# AMATEUR RADIO

# 73

July 1962

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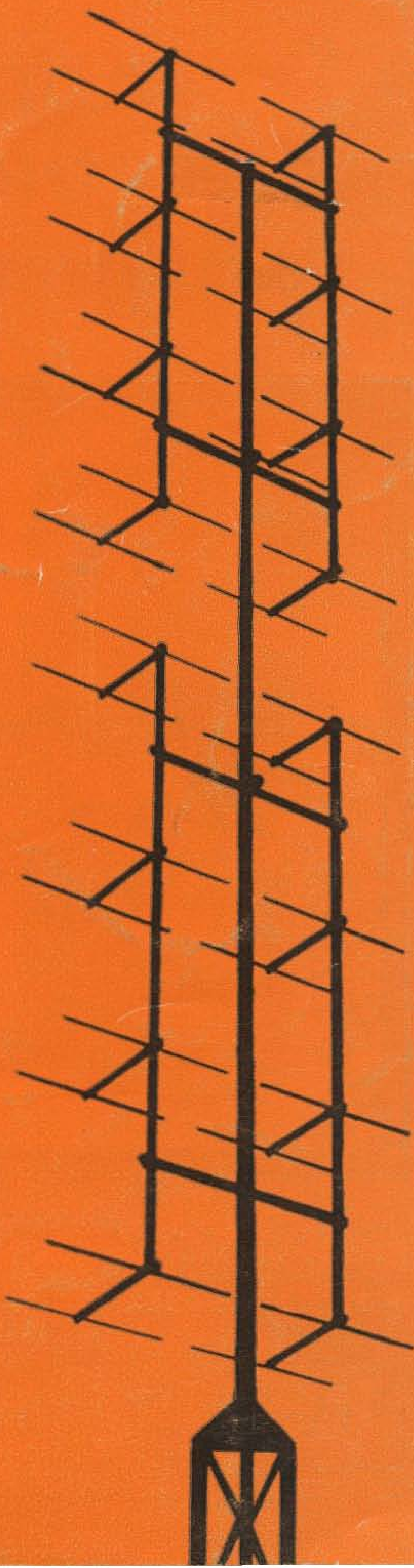

420 mc by W4HHK

VHF Construction

All Band Nuvistor Pre-selector

73 Magazine Peterborough, New Hampshire July 1962 • Vol. VIII, No. 1
Wayne Greene W2NSD—Editor, etcetera Phone: DE 6-8880



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# . . . de W2NSD

. . . never say die

Convention Hall

## National Convention

The gang up Oregon way are cooking up quite a convention. Though it has been my policy to let the League promote League functions, there is an off chance that some eyes might scan this page that might otherwise miss the news through a too-hurried scanning of QST's pages. The convention will be held at the Portland Memorial Coliseum on September 1-2-3. There will be exhibits, talks, prizes, tours, and all other convention-like events. Drop a note or QSL to Convention, Box 1335, Portland 1, Oregon for a nice brochure. Perhaps by next year I'll have 73 well enough in hand to be able to get to some conventions. I sure wish I could make it to Portland and the nearby Seattle World's Fair for this National ARRL gathering.

## . . . de W2NSD/1

If you are normal and read the magazine from the back, you have probably already noticed that I have cut down the number of pages in this issue even though there are plenty of ads. There is a method in my madness. It isn't just that I think you have been living too high with us publishing 27 feature articles last month to seven and eight in the other two ham magazines, it is only that I have to save a little money this month so we can move our editorial offices to a new location. Let me explain.

In the interests of economy we have been publishing 73 from a small, dingy apartment in Brooklyn. This has been incredibly frustrating for we have been cramped and have not been able to set up anything passable in the way of a ham station. Thus, for well over a year we have been trying to figure out where we would most like to have the magazine located. We looked over Westchester County pretty carefully and found that in most places ground was sold by the foot, not the acre. This makes an antenna farm awfully expensive. Next we investigated upper New York State, then Connecticut. Still too costly. We finally decided to look for our new home in lower New Hampshire. This seemed to offer us the most. It would only be an hour or so out of Boston so we could get all the big city services we need for running a publishing business. It would be much cooler than New York and more comfortable for working. Land is so much lower there that we could afford something a lot nicer than we could manage further south. New Hampshire has extremely low taxes, the third lowest of all the states! Thus, should we ever make any money, we would not have to immediately turn it over in taxes.

On May 30th Virginia and I settled into the Porsche and headed for New Hampshire to find our new headquarters. After trying two different real estate salesmen we came across a natural: John Peterson in Peterborough. John had a Porsche Speedster just like mine. It didn't take long until we were on our way to our new offices.

We had discovered that it is difficult to buy a large house and grounds if you don't have any money. This developed into quite a stumbling block. It didn't even slow John down, he immediately thought of a place that was available for rent. We drove over, looked at it, and knew immediately that this was for us. Wait'll you see it! There are so many rooms that even I will be hard put to fill them up. We counted at least 20 rooms and five or six bathrooms. There is a huge garage that will hold all of the cars that happen to be visiting. There is even a nice modern clean barn. We walked from


room to room mentally planning where the ham shack would be, the test lab, the workshop, the subscription department, the art department, my office, the library, and so on. We thought John was kidding when he said there was a bowling alley in the attic . . . there it was! The rent? Almost exactly what we have been paying in Brooklyn!

When we get all set up in Peterborough the welcome carpet will be out for all passing hams. Just look for the tri-bander on route 101 as you come into town from the east.

### U. S. Gum Mint

Most publishers probably have been reading the news stories about the proposed raise in postage rates with the same horror that I have. They are apparently about to increase first class mail, airmail and second class rates. This will, as you have no doubt read, have a profound effect on your magazines. We can probably survive, but it will mean an increase in the subscription rate.

There are two basic problems at the root of this increase. Not only do we have a constant devaluing of the dollar, but our post office is getting more and more out of date and has been trying to meet the growing flood of mail with a growing mountain of employees. If we were using hand set type and hand presses our costs would be a lot higher. We do not meet growing demand for magazines by hiring more men to hand set type; we use machines. The sooner the post office recognizes the fact that they are going to have to automate and seriously sets about doing it, the sooner they will be able to give us the service that we should be able to get in this day of jet planes and television.

"Now Mr. Green, as the new Postmaster General, what do you propose to do about the department?"

"I'm glad you asked that question. As the new Postmaster General I propose to make sweeping changes."

"That's fine, Mr. Green, but can you give us an idea of what some of these changes might be? Can you be a little more specific?"

"Yes. We're going to meet the challenge of the modern world with modern methods. We're going to *automate*."

"But Mr. Green, Postmaster Summerfield tried that and wasn't it found to be impossible? Didn't the automated post office in Providence fail rather miserably?"

"Hmmm, yes, a few snags did crop up

(Turn to page 69)

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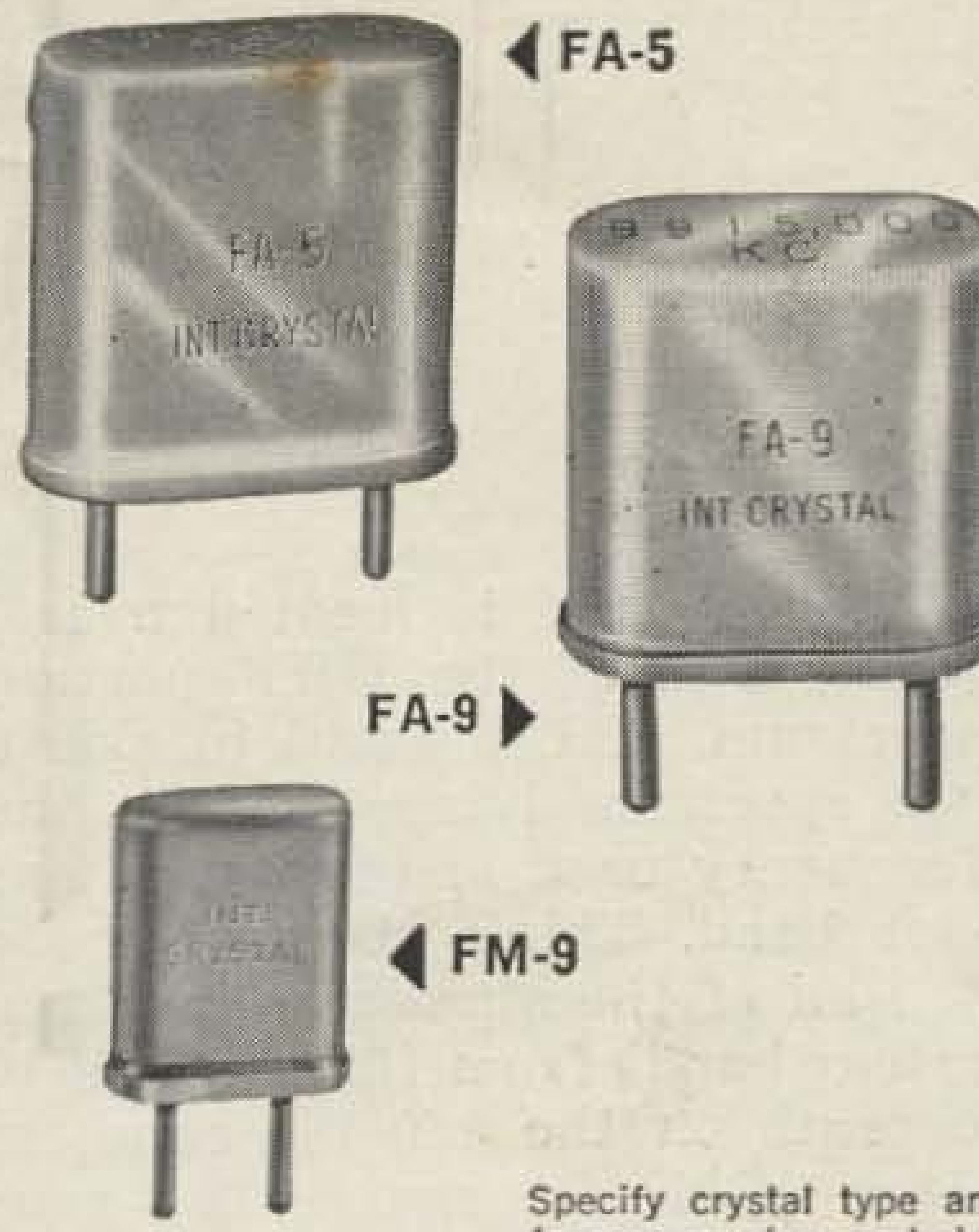


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* Allow three to four day processing.

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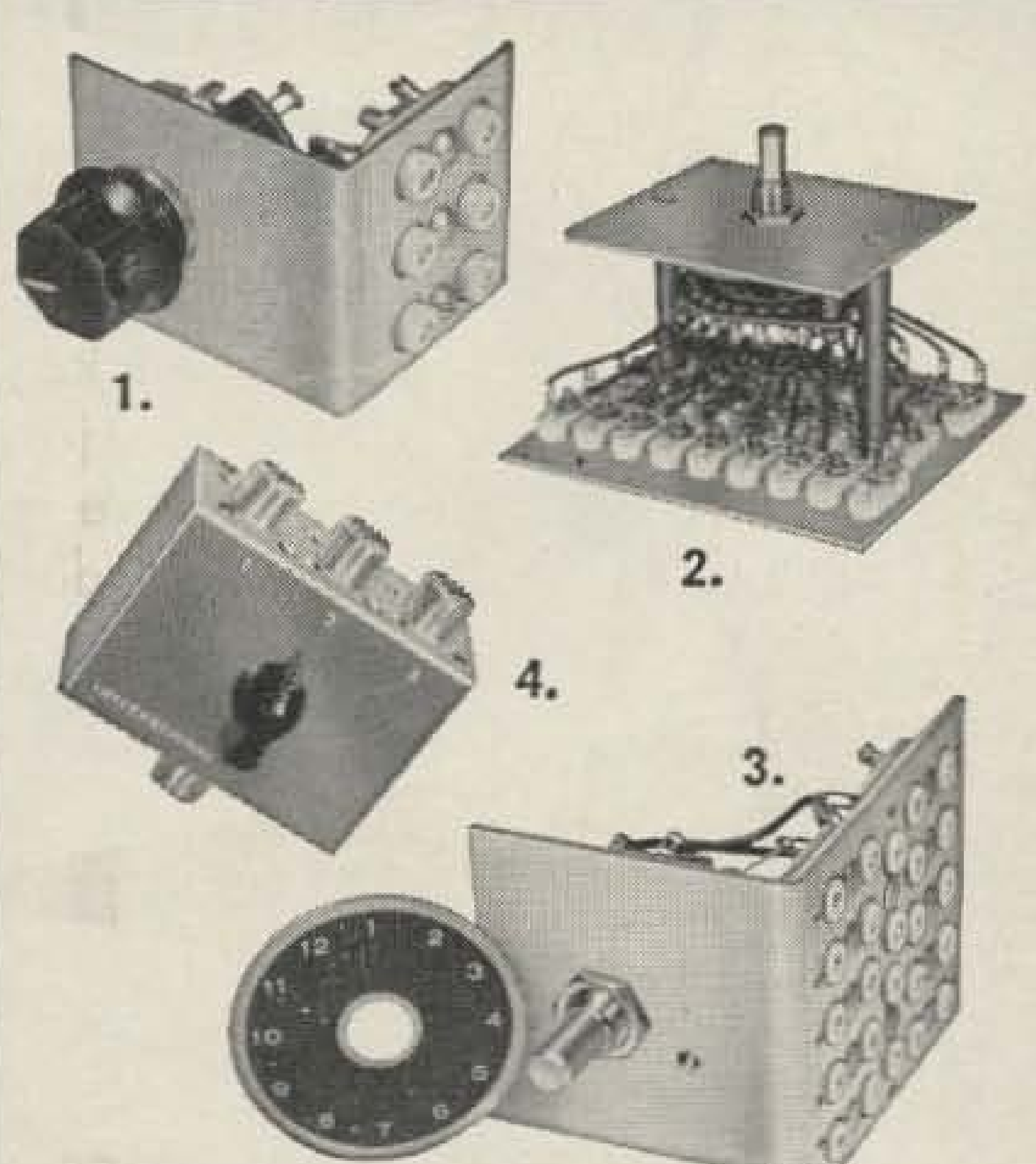


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# The 420 mc Band

Paul M. Wilson A/W4HHK
226 Peterson Lake Road
Collierville, Tennessee

THE 420 mc band is located near the low frequency end of the UHF portion of the radio spectrum, and is equal in size to all of the radio spectrum lying between the lowest radio frequency used and the high end of the ten meter band. Think about that for a moment . . . all of the amateurs operating on all the amateur bands from 160 through 10 meters could operate on the 420 mc band, and with much less QRM. Of course the range of a typical station is limited . . . from across town out to a hundred miles, depending on terrain, but it can be used to good advantage for local work and for experimenting. At this frequency the size of a dipole is so small, approximately 12¾ inches, that an array producing worthwhile gain may be constructed in the attic workshop and even used there for short haul experimenting and contacts.

Sub-assembly for a 432 mc. collinear/broadside all-metal (aluminum) array. Elements are one quarter inch diameter aluminum tubing. Booms and horizontal support are one half inch square aluminum tubing. Spacing between driven elements and reflector elements is one quarter wavelength, permitting use of driven and reflector elements having identical length.

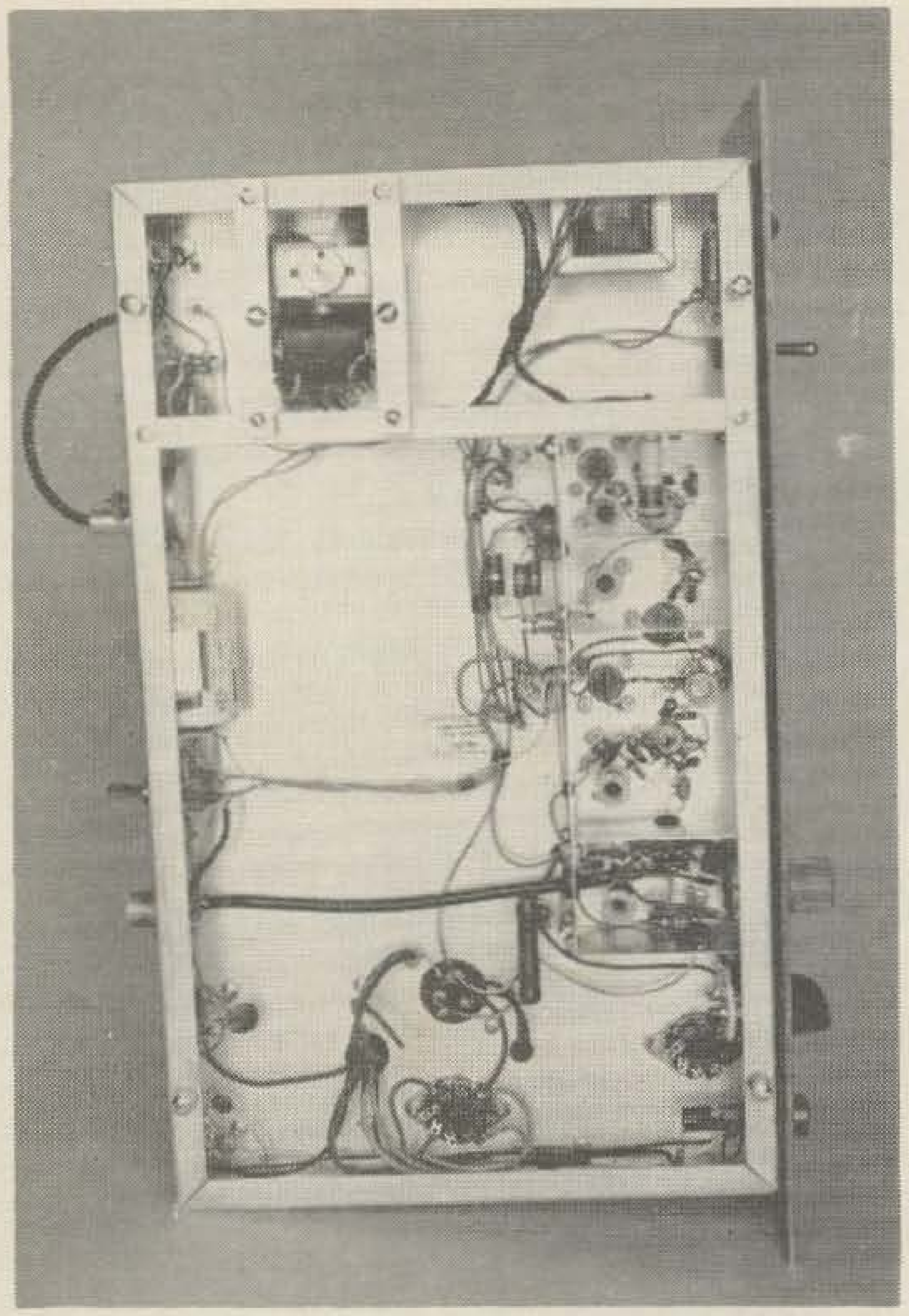
Propagation is primarily tropospheric. At this frequency ionospheric propagation does not occur and reflections from meteor trails or the aurora borealis are almost nil. The fifty watt input power limit does not help matters, but it is hoped that some day this can be raised. The various types of emission permitted on this band allow the operator a wide range of choice. They are Aφ, A1, A2, A3, A4, A5, and FM. Yes, amateur television, A5 emission, is permitted on the 420 band. Usually the audio portion of the transmission is made on another VHF band such as the six meter band. In listening to other amateurs discuss this band you will often hear them refer to operation on 432. The band actually extends from 420 to 450 mc, but because it is convenient to triple from the low end of the 144 mc band, thus producing a frequency of 432 mc, it is common practice for those using crystal controlled equipment to operate in the range 432-435 mc, hence the reference to "432" instead of "420."

Some operators get their start on this band by using modified surplus equipment of the modulated oscillator variety, or by building it themselves. The band is wide enough to accommodate these unstable signals without much danger of off frequency operation. Receivers used for such signals are wide band type and no very sensitive as UHF receivers go . . . but the simple equipment does allow one an easy means of diving into the fun of operating on 420. As experience is acquired the operator soon learns that better results are to be obtained by using stable crystal controlled transmitters and low noise, crystal controlled converters. In some ways, the use of this type of equipment is easier to handle than the simple oscillator type. For example, output frequency of the transmitter is a definite multiple of the crystal frequency. With the modulated oscillator the frequency obtained is anybody's guess and not easy to measure. Finding a wandering signal in a band that is thirty megacycles wide is a difficult job. Earlier the matter of stable operation between 432 and 435 mc was pointed out. In actual practice the majority of the activity may take place between 432 and 433 mc. A check with local amateurs operating on this band would give you the information regarding this and the matter of antenna polarization. It is important that your antenna polarization be the same as that of the other stations, for cross polarization means high signal loss.

Speaking of losses, one should bear in mind the matter of feedline loss. At this frequency it can be terrific, resulting in very little of the precious rf developed in the transmitter ever reaching the antenna. As an example, RG-58 coax has a loss of about 10 db per hundred feet at 420 mc. Expressed another way, this means that for ten watts fed into one hundred feet of RG-58 only one watt will reach the other end. RG-8 cable is somewhat better, having a loss of about 5 db per hundred feet. Amphenol 214-022 300 ohm line has a rated loss of about 2 db per hundred feet. It is easy to see that choice of feedline and keeping line length to a minimum are very important. One way to offset feedline loss is by use of a directional array. A sixteen element collinear/broadside array . . . a mere two feet wide by three feet high and less than a foot deep gives about 13 db gain over a dipole. A single long yagi with thirteen elements has a theoretical gain of about 16 db, but a word of caution is in order here. At this frequency the dimensions of a yagi are extremely critical. Elements that are not precisely the correct length and diameter will not produce the theoretical gain. There are some experienced operators who are not sold on the use of the yagi at 420 mc. The collinear/broadside type of array is a broad band type of antenna . . . dimensions not critical a bit . . . and can be built and erected without tedious tuning and adjusting, and be expected to deliver the advertised gain. Many will disagree on which type is superior . . . but you can find out for yourself . . . it is so easy to construct an antenna for 420 mc. It is worth mentioning that both types, a yagi and a collinear, were used on the 600 mile contact between W5RCI, Marks, Mississippi, and W8TYY, Columbus, Ohio. Other types of antennas are also employed on 432. The corner reflector is practical at this frequency. The reflector screens forming a ninety or sixty degree angle may be solid or of fine wire mesh, and have a width of one or two wavelengths and length of two to four wavelengths. The gain of a ninety degree corner reflector is on the order of 10 db and for the sixty degree corner about 12 db. Flat screen reflectors may be used to back up a curtain of driven elements. Some operators use such a reflector with elements on one side for 420 and elements on the other for 220 mc. Indeed, the 420 mc band is a fine place for experimenting with antennas. To give you a better idea of the materials needed and dimensions for a 432 mc antenna, the measurements for a typical sixteen element collinear/broadside array will be related. The design frequency is 435 mc, the center of the band. The driven element will be 12¾ inches long, the reflector element 13⅝ inches, and quarter wave spacing between the two amounts to 6¾ inches. The feed point impedance of a typical 16 element collinear/broadside array is approximately 300 ohms. If necessary, a quarter wave matching transformer could be used between the feedline and the array. Element diameter may be one eighth inch or larger. On quarter inch tubing is frequently used. In the construction of yagis the element diameter and length are both critical . . . the diameter being about one eighth inch. To sum up the antenna department . . . the antenna should be as large as possible and as high as possible, consistent with reasonable feedline length. A good quality, low loss line should be used.

Crystal controlled transmitters are not so difficult to construct as it might seem at first glance. For the operator already in business on the two meter band, a tripler-amplifier may be used to develop usable power on 432 mc. The station operating on the 220 mc band can multiply to 432 by retuning the 220 rig to drive a suitable doubler stage at 216 mc. All things being equal, a doubler stage can be expected to have greater efficiency than a tripler. Remember, the power limitation is power input . . . not output. Every effort must be made to achieve maximum efficiency in the transmitter and antenna system. Needless to say, a straight through amplifier would have the greatest efficiency. Stability problems might arise with this type of operation, however, so an efficient doubler stage should be considered. Tubes for this band that are within the reach of the average amateur are few in number. Many have started with nothing more than an 832A tripler that produced about two watts output. Such a final will produce contacts over many miles *if* a good antenna system is used. Other twin tetrodes that may be used as push-pull triplers and straight through amplifiers are the 6360, 6524, AX-9903, and 5894. Two very popular tubes for running the maximum input power are the 4X150 tetrode and 2C39 triode. Some use the 4X250 tetrode which has a greater dissipation rating. These tubes are built for use in a coaxial type cavity. Strip-line construction may be used, however. They may be operated as doublers, triplers, or straight through amplifiers.

The tube line up in a typical 50 watt crystal controlled transmitter might be as follows: a 5763 crystal oscillator using an 8 mc crystal, 5763 tripler to 24 mc, 5763 doubler to 48 mc, 6360 tripler to 144 mc, 832A amplifier at 144 mc, and 2C39 or 4X150 tripler to 432 mc. The order of frequency multiplication mentioned is quite common with many amateurs operating on the 144 mc band who use their existing two meter transmitters to drive a tripler for output on 432 mc. The other system frequently used is that making use of a 220 mc transmitter. The proper crystal frequency, approximately 8 mc, is used in place of that used for output in the 220 mc band, and the multiplier stages are retuned slightly for output at 216



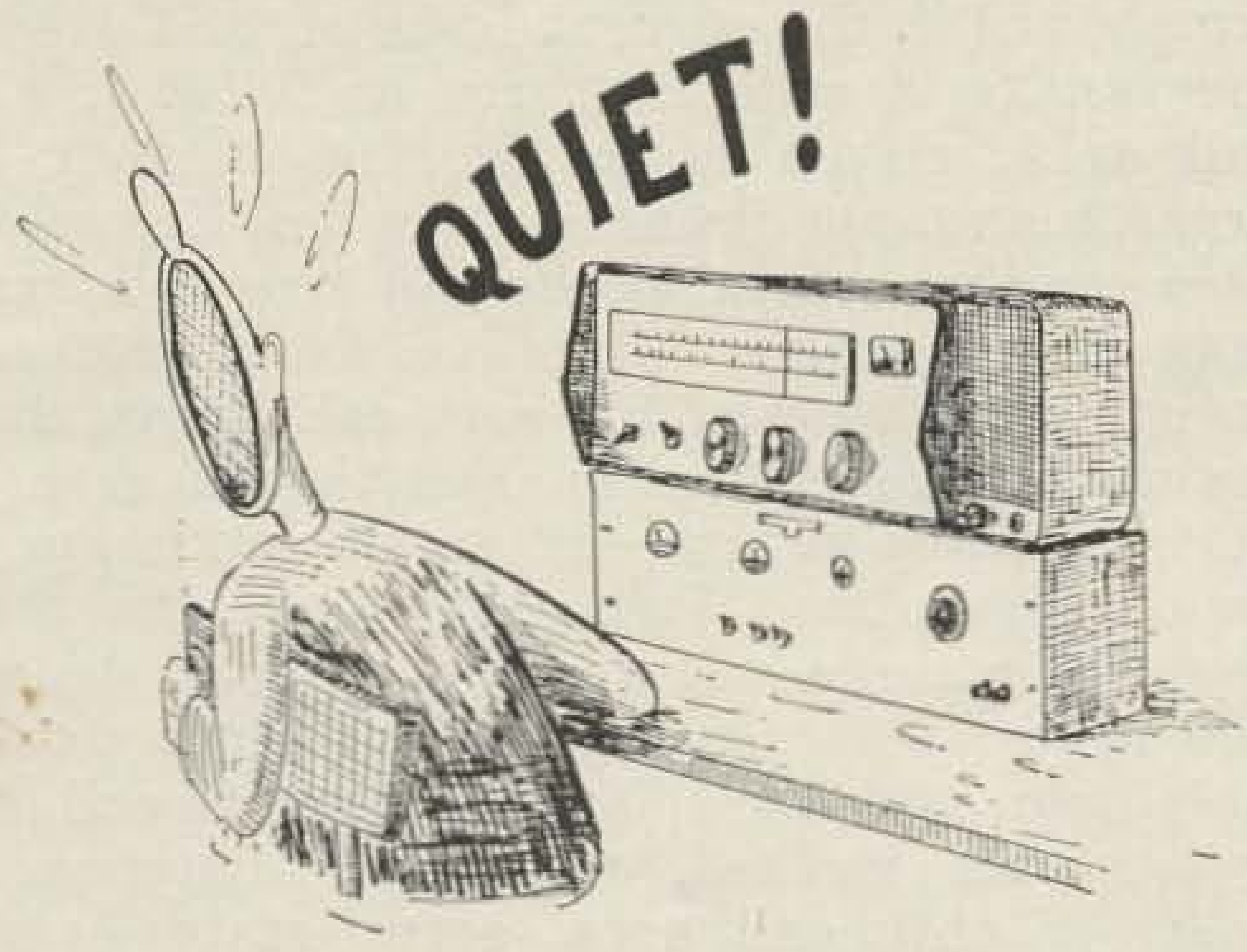
Bottom-side view of 432 mc. converter at A/W4HHK. The compartments for the 50 mc. cascode i.f., second mixer, and cathode follower output stage are seen along the panel side of the chassis. Blower for the 416B r.f. stage is in the upper right hand corner and bias battery along the rear (top-center) of the chassis.

mc. A doubler is driven by this, providing better efficiency than can be obtained with a tripler stage. Stations employing a doubler stage in the output should be alert to the possibility of TVI to nearby TV receivers if channel thirteen is used in their area. The most common types of emission used are A1 and A3, with some FM. If long haul dx is one of the aims of the 432 mc operator a means of keying the transmitter for CW work is a must. A convenient way of doing this with a tetrode final is to use a keying relay to break the screen voltage.

