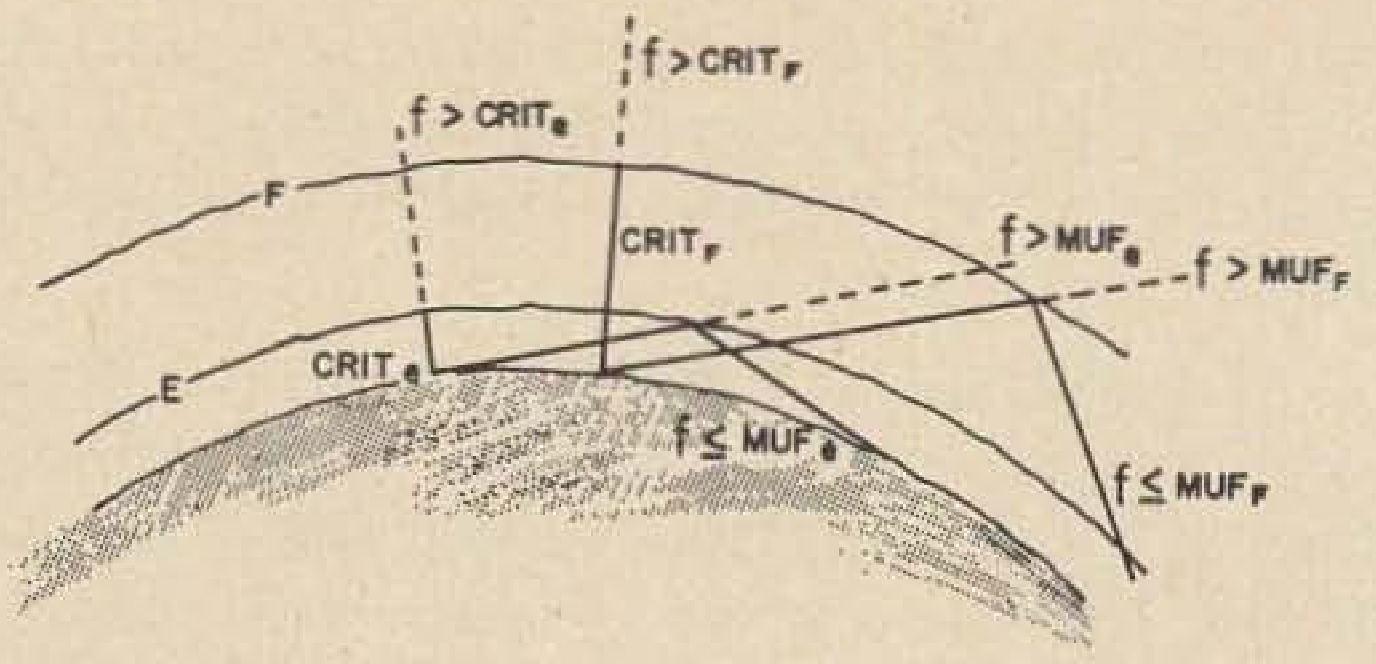


FIGURE 12. Critical and Maximum Usable frequencies for both E and F layers are shown here. When operating frequency (f) is above MUF for layer and path, signal goes on into outer space without returning to earth. Each layer and each path has its own MUF, which varies from minute to minute. MUF predictions are made by measuring the Critical frequency, at which straight-back reflection occurs.

a straight-up straight-down reflection with consequent good coverage) and a VHF band such as 50 or 144 Mc (where medium-power and scatter techniques can give consistent 400-mile range). For daytime DX, the highest usable one of the 20, 15, and 10 meter bands would be preferable, since MUF normally drops in the early evening, nighttime DX is usually best on 40, 20, and 15.

The daytime-nighttime relationship isn't the only way in which the sun affects the ionisphere. Let's continue to the last of our questions and look at some other implications.