Most surplus equipment obtained for use on the 420 mc band employs receivers that are without rf amplification ahead of the first mixer and with broad tuning *if* strips. These work well with modulated oscillator type transmitters, but are useful only for work over relatively short distances. The receiver noise figure is quite high, making them useless for weak signal work. To obtain maximum performance on the 420 mc band, a crystal controlled converter working into a stable high frequency receiver should be used. Only a few tubes will work satisfactorily as rf amplifiers at this frequency. The 416B, an expensive little bottle, or the 6299, equally rare, are probably the best generally available. The 6AJ4 is sometimes used. A good parametric amplifier is far superior to the best tube amplifier, producing a noise figure on the order of one db. Some UHF workers have found that a converter employing a 1N21F diode mixer stage followed by a low noise *if* strip will give a noise figure only slightly inferior to that obtained when a 416B rf stage is added ahead of this same converter. Parametric amplifiers are tricky devices to handle, and a bit more involved than a grounded grid 416B rf stage, but it is the opinion of some that the converter should use a 1N21F mixer/low noise *if* combination and if rf amplification (and lower noise figure) is desired a parametric amplifier should be added. In short, there is little to be gained by adding anything other than a parametric amplifier for rf amplification.

In the matter of first *if* frequency several factors should be considered. The rule of thumb method is that the *if* should be five to ten percent of the signal frequency. The *if* should not be so high, however, that it will be difficult to obtain a low noise figure, but should be sufficient to reduce image response to a negligible amount. Where a diode mixer front end is employed the noise figure and gain of the first *if* are very important. If the communications receiver to be used with the converter is a double conversion type and has good stability at the high end of its range the converter output might be 26-30 mc. If this range is not suitable on the HF receiver a lower one could be used and double conversion achieved in the converter. In such a converter the first *if* could be 50-54 mc and a second conversion to 7-11 mc. For the operator already equipped with 50 mc receiving gear it would be very convenient to make the first *if* 50-54 mc. This would allow him to feed the output of the 432 mc converter into the six meter receiver and thus get going with a minimum of new equipment. Mention has been made of the importance of a low noise first *if*. Assuming the frequency is 50-54 mc, the typical converter might employ a cascode amplifier using two 417A type tubes or a 417A/6AJ4 combination. If the budget won't allow the use of a 417A then two 6AJ4 or 6AM4 type tubes could be used. For best noise figure a pentode should not be used in the first stage of the *if* amplifier. A vacuum tube such as a 6J6 or 6AM4 might be used for the mixer, but at this frequency the diode mixer works as well, or better, and the construction of a mixer cavity for a diode is much simpler than one for a tube. There is one drawback to the use of a diode mixer . . . it is more easily damaged by excessive rf than a tube. Precautions should be taken to insure that the rf present at the converter input is nil or quite low when transmitting. A good coaxial relay will help fill this requirement. Something else to consider is rf present when a high power transmitter on another band is used, especially the two meter

# ARM CHAIR COPY?

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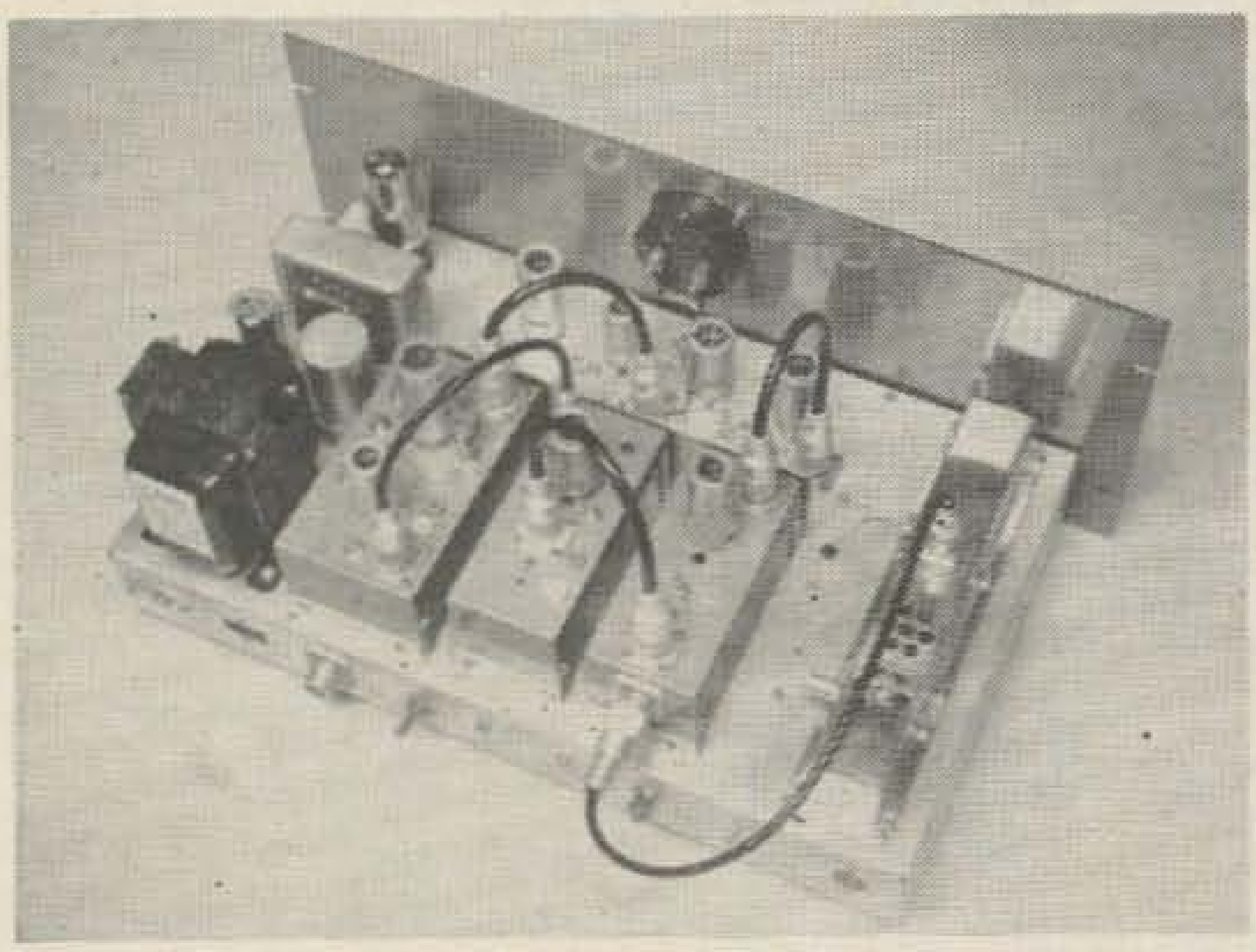
band. The third harmonic rf present when the the two meter transmitter is operated could damage the diode mixer or rf amplifier tube in the 432 mc converter. One solution to this problem would be the use of a control system so that the 432 antenna relay operates when either the 144 or 432 mc transmitter is operated. Diode mixers require relatively little injection for good mixing. For a converter with a 50 mc first if the oscillator/injection string might be as follows: a third overtone crystal at 42.444 mc, 12AT7 oscillator/tripler, and 6AK5 tripler with output on 382 mc. The output of the last multiplier stage could be link coupled to the diode mixer cavity. The plate voltage for the 12AT7 oscillator/multiplier would be supplied by a voltage regulator tube. If this oscillator/multiplier unit did not supply enough injection, as in the case of a tube mixer, a grounded grid amplifier using a 6AJ4 or 6AM4 could be added between the 6AK5 tripler and the mixer unit. With a diode mixer this would be unnecessary. An injection amplifier would help reduce spurious responses, however. It is common practice to measure the diode current in order to arrive at the proper amount of injection. Mixer current should be on the order of .2 to 1.0 milliamperes.

The range of a 420 station may be up to several hundred miles, depending on the terrain, local weather conditions, and the equipment used. The most outstanding work thus far has been the one way reception of KH6UK, Hawaii, by W6NLZ, Los Angeles. Path attenuation is great when there is heavy rainfall. Local rainfall may increase antenna and feedline losses, too. If activity is low in your area it may be necessary to use prearranged schedules. Many stations operating on 432 use the two meter band for liaison, especially when seeking to work a new state or set a new dx record that might be possible during a good tropospheric



Top view of 432 mc. converter at A/W4HHK. Left to right along rear of chassis: power supply, oscillator/multipler unit, injection amplifier unit, mixer unit, and r.f. amplifier unit. Tubes along front panel are 50 mc. cascode i.f., second mixer stage, and cathode follower output stage. Note sub-assembly construction technique.

opening. Watch for two meter stations calling "CQ any station with 420 gear." In QST the states worked column for 432 will give you a pretty good picture of coverage and dx worked in the various areas. In glancing over the 420 scoreboard in the current issue of QST we find the results in each call area as follows: First call area, eleven states worked in four call areas, maximum distance 410 miles. Second call area, twelve states worked in five call areas, maximum distance 360 miles. Third call area, seven states worked in three call areas, maximum distance 296 miles. Fourth call area, six states worked in four call areas, maximum distance 550 miles. Fifth call area, ten states worked in three call areas, maximum distance 600 miles. Sixth call area, one state worked, maximum distance 180 miles. Seventh call area, two states worked, maximum distance 180 miles. Eighth call area, seven states worked in four call areas, maximum distance 580 miles. Ninth call area, nine states worked in four call areas, maximum distance 608 miles. No listing for the tenth call area.

If the present power limit of fifty watts input were raised to one kilowatt it is barely possible that successful moonbounce work might be done on this band. In any event, if equipment equal to the best in use on two meters is employed, and antennas of equal physical size are used, outstanding dx may be worked on 420 mc under favorable tropospheric conditions. In fact, under certain conditions, the signal of a fifty watt 420 station may exceed that of a higher powered one on 144. Generally speaking, however, bending conditions on 144 mc have to be good enough for a solid voice contact before the same station can be worked on 432 using CW. Knowing your own frequency to within a few kc and the calibration of your converter/receiver combination are two important factors. Often stations will be scheduled who do not have the means of measuring frequency reliably on 420. Simple multiplication of the fundamental oscillator frequency (as marked on the crystal) is not enough. By the time an 8 mc frequency is multiplied fifty-four times to arrive at 432 an error of 1 kc at the oscillator frequency will result in an error of 54 kc at 432.

A round about way of checking the calibration of your transmitter or converter is to do the measuring at 144 mc. This, of course, assumes accurate calibration of the two meter gear. The two meter converter may be calibrated accurately by the use of a 1 mc crystal controlled oscillator/harmonic generator. The procedure is as follows: The one mc oscillator is zero-beat with WWV at 10 or 15 mc. It is loosely coupled to the HF receiver used with the converter, and as much coupling to the input of the two meter converter as is necessary to produce a detectable signal. The 144th harmonic of the 1 mc oscillator is tuned in on the converter/receiver. The crystal oscillator in the converter is then adjusted until the *if* signal delivered to the HF receiver at, for example, 7.0 mc, is zero-beat with the 1 mc harmonic falling on 7.0 mc. After this, the sub-frequency of the 432 mc signal (144 mc) may be tuned in at two meters and the true frequency at 432 determined by multiplying by three. In order to hear the 144th harmonic of a 1 mc oscillator on a two meter receiver it may be necessary to accentuate the harmonics by inserting a diode and/or tuned circuit in the output of the oscillator unit.

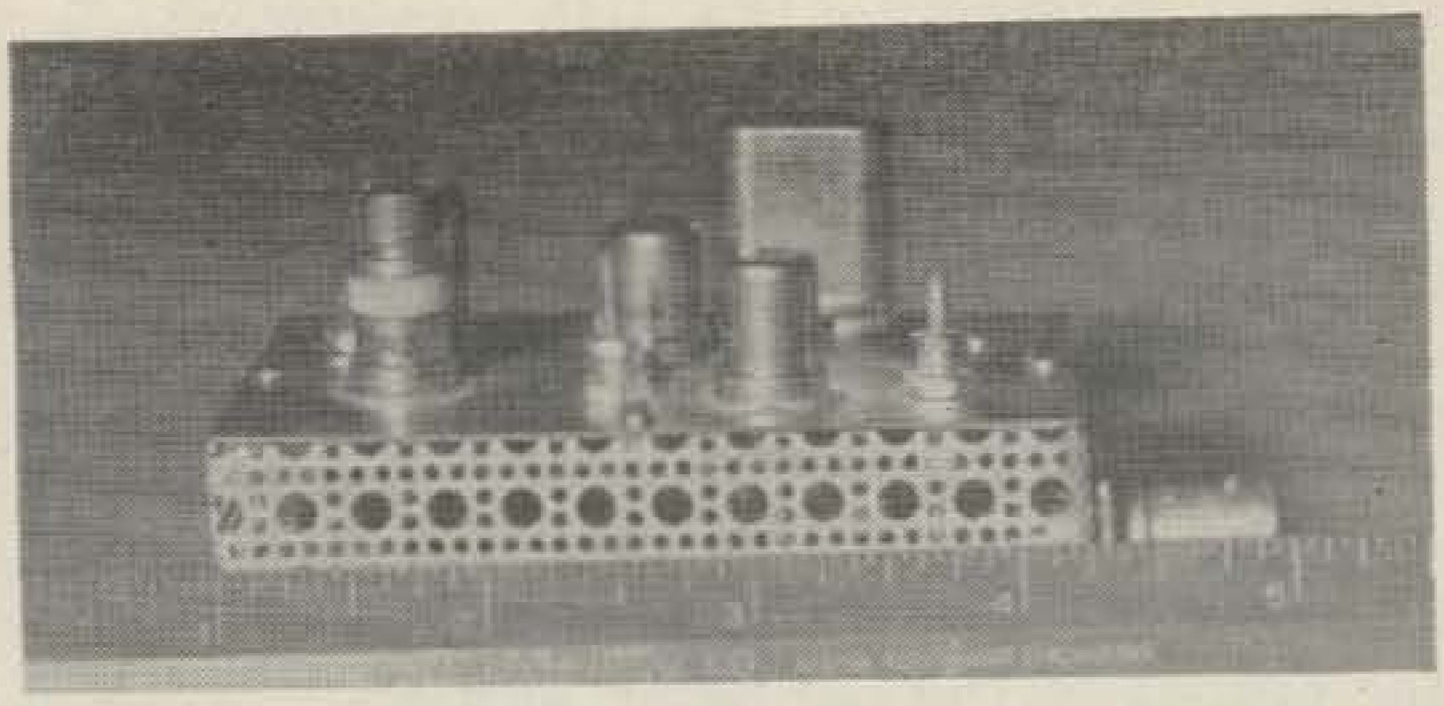
The crystal oscillator in a 144 or 432 mc converter will drift a few kc when first turned on. In addition, as the oscillator tube ages . . . over a period of many weeks . . . the calibration may change a few kc. The converter calibration should be checked at regular intervals for reliable dial readings. As with any VHF receiver, a noise generator is very useful in adjusting for best weak signal performance. In the absence of one of these, a low-powered crystal controlled oscillator/multiplier unit may be used to good advantage. A steady test signal for those time consuming adjustments and cut-and-try work is invaluable. Such a signal generator might be set up across the back yard so that the signal is received on the station antenna. If it is low powered and well shielded it could be loosely coupled into the feedline to the receiver. If the device is conveniently mounted so that it may be easily connected into the system at regular intervals, a fairly reliable check on receiver performance can be made. It is even better if the antenna system is included in the check. A faulty connection, relay failure, or tube failure would show up that might otherwise go unnoticed on a band where signals are few and man made interference is not easily detected. The absence of regular signals for checking equipment performance could mean the loss of a new dx record.

These comments have emphasized the use of crystal controlled transmitters and receivers. If outstanding results are to be enjoyed, only the best possible equipment should be used. This does not prevent the newcomer from getting started with the more simpler gear. After the thrills of the first qso across town are experienced, the desire to work more stations at greater distances will develop, and thinking will progress to 4X150 amplifiers and the like. For more information on the subject you are referred to: The Radio Amateurs Handbook, published by the ARRL, Inc.; The VHF Handbook by Orr and Johnson, published by Radio Publications, Inc.; The Radio Handbook published by Editors and Engineers, Ltd.; VHF For The Radio Amateur by Frank C. Jones, W6AJF, published by Cowan Publishing Co.; and the VHF Amateur Magazine published by K2ZSQ. A rather complete bibliography on VHF material appearing in QST in recent years may be found on pages 182 and 184 of the October, 1959, issue of QST. See you on 432! . . . A/W4HHK

# 6M Nuvistor Plug-in Converter

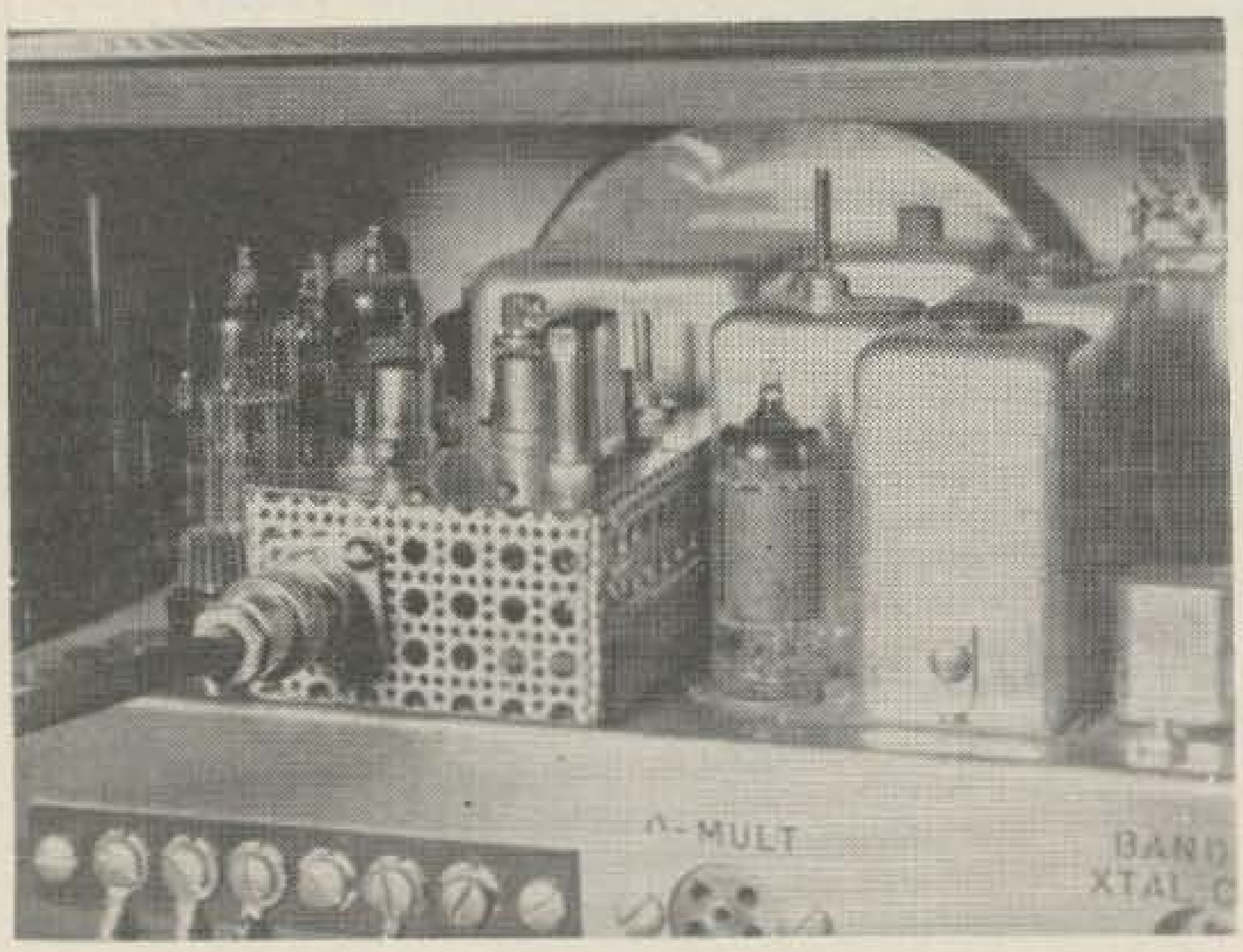
Capt. John J. Sury K8NIC/5

*Photos by Ben Head K5HWF*
*City Photo Service, Abilene, Texas*



Here is a gem I believe all you 6 meter boys have been looking for. A small compact 3 nuvistor 6 meter converter (2) 6CW4 and (1) 7587 which measures 2⅛" high over all, 2 inches wide, and 3¼ inches long, not including the coax connector. The largest item on top of the chassis is the overtone crystal. The author had in mind of developing a low voltage low current 6 meter converter which would fit into the crystal calibrator slot of his Drake 2A receiver. A separate converter, power supply, and a bunch of wires around makes things a mess, and causes entanglements. This converter has only one, the antenna connection. So if you are a owner of a Drake 2A or 2B, this is especially the project for you. The voltage is low, rf 55 volts, oscillator 40 volts and the mixer 90 volts, using not over 25 ma. total current, not including the heaters. Don't underestimate this little gem; it's hot and will stay with the best of them. This is strictly a straight forward design—no gimmicks to complicate the situation to get more gain or fancy it up. The nuvistor replaces the tube; the most expensive items are the overtone crystal and the 7587 tetrode nuvistor, but the results are very gratifying.

Let's get the building started. Follow the layout Fig. 2 and no problems will be encountered. Keep the wiring neat and the leads short as possible. Use insulating lugs for B plus and filament. A grid dipper should be handy to pre-tune the coils. The capacitance or the turns on the coils may vary from mine by a turn or two or a mmfd or two. Only one small shield is incorporated between the rf and the intermediate coil. A piece of copper shim stock will do.




Take a sheet of brass 2X3-¼" about 1/32" thick and make the layout. Brass is preferred because you will solder the nuvistor sockets to the chassis. Drill all holes and shape the nuvistor socket holes to fit the nuvistor sockets. Install the sockets and solder them in around the edges. Install the crystal socket. Next take three slug tuned coil forms 3/16" in diameter (obtained at your local surplus or electronic store) and #28 HNC nylclad copper wire and wind the coils. $L_1$ is tapped for the antenna three turns from the ground. Solder on $C_1$ and tune for 50.5 mc or desired receiving frequency. Wind $L_2$ on a form and then wind $L_3$ over $L_2$. Tune the same frequency as $L_1$ with $C_4$ installed. You may increase $C_1$ and $C_4$ by decreasing the turns of $L_1$, $L_2$, and $L_3$. Wind $L_4$, install $C_8$ and tune to 43 mc. $L_5$ comes later. Take a ⅜" coil form and wind 40 turns of #28 wire on it for the primary for $L_6$ and on the ground end wind $L_7$ over $L_6$ with the same size wire. Shunt $L_6$ with $C_{10}$ and $C_{11}$ in series and tune to 7 mc.

Install coils as indicated on the layout. Solder shield in place between $L_1$ and $L_2L_3$ as indicated by the dotted lines on the layout (solder to brass in spots). Complete the wiring of the converter with care. Take a piece of approximately #24 solid hook-up wire and make 1½ turns over $L_4$ loosely. Take the other end and solder to pin four of the 7587 nuvistor socket. This is all the oscillator coupling that is needed to the mixer. For neutralization of the rf a choke made with 28 turns of #28 or 30 nylclad wire over a ½ watt 1 meg resistor is a good starter. You may have to decrease or increase the turns to neutralize the rf.

Take a piece of 10-¾" X 1⅝" do-it-yourself aluminum, obtained in any hardware store, and form the bottom part of the chassis.

### For Drake 2A or 2B Owners

Form the bottom chassis and fit into the crystal calibrator slot of the receiver. Cut a piece of fiber 1-15/16" long, ⅝" wide and 3/32" thick. Obtain a four pin battery plug from your local electronics dealer that will fit the crystal calibrator socket. Install it to the fiber board and install to the bottom of the chassis. Refer to proper wiring of the plug from the Drake receiver handbook for the crystal calibrator. Then install the top chassis

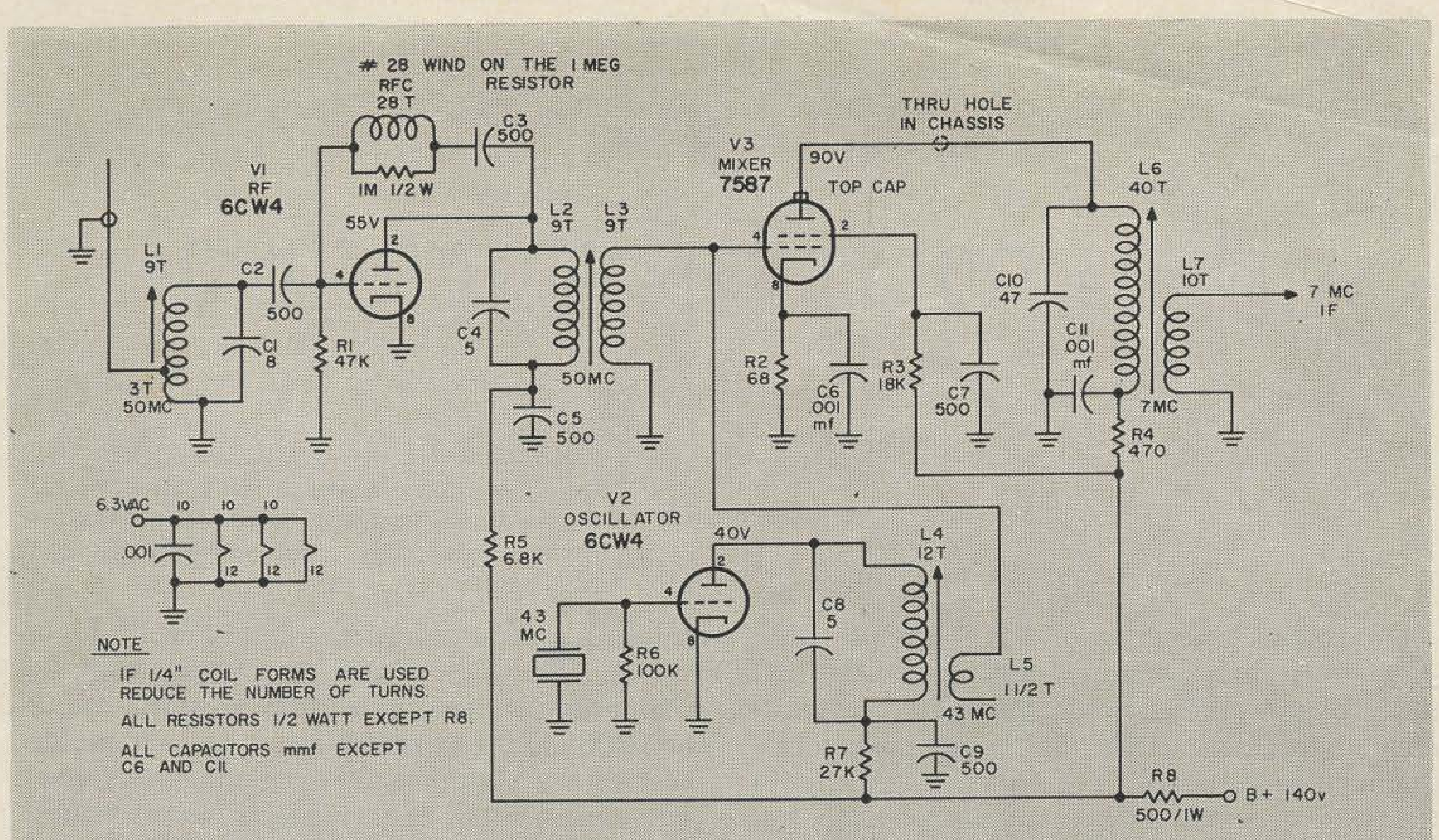


FIG. 1

to the bottom. Hook up the B-plus, filiment input to the antenna, and ground. It will be easier to align if the receiver is removed from the cabinet.

With the converter plugged in, turn on the receiver and crystal calibrator switch. Tune for maximum signal using a grid dipper or a signal generator not connected or coupled on approximately 50.3 to 50.5 mc. When you have it properly tuned the generator or dipper will almost peg the S-meter with the antenna connected. The noise level will be approximately 4 to 5 S-units. If the rf nuvistor breaks into self oscillation, take 1 turn off the RFC at a time until it stops. Then check for images.

You fellows with other types of receivers can install a coax connector or RCA female phono plugs to go to the antenna and receiver. Take B plus and filament from the receiver. Do not exceed 125 volts on the 7587 plate or she will blow. Desirable voltage on the 7587 is 90 volts for the best signal to noise. Use a larger dropping resistor $R_8$ if needed to drop B-plus on the 7587. The other nuvistor's B-plus will be taken care of automatically.

Don't let the size fool you. It outperforms the author's commercial converter. This should be a terrific project for the printed circuit ham. Build this gem and get the kicks I got out of it with the first local and the first DX.

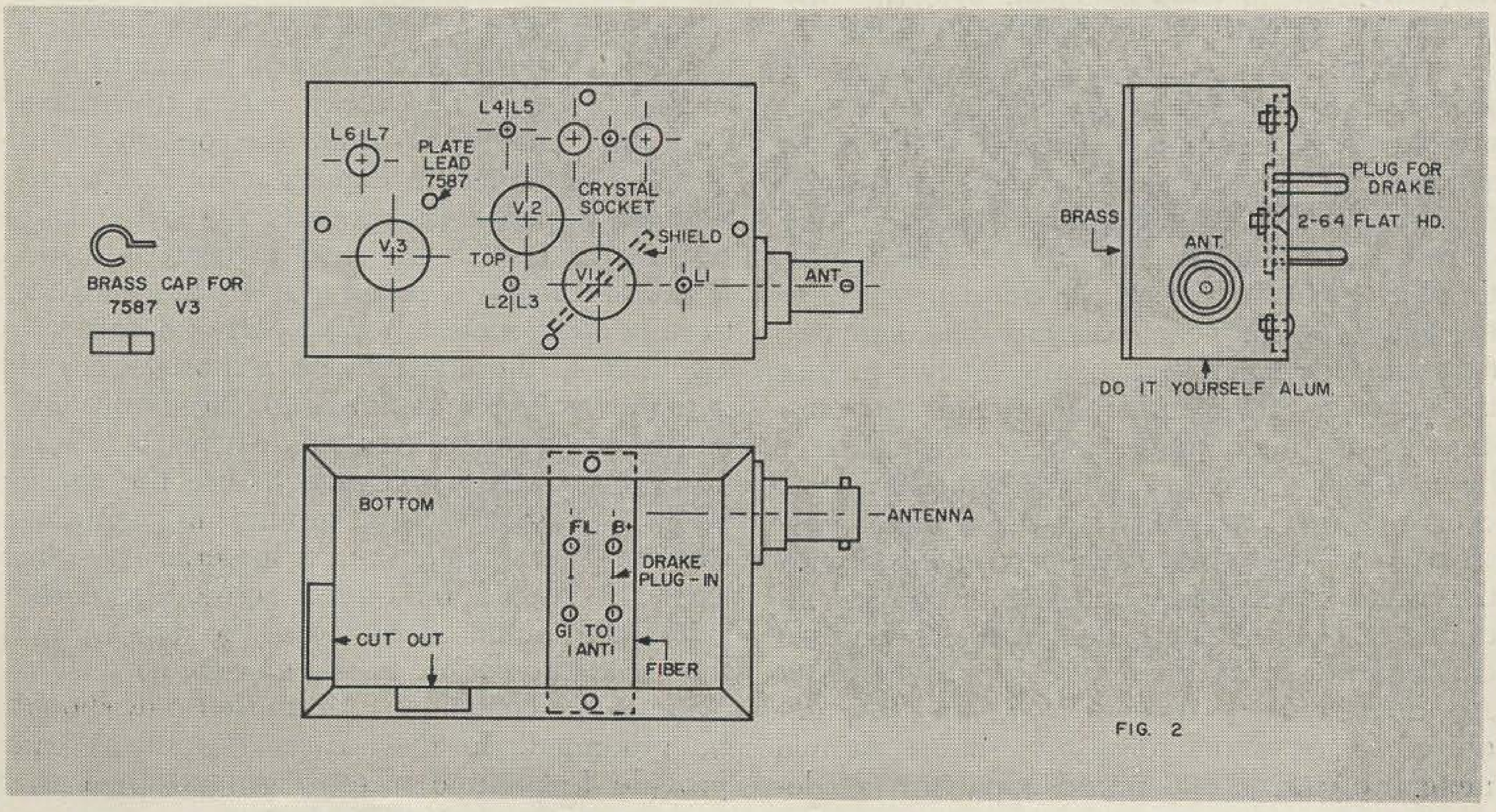


FIG. 2

# Hints on VHF Construction

Larry Levy WA2INM
1114 East 18th Street
Brooklyn 30, New York

A LARGE number of VHF circuits built do not always function properly the first time. Usually the stage or stages have a tendency to oscillate either at the operating frequency, or some other frequency, mostly in the UHF region. This can be traced to improper bypassing, faulty layout, inadequate shielding, improper neutralization, the wrong type of parasitic suppressors, and numerous other causes. It can be any one or a combination of the common causes. Another problem is lack of drive or shortage of drive. This can be caused by not enough power input to the multiplier stages or improper coupling.

## Bypass Condensers

At VHF frequencies, there are a large number of bypass condensers that do not bypass. The self-inductance of the condenser becomes large enough to act as an rf choke. The highest frequency that a condenser can bypass is the frequency at which the condenser is resonant. To test the resonant frequency of a condenser short the leads together by soldering to a copper sheet, the tip of a beer can, or any other similar sheet of metal. The leads should be the length that is going to be used in the circuit. A grid-dip meter can be used to determine the frequency. If the frequency is near the operating frequency, discard the condenser for that purpose and frequency. At two meters the majority of the commonly found .001 condensers are inadequate. A superior unit can be made by connecting two 300-500 mmfd condensers in parallel using the shortest possible leads. This gives a bypass condenser with the same capacitance but with half the inductance. (Since the inductances of the two condensers are in parallel they are halved.) As the frequency increases, the capacity required to bypass effectively decreases. At two meters a 700 or 800 mmfd capacitor is adequate. About 400 or 500 mmfd will do on 220 mc. For use on 200 mc, a very effective condenser can be made from two sub-miniature 200 mmfd ceramic discs. On six meters most of the common .001 ceramic discs work very well. On the higher bands one extremely effective bypass condenser is the button variety. A well constructed silver mica button should be effective well upward of 420 mc. It is recommended that these be used in ultra high gain circuits. In most other cases the paralleled ceramic discs will work. For bringing leads out of a chassis, a feed-through condenser should be used. This becomes doubly important in a transmitter with a large number of multiplier stages, as signals from these stages can cause considerable TVI.

## Layout

The unit should be planned so that all the leads are as short as possible. If possible, a receiver or chain of frequency multipliers in a transmitter should be laid out in a straight line. A shield should be placed across the socket to isolate the input from the output. This becomes exceedingly important in a straight-through amplifier. All grounds should be made to the chassis with the shortest possible leads. If the socket has a center pin, try to avoid returning all grounds to that point and connecting them to the chassis with a short length of wire, as voltages common to the input and output can develop across that wire and cause instability. It is permissible to use the shield across the socket as a ground in some instances. If the shield is of a material that tins easily, it should be tinned across the entire shield and soldered between the two screws that hold the socket to the chassis, as well as through the center pin. All unused pins should be grounded. In most cases the shield will provide less inductance to ground than the

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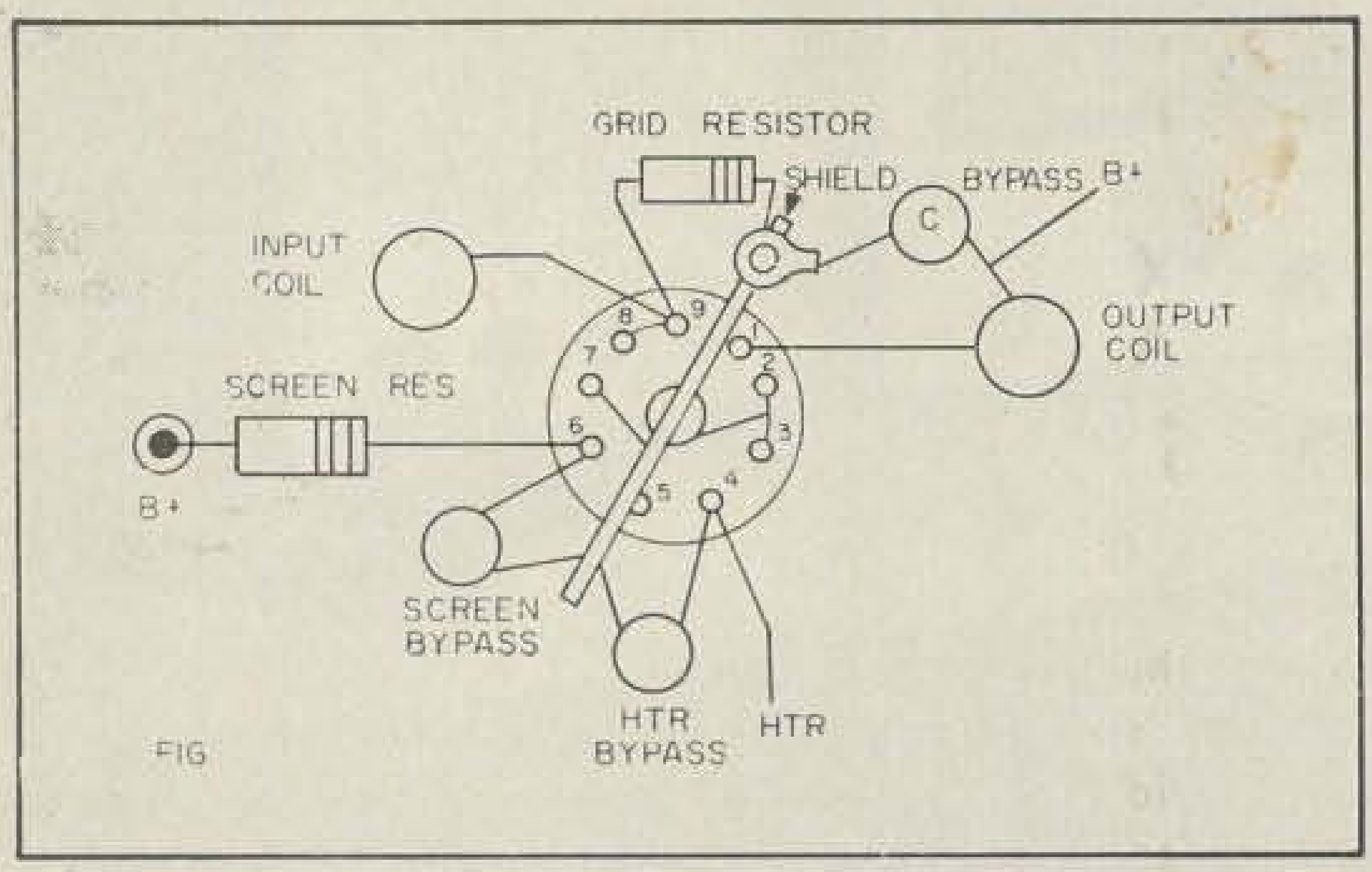
leads of the parts, unless the parts are at the pins near the screws that are used for ground points. Fig. 1 gives a typical layout for a 5763 amplifier. The top of a beer can is one of the best materials available for shields as they are usually copper-plated on one side and tin-plated on the other. The tin side takes solder easily and should be used on the side where most of the soldering is to be done. The rest of the can is excellent for making larger shields.



FIG

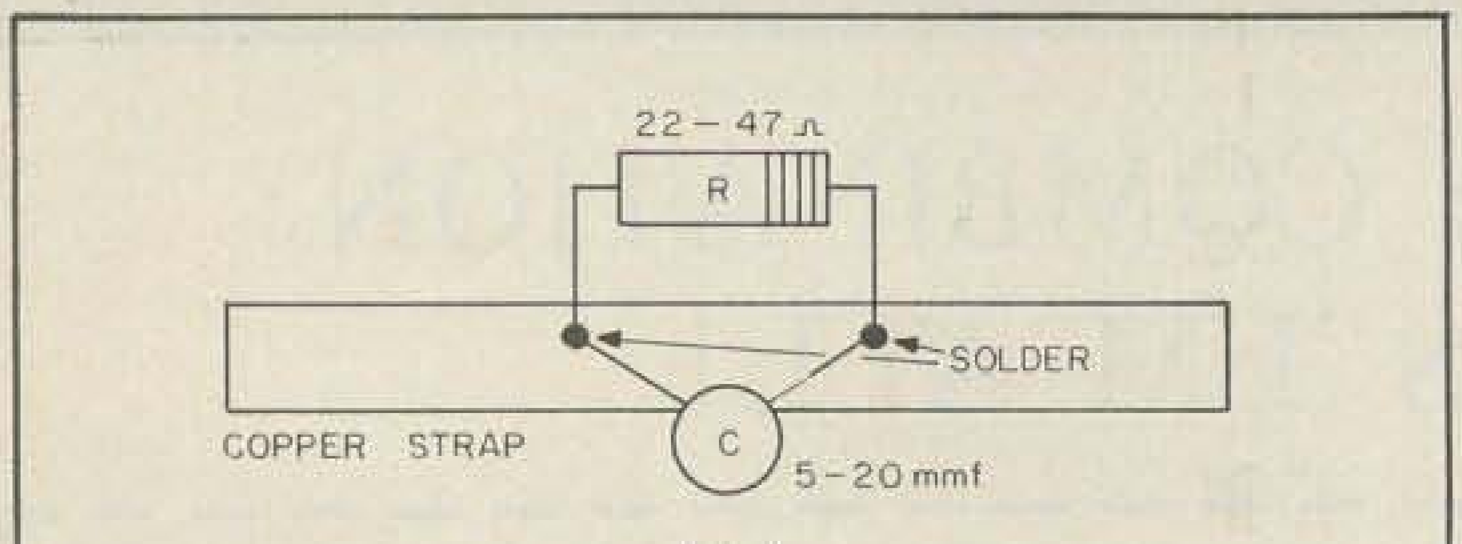


FIG. 2

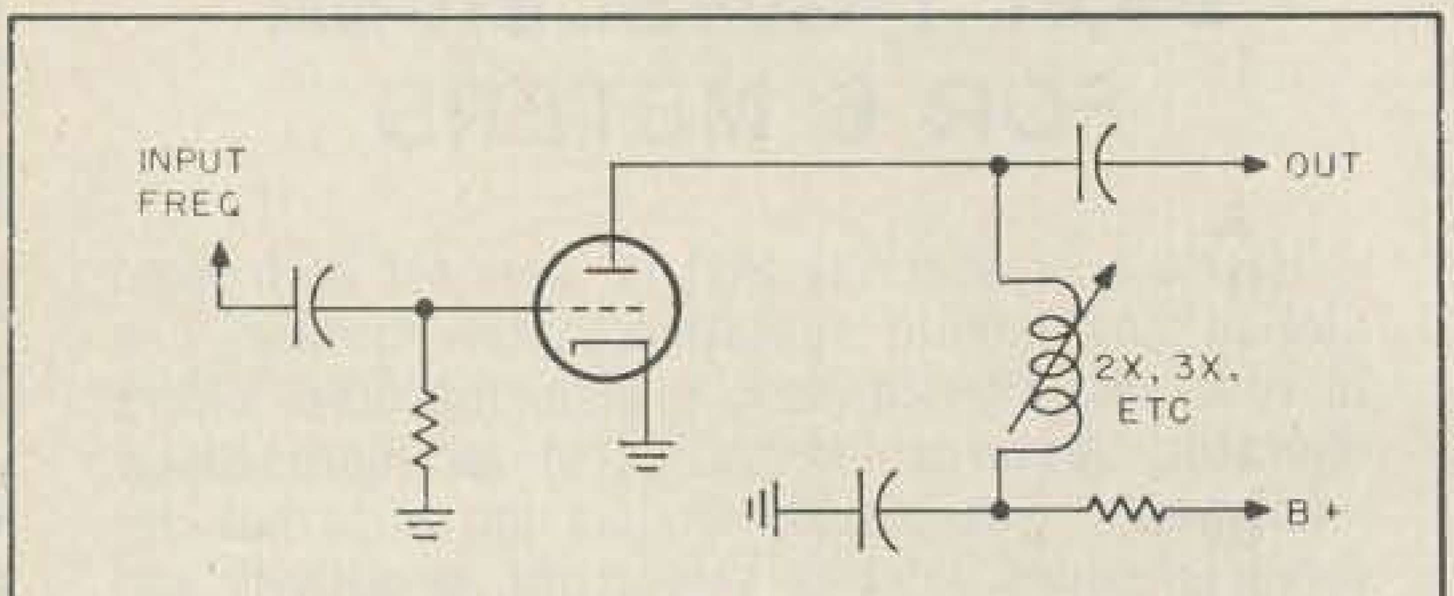


FIG 3

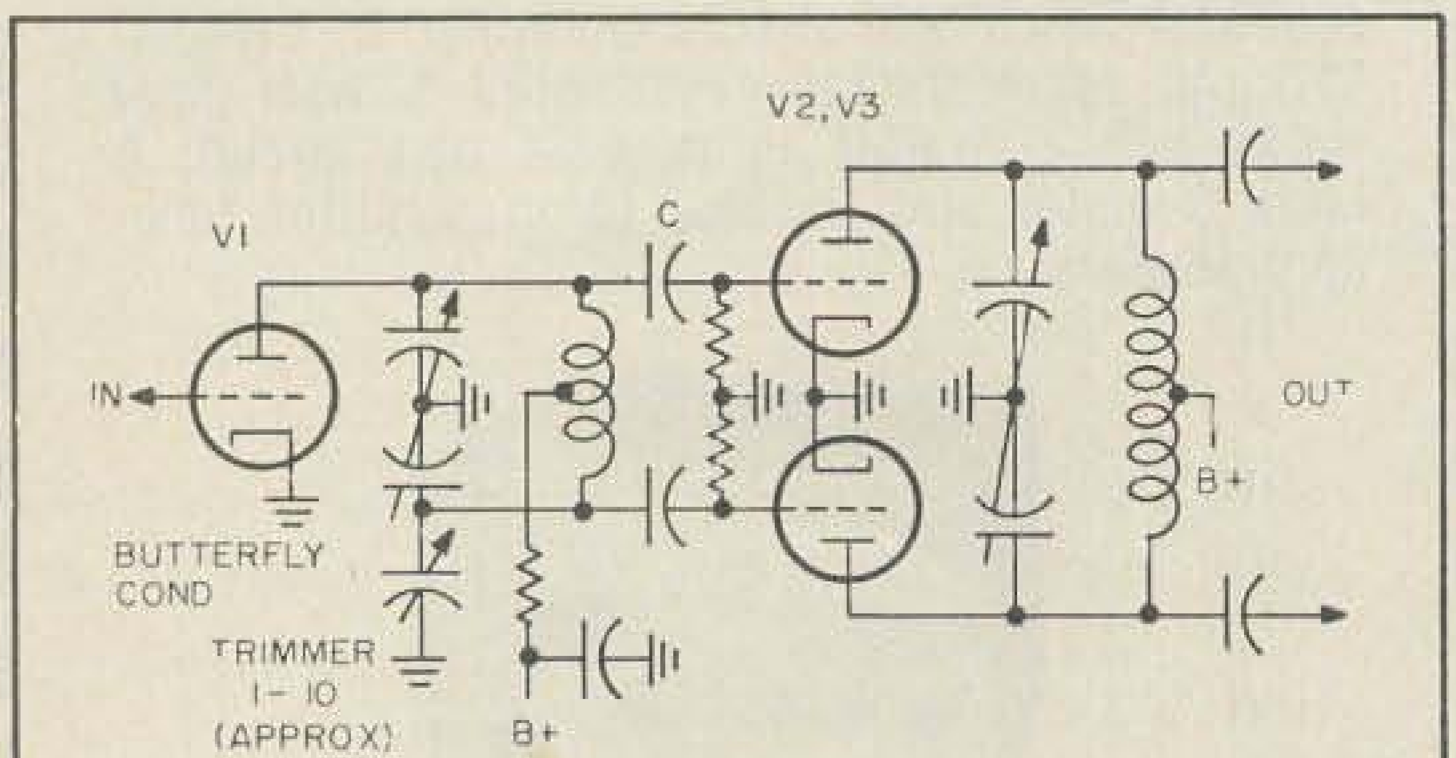


FIG 4

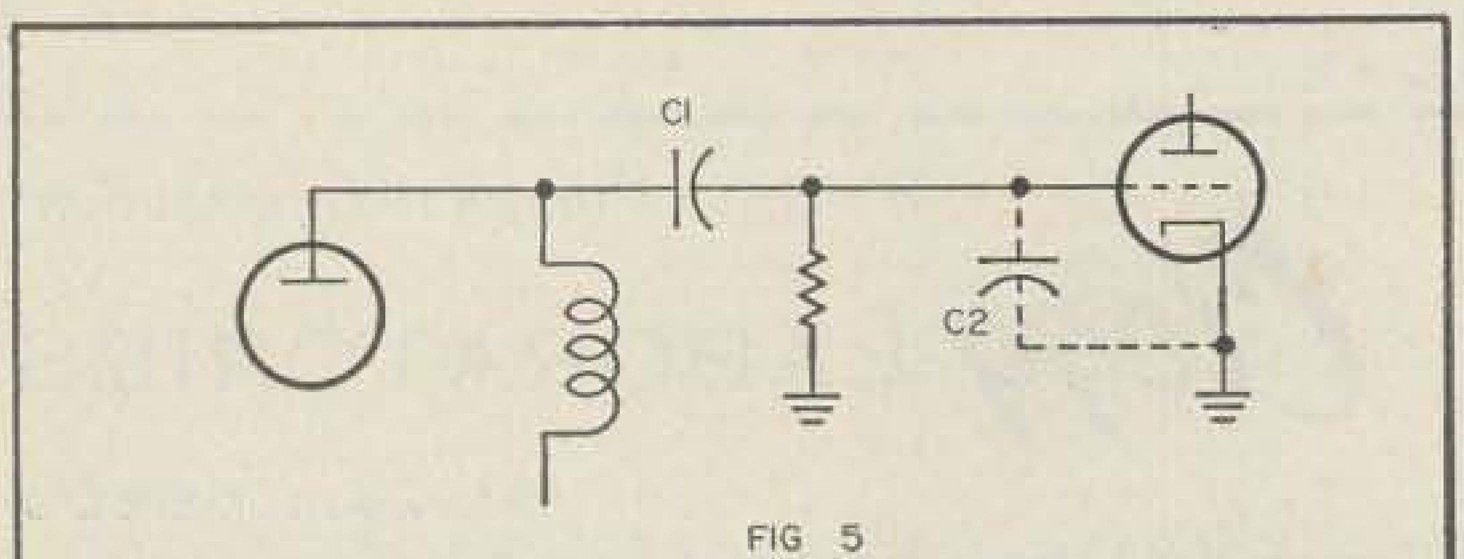


FIG 5

### Neutralization and Parasitic Suppression

Oscillation in a final amplifier can be of two general types. The first type is parasitic oscillation and is usually at a frequency that is quite different than the operating frequency. If the oscillation is near the operating frequency, it is usually due to improper neutralization. One type of neutralization that works quite well is the use of a stub to cancel the grid to plate capacity of the tube. A hole is drilled in the chassis near the grid pin and a stiff piece of insulated wire is brought through the hole and connected to the grid pin. The wire is placed near the plate of the tube and the length and position are adjusted for minimum feedthrough. In push-pull circuits the stubs are crossed so that the grid wire of one tube is near the plate of the other. The position of the wires is adjusted for minimum feedthrough. In some circuits (single ended) capacity bridge neutralization is used, but this is usually trickier to adjust. Parasitic suppression is accomplished by placing a suppressor in series with either the grid or plate leads to break up parasitic resonance. The type of parasitic chokes used on the lower frequencies do not work well on VHF because their inductance is a good part of the inductance of the resonant circuit. Usually they cause more parasitics than they eliminate. A recommended type is a copper strap (usually the flexible plate lead) with a resistor and condenser connected in parallel across a small section of it, see Fig. 2. This is usually sufficient to lower the Q of the parasitic circuit enough to prevent oscillation. Another type of oscillation encountered is when the grid and plate circuits have some common resonant frequency in them, as could be caused by two similar rf chokes, etc. The tube will oscillate at a frequency at which the chokes are both resonant. This can usually be prevented by using two different type chokes for plate and grid. If that is impossible, a resistor of about 500 ohms can be connected in parallel with the choke (in push-pull circuits) to lower the Q. Another cause of oscillation is inadequate bypassing of the screen when tetrodes are being used. If possible avoid using rf chokes in the screen leads of tetrodes. It is usually advisable to use a button condenser to bypass the screen or with tubes like the 5894, 6360 and many others, to leave the screen unbypassed. It usually helps to mount the tube socket with the metal rings above the chassis if octal tubes are being used.

## Frequency Multipliers

In the design of a transmitter the initial frequency is usually around 8 mc and this is multiplied to the desired frequency. The simplest type of multiplier is shown in Fig. 3. Pentodes can be used. Dual tubes are excellent for multipliers as they save considerable space. This should not be done at the sacrifice of power. The final multiplier stages should have more than enough power to drive a final or driver. All things being equal, the output decreases directly with the amount of times the frequency is being multiplied. At the higher frequencies plate losses reduce the output even more.

One idea for a 6 meter rig is to use a 6AU8 driving the final in a power class of about 20 to 50 watts. The pentode section is used as an oscillator-tripler and the troide doubles to 50 mc. An arrangement like this should have adequate drive for a 6146 or similar tube. For 2 meters the 6AU8 could drive a 6360 as a push-pull tripler to 144 mc. A phase inverter of the type shown in Fig. 4 works quite well. That type of circuit could also be used to multiply 72 mc to either 144 or 220 mc. The phase inverter circuit can also work on driving push-pull finals. Coupling capacitors C will be discussed shortly. A 6360 tripler should have adequate output to drive a 5894, 829B, 832A, etc., on two meters or a 6360 buffer on 220 mc. When working at higher frequencies plan the driving power with an extra 10 times the driving power stated in the tube manuals, as it is extremely difficult to get drive otherwise. Coupling condensers tend to be a problem as using large coupling condensers causes losses due to the series inductance of the condenser and smaller ones cause losses due to the voltage dividing action of the input capacity of the tube (C2 Fig. 5) and the coupling capacitor (C1). The value used should be a compromise. If the input capacitance of a tube is 5 mmfd and a 5 mmfd coupling capacitor is used, ½ of the drive voltage will appear at the grid. This should be avoided whenever possible by using larger coupling condensers.