How Does The Sun Affect The Ionisphere? We've already looked at the means by which the radiant energy from the sun ionizes the gases of the upper atmosphere to form the ionized layers or ionisphere, in terms of the 24-hour day-night cycle of Earth's rotation. This is not, however, the only effect of the sun.

While science does not yet know all the reasons why—or even all the details necessary to put its questions accurately—it does know that the sun has a "sunspot cycle" of approximately 11 years duration. During this 11-year cycle (we're just winding up for the peak of the 19th such cycle studied), the count of freckles visible on old Sol varies from a minimum to a maximum number. The last cycle set all-time records, three years running, for high sunspot counts and accompanying solar activity. In addition to the spots, the sun appears to undergo severe magnetic disturbances, and to spray out streams of charged particles with extreme energy.

These "magnetic storms" and "solar flares" occur predominantly during periods of high sunspot count; such periods appear to be relatively active ones for our nearest star, and the minimum-sunspots part of the cycle appears to be the quiet time.

When the sun is active, the solar flares, magnetic storms, and less spectactular but still energetic goings-on result in additional energy reaching earth, and a consequent increase in the ionization of the ionisphere. This in turn shows up as dramatic increases in MUF for any given point-to-point radio path; during the 1957-58 peaks a number of VHF men worked all continents on 50 Mc by means of F2 skip, which normally never gets much above 30 Mc. The increase in ionization also hurts by making the D layer stronger and keeping it alive longer at night, so that 160 meters is almost unusable at any time during the strongest peaks of the cycle.

The changes in the D, E, and F layers brought about by the sun's changes of activity then modify the frequency recommendations mentioned in the previous question. Those recommendations are based upon "average" conditions which almost never exist. When the sun is most active, move all conditions one band higher. When the sun is most quiet, move one band lower in frequency (from 40 to 80, etc.) While this isn't precisely the most accurate way to do it, the limitations of amateur band assignments prevent any more accuracy anyway.

The sunspot cycle isn't the only thing which changes. As our planet moves from winter to summer, the angle at which the sun's energy hits the ionisphere above us also changes—and this, too, changes the energy reaching the layers. The MUF moves up in the summertime, and down in the winter, to almost as great a degree as it does during the 11-year sunspot cycle. To sum up, then, the ionization is most intense, the MUF and critical frequencies highest, and the D-layer losses worst for lower frequencies, on a hot summer day around noon to early afternoon local time during the peak of the sunspot cycle. Conversely, the ionization is weakest, the MUF and critical frequencies lowest, and the D-layer losses least, between midnight and 5 a.m. local time on cold winter nights during the minimum of the sunspot cycle.

When ionization is highest, it's possible to work someone halfway around the world on 50 Mc by double-F-skip propagation (and a few other E skips as well). When ionization is lowest, you can get almost as great distance on 160 meters. In between, you can pick your frequency and power to suit the distance and specific directions in which you want to work, according to the state of the ionisphere at that time (as determined by listening to the various bands and finding out who's coming in, from where, at what frequencies), and take part in one of the most gigantic games of chance ever started!

Next month. Much of the scope of the new examinations appears to cover single-sideband principles and techniques. In the next instalment, we'll go into them in the same amount of detail. Until then, good DX.

Next: Questions 3, 7, 8, 25, and 44 of the FCC list, all dealing with SSB.

■

The Omega DA Keyer

With the advent of incentive licensing, lots of our long time phone operators are coming to the realization that CW is a necessary evil. It is more than coincidence that the 75 meter round tables seem to drop in numbers when the W1AM code broadcasts are scheduled to begin. For some, the return to CW is a temporary thing and simply a means to the end of achieving the higher class license. For others, it is a discovery that CW can be fun after all. For the straight key man or the "bug" artist, the discovery of automatic keying can mean the difference between fun and a chore. Once mastered, the Omega DA keyer provides the maximum in fun.