## Parts and Materials

The success of many circuits is attributed to the type of parts used. Tube sockets should be of a type that have low loss and low inductance. Wafter sockets have very low inductance leads and their insulation is fairly low loss. This will contribute greatly to stable operation. Tubes used in VHF work should be those designed for VHF work as most of the types used on the lower frequencies perform miserably in the VHF range. This applies more to transmitting tubes than receiving tubes. Coils should be air-wound if possible and wound with bare wire. A good grade of coil dope, such as GC "Q Dope," should be used if any is going to be used at all. Slug tuned coils should have slugs designed to work at the frequency at which the coils are being used. The type of slugs used on the broadcast bands and below 30 mc are completely unsuitable for VHF work. Brass slugs decrease the inductance of the coil and are usually used at 2 meters and above as it makes the coil easier to wind. Stray inductance in leads should be avoided. VHF gear usually does not look neat because some of the neat wiring in which parts are parallel and at right angles to each other requires extremely long leads which make that type of wiring unsuitable for VHF.

These are the most common pitfalls to be avoided in VHF work. There are many more, but these are the main ones. If a rig is built using this as a guide, very little trouble should be encountered with getting successful results.

. . . WA2INM

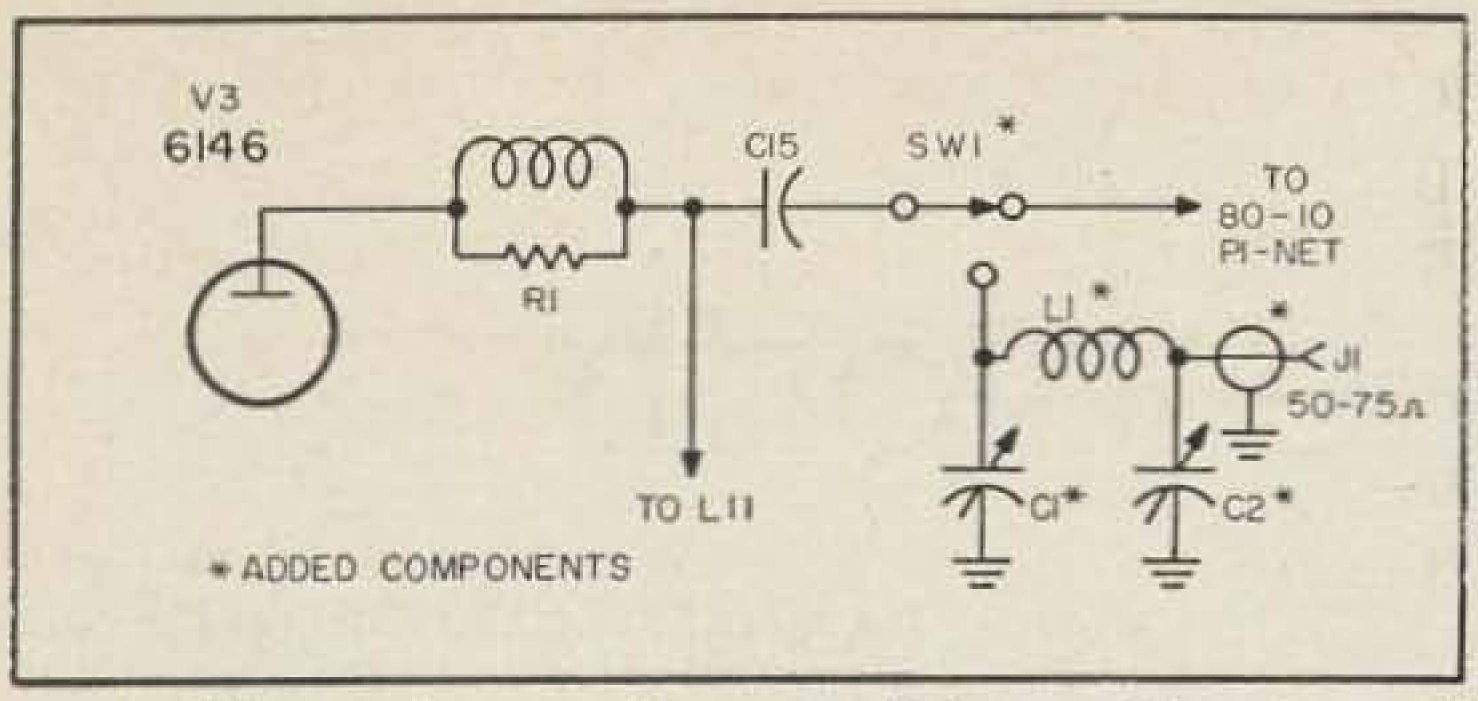
# Putting the Eico 720 on Six Meters

James Beckett WA2KTJ
344 Park Avenue
Corning, New York

No doubt there are many of these fine transmitters being used by Novices and Generals. So, in case you went from Novice to Technician or would just plain like to get on six without too much effort, this addition to the 720 will do the trick.

The oscillator of the 720 will oscilliate with an 8 mc crystal if the oscillator coil L1 is slightly readjusted. This 8 mc output will then triple to 25 mc in the buffer multiplier with the bandswitch in the 10 meter position. In turn, the 25 mc output is doubled in the final to 50 mc. The latter is accomplished by the addition of a separate pi-net output circuit.

Mounting of the components at first seems




a problem, but with careful application of dexterity, the trusty hack saw will solve the problem. A panel 6½" wide by 4½" high is cut from the right side of the top cover. Replace the top cover and establish the proper position of the newly cut panel. Mark this positioning so it may be relocated after the top is removed. Remove top and relocate panel with flange resting on chassis. Mark two or three places on the flange for drilling holes for the bolts that will hold the panel. After this is done replace panel and mark the holes for the chassis. Drill same. Placement of the components on the panel will depend on the parts you use. In my case the switch is on the left of the panel, the plate tuning capacitor in the middle, the antenna loading capacitor on the right, and the SO-239 bottom right. The parts may be juggled around so that everything clears.

The only change in the original circuitry suggested is to remove L 17, the parasitic suppressor, and replace with a 47 ohm 2 watt resistor, over which, wind a two turn coil of number 18 tinned wire.

Coil L1 must be readjusted to produce about 3.5 ma drive with the bandswitch in the ten meter position. This will be the normal position of the bandswitch while operating six meters. (Some loss of drive may occur while on ten meters, in that case L1 may need to be reset while on ten). Use an 8 mc crystal in this adjustment.

Tune up follows the same procedure as the other bands except that the bandswitch must be on ten as mentioned and switch S1 in the six meter position. Connect a good antenna with a low SWR and you're in business.

This modification has been in use for over a year with very good results. All in all it's a very inexpensive conversion.

**Parts List**

C1—50 mmfd variable—Bud 1853
C2—250 mmfd variable—Lafayette MS-214
L1—4½ turns number 18¾ in. dia. (resonate with C1 at 50 mc by spreading or compressing turns)
J1—SO-239 coaxial connector
SW1—One pole, two position, ceramic switch—Centralab 172C
R1—47 ohm 2 watt resistor with two turns number 18 wound on it.

# Finding True North

*almost every night*

Andy Wisler KH6BW

BACK in Volume 1 No. 2 of 73, the November 1960 issue, Mr. Calvin R. Graf W5LFM was the author of a short article on an excellent method of determining True North from your location by means of vertical alignment of the North Star, Polaris, with Eta of Ursa Major—the last star of the handle of the Big Dipper, and Epsilon of Cassiopeia, the End star of the "W." The illustration accompanying the article showed Polaris directly below the Pole, indicating True North. This position of the North Star also is known as the Lower Culmination. When the North Star is directly above the Pole, it also indicates True North and is known as the Upper Culmination. These events occur every day and are approximately 12 hours apart.

For various reasons, such as living too far South, on the wrong side of a hill, a wooded area, or due simply to low lying clouds on the horizon, you may not be able to line up all three stars when they are in a vertical position and that beam or whatever it was that you needed to know True North, project will have to be postponed.

Life can be made simpler though. For 35 cents a 17 by 11 inch chart can be obtained which tells us all sorts of things that take place in the sky during the hours of darkness, or to be more specific from 4 P.M. to 8 A.M. your local time. It is called the "Graphic Time Table Of The Heavens—1962," and is obtained from the Maryland Academy of Sciences, 400 Cathedral St., Baltimore 1, Maryland.

To find True North you determine the Local Standard Time for either the Upper or Lower Culmination for the date desired. A simple correction for locations east or west of the Standard Time Meridian, minus or plus four minutes per degree of longitude is made. Most of the larger cities are already given in the chart. At that time you look at Polaris. You are looking at True North. I should point out though, that these culminations can occur too near sunset and sunrise to be visible easily during the summer months, say June and July.

Many other interesting events can also be determined from this chart, such as moonrise and moonset, sunrise and sunset, rising and setting of the planets, etc. However, if you are working on Moon Bounce projects, a more sophisticated means of obtaining moonrise and moonset time during the day from 8:00 A.M. to 4: P.M. must be available.

. . . KH6BW

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# Modifying the Modifications on the Modified HE-35

It seems to me that the HE-35 that I modified (See 73, Feb. 1962, P. 54) was a very unusual one in several ways. By this, I mean that two of the bugs that seem to be quite common were non-existent in my transceiver. By borrowing one that had these defects, I was able to work on and solve the problems. The problems are in the oscillator circuit, one of them being a drift and change in frequency during mobile operation, and the other being a sort of oscillation caused when a strong signal was tuned in with the audio gain turned up somewhat. This situation became much worse with the noise limiter on. For anyone that operates mobile, as well as someone who uses the rig on ac, this can get to be annoying, to say the least. To say the most, it can get extremely frustrating. Fortunately, these problems can be corrected with a minimum of effort and expense.

The oscillation problem is caused by what is the equivalent of a microphonic oscillator coil. The coil itself is not really microphonic, but the leads near the oscillator coil tend to vibrate when there is any appreciable volume coming from the speaker. The leads do not have to be in the oscillator circuit themselves, just near the oscillator coil, leads to the coil, tuning condenser, or associated circuitry being sufficient. The cause is really quite simple—when the leads vibrate, they cause a change in capacity, small as it is, with the leads in the oscillator circuit. This results in the varying of the oscillator frequency at an audio rate. To put it plainly: frequency modulation. When this reaches the detector, it is detected and amplified like a regular signal. When it reaches the speaker, it causes the leads in the oscillator circuit to vibrate and so on through the cycle. The result is an audio oscillation every time a strong signal is tuned in. The cure is simple—a thorough coating of the oscillator coil and leads in the vicinity with a layer or two of "Q Dope"

The other problem is caused by a variation of the plate voltage on the oscillator tube. The addition of a voltage regulator tube will eliminate all drift of this type. An OA2 is mounted under or on the chassis, wherever there is more room, and connected to the plate supply of the oscillator tube. This requires a modification of the previous modification Remove the 5k resistor going to the B plus (See Fig. H, P. 58, Feb. 1962 issue of 73 Magazine) and connect a 3k 2 watt resistor in its place. From the junction of the 3k resistor and the 5 mfd filter, connect a 5.1k 2 watt resistor to the anode of the VR tube. From the anode of the VR tube, connect a 5.6k ½w resistor to the plate of the oscillator tube, using this in place of the 10k resistor used previously. The 3k resistor should be connected directly to the cathode of the rectifier instead of the normal B plus connection. Doing this will improve stability in two ways—1: by eliminating voltage changes caused by variations in plate current as AVC is applied and 2: by leaving the oscillator running continuously. The changes are shown in Fig. 1. These improvements make the receiver considerably more stable than it was before and can be done in not much more time than it takes to read this article.

. . . WA21NM

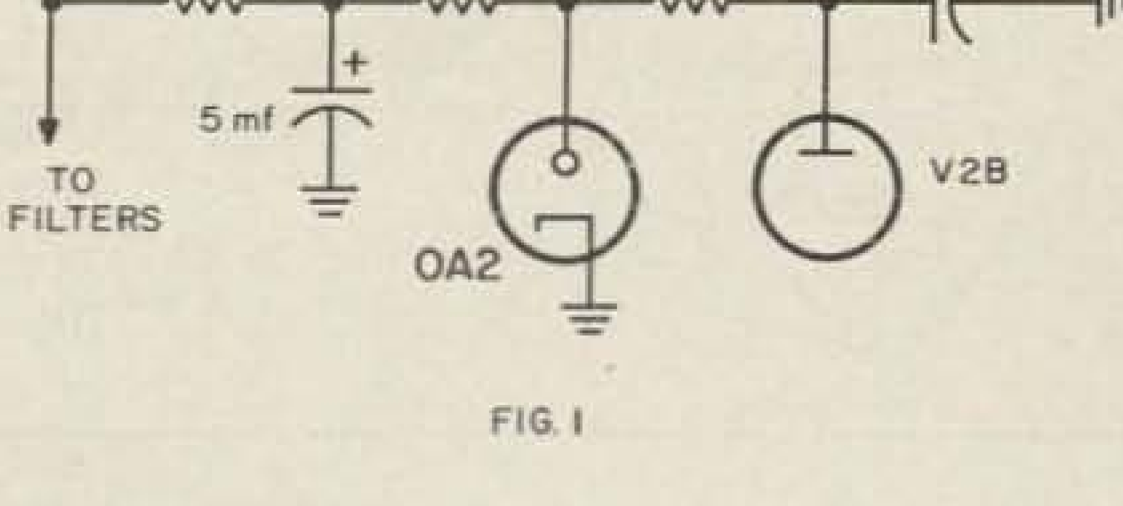
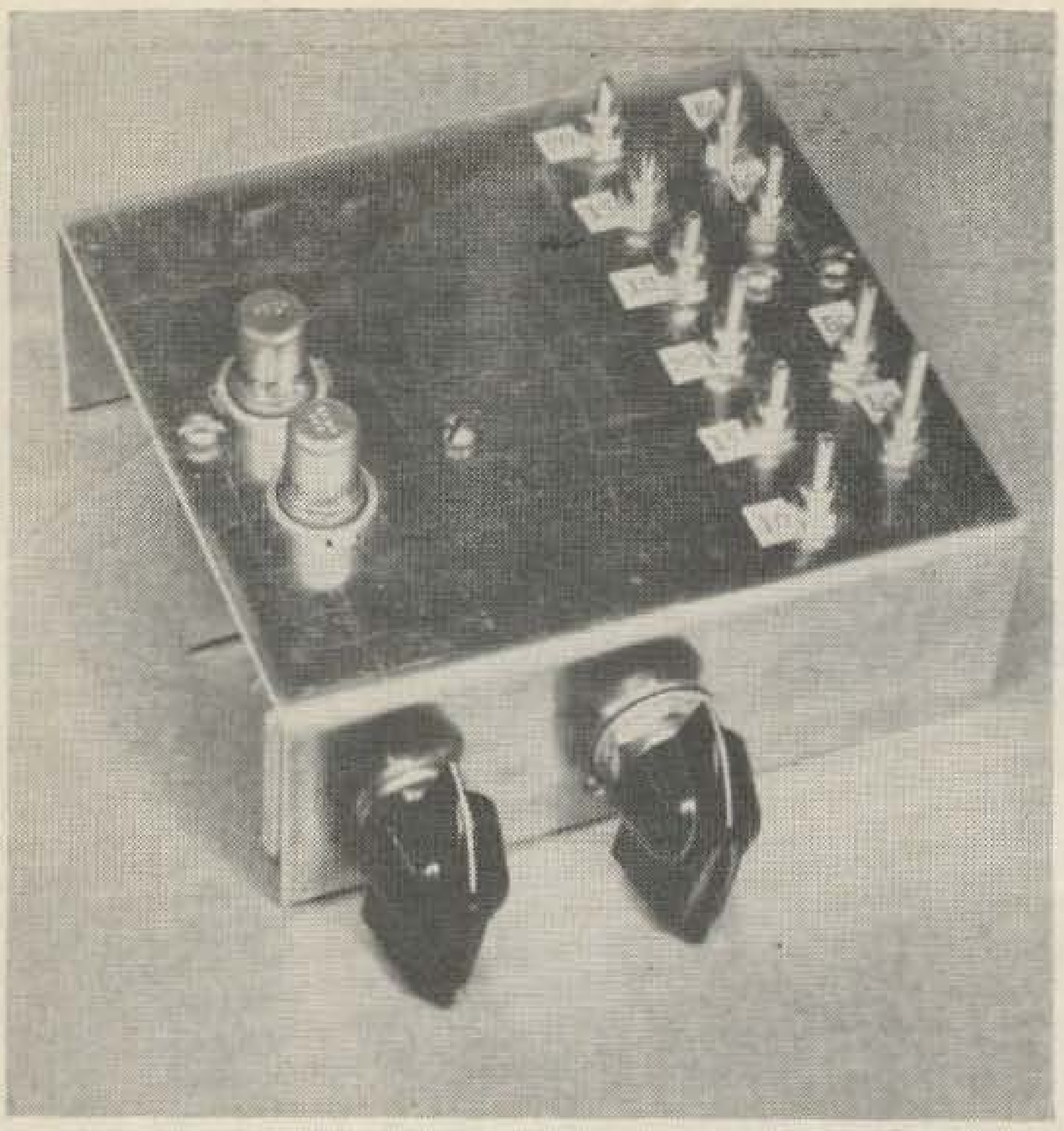



FIG. 1

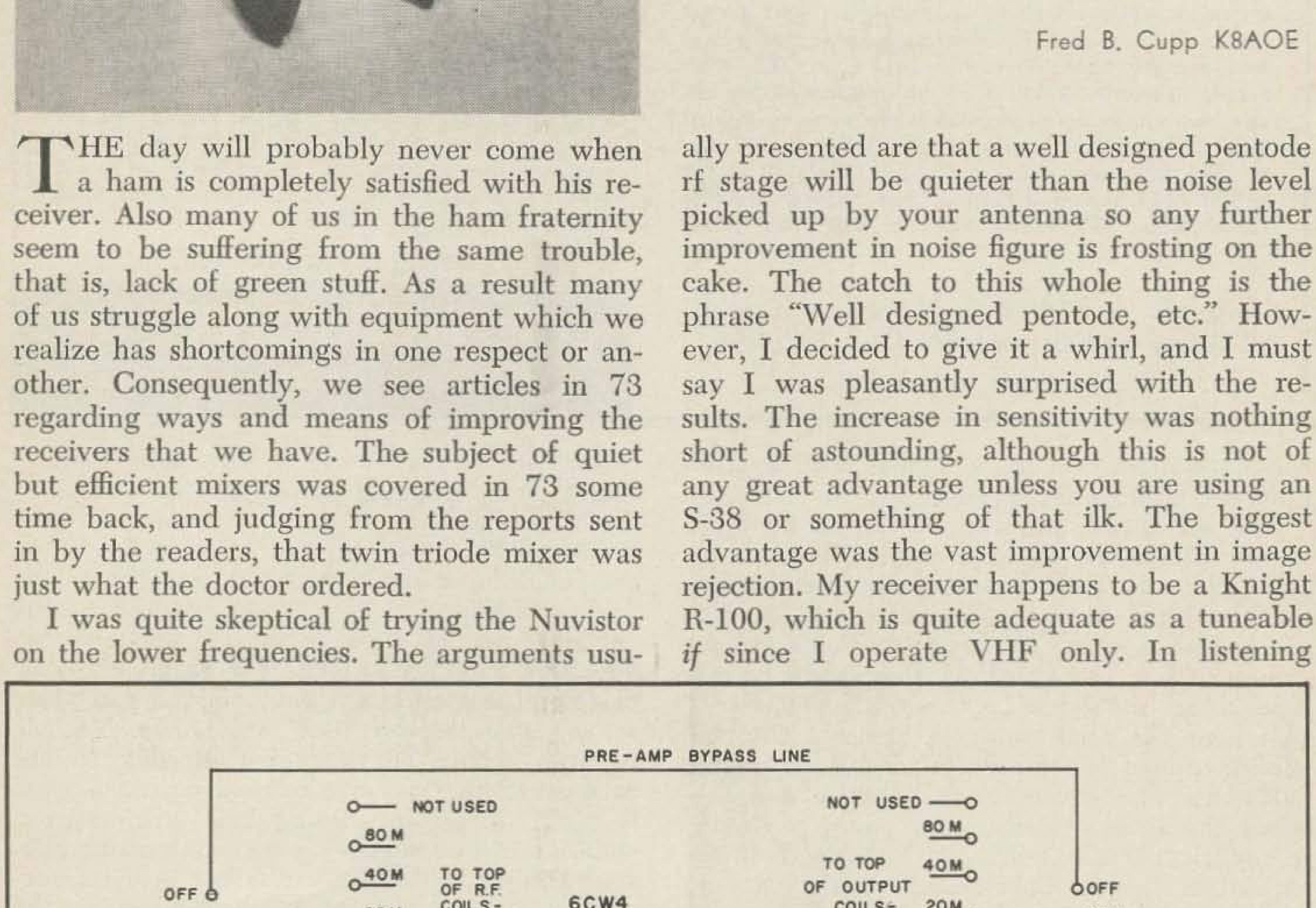


# All Band Nuvistor Pre-Selector

Fred B. Cupp K8AOE

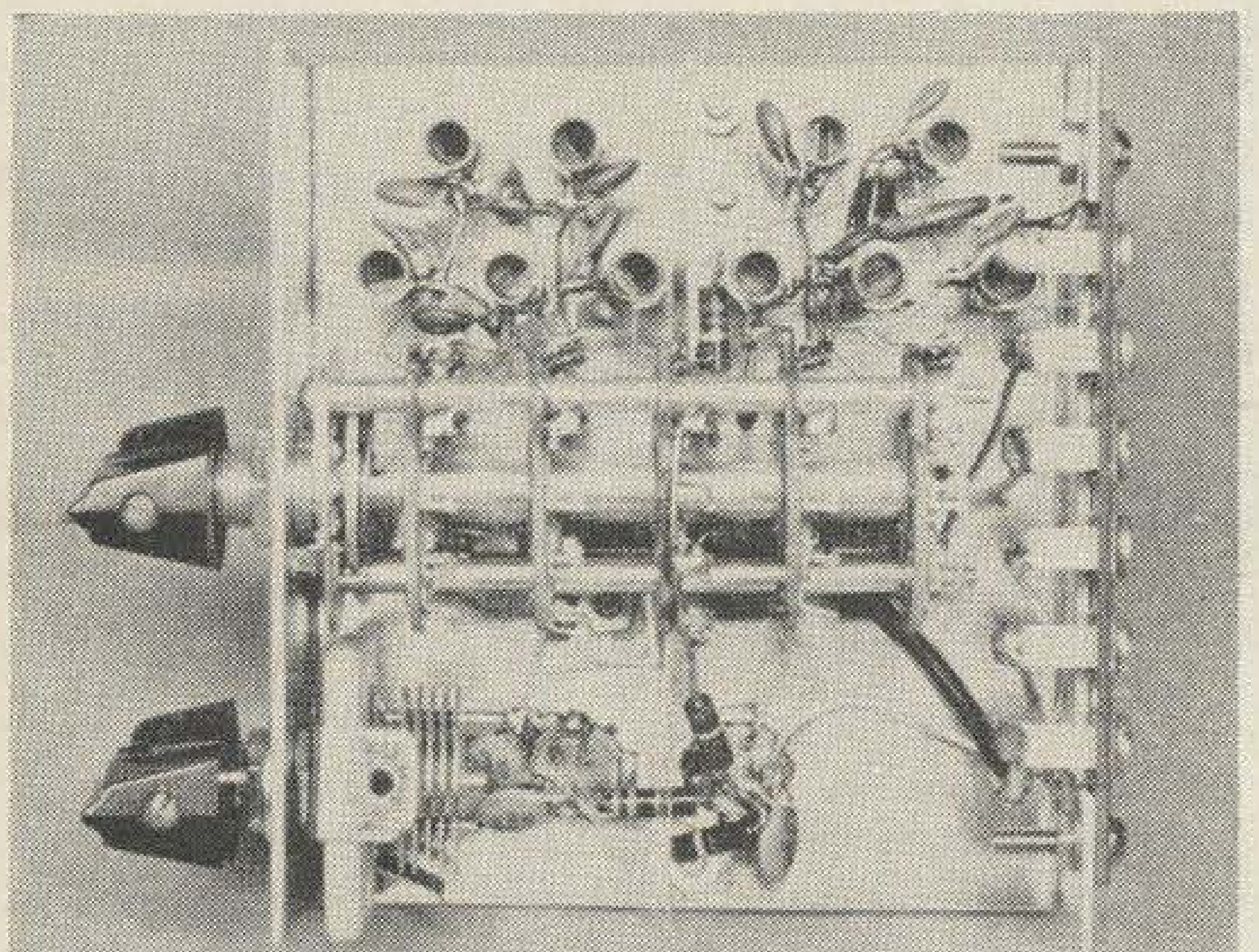
THE day will probably never come when a ham is completely satisfied with his receiver. Also many of us in the ham fraternity seem to be suffering from the same trouble, that is, lack of green stuff. As a result many of us struggle along with equipment which we realize has shortcomings in one respect or another. Consequently, we see articles in 73 regarding ways and means of improving the receivers that we have. The subject of quiet but efficient mixers was covered in 73 some time back, and judging from the reports sent in by the readers, that twin triode mixer was just what the doctor ordered.

I was quite skeptical of trying the Nuvistor on the lower frequencies. The arguments usually presented are that a well designed pentode rf stage will be quieter than the noise level picked up by your antenna so any further improvement in noise figure is frosting on the cake. The catch to this whole thing is the phrase "Well designed pentode, etc." However, I decided to give it a whirl, and I must say I was pleasantly surprised with the results. The increase in sensitivity was nothing short of astounding, although this is not of any great advantage unless you are using an S-38 or something of that ilk. The biggest advantage was the vast improvement in image rejection. My receiver happens to be a Knight R-100, which is quite adequate as a tuneable *if* since I operate VHF only. In listening

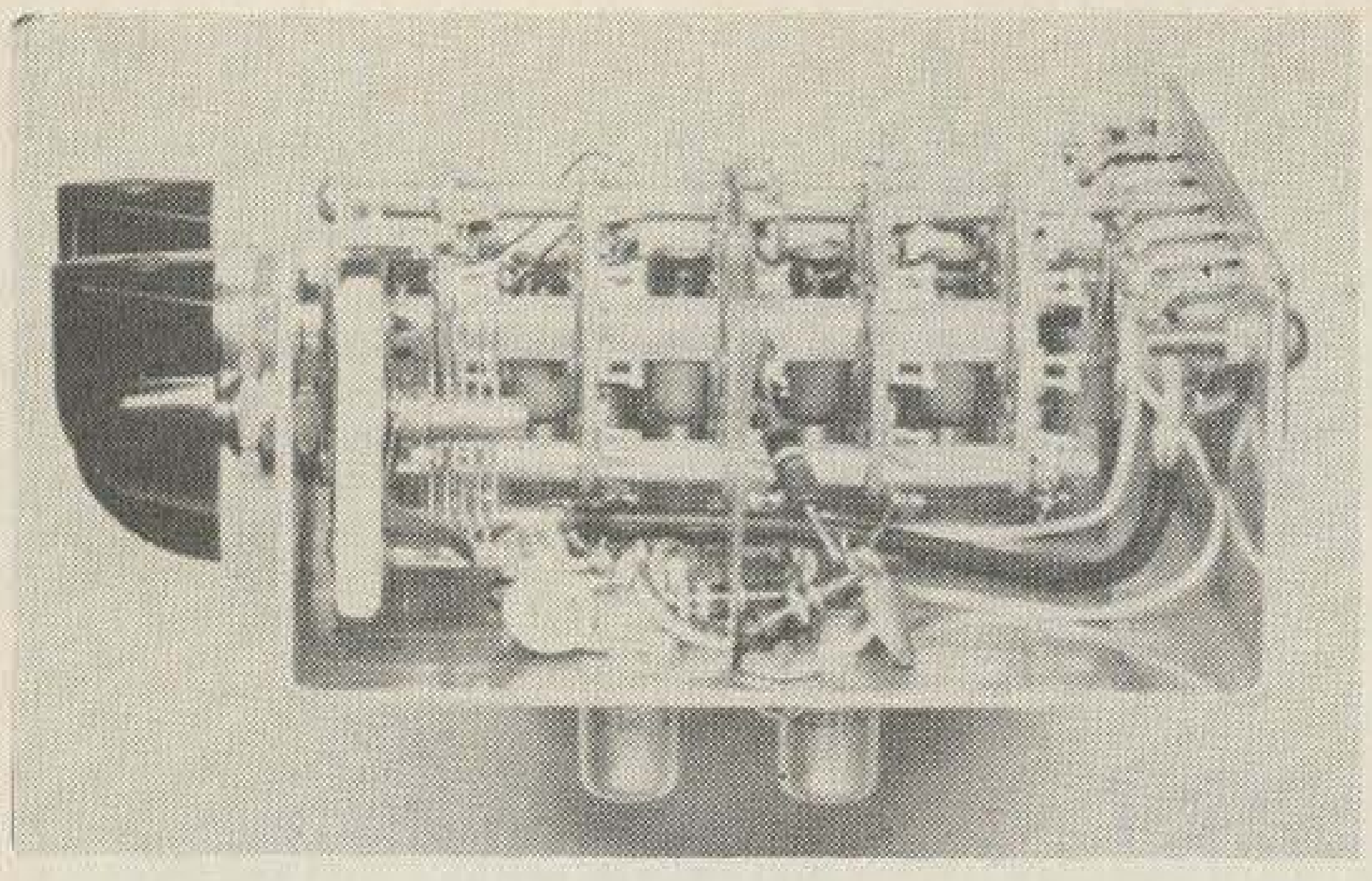


around the lower frequencies, I had come to the conclusion that the image rejection was nothing fabulous, and on 20 meters or more it became almost non-existent. Switching this pre-selector in and out of the line causes the images to drop right out of the picture. Also, don't neglect what this increase in image rejection can do to help lick the noise. Any noise at the image frequency will come right on into the mixer and help cover up that weak one you wish to hear. The better the image rejection the less image noise or interference will get through.

From the electrical standpoint there is nothing new or unusual about the pre-amp. It is the standard old cascode circuit which has been around for years. A purist might wish to neutralize the amplifier, but this was omitted in order to simplify the bandswitching circuits. A pre-amp bypass line was provided in the OFF position of the switch for obvious reasons. The heaters remain on at all times and B+ is switched to kill the pre-amp when not in use. Power can easily be robbed from the receiver's power supply. Don't worry if your receiver has regulated 105 instead of 150 volts. The Nuvistors won't know the difference. The Centralab #1017 bandswitch has eleven positions available, so if you wish to add more coils and have additional bands available, go right



ahead. For VHF use, the output link, L4 should go directly to the appropriate converter, and the output of the converter brought back to the proper contact of S-1E. In this manner you may have 80 thru at least 2 meters available at the turn of the switch, without all the plugging and unplugging of converters and power supplies. Naturally if you have separate antennas for the VHF bands they should bypass S-1A and go directly to the link on the coil in use. Although this pre-amp has not been used above 2 meters, the nuvistors are quite capable so you can experiment



with some hairpin loops right on the switch contacts for even higher frequencies. Don't forget to set the trimmer, C-2 to minimum capacity or you'll never make it.

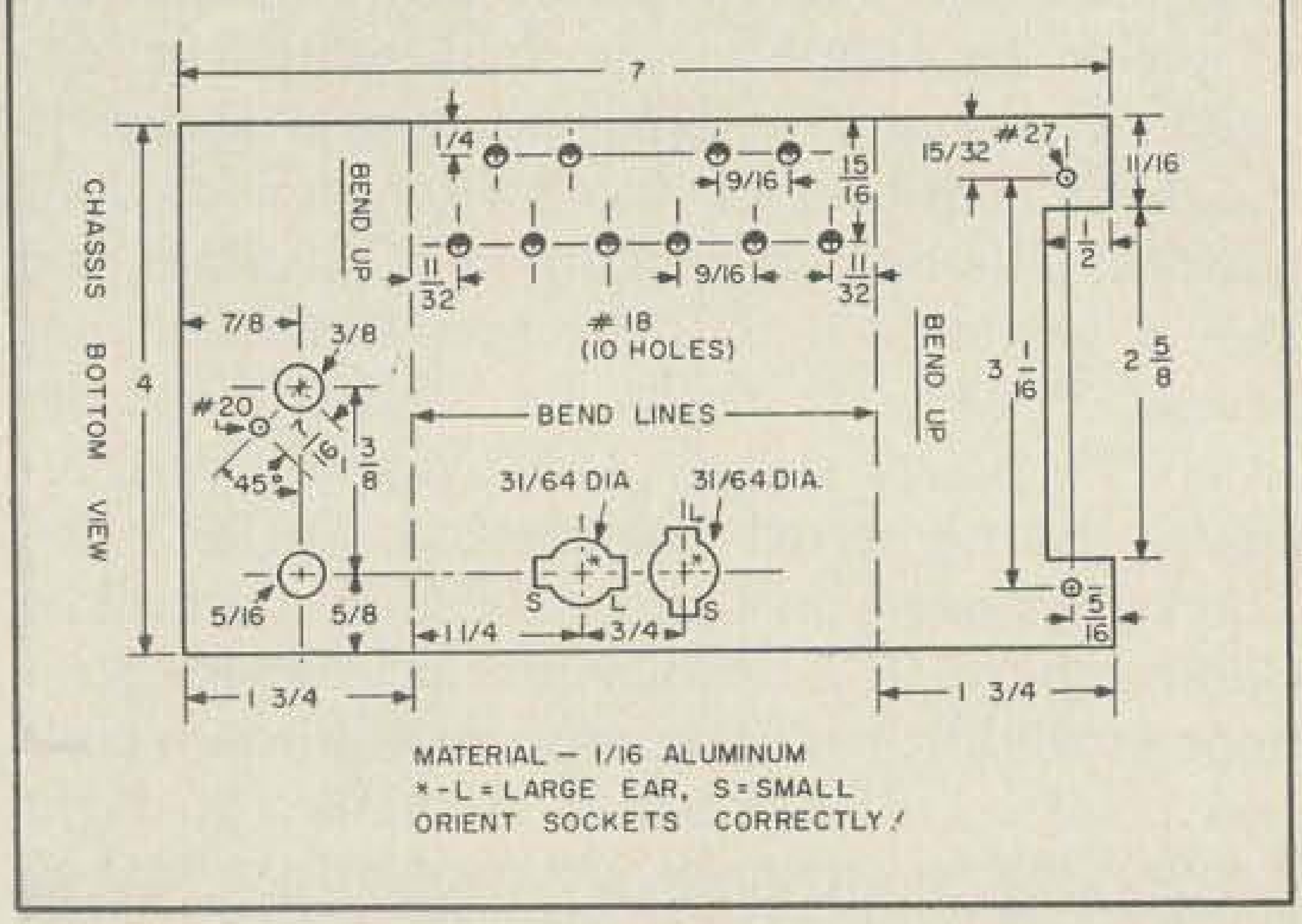
Many of the physical layout details can be seen in the underside photos, however the necessary dimensions are given in the chassis layout, Fig. 2. The two sheet metal shields which separate the input and output stages have not been detailed and should be fitted after all the other parts have been mounted. They are quite necessary, so don't eliminate them or you'll have an unstable VFO for your efforts. After all the holes have been drilled, bend up the two ends to form the chassis. Make sure you bend them the right way or you'll have a nice conversation piece. The Nuvistor sockets are placed in their respective holes, and the tabs bent over and peened with a drift punch.

Wiring the nuvistor stages themselves is very easy as all parts go point to point. The bandswitch is another matter. The task is somewhat simpler if you solder some pieces of bus bar to the switch contacts before mounting it (S-1B and S-1D only). The jumpers on the B+ wafer, S-1C may be installed before mounting the switch. The switch sections are designated S-1A thru E starting at the front panel end. The coils were all wound starting at the open end of the coil, which is the "hot" end in all cases, and the links were wound over the bottom or "cold" end. A ground lug was mounted under each of the 15 meter coils and is used as a common tie point for all of the links. The capacitors are mounted on the terminals on each coil.



After completion, grid dip the coils to their approximate frequency and try it out. The slugs may then be adjusted to exact frequency. There will be more than enough gain, so the coils may be stagger tuned for each band. VHF coils mounted on the switch contacts (not shown in the photos) may be adjusted by squeezing or spreading the turns.

In use, the Pre-selector will add enough gain that cross modulation may become a problem in congested areas. Running your receiver at low rf gain should help this condition. If it is still a problem, an rf gain control may be added in the cathode of the first Nuvistor. A 5K pot bypassed with a .005 mfd capacitor should fill the bill.




Since writing the above, I went back to the bench and tried the Pre-selector out again with both an NC-98 and an S-38. As mentioned earlier the main advantage was the improvement in image rejection. The additional gain was necessary only on the higher frequencies with the NC-98, but on the S-38 it made the difference between hearing signals on all bands or hearing only mixer noise (with 60 cycles). I hope you feel as I do that the Pre-selector puts a lot more steam in your receiver for a lot fewer bucks than trading for a new "sooper 17" at several hundred extra cash. Thanks to John Yeagle, K8MSB for his help on the circuit drawing and layout. . . . K8AOE

**Coil Table**

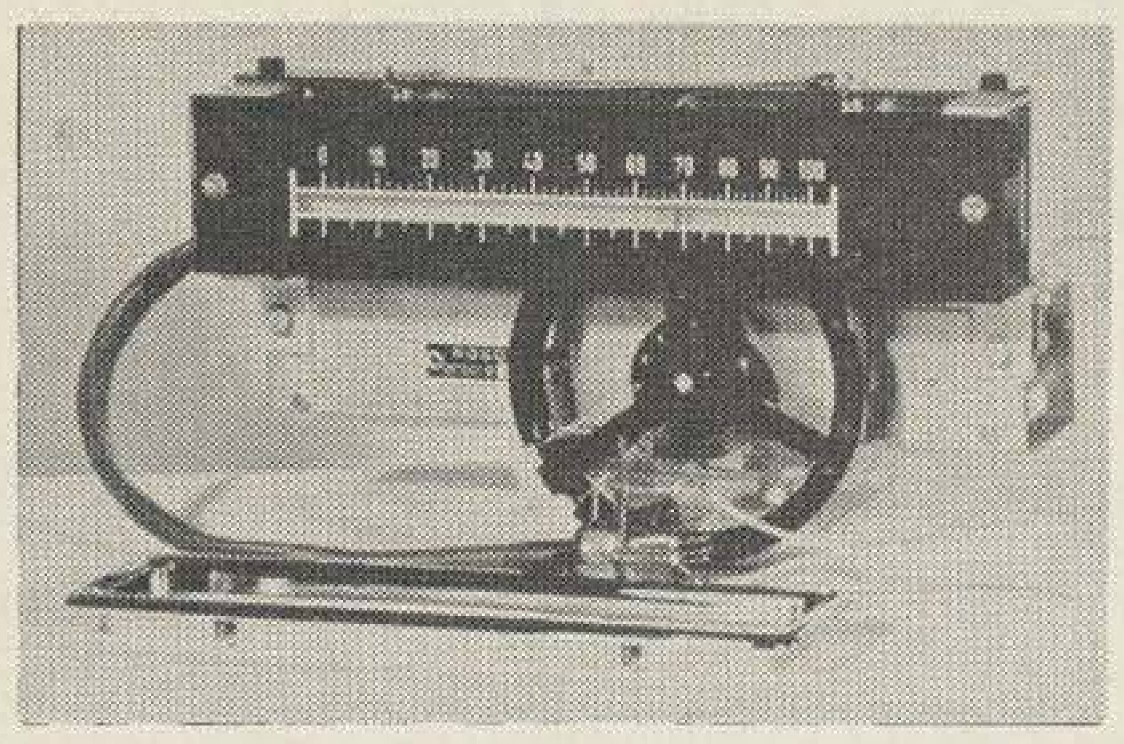
| BAND | $L_1$-$L_4$ | $L_2$-$L_8$ | $C_1$-$C_3$ |
|---|---|---|---|
| 80M | 9T | 45T | 130 PF |
| 40M | 5T | 27T | 91 PF |
| 20M | 4T | 17T | 25 PF |
| 15M | 3T | 15T | 15 PF |
| 10M | 2T | 11T | 10 PF |

Wire Size—#32 Enam.

**Misc. Parts**

Coil Forms—C.T.C. LSM-E
Bandswitch-CRL—1017
Terminal Strip-Cinch 17-6
$C_2$-Hammarlund HF-35
Nuvistor Sockets-Cinch 133-65-10-001

# THE NOGOTON TWO METER RECEIVER



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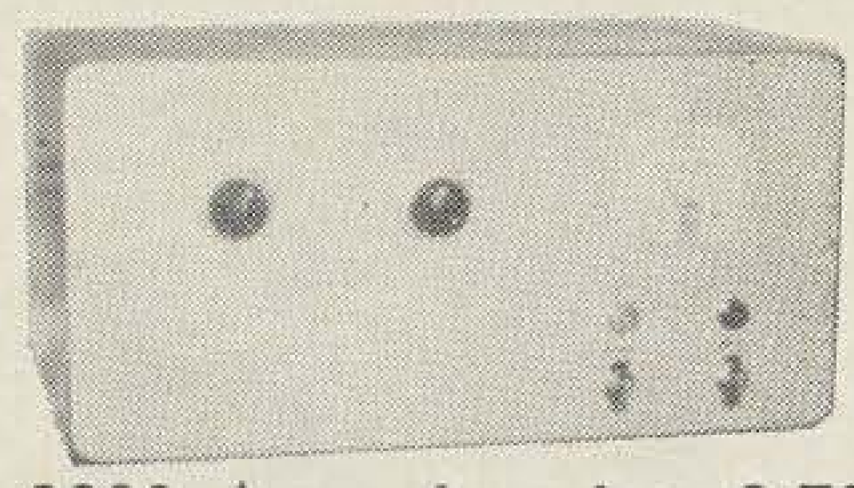

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ONE very obvious application of transistors is in dc amplifiers. The low weight and simple circuits make transistor amplifiers truly ideal. To narrow the application further, dc amplifiers to increase meter ranges are a logical step. Such amplifiers can make possible a 0 — 0.1 microampere (full scale) meter that is rugged enough for any type of field operation. Pocket size VTVM's are also a possibility. Think of having a VTVM in your pocket on outside calls!

Rugged meters, such as 0 — 100 microamp can be used. In most cases a single small battery will supply power for many months. Potting in epoxy is possible, giving greatly extended service life and freedom from moisture or atmosphere conditions.

However, there is another side to the picture. We all have read about temperature effects on transistors, but until you try a dc amplifier you cannot fully appreciate it. To

Fig. 1. Two transistorized meter amplifiers. The top amplifier uses push-pull transistors to eliminate the temperature effect, and also has a self-contained battery. The bottom board is used with a 1.0 ma meter which is not as sensitive to the temperature effect, and power for it is tapped off the circuit in which it is used.

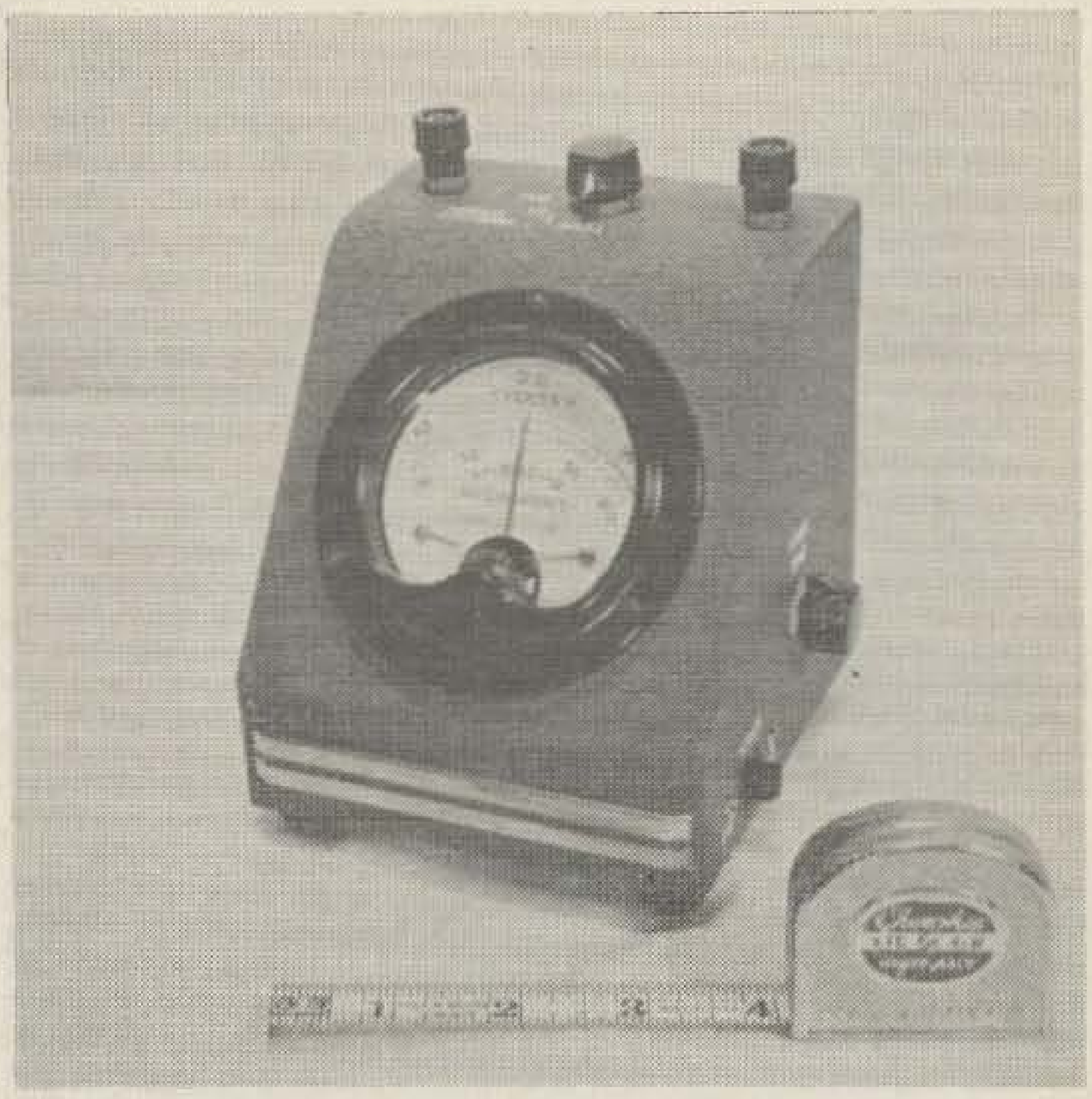


Fig. 3. The experimental wide range microammeter. The circuit fits easily into a three-inch meter case. The side of the case holds the power switch and the zero adjustment. An army surplus meter is used, removed from a teletype bias meter circuit, having a sensitivity of approximately one milliampere each side of center.

quote one electronic authority, "transistors are better thermistors than thermistors!" And this is literally true. In fact the percent of change with temperature is greater with a transistor than with a thermistor. Even with this objection it is still possible to build a practical circuit. Another troublesome feature of a transistorized dc amplifier is that the internal resistance of the circuit to be measured must be high. We can avoid this difficulty, however, by limiting our measuring to very small currents, such as 1 microamp.

Even with these disadvantages, the transistor compares favorably with the vacuum tube. Considering the extra bucking batteries, the higher voltages required, and the necessary waste of a heater supply, you might wonder if the vacuum tube compares favorably with the transistor! However, the simple, re-

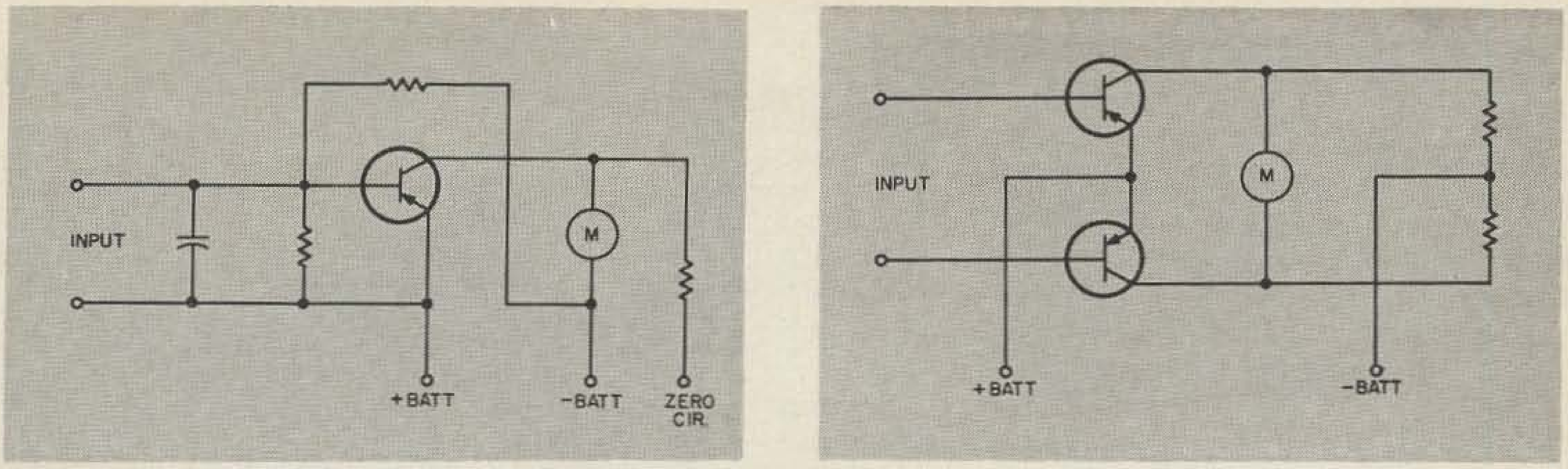



Fig. 2. Schematic of boards in Fig. 1.

liable operation of transistors is offset by the excellent input characteristics of the vacuum tube.

It is possible to build a transistor dc amplifier using only one transistor. Even though such an amplifier is sometimes desirable it has two troublesome features. The temperature effect can be partially compensated by proper use of thermistors. The zero signal current of the transistor must be bucked out also, and this requires several resistors and a potentiometer in some cases, and a bucking battery in addition, in others. Fig. 1 and 2 show the mounting board and schematic of a single transistor amplifier. The amplifier is constructed on a printed circuit board and designed to mount on the back of a meter directly.

A typical practical ciruit is shown in Fig. 3, 4, with the schematic in Fig. 5. This is a transistor dc amplifier, used to measure currents from 0.1 to 1000 microamperes. The amplifier is constructed on a printed circuit board which I constructed from a kit sold by Lafayette Radio Co. Although there is no advantage timewise in using printed circuitry on a single instrument, it is a very neat and practical construction method. Two four volt batteries are used in the circuit; one to power the transistor, the other to power the bucking circuit. Compare the simplicity of this circuit with a vacuum tube dc amplifier.

Fig. 4. Rear view of the wide range microammeter. The two mercury batteries can be seen mounted on the bottom of the case. The amplifier circuit is built on a printed circuit board and mounted on the back of the meter. The range calibration resistors are seen at the top of the case.

A low range microamp meter is certainly not a necessity for a service technician. However, in electro-biology, the measuring of very low currents is a frequent occurrence.

By using cascaded transistors, the amplification can be even higher. A reading of 0.01 microamp full scale is possible, using a circuit

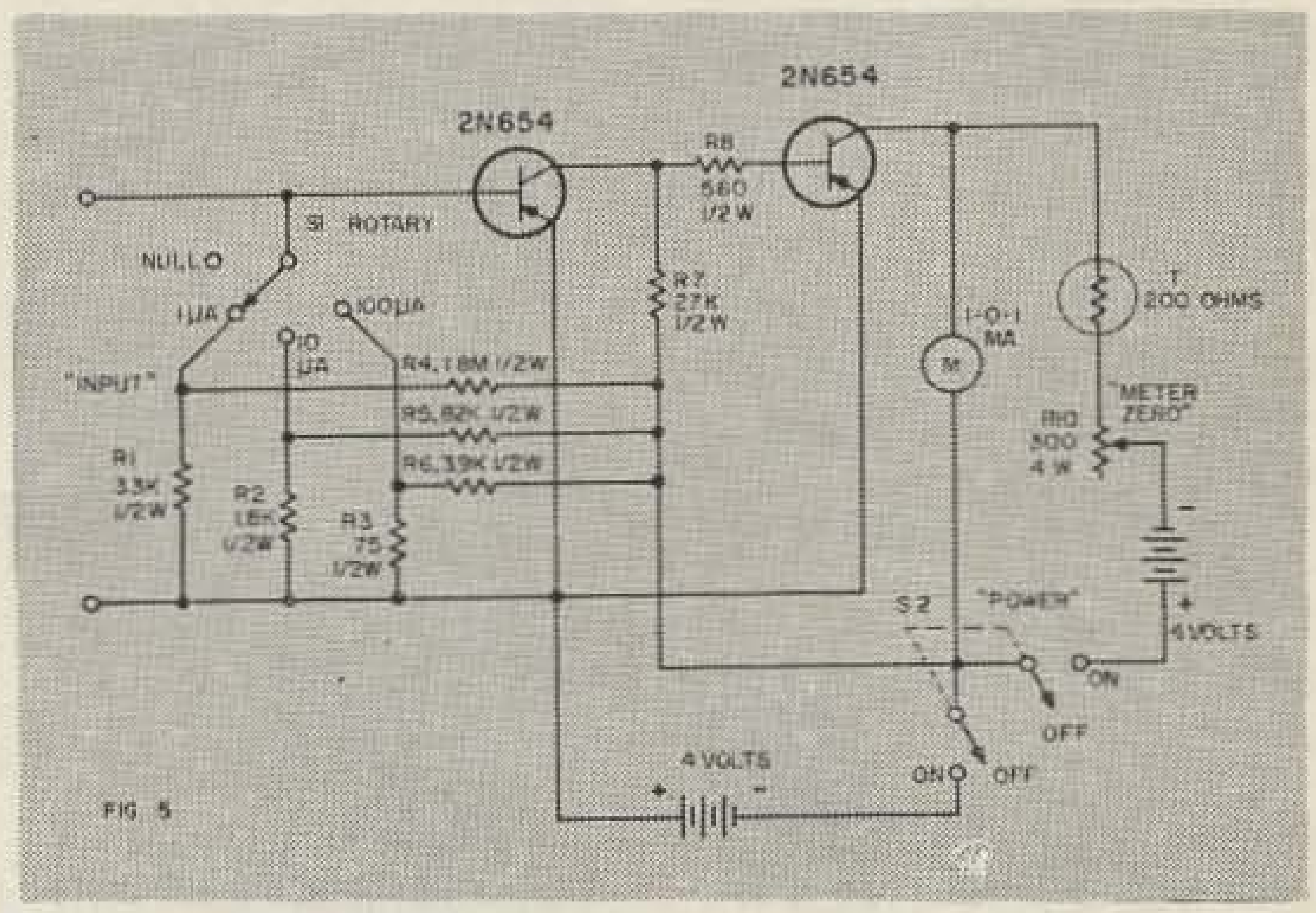



Fig. 5. Wide range micro-ammeter.

such as shown in Fig. 6. Cascade operation has the disadvantage that all your problems are multiplied. This is especially true of the temperature problem. Such a cascaded amplifier, with the input transistor in a parabolic reflector with infrared shield, makes a very effective heat detector. A dc to ac to dc converter circuit should be considered for more reliable operation if greater amplification is needed.