The DA keyer is a fully automatic solid-state device using integrated circuits, transistors, and diodes where each will perform the job best. It requires no external connections except to the transmitter key terminals. It can be operated from a variety of power sources, but the DA-3 optional power supply will provide the most reliable source and should be considered, especially by the CW operator who will be using the keyer regularly. This option permits the operator to borrow 6.3 volts from the receiver or a small filament transformer. Internal batteries or an external DC power source can be used with good success.

The keying is also versatile. The DA can be used with a straight key for non-automatic sending, or with any type paddle you prefer. For perfect CW the use with a squeeze type paddle is the best method. The instruction manual which accompanies the device gives full instructions for learning the squeeze method of sending. This requires a few hours of practice but the end result is perfect code every time.

Squeezing the two paddles together produces alternate dashes and dots. To produce the letter C, you squeeze the two paddles with a slight advance to the dash paddle and the letter is automatically formed. Insertion of either a dash or dot is easily accomplished. To form a letter F, merely squeeze the dot side and insert the dash at the appropriate time. This may sound terribly complicated on paper, but in practise it is a matter of playing with the DA keyer for a short time until you have mastered the technique. If you are accomplished with either a bug or another type of keyer, the transition is an easy one and you can simply continue your present system of motion, but some characters are so much easier to send using the squeeze method that the time required to learn the new technique is well worth the effort.

The DA has a built in monitor which is extremely pleasant to listen to as it is not a perfect sine wave output. This should reduce fatigue for the contest operator who has to listen to the monitor for hours on end. Volume and tone are completely adjustable.

The DA keyer is adjustable from 6 to 60 words per minute and should satisfy all the requirements of any CW operator. The gap and tension adjustments are internal, but are easily made, and, once the proper adjustment is made, it remains stable.

I began with a hand key, graduated to a bug, and have used a variety of automatic keyers from home brew to the more sophisticated commercial ones. The DA is a dream. The only problem is with automatic perfect keying, the characteristic "first" is disappearing from the CW bands. Time was when one could tune across a CW band and recognize a CW signal like one can identify a voice. These days, we all have the same voice on CW and I have to listen to the calls to find old friends. However, once I find them, copy is much easier.

Specifications:

Speed range: 6-60 Words per minute.
Output: Reed Relay, 250V, 3A, 50 watt maximum ratings. Power Requirements: Internal Batteries (.30 Watts or 10-14 VDC @), 100 mA (intermittent), or 6.3 VAC @ 1/4 A (requires DA-3 option).

$85.00 Wired and Tested. Omega Electronics Co. 10463 Roselle St., San Diego, Calif. 92121

QUESTIONAIRE

Please either clip this out and send it in or copy your answers on a card for us.

What 1968 radio catalogs do you have?

1. Allied Radio.
2. Lafayette Radio.
3. Heath.
4. What other catalogs?

Approximately how much ($) have you ordered during the last year from the following?

5. Allied Radio.
6. Lafayette Radio.
7. Heath Company.
8. Surplus equipment.
9. About how much did you spend on ham radio last year total?

Do you read the following every month?

10. QST.
11. CQ.

Please send the above answers to 73, Peterborough, N.H. 03458.

73 Magazine

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East Melbourne

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Sweden

Eskil Persson SM5CJP
Sollentunavagen 95D
Sollentuna, Sweden

Propagation Chart

MARCH 1968

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	14	7A	7	14A	21A	21A	21A	28	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	14A	14	14	21A	21A
CANAL ZONE	14	14	14	7A	7	7	14A	21A	28	28	28	21A
ENGLAND	7A	7	7	7	7	14	21	21A	21A	21A	21	14
HAWAII	21A	14A	14	7B	7	7	7	7B	14A	21A	21A	21A
INDIA	7A	7A	7B	7B	7B	7B	14	21	21	14	14	14
JAPAN	21	14	14	7B	7B	7B	7	14B	14B	14B	14	21
MEXICO	14	14	14	7	7	7	14	21	21A	21A	21A	21A
PHILIPPINES	14	14	14	7B	7B	7B	7B	14	14	14B	14B	21
PUERTO RICO	14	14	14	7A	7	7	14	21	21A	21A	21A	21
SOUTH AFRICA	14	14	7	7B	7B	14	21A	21A	28	28	28	21
U. S. S. R.	7	7	7	7	7	7B	14	21	21	14	14	7B
WEST COAST	21A	14A	14	7A	7A	7	7	14	21	21	21A	21A