A further simplification of the circuit develops if push-pull operation is used. Although the number of transistors is doubled, the temperature problem is considerably reduced. The zero bucking circuit can be eliminated altogether, of course.

Figs. 1 and 2 illustrate a push-pull transistor amplifier. As the diagram shows, this is true push-pull amplification, and the meter will indicate zero with no input and the circuit balanced. The temperature effect will tend to cancel itself also if two similar transistors are used. It will be unnoticeable with a 0 — 1 ma meter, but it will be necessary to provide a balancing potentiometer for a zero adjustment when using a 0 — 50 microamp meter.

You will notice that the transistors are connected in a common collector type circuit. The reason for this is although the current gain is slightly less in this connection, the temperature variation is greatly improved.

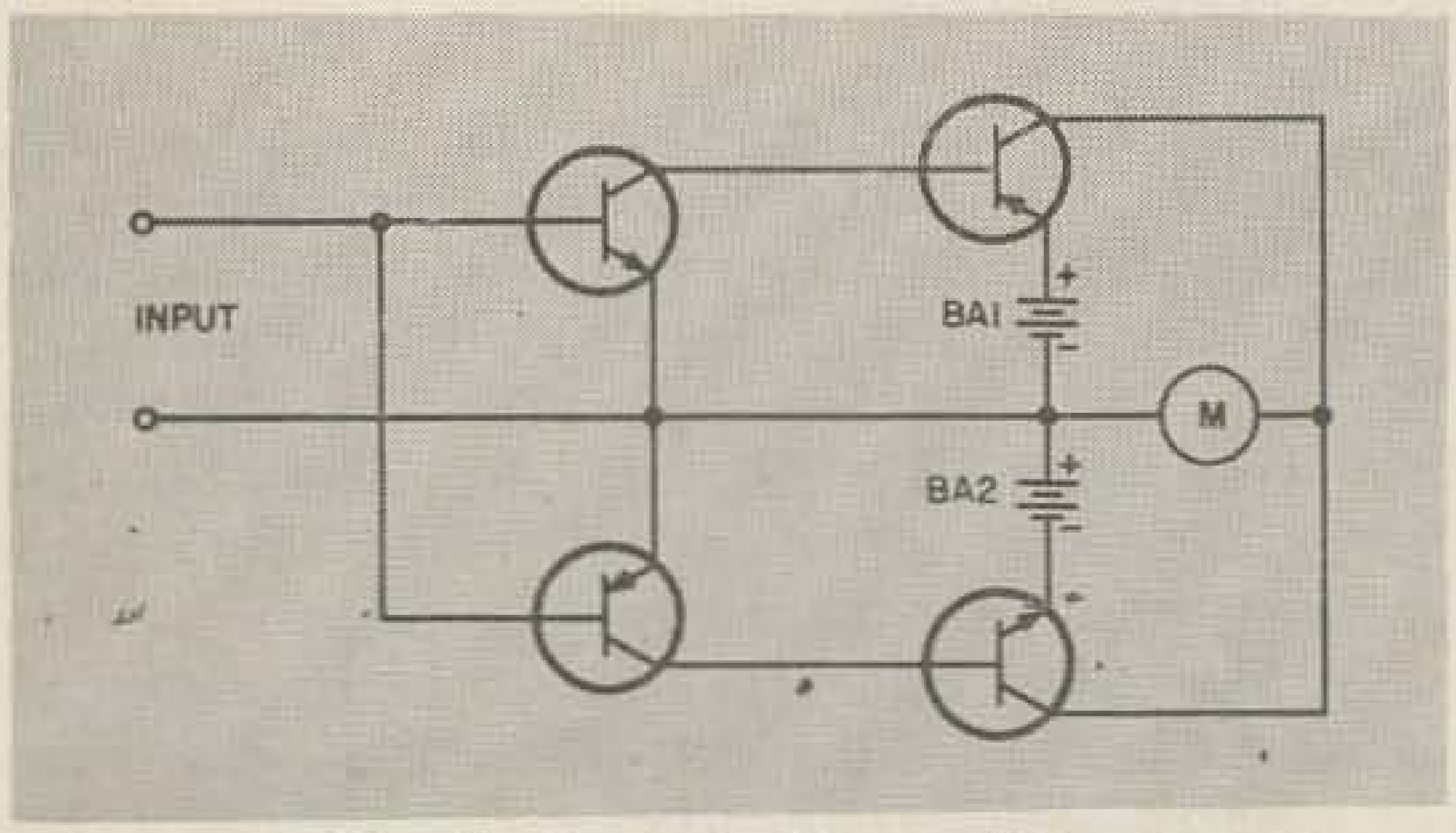



Fig. 6. Cascode dc amplifier.

Cascaded push-pull circuits are much more practical than single ended circuits, since the temperature compensation necessary will be substantially less.

A perfect application for a push-pull transistor dc amplifier suggests itself immediately. A pocket VTVM! What service technician has not wished for such an instrument?

It is in fact an easy matter to add a VTVM circuit to your VOM, if we consider the following items. First, the only advantage of the


Fig. 7. Front view of the modified VOM. The VTVM jack was originally the OUTPUT jack. The only mechanical work necessary is the mounting of the power switch on the top right side of the meter. Of course, if your meter is a different type, you will want to change the design to suit your requirements.

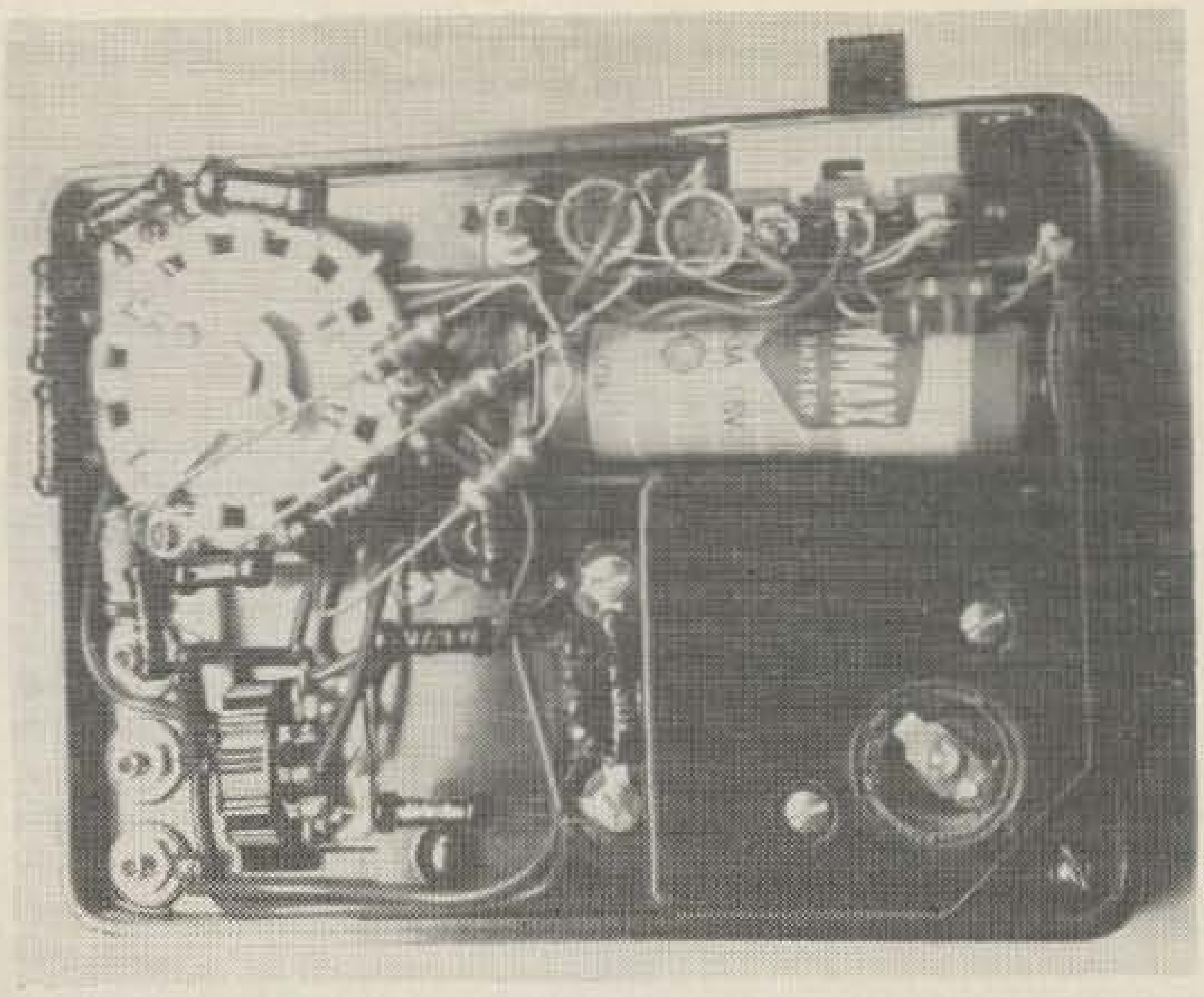
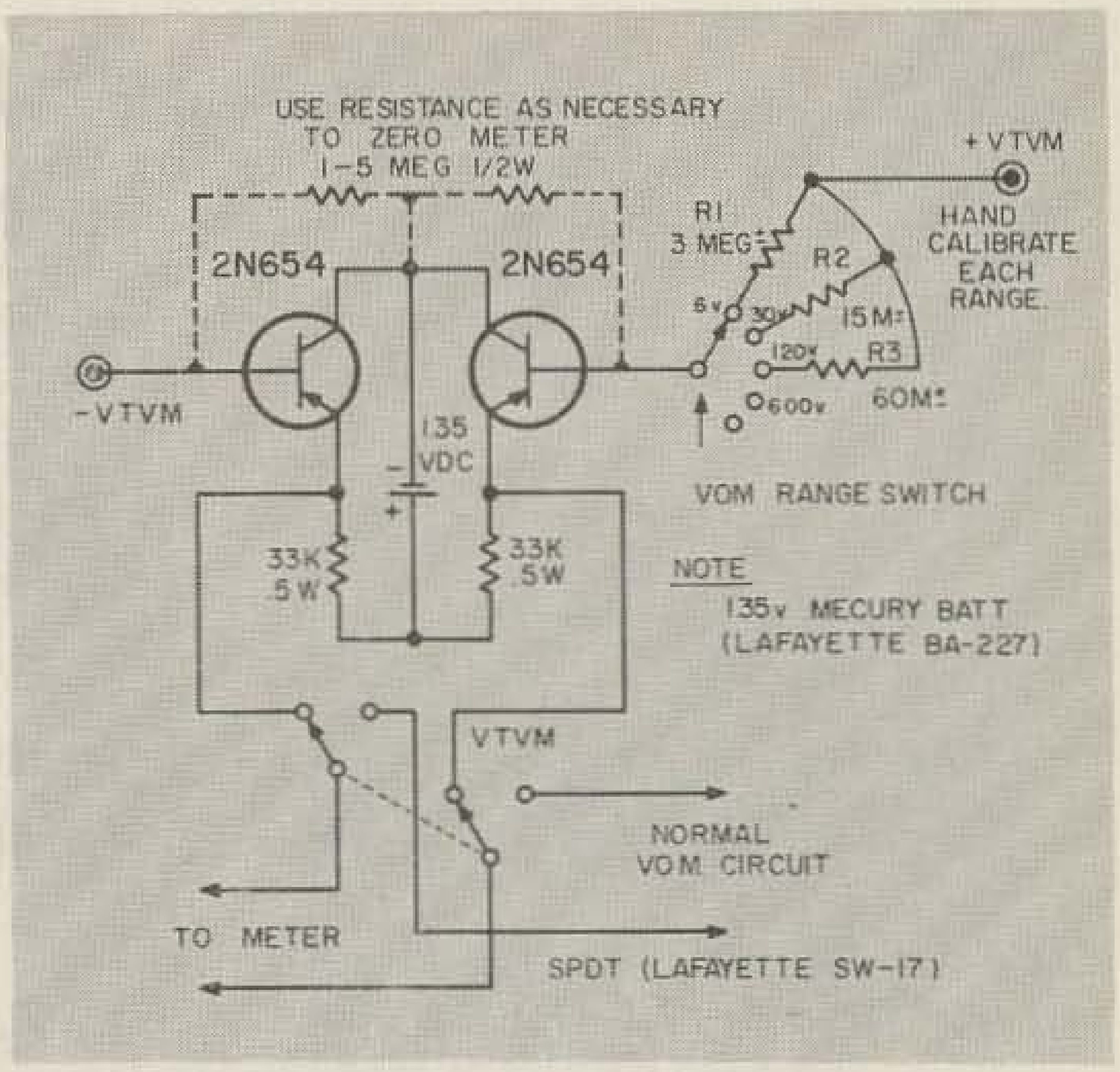


Fig. 8. Even though the space is very limited in this meter, the small size of the modification components allows easy mounting.

VTVM over the VOM (20000 ohms/volt) is in measuring dc voltages from 1 to 300 volts. This is easy to see if we examine the differences between these two types of meters. On ohms measurement, circuit loading is not a factor, and the meters are equal in their applications. The same is true in most cases on ac volts measurement, since the ac voltage source is usually of a low impedance. The input resistance of a VOM above 300 volts dc *exceeds* the input resistance of a VTVM, and will give *less*




SW17 is DPDT

circuit loading. Then to have a pocket size VTVM, it is only necessary to make the input resistance of the VOM comparable to the VTVM on the low voltage ranges. The transistor dc amplifier is perfect for this application.

It would be possible to outboard the transistor amplifier circuit, but this is unsightly and inconvenient. The transistor circuit can be easily fitted into the smallest of VOM's. The cost is low, and potting with epoxy resin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Figs. 7 and 8 show a VOM with a VTVM circuit added. This is a 10,000 ohm per volt meter, having a basic meter sensitivity of 80 microamperes, full scale. With most medium power transistors, a full scale reading of 2 microamperes is easily possible. This means, on the three ranges used, the input resistance will be 3 megohms. The next scale, 600 volts, has an input resistance of 6 megohms, and there is little advantage in increasing this for the majority of applications.

A double-pole double-throw switch was added to the side of the meter, to switch from VOM to VTVM operation. A notch is cut in the meter back, and the switch is secured in place with epoxy resin. No power switch is used, but even the small battery will last one to two years, so a power switch is really not necessary. The regular 1.5 volt penlite cell is removed from the meter, and two mercury cells used in its place, one acting as the ohmmeter battery and the other to power the transistor amplifier. The normal OUTPUT jack of the VOM was disconnected, and labeled VTVM. When using the VTVM, input is made to this jack and the added jack, J.

Added to the low cost and simplicity is the fact that the VTVM conversion does not affect the regular VOM operation on any range.

Although only two specific practical circuits are shown here, the features of transistor amplifiers are equal to a tremendous variety of applications. In some instances it may be economical to consider raising the sensitivity of a 100 microamp or 1 milliamp meter permanently through the use of potted, transistorized dc amplifiers, built directly into the meter case.

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# Rambunctious Radiations

James Ligon, W4KOC
Ex K2AQN, F7BB, 3A2AQ
2185 Hawthorne St.
Sarasota, Florida

OUR hobby of ham radio can certainly produce some bizarre and confusing situations. All of us have experienced at one time or another certain phenomena which defy logical explanation and which appear directly contrary to some of the accepted positions of Messrs. Ohm and Kirchoff.

When these confusing, and certainly at times frustrating, occurrences take place, we tend to blame "gremlins" or the "innate perversity of inanimate objects" (short name: IPIO, pronounced "Ippy-O"), or perhaps some other unscientific scapegoat. Now it is quite possible that an explanation can be found in Mr. Einstein's Theory of Relativity — at least in that part which upon analysis reveals itself as "it depends upon the point of view." His position seems to relate the human factor or "the innate perversity of animated Homo sapiens" (short name: IPAHS, pronounced "Eye-Pass") to the problem.

As a common and interesting example, let us consider the matter of transmitting antennas as related to power input and the effective radiation as evidenced by the signals at the receiving end.

Antennas have an interesting property referred to as gain. This is the plus or minus power factor of a particular antenna as compared with a reference radiator. Perhaps it would assist in our understanding if we simply say that some antennas are better or worse than others and that this difference is measurable in decibels.

The following are a few of my own documented experiences while in Europe operating with a 120 watt commercial transmitter.

I first used a long wire antenna. It was never actually measured electrically or physically but it was really quite long. This antenna worked well for European contacts but proved erratic when working W-land. I rigged a rope and pulley arrangement so that the end opposite the transmitter could be rotated about 90° and laid directly on Stateside. Voila! A rotatable long wire. Results followed somewhat the following pattern:

W2: CQ DX.

F7BB: Your signals 5x9 here in Orleans, France. Handle here Jim, tx 120 watts, antenna rotatable long wire.

W2: Thanks for call. F7 not DX. Your signals 3/4 x 4/5 in New York. See you later. CQ DX.

Another W2: CQ DX.

F7BB: Your signals 5 x 7/8, etc.

This W2: Thanks OM. You are my first F7. Your signals 5 x 9 + + + here in New York. Please give address will QSL direct with round trip ticket to US.

These same phenomena held for practically all my W-land contacts — no matter the antenna — long wire, folded dipole, flat-top beam, Sterba curtain, etc.

This was a most confusing situation. I was discouraged and unhappy. As I was licensed as 3A2AQ, a vacation to the French Riviera and Monoco appeared in order.

In discussing my plans over the air, signal reports suddenly and without logical reason increased to 5x9 minimum. Further confusion!

In Monoco, the regular 3A2AQ antenna was a random length of wire which extended from the balcony of my fifth floor room down and across the small interior patio of the hotel, terminating about six feet above the ground.

Prior to critical analysis of my operations, I knew that this antenna was to be far superior to those used at the home QTH. Stateside contacts indicated that I was "local broadcast quality in Siwash" and would I please listen for W Ooble Ooble two up or down as he was also reading me 5 and 9er. This same situation prevailed when I loaded the balcony railing and the door screen. No appreciable change in signal reports was noted when I loaded the bedsprings on 20 meters. I was very happy with these reports particularly considering the extreme difficulty I was encountering copying the KW beams.

Upon my return home, I found that the vacation had done wonders not only for me but for my rig and antenna system as well, for in discussing the trip (and one proposed to PX1-land) no report was less than 5x9.

There are undoubtedly numerous valid and informative conclusions to be gained from these experiences but I shall leave detailed evaluations to those readers who may be interested. My conclusion relates only to the human factor, as I see it, in Einstein's Relativity Theory and that is: regardless of sunspot activity, if the Ws want to work you, they will — it depends upon their point of view — IPAHS!

. . . W4KOC

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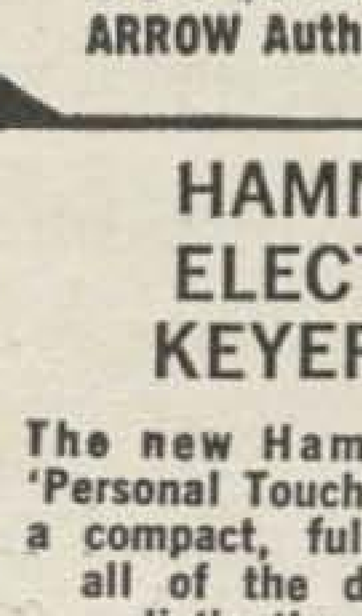

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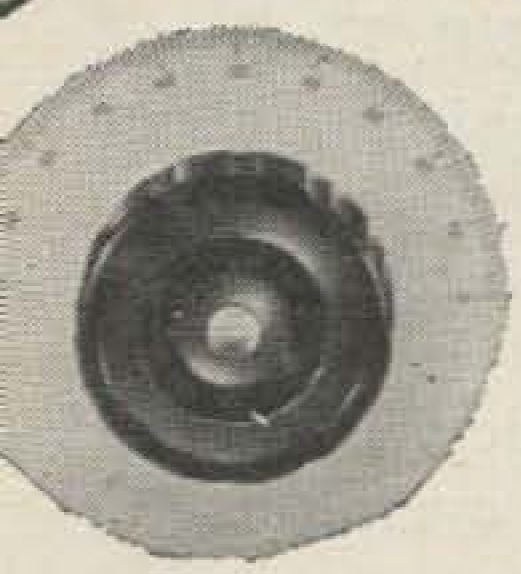

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Southport, North Carolina

# The Windom

IN radio's infancy a man named Hertz did wonders with things he modestly called Hertzian waves. In carrying out his early experiments he devised an antenna known (oddly enough) as the Hertz antenna. It worked well.

During the '30's a ham by name of Loren Windom, W8GZ, refined the old Hertz antenna, the modification becoming known as the Windom antenna. In principle the Windom was a Hertz antenna, fed off-center.

One of the first antennas I tried was a Windom. It worked well and was downright cheap to put up! I have always liked it.

Recently, though, I ran into some snags with one and consulted Windom. His advice was so sound, and it brought about such a marked change in the performance of my version of his antenna, I decided to pass along to others some of the things I've learned about the Windom.

In essence, the Windom is an off-center fed, harmonic antenna. That is, it will work with almost equal effectiveness on all frequencies lying in a direct harmonic relationship to the fundamental. It is simple to build, and inexpensive. If you have an old 80 meter dipole, it probably won't cost you a penny; if you have to go out and buy everything, it still will run only a few dollars.

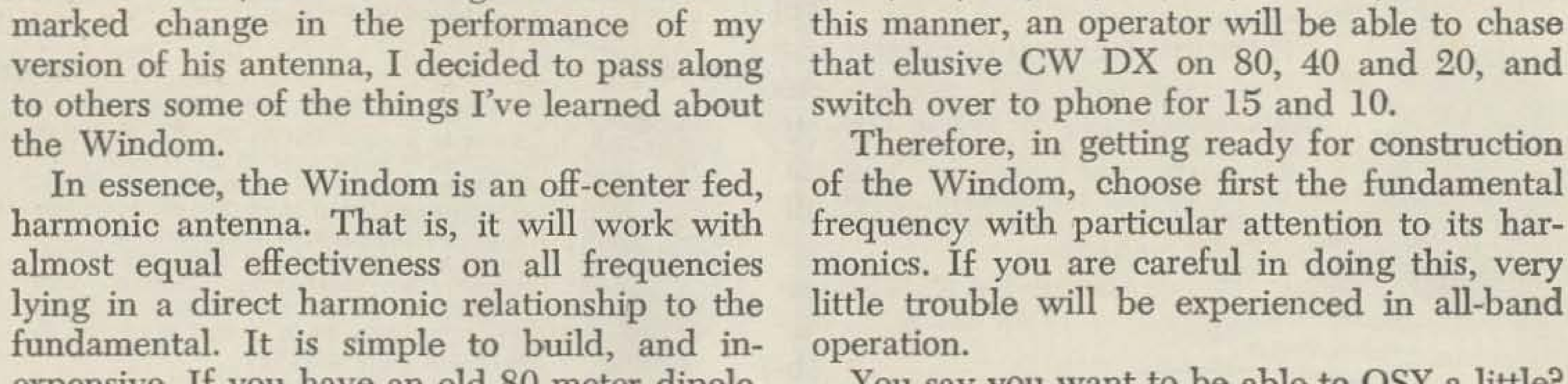
First, you will need two antenna insulators. If you run a few hundred watts, a couple of 5¢ egg insulators will be perfectly sufficient. Next, you will need a length of #14 wire. How much depends on the fundamental frequency to which your antenna will be cut, plus enough for the feedline. And that is absolutely all!

Before going further, it would be well to brush up on the characteristics of harmonic antennas. First, with just a small amount of investigation, it can easily be determined that all CW bands fall into perfectly related harmonics; that is, 3.5–7.0–14.0–21.0–28.0 mc. However, the rub lies with the phone bands: they do not fall into such perfect harmonic relationships. Therefore, if one operates mostly CW on the lower frequencies (and most DX chasers do) and mostly phone on the high bands, 10 and 15, the Windom is a perfect choice for an all-band antenna. Here's why: if the antenna is cut for, say, 3550 kc as the fundamental frequency, its harmonics will fall on 7,100, 14,200, 21,300, and 28,400 kc. In this manner, an operator will be able to chase that elusive CW DX on 80, 40 and 20, and switch over to phone for 15 and 10.

Therefore, in getting ready for construction of the Windom, choose first the fundamental frequency with particular attention to its harmonics. If you are careful in doing this, very little trouble will be experienced in all-band operation.

You say you want to be able to QSY a little? According to W8GZ, a frequency deviation which is not too great will have negligible effects on radiated power and SWR. However, if your antenna is cut for a harmonic frequency of 28,400 and you desire to operate it on a 29,600 ground wave net, better choose a dipole.

After a fundamental frequency has been chosen, refer to the chart for the overall length of the flat-top portion of the antenna.



Now, what makes this antenna off-center fed is the simple fact that a *single feed-line* (*not* 300 ohm ribbon) is connected to the flat-top a certain distance off center. Special emphasis should be given to the feed-line here as almost all hams which I have contacted question that. It *is* a single piece of #14 wire, just like the flat-top, of random length. It is soldered directly to the flat-top at the proper point. The other end of it goes directly to the output of the rig, or antenna coupler (preferably the latter, but the former works quite well with a pi-net output).

The distance off center is fairly critical, and close attention should be given to the accompanying chart showing this. Be sure the joint between the feed-line and flat-top is clean, and well soldered.

In erecting the antenna, the feed-line should come away at right angles to the flat-top for as great a distance as practical. It should not have any sharp bends in it, either.

Now, here's what makes this antenna such a dilly for high frequency DX work. It acts just like a long-wire on those frequencies. And anyone who has ever read anything on antenna fundamentals knows that the longer a long-wire is, the greater its gain and directivity. And the gain on a wire of this length on 10 meters is not to be sneezed at! Neither is its directivity! With a little care in erection, a whopping signal can be pin-pointed in a certain locality with one of these antennas.

For exactly how much gain, and what sort of pattern to be expected, refer to the charts in the ARRL Antenna Handbook. Remember that an 80 meter antenna that is a half-wave at the fundamental frequency is a full-wave at 40 meters, two full wavelengths on 20, three and a half on 15, and no less than four wavelengths at 10 meters.

"Sounds great so far," I hear you say . . . "what about TVI . . . after all, the neighbors are real dogs when it comes to "Gunsmoke"." If they have a 21 mc *if* in the TV set, there's a simple solution . . . move. If not, there is little to worry about, *so long as you have a good ground!* Of course, this should apply to any transmitter, but to one which gets its whole theory from operating against ground, it's doubly important. I have had no trouble with my Windom by operating against a ground comprised of an 8′ rod driven into the ground a depth of 7′. A good ground is a necessity.

TVI suppression will be all the better, as well as loading problems, if a good coupler is used. If you don't have a good ground or a coupler then listen to this direct quote from

W8GZ: "I still hold the world's record for miles per watt using the antenna WITHOUT ANY GROUND WHATSOEVER on a battery operated 199 tube!"

Now a word or so about the recent trend toward modifying these antennas and using a 300 ohm TV ribbon feed-line. The Handbook says that many hams are doing this, claiming good results, but I think this is more fancy than fact. This is confirmed by the fact that the characteristic impedance of this antenna (using #12 or #14 wire) is 500 ohms at the feed point. Therefore, if balanced feed is desired, it should be effected through 450, or 500, ohm open wire feeders, *not* 300 ohm. The use of 300 ohm ribbon only adds to a mismatch.

Finally, the question must always be asked, "Does it work?" Basing my opinion on my own results with it, I say most heartily that it does! Using 100 watts maximum input, phone operation only, I have worked into Hawaii, Puerto Rico and Canada on 40 meters with over S-9 reports. The latest hour of the night for any of these QSOs was 2300 EST. Many comments were received from Stateside hams who told me my 100 watts was "the loudest signal on the band." A series of tests was run with a ham in Maine over a period of several weeks with the Windom, again on 40 phone, and the weakest signal strength reported was five over S-9. But to top this all off was the fact that New Zealand on 40 phone was worked!

On the higher bands, over 70 countries have been worked using the Windom. All of this was on phone operation during the late summer of 1961 when band condition on 15 and 10 were not red hot.