CENTRAL UNITED STATES TO:

ALASKA	21	21	14	7	7	7	7	7	14	14	21	21
ARGENTINA	21	21	14	14	7A	7	14A	21A	21A	21A	21A	28
AUSTRALIA	28	21	14	14	14	7	7	14	14	14	21A	28
CANAL ZONE	21A	14A	14	14	7A	7	14	21	28	28	28	28
ENGLAND	7A	7B	7	7	7	7B	14	21	21	21A	14	14
HAWAII	28	21	14	14	7A	7A	7	7B	14A	21A	21A	28
INDIA	14	14	14	7B	7B	7B	7B	14	14A	14	14	14
JAPAN	21	14	14	7B	7B	7B	7	14B	14B	14B	14	21
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	7B	14	14B	14B	21
PUERTO RICO	21	14	14	14	7	7	14	21	21A	21A	21A	21A
SOUTH AFRICA	21	14	14	7B	7B	7B	14A	21A	28	28	28	21
U. S. S. R.	7B	7	7	7	7	7B	14	14A	21	14	14	7B

WESTERN UNITED STATES TO:

ALASKA	21A	21	21	14	7	7	7	7	14	21	21	21A
ARGENTINA	21A	21A	21	14	14	14	7	14A	21A	21A	28	28
AUSTRALIA	28	28	21A	21	14A	14	7A	7	14	14	14A	28
CANAL ZONE	21A	21	14	14	14	7	7	14A	21A	21A	28	28
ENGLAND	7A	7B	7	7	7	7	7B	14	14A	21	14A	14
HAWAII	28	28	21A	14	14	14	7A	7	14A	21A	28	28
INDIA	14	21	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	21A	21A	21	14	7B	7B	7	7	7A	14	14	21A
MEXICO	21	14	14	7	7	7	7	14	21	21	21	21
PHILIPPINES	28	21A	21	14	14	14B	7B	7B	14	14	14	21
PUERTO RICO	21A	14A	14	14	14	7	7	14A	21A	28	28	28
SOUTH AFRICA	14	14	7	7B	7B	7B	7B	14	21A	21A	21A	21A
U. S. S. R.	7B	7B	7	7	7	7B	7B	7B	14	14	14	7B
EAST COAST	21A	14A	14	7A	7A	7	7	14	21	21	21A	21A

A. Next higher frequency may be useful at this hour.

B. Very difficult circuit this hour.

Good: 1, 3-7, 14-16, 18-21, 23-24, 26, 27, 30, 31.
Fair 2, 8-13, 17, 22, 25, 28.
Poor: 29.
VHF: 14, 15, 16.

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6Hy-500Ma $5@ ....2/$6
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Cndsr Oil 10Mfd x 600VDC 45c@, 10/$3
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240	3.75	4.75	7.75	10.45
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12	1.20	1.50	1.75	2.50
** 18	1.50	Query	Query	Query
45	2.25	2.70	3.15	4.00
160	5.75	7.50	Query	Query
240	14.40	19.80	23.40	Query

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★ Price—$2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. Include your check with order.

★ Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

★ We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

★ For $1 extra we can maintain a reply box for you.

★ We cannot check into each advertiser, so Caveat Emptor . . .

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HAM TV, Dage CCTV Camera $125.00, Shibada Transistor CCTV Camera $145.00, Hitachi 7735A—$15.00, Toshiba 7038—$8.00. WB2GKF, Stan Nazimek, 506 Mt. Prospect Ave., Clifton, New Jersey 07012.