The Windom deserves a place of recognition in today's antenna repertoire; it is inherently a sound antenna, using straightforward principles, and is very economical. Remember, should you put one up, that the overall length must depend on the fundamental and harmonic frequencies, that the feedline must be tapped in very carefully at the prescribed distance off center, and it should always be worked against a good ground.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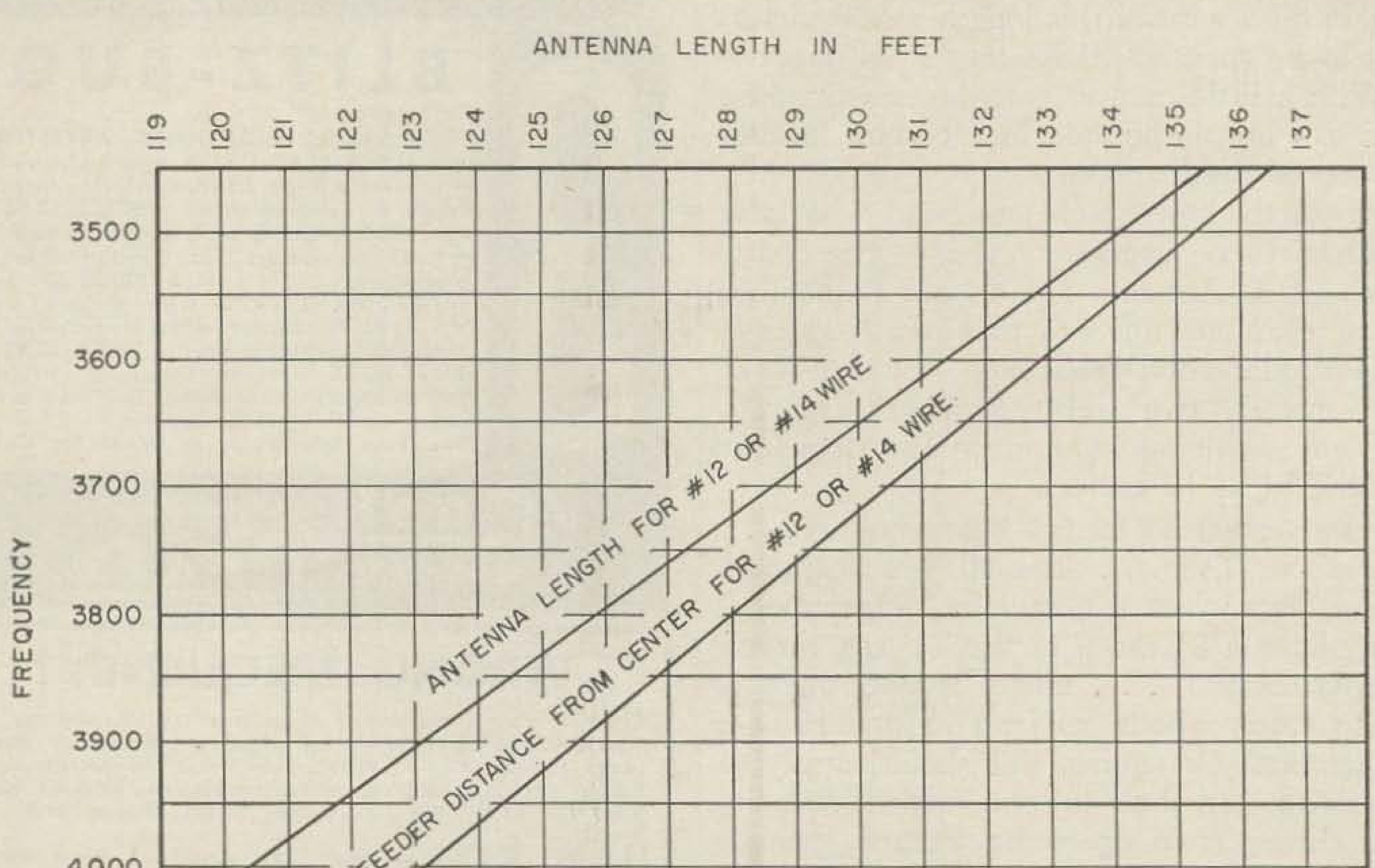


NOTE IF AN ANTENNA FOR 160 METERS AS FUNDAMENTAL FREQ IS DESIRED LENGTHS WILL BE TWICE THE ABOVE

EXAMPLE 1800 KCS = 1/2 OF 1300 KCS = 2 X 131' 4" = 262 8"

FEEDER LENGTH FROM CENTER = 36

# to each his own


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# The Whistler

Bill Leonard W2SKE

THE rig they are using on Deception Island these days uses 12 power transistors in parellel in the final running 1 KW input on 5 kc.

The antenna *is* Deception Island, a no-good location for anything but penquins, or a man trying to figure out how to work out on 5 kc.

One of these bitter winter nights a couple of British scientists will key that alternator, and hopeful folks like Professor Millett G. Morgan, W1HDA, and Wilbur C. Johnson, W1FGO, ten thousand miles away in Hanover, New Hampshire will listen for them.

For a receiver Morgan and Johnson can disconnect the family hi-fi set and replace the phono pickup with an antenna, a closed loop, 50 by 100 feet.

All the above is for real . . . simply the latest and most dramatic phase of their five year search for the Whistler!

A Whistler is not a character in a channel 2 TV series. It is an ultra low frequency *radio* emission—in the frequency range from 300-15,000 cycles . . . naturally created by an unknown source or sources, not necessarily by visible lightning as was believed for a long time. The Whistler is so called because it sounds like a warble, or whistle . . . the sound rolling down the musical scale from 10 kc to 1 kc in about one second.

Millett Morgan and his associates won't be generating whistlers—just signals of the same nature.

The story of Whistlers, now climaxing with the fantastic "Island Antenna" experiment, starts way back in 1880 in Austria when a scientist heard and made some notes about odd whistle-like noises coming out of telegraph lines. Curiously, the paper in which he described the phenomenon didn't come to the attention of the scientific world until 1955. Whistlers were first actually recorded by a Bell telephone scientist named Burton in 1931 and 1932.

About nine years ago Professor Morgan, attached to Dartmouth College's Thayer Engineering School, became interested in Whistlers, and while most electronic brains have been concentrating in the microwave world, he's lived with them. There's still an enormous amount we don't know about these strange VLF signals, but what we do know can be summed up about as follows:

They are generated by unknown sources (thunderstorms, lightning discharges seem to have *something* to do with it).

They travel with low attenuation along the lines of the earth's magnetic field and, in passing through the earth, move at speeds a lot slower than ordinary radio waves, only 10,000 instead of 186,000 miles per second.

They then keep right on going and penetrate the lower ionosphere, but are reflected back to earth at distances of 8-10,000 *miles*. . . a region where ionization is extremely low, perhaps 100 electrons per cubic centimeter.

In the northeast part of the U. S., the Whistler 'band' is 'open' most frequently between midnight and 3 AM local times.

Although Morgan and his associates recorded and analyzed 2700 kinds of whistler signals (some whistlers go swish, some go pop, and some make a sound like the fellows standing on the corner watching all the girls go by) it became obvious that a controllable emission would be most desirable if further knowledge was to be gained.

Morgan knew, of course, that there's no problem building a high power transmitter at 5 kc . . . the questions was how to radiate energy effectively at that frequency. Let's suppose you could build a half wave dipole (20 miles long), it would be, if suspended from a series of fifty foot telephone poles, the equivalent of a 20 meter antenna about a fifth of an inch off the ground! A vertical of practical height would be such a tiny fraction of a wave length as to do almost no radiating.

But Morgan remembered the slot antenna which is, in essence, the reverse of the ordinary dipole concept . . . i.e., by cutting a hole, or placing an insulator in the middle of a large conducting surface, radio waves will be effectively radiated from the hole, or slot. Slot dimensions are comparable to normal dipole dimensions.

The men set about looking for a natural slot, in the area where Whistlers seem to eminate in great numbers, the South Atlantic. Scanning an atlas, they came across Deception Island, an extinct volcano, just above the Antarctic circle north of the Palmer Peninsula. The island is shaped like a horseshoe, and its total length makes it just about resonant on 5 kc. If it turned out that Deception Island actually would act as an insulator, so that currents generated near its edges actually flowed around the island, perhaps the 'skywire' problem could be solved by a 'seawire.'

Two British scientists set out a year ago laying cables—feeders if you will—in the Deception Island harbor. Wires were laid from the center of the ridge toward the sea in both directions. They were laid ten meters apart and there were ten wires, paralleled at the center. The ends of these were bared for 50 feet, a rock tied on, and the 50 feet flung into the water—one group into the sea outside the island, and the other group into the bay within the arms of the island. The wires were paralleled so that the impedance of the wires would not get into the act any more than necessary. When they measured the surge impedance, it turned out to be amazingly close to 52 ohms!

The British scientific team is now on Deception and soon expects to fire up the rig and poke a signal into receiving locations not only in Hanover, where Morgan and Johnson will be listening, but in a dozen other locations around the world.

Hams interested in trying to get in on some of this extraordinary Whistler DX—we don't know if Deception Island qualifies for separate country status—should contact W. C. Johnson, W1FGO, at Dartmouth College, Hanover, N. H.

The suggestion from this corner is that Morgan and Johnson work up a WOW! (Worked Our Whistler) Award. . . . W2SKE

Jim Kyle K5JKX

# Power Booster

*Increase your rf power output by 35 percent*

WOULD you like to increase the rf power output of your transmitter by 35 percent for less than $6?

If you're now using a rig in the 30-to-90 watt class, with either an 807 or a 6146 as the final amplifier tube, and operating in the 3-30 mc range, you can do this (or at least approach this performance increase) simply by rewiring the final-amplifier socket to accept a type 6DQ5.

Before you rush out to buy the bottle, though a word of caution—this trick works only for the low-frequency gang. The 6DQ5 will not operate at 50 mc and above, because of series resonances within the tube structure; any attempt to use it at these frequencies can result in serious damage to the transmitter.*

In case you're interested in how this "something for nothing" improvement in performance works, take a look at the characteristic curves of both the 6DQ5 and the 6146 (Fig. 1). The key lies in the locations of the "knees" of the curves.

*Yes, this is true, although certain models of Gonset equipment use the 6DQ5 at 50 mc. The tubes they use are specially made, Gonset informs us. Off-the-shelf tubes will not work above about 35 mc.

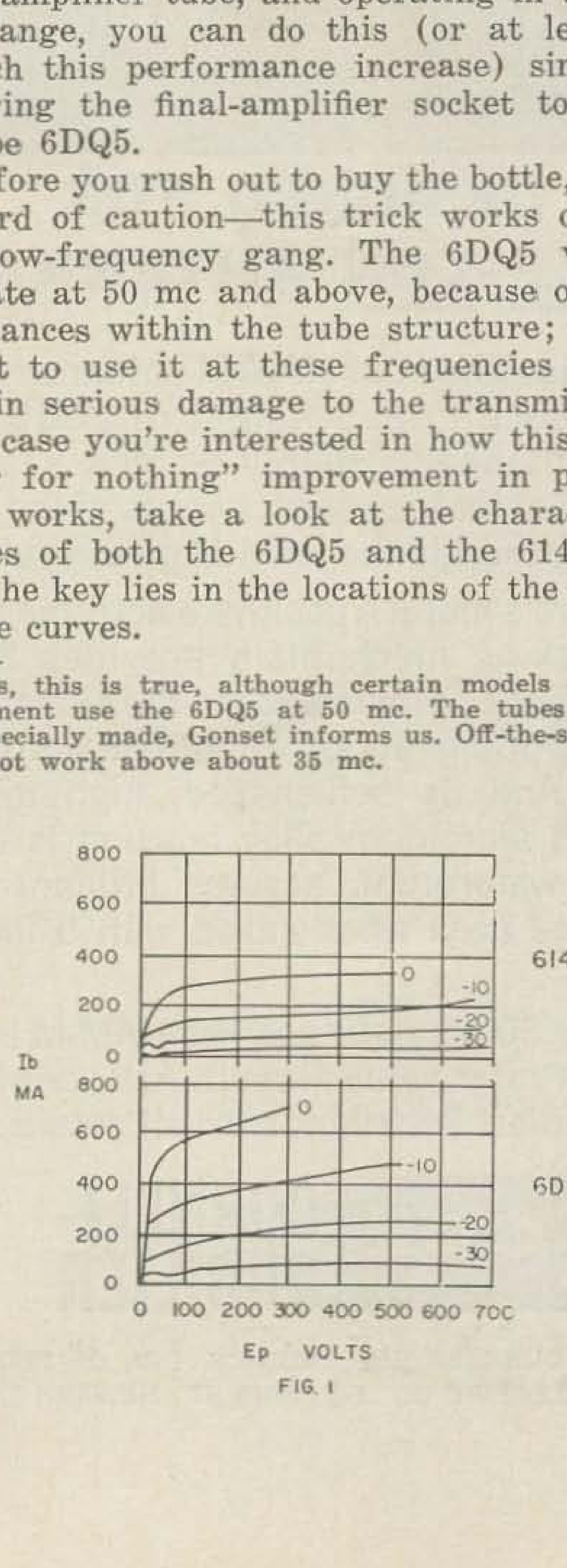


FIG. 1

Notice that the knees of the 6DQ5 curves lie more to the left than do the knees of the corresponding 6146 curves. This means that the 6DQ5 requires less plate voltage to deliver the same amount of current than does the 6146. With less plate voltage required by the tube, more voltage can appear in the output circuit (since the tube and the output circuit are in series, the supply voltage must be divided between them).

The resulting increase in efficiency is most noticeable at low plate voltages. If you're operating with a 750-volt power supply, you'll get only a 5- to 10-percent increase in power output. If your power supply is 400 volts, though, the rf output will climb by nearly 25 percent. With a 300-volt power supply (often used in mobile rigs), rf power output may nearly double for the same input power.

The 6DQ5 offers an added bonus, if your power supply can stand it. This tube is rated to handle 285 ma cathode current, in contrast to the 160 ma rating of the 6146. This means that a single 6DQ5 can offer performance comparable to a pair of 6146's or 807's. With a 750-volt supply, the single 6DQ5 can be loaded up to 160 ma, and of this 120 watts input power, 96 watts will appear in the output.

A comparison of characteristics between the 6DQ5 and the 6146 is given in Table I, for various input voltages and plate inputs. The "6DQ5 Increase" column represents percentage increase over 6146 power output, not increase in efficiency.

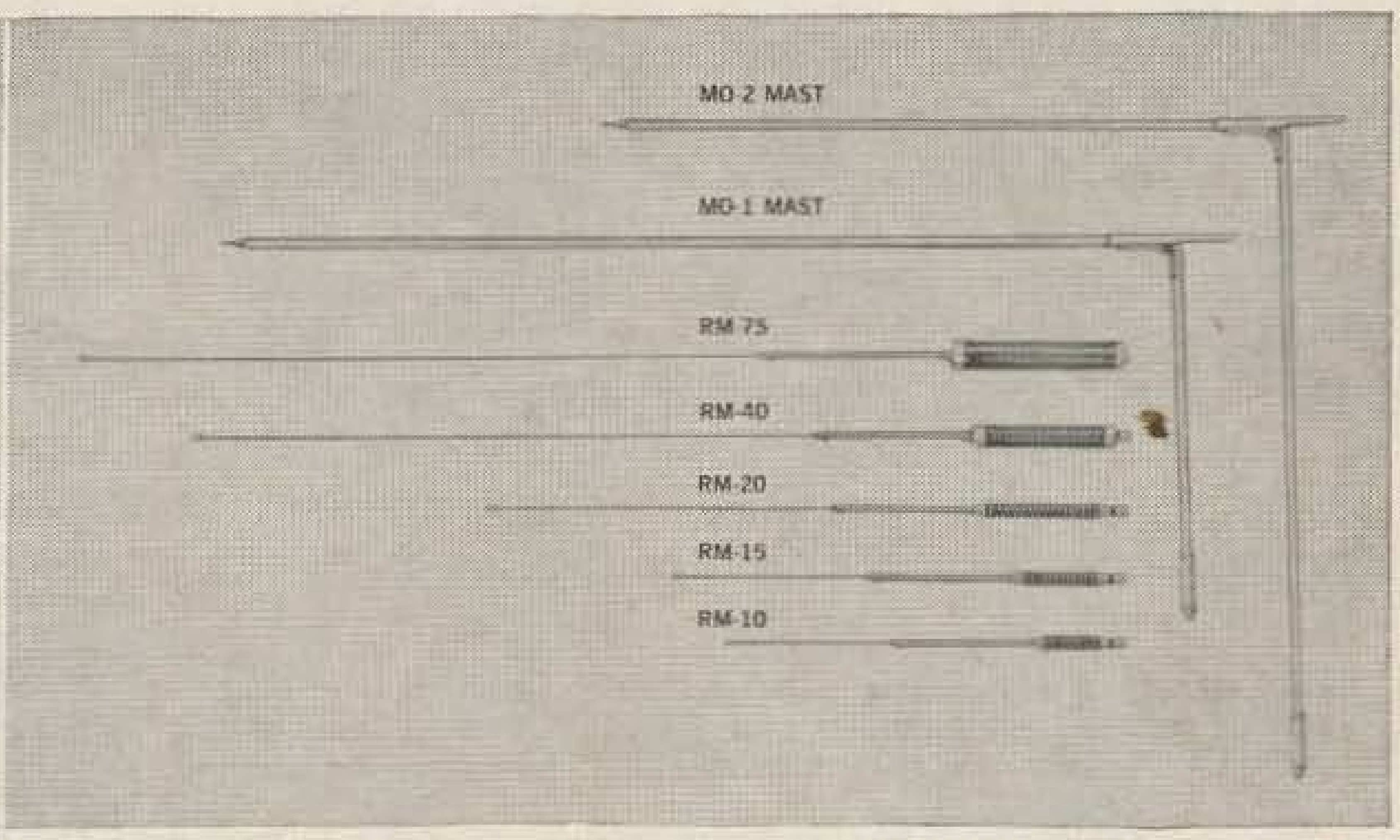
All this theory is very nice, you may ask, but how does it work in practice? To answer that question, an ancient Harvey-Wells TBS-50 Bandmaster was subjected to the acid test.

Using a 400-volt supply (the maximum recommended by Harvey-Wells), the original 807 would load to 125 ma. At this input, the output lit a 60-watt lamp bulb to a reddish-orange glow.

# GOOD MOBILES *GO...*

## HUSTLER

## 10-15-20-40-75 METERS
## *NEW-TRONICS*
## MOBILE ANTENNA

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| MO-2 | 54" Mast folds at 27" from base | (For Bumper Mount) | 7.95 |
| RM-10 | 10 Meter Resonator | Maximum 80" — Minimum 75" | 5.95 |
| RM-15 | 15 Meter Resonator | Maximum 81" — Minimum 76" | 6.95 |
| RM-20 | 20 Meter Resonator | Maximum 83" — Minimum 78" | 7.95 |
| RM-40 | 40 Meter Resonator | Maximum 92" — Minimum 87" | 9.95 |
| RM-75 | 75 Meter Resonator | Maximum 97" — Minimum 91" | 11.95 |

**ANY MAST OR RESONATOR MAY BE PURCHASED SEPARATELY**

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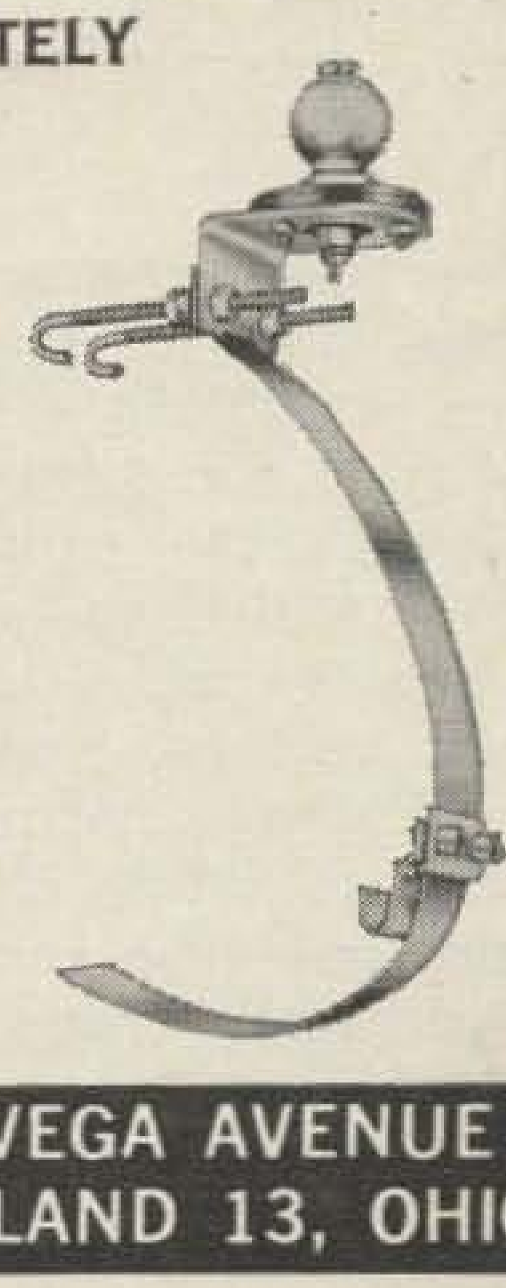

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Assembly is held in place by two "J" bolts at the top of the bumper and strap clamp at the bottom. "J" bolts may be inserted between top of bumper and car body where clearance is as low as ¼".

Whip receptacle assembly consists of a heavily chrome plated 1½" die cast Zamak ball with ⅜-24 thread. Adjustable so as to maintain whip in true vertical position. Black phenolic base. All metal parts of the bumper mount are heavy cadmium plated. .................................................. **$6.95**

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## *NEW-TRONICS CORP.* 3455 VEGA AVENUE CLEVELAND 13, OHIO

With the 6DQ5, the same intensity of glow in the lamp bulb could be obtained at about 80 ma of plate current. When the rig was loaded to 125 ma, the bulb's glow was almost normal (calculated power for this input is 39 watts). Loading was then increased to 200 ma. At this load, the power supply voltage dropped to 300. The bulb's glow increased slightly, but the increase was barely perceptible.

At the 125 ma loading, the rest of the rig operated normally. Modulation was comparable to the original 807; drive was adequate. The only difference noted was a stronger signal getting out of the antenna.

To install this bottle in your own rig, three circuit changes will be necessary; a fourth may be required, depending upon the rig.

The first and most obvious change is the rewiring of the socket. The pin connections for all three tubes are listed below:

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 6DQ5 | Grid | Fil | Cath | Scr | Grid | Cath | Fil | Scr |
| 6146 | Cath | Fil | Scr | Cath | Grid | Cath | Fil | Shell |
| 807 | Fil | Scr | Grid | Cath | Fil | — | — | — |

The second change provides proper grid bias. The 6DQ5 requires approximately —70 volts on its grid, where the 6146 likes —45 volts. Since the 6DQ5 draws little grid current (more on this later), grid-leak bias is impractical. Battery bias is recommended. Lift the ground end of the existing grid resistor from ground and connect it as shown in Fig. 2. At any convenient location, install two 30-volt hearing-aid batteries connected in series to provide 60 volts. Ground the positive terminal, and connect the lead from the grid resistor to the negative terminal. This applies —60 volts fixed bias to the grid; current through the grid leak will supply the additional 10 volts needed.

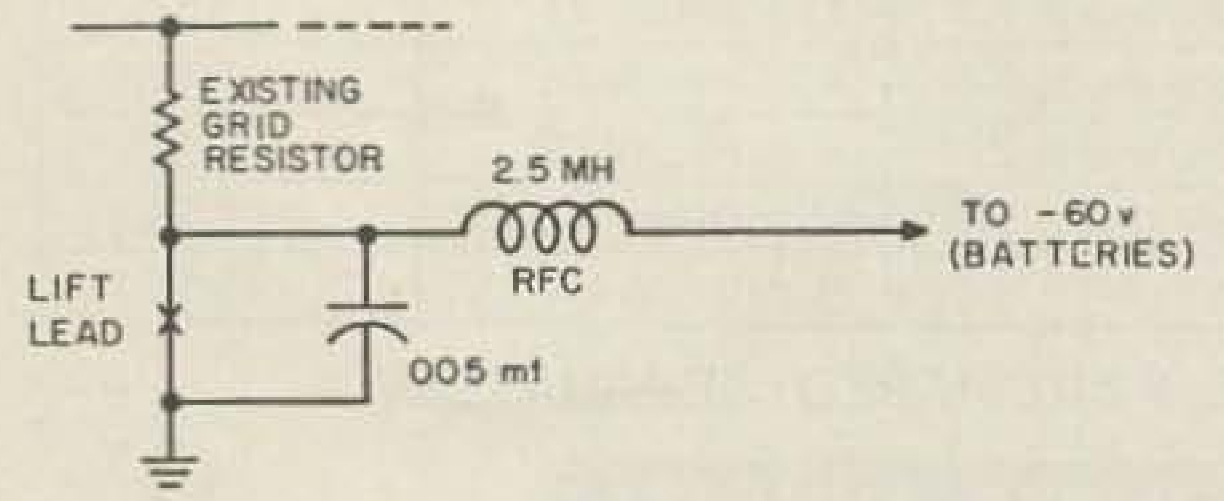



FIG. 2

The third change provides correct screen voltage. The 6DQ5 requires 150 volts on the screen, at 20 ma screen current. This is 8 ma more than the 6146 screen takes, although the voltage is the same, so the screen-dropping resistor will have to be changed. To determine the new value, subtract 150 from the plate-supply voltage, and divide the remainder by 0.02. Wattage rating of the new resistor, including a safety factor of two, is equal to 0.0008 times the resistance.

With many transmitters, this completes the modification. However, the output capacitance of the 6DQ5 is appreciably greater than that of the 6146 or 807, and as a result you may have to remove a few turns from the 10- and 15-meter tank coils to be able to tune through resonance. In addition, slight pruning of the coils may increase efficiency by getting a higher tank-circuit Q.

If your rig uses fixed tuning in the final grid circuit, re-peak the tuning slugs after making the modification. This is standard procedure whenever the final tube is changed, but the adjustment may be greater this time since input capacitance, too, is greater than that of the tubes replaced.

Don't expect grid current of the 6DQ5 to be so great as it was with the previous tube; the 6DQ5 is capable of delivering 175 ma of plate current without ever driving the grid positive, which means that no grid current at all need flow to be able to load the tube to its maximum ratings. The fixed bias added in conversion step two makes grid current unnecessary for tube protection.

The best way to determine the amount of drive needed with your rig is to hook up an output-power indicator of some sort (lamp bulb, wattmeter, etc.) and fire up. Start with maximum drive, and decrease the drive until output just begins to fall off. Now, increase the drive a hair. Check to see that power output increases with modulation. If not, increase the drive a bit more until upward modulation is obtained. This is the correct operating point for your rig.

So far, we've talked only about modification of existing equipment. Naturally, the 6DQ5 can also be used in new-design homebrew equipment. The no-grid-current feature eliminates the need for bulky drivers, since the oscillator itself may furnish enough voltage to drive the tube to its limit. Thus, high power becomes practical for mobile use—or for apartment dwellers.