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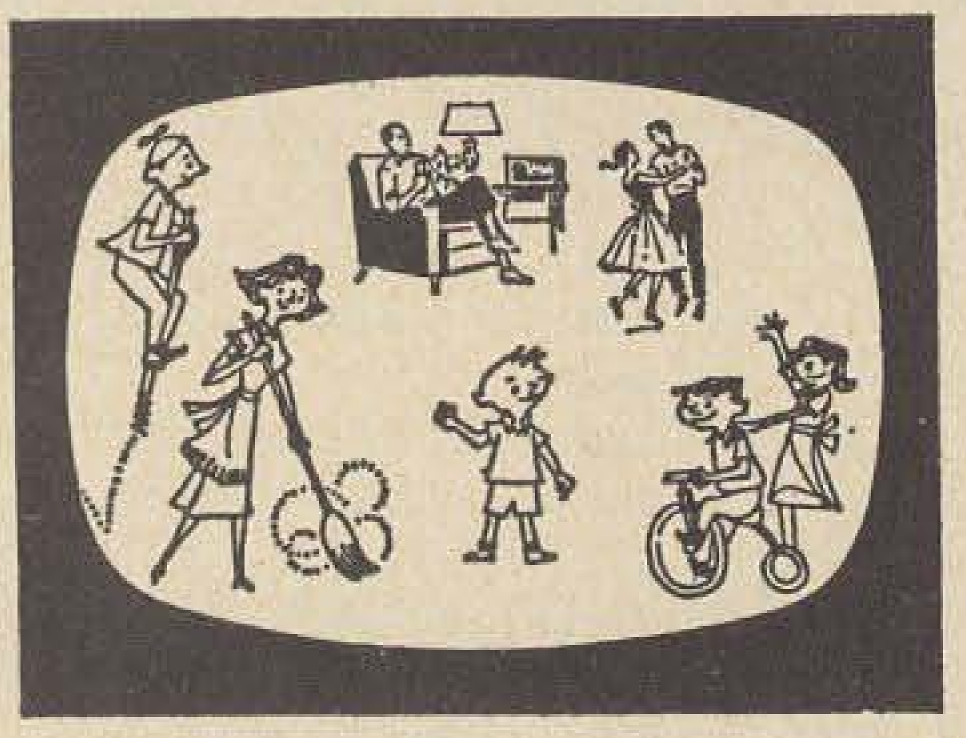

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THE NORTH JERSEY DX ASSOCIATION is sponsoring its annual DX Round-Up on Saturday, March 23, 1968. This is the Saturday following the IEEE Convention in New York and it is expected that many out-of-towners will find it convenient to attend. Site of the Round-Up is the Holiday Inn, Wayne, N.J. at the intersection of Route 46 and Route 23, just 30 minutes west of the George Washington Bridge. The afternoon program starts at 2 P.M. and banquet at 7 P.M. Further details available from W2PXR.

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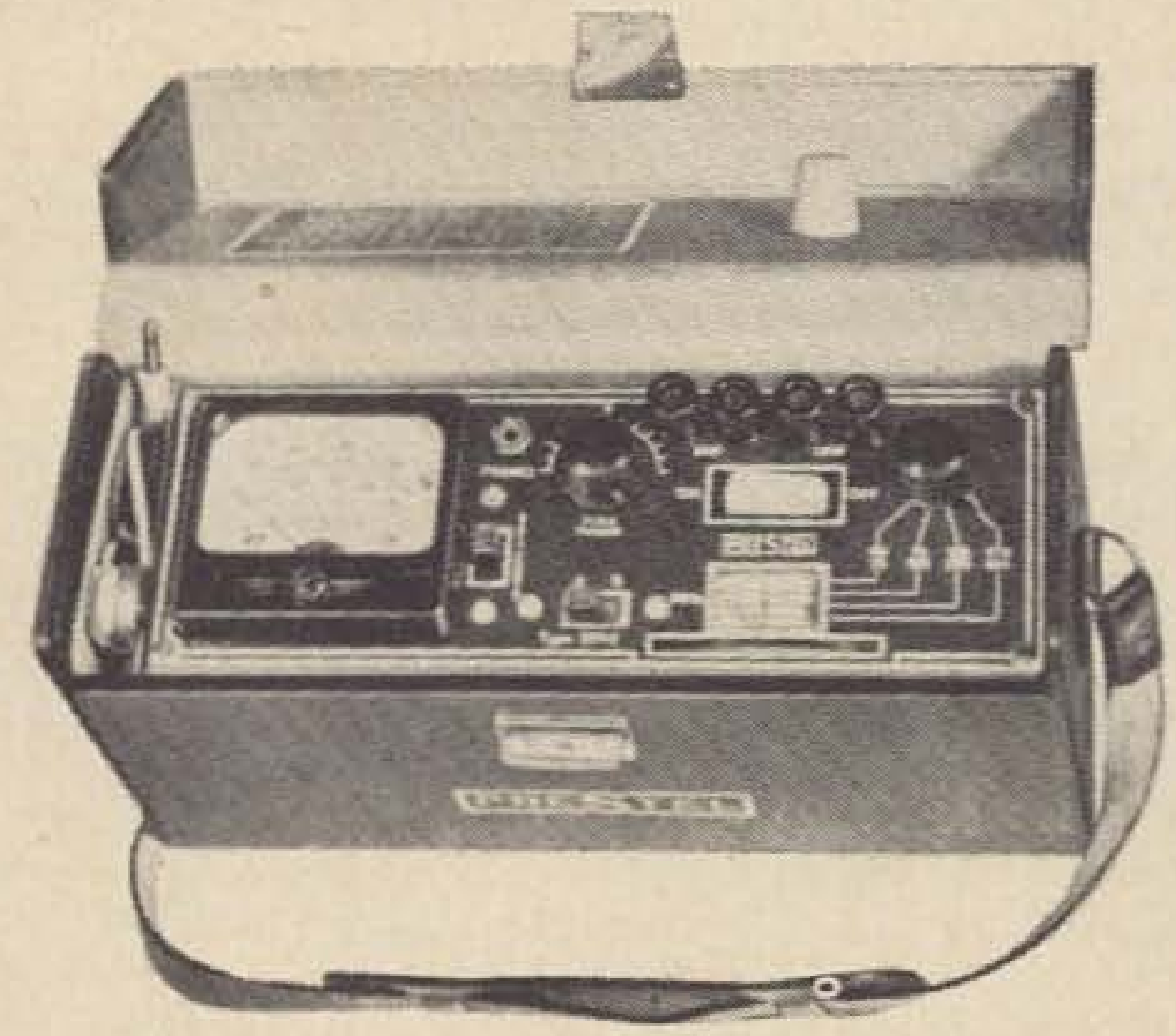

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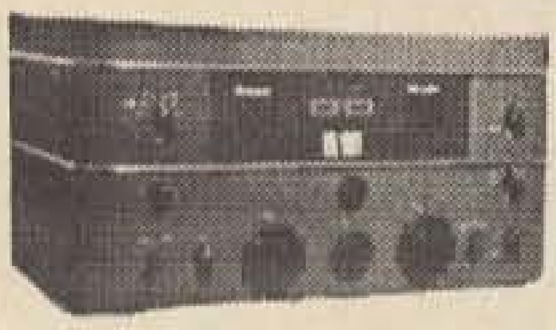

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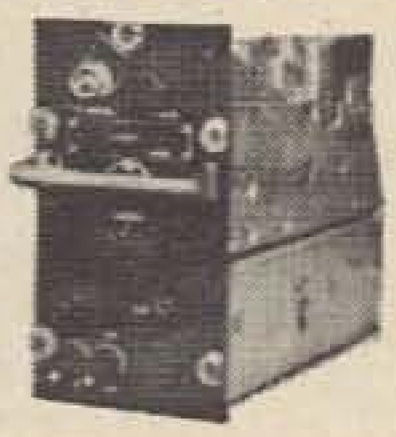

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