. . . K5JKX

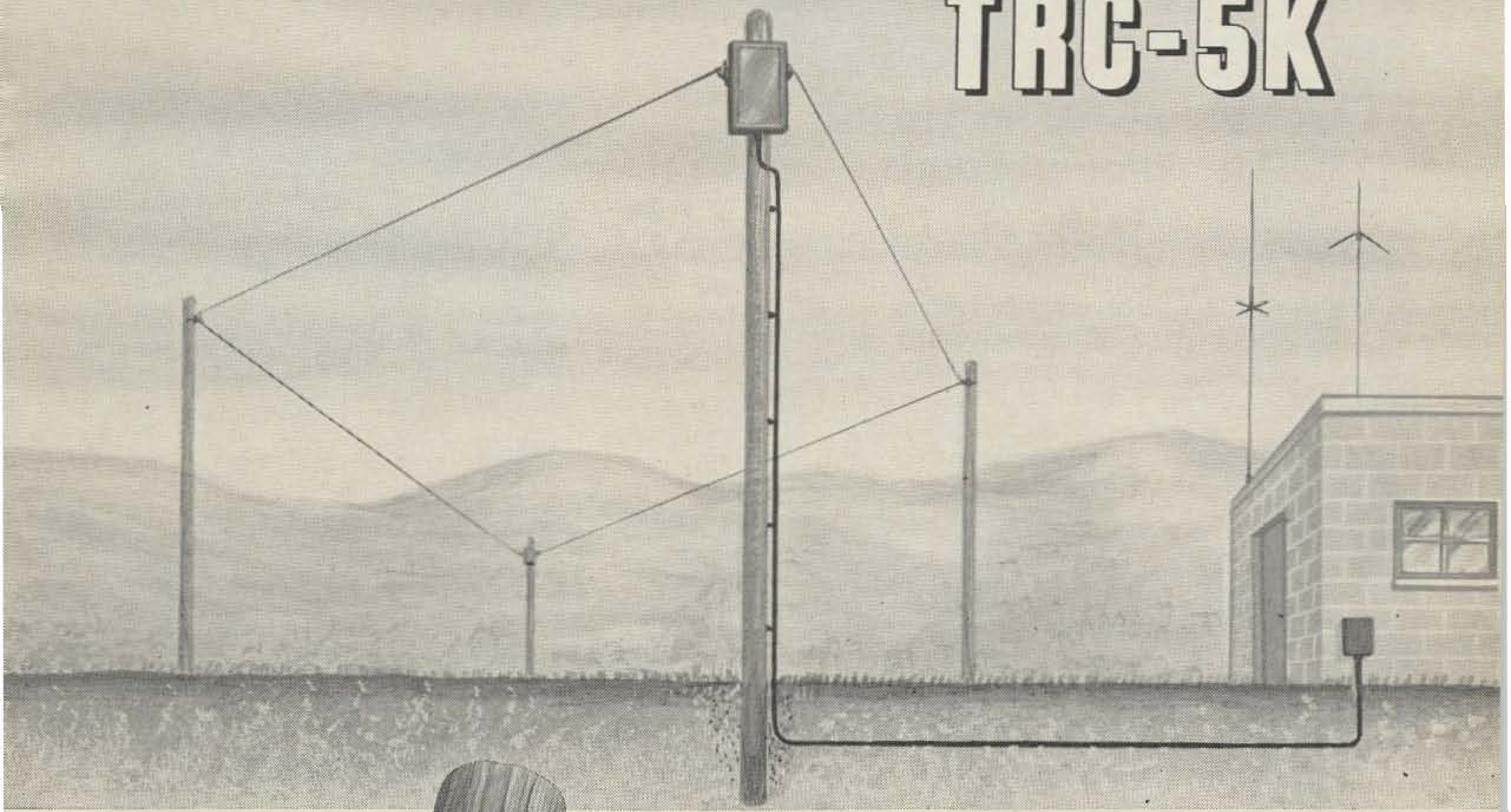
| INPUT VOLTAGE, CURRENT, AND POWER | | | 6146 | | 6DQ5 | | 6DQ5 |
|---|---|---|---|---|---|---|---|
| Volts | MA | Watts | Output Power | Efficiency | Output Power | Efficiency | INCREASE |
| 300 | 100 | 30 | 17 | 56% | 23** | 72% | 35% |
| 400 | 125 | 50 | 32 | 64% | 39** | 78% | 22% |
| | 185 | 74 | Exceeds Tube Rating | | 57 | 77% | .... |
| 500 | 200 | 100 | Exceeds Tube Rating | | 79 | 79% | .... |
| 600 | 112 | 67 | 48 | 72% | 54** | 81% | 12.5% |
| | 200 | 120 | Exceeds Tube Rating | | *95 | 79% | .... |
| 750 | 100 | 75 | 56 | 75% | 60** | 80% | 7% |
| | 120 | 90 | *67 | 75% | 72** | 80% | 8% |
| | 160 | 120 | Exceeds Tube Rating | | *96** | 80% | .... |

* Maximum Tube Ratings.
** No Grid Current Necessary.

**Table I. Comparison of Characteristics, 6146 vs. 6DQ5**

# BROADBANDED TRANSMITTING COUPLING TRANSFORMERS

## TMC MODELS TRC-20K TRC-5K



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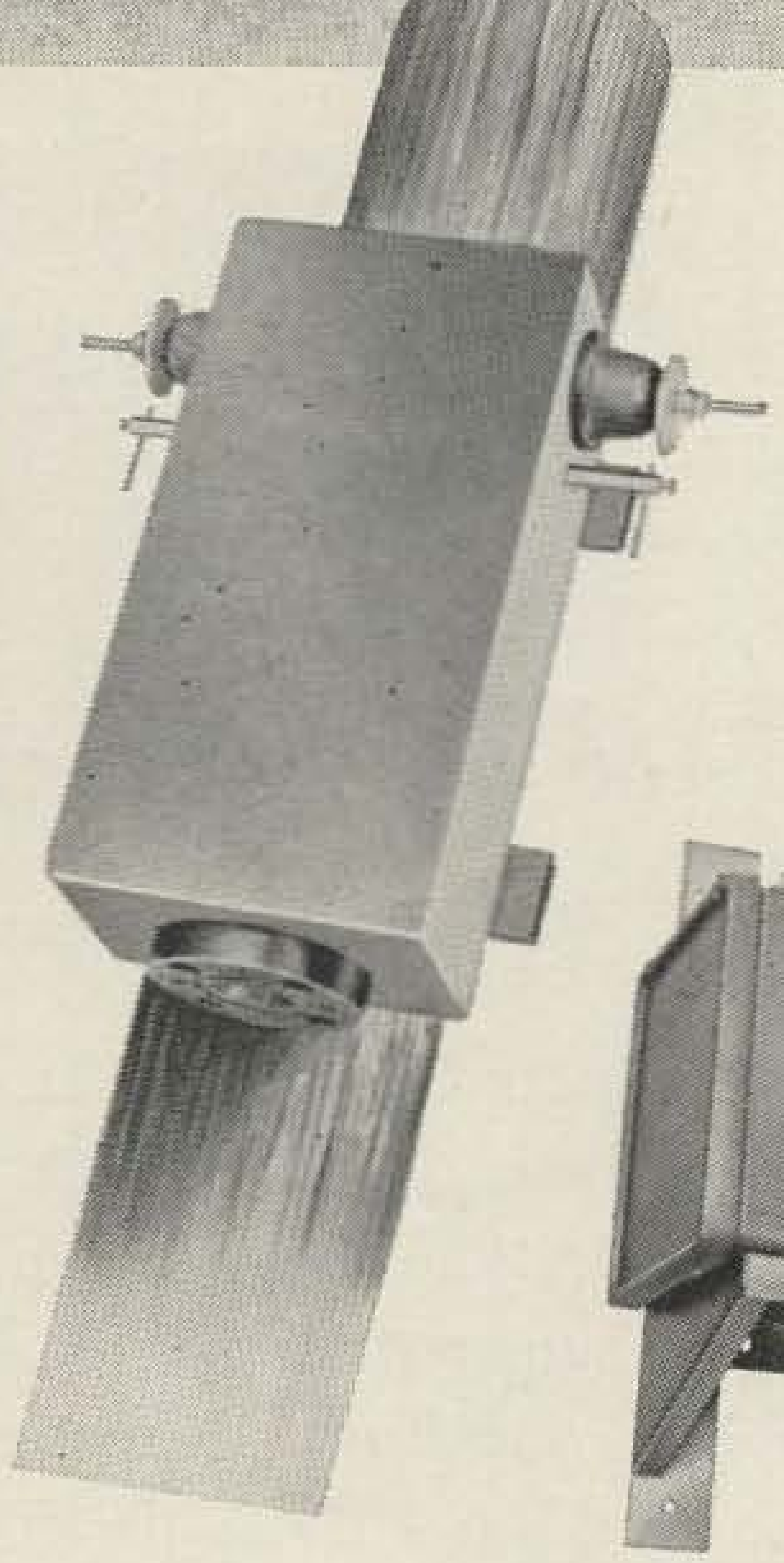
TRC-5K



TRC-20K

TMC's Model TRC-20K and TRC-5K are recent additions to a family of broadband RF transformers that provide coupling of RF energy from 250 watts average to 40 kw peak power with insertion loss of less than 1 db, and VSWR not exceeding 2:1.

Models TRC-5K and TRC-20K provide efficient impedance match over the frequency range of 2 to 28 megacycles between 50 and 600 ohms or 70 and 600 ohms, and are housed in fiberglass reinforced cases for operation in any ambient environment from $-50^\circ$ C to $+75^\circ$ C.

Spark gaps provide protection against static electricity on the antenna as well as against lightning discharge. These units are provided with either wall or pole mount and may be mounted in isolated places, such as an antenna field, since they require no maintenance. A wide variety of RF fittings can be provided to match any standard transmission system.

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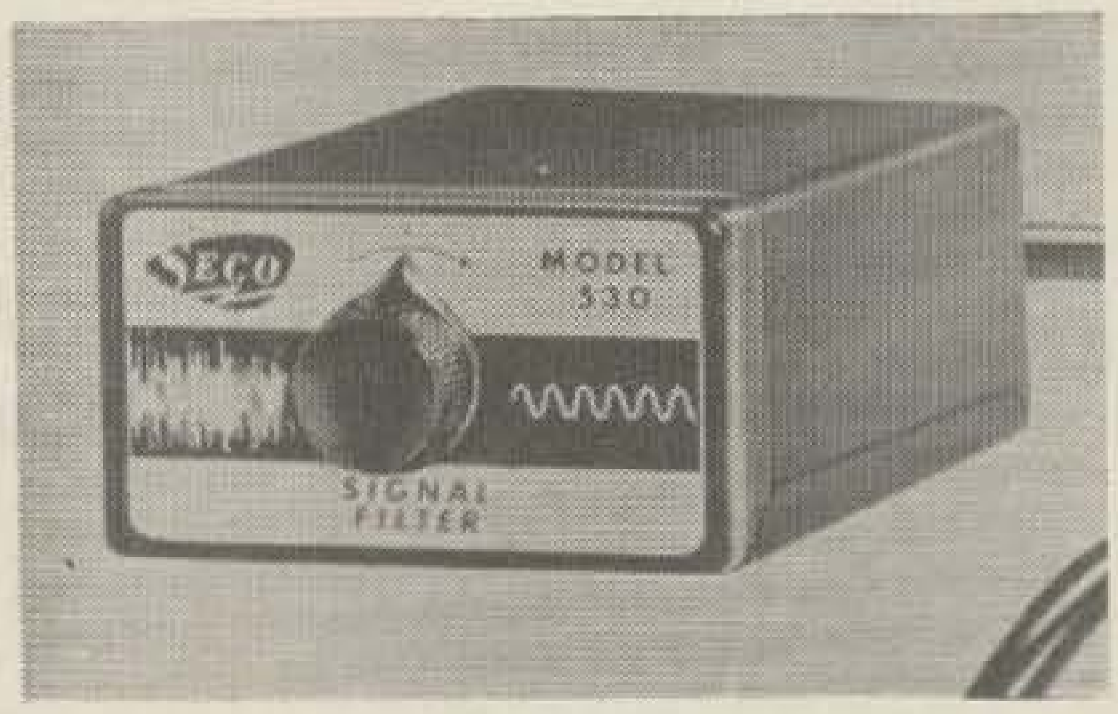
# New Products




Mobile Noise Limiter

Seco Electronics has a small unit that connects to your mobile receiver and clips out the noise pulses generated by your own or passing cars ignition. The unit also has a controllable squelch built in. Quite a package for $16.88! Ask Seco about the Signal Filter, 1201 Clover Drive, Minneapolis 20, Minn.

40 & 10 Meter Beam

Mini-Products hasn't been too busy filling orders for their 10, 15 and 20 meter beams to put in some time designing an answer to the dwindling sun-spot band condtions. Their answer is a miniature 40 meter beam which will also work on 10M. This $79.50 end-loaded beam will handle up to 1 KW on AM and is designed to operate with an SWR of less than 1.5:1 on 40M and less than 1.2:1 on 10M. Each element is only 20 feet long, which means that just about anyone can whip one of these around. It feeds with a single 50 ohm feedline. You can drop Mini a card for mere details. Mention that you read about it in 73 . . . even if you didn't. 1001 W. 18th St., Erie, Penna.

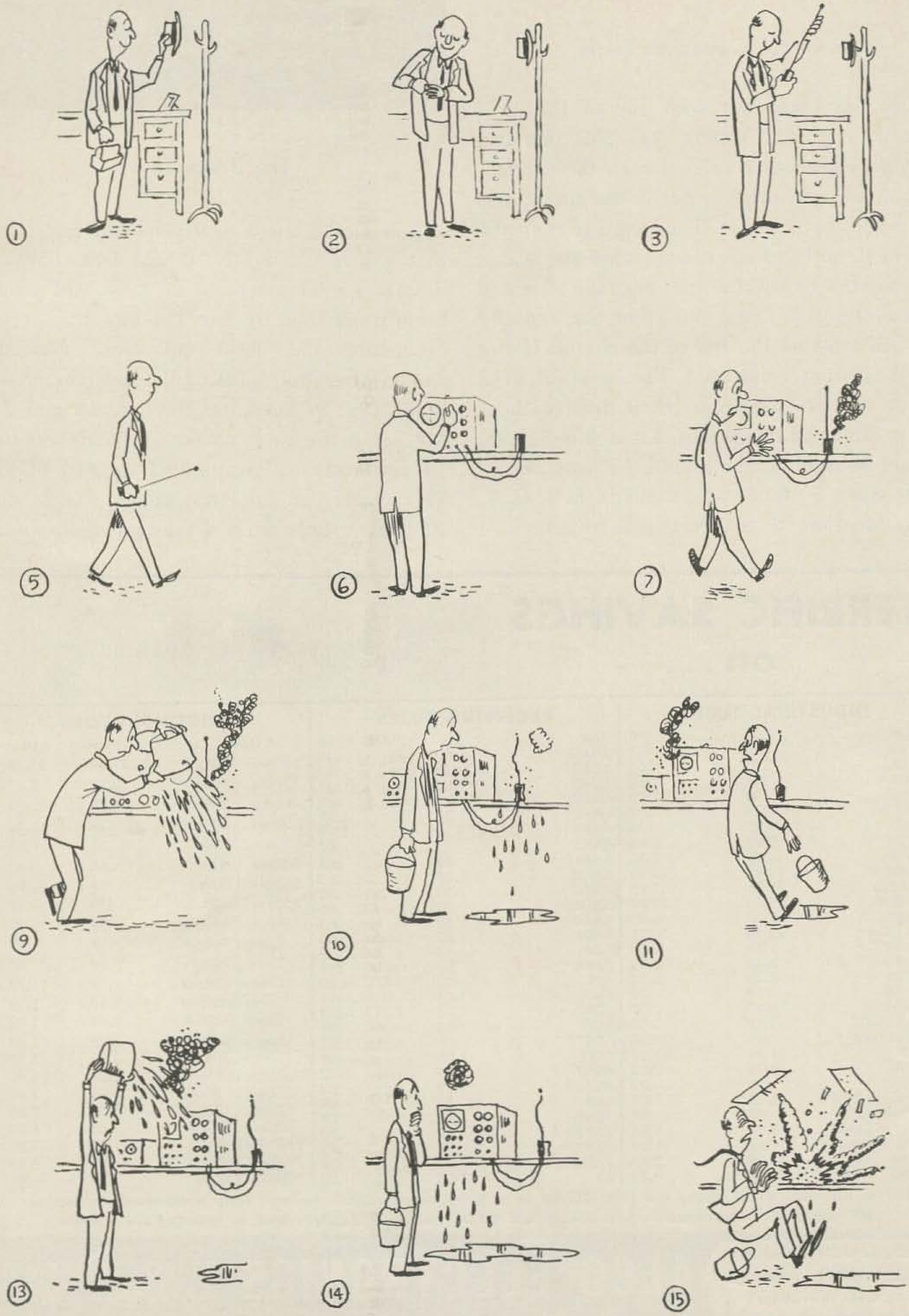
### In-Circuit Capacitor Tester

Eico has come out with one of the most versatile capacitor testers yet. This one can measure capacitance even though the condenser you are measuring is left in the circuit and has a resistor across it. The range is from 0.1 mfd to 50 mfd and you can see when the bridge is in balance by means of an eye tube mounted behind the dial. Once you know the capacity you can measure the RC of the circuit. If you are measuring condensers that are not in a circuit you can determine their dissipation or power factor by this means. Kit is only $19.95. Should be right handy around the work bench. Write Eico, 33-00 Northern Blvd., L. I. C. 1, N. Y. Mention 73, maybe they'll advertise.

### The Drake TR-3

Bob Drake has a new sideband transceiver that will break shortly. It was first shown at the Dayton Hamvention in April and should be in production by fall. The new transceiver, designated the TR-3 (question: was this named after Bob's Triumph sports car or was it the next in line after the 1A, 2A and 2B? My bet is the car), covers all bands, 80 thru 10 and runs 150 watts PEP to two 6GJ5's. This sports car sized transceiver weighs only 12 pounds, not counting the power supplies.

# The Engineer and the Transistor Radio



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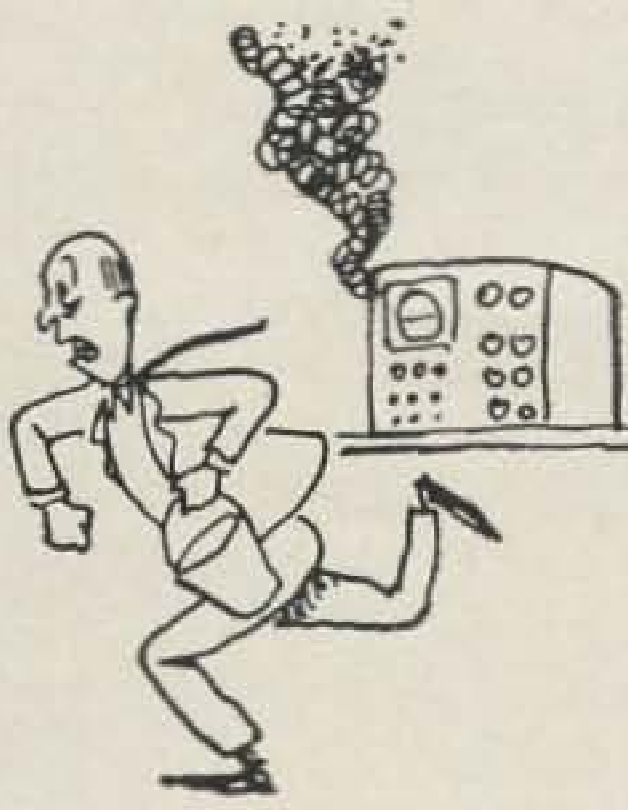

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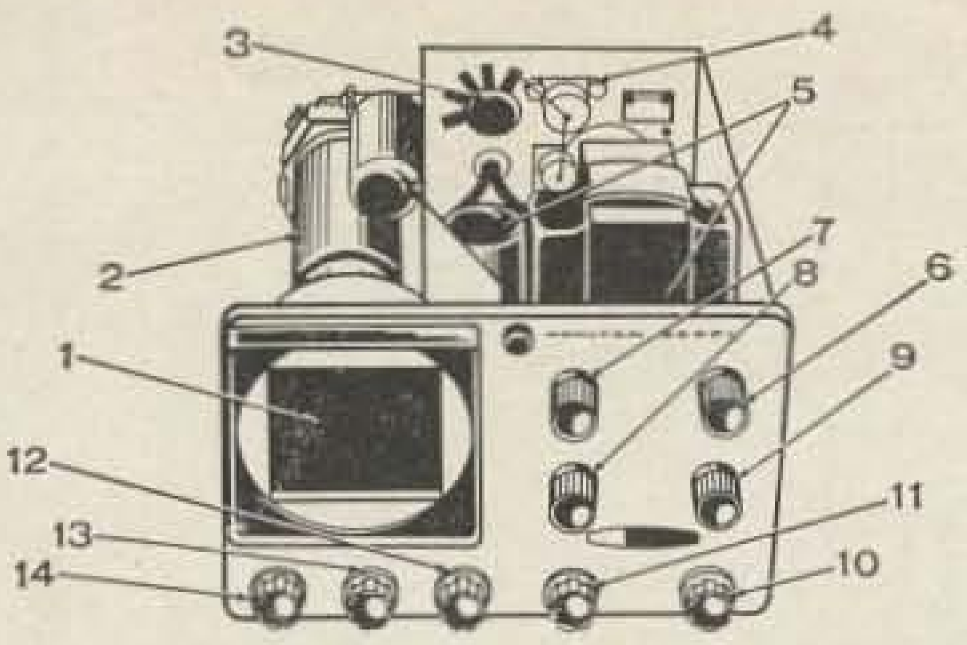
B. ROGERS

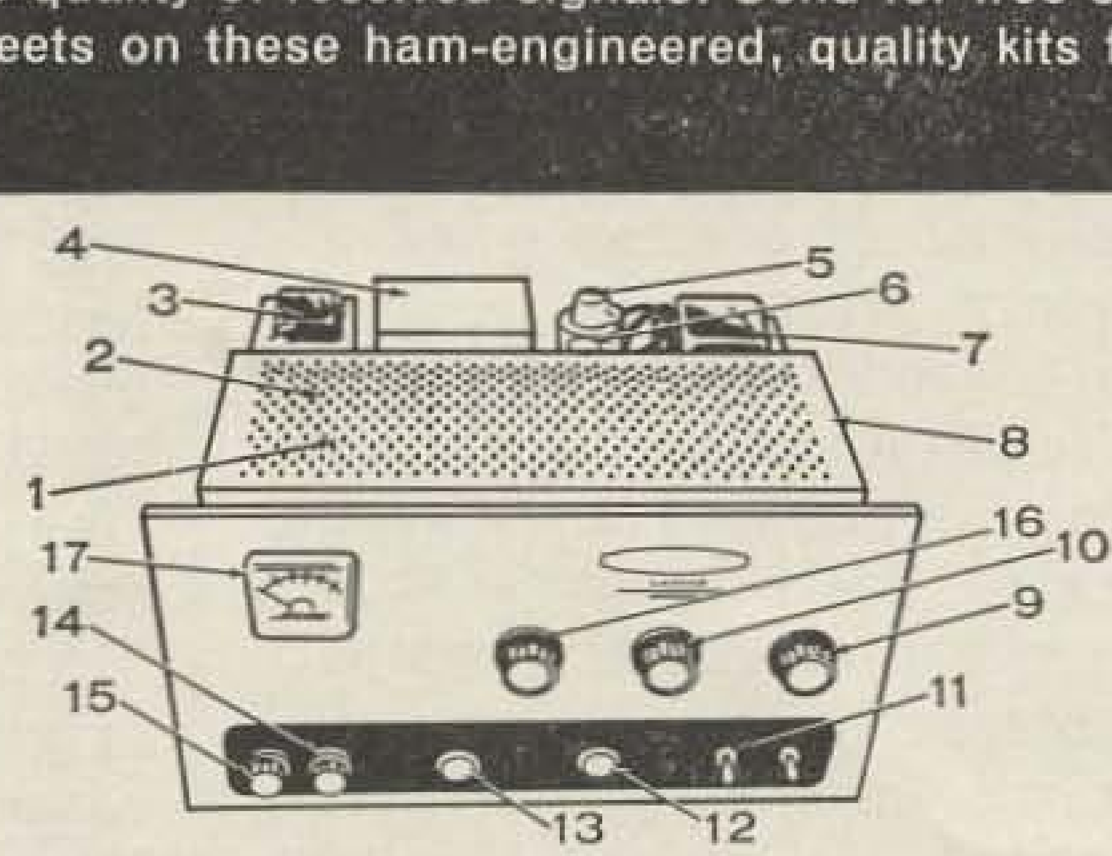


**HEATHKIT AMATEUR MONITOR 'SCOPE...just $59.95**

**1.** 3" CRT **2.** Neckshield minimizes external field effects **3.** RF attenuator accommodates 5w to 1 kw power levels **4.** Rear panel RF feed-through connectors and input and output jacks **5.** Compactrons for space-saving layout **6.** Sweep frequency adjust with "clamp" position to prevent CRT burns under SSB no-modulation conditions when using trapezoid function **7.** Wave envelope, AF or RF trapezoid selector **8.** Built-in single or two tone test generator **9.** Horizontal gain **10.** Horizontal position **11.** Vertical position **12.** Vertical gain **13.** Focus **14.** On/Off/Intensity

## Go Linear with the Heathkit Desk-Top Kilowatt...$229.95
## Stay Linear with the Heathkit Monitor 'Scope.....$59.95

Put this space-saving twosome to work in your shack for a clean KW of single sideband. The "Warrior" in a short time has justly earned a world-wide reputation as the finest watts-per-dollar value anywhere in kilowatt linears. QSO an amateur who has one, there are hundreds on the air. The new Heathkit Monitor 'Scope is especially designed for hams with useful patterns for checking "flattopping" and non-linearity in SSB linear amplifiers, observing modulation characteristics of AM and SSB transmitters, and monitoring the quality of received signals. Send for free specification sheets on these ham-engineered, quality kits from Heath.



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# Vermin Traps and Dragon Eggs

Sidney Rexford W2TBZ/4
5409 Fremont Street
Springfield, Virginia

THE most disheartening phrase heard on the air is "I built a ——, but I couldn't get the bugs out!"

The original model of a piece of commercial gear is usually a prime example of excellent engineering. The design engineer, knowing the pitfalls of interaction between stages, self-oscillation, parasitics, heat conduction, etc., carefully takes all these things into consideration in his original design. The unexpected bugs which arise during the building of the engineering model are also worked out and the final result is a stable piece of gear, capable of doing exactly what is expected of it and incapable of doing that which is not desired.

The job is now half done. The engineering model, in its present form, may be a pleasure to behold and operate but its cost of reproduction would be more than the average consumer would be willing to pay. The second half of the job is to find every possible shortcut, labor saving trick and money saving step that can be devised. How well this is accomplished will determine the company profit.

The first step is to reduce the number of parts in a piece of equipment to a minimum. Parts cost money to procure and more money to install. These extra costs must be borne by the buyer and serve to make the competitors product more attractive.

The first possibility in this parts saving campaign to fall under scrutiny are the "stability insurance" components such as extra by-pass capacitors, decoupling circuits and shield baffles. A systematic campaign is set in motion to remove as many as possible of these components or to employ a cheaper scheme to accomplish the same end. It is very true that the final production gear's operation suffers somewhat for this cutting and slashing, but only laboratory instruments can usually determine how much.

The final production line model, stripped of as many safeguards as possible, is a reasonably stable piece of gear capable of good performance under normal circumstances and may be expected to enjoy a reasonable life expectancy.

Engineers of commercial gear are a sly lot, usually of the grey hair variety and armed with years of experience. They know how far they can carry this austerity program before trouble sets in and that particular piece of equipment gets a bad reputation. Occasionally some model slips by that causes headaches from complaints from irate customers, but not often.

## The Home Constructor

The home constructor works in reverse from the manufacturer. He begins with basic circuits picked at random and combines them into a multi-stage transmitter or receiver. Such things as extra by-pass capacitors, decoupling circuits, etc., are usually omitted from the basic circuit diagrams available to the home builder. He is also prone to simplify construction to the highest possible degree. If the Goode Electronics Company's PDQ-3 receiver doesn't have a decoupling network in the first *if* stage but does have one in the second, and the Goetter Beacon-6 receiver has one in the first but none in the second then you may rest assured that the receiver built by the home builder will copy the first *if* stage of the PDQ-3 and the second *if* stage of the Beacon-6. Our boy has no decoupling circuit in either stage. He is in trouble!

The home constructor who appreciates the original areas of difficulty in the design of commercial equipment and who does the first half of the engineers job faithfully will find that many of his difficulties will solve themselves. It is also much easier (and neater) to plan for and install vermin traps from the beginning than it is to try to squeeze them in somehow after the equipment is completed.

The manufacturer can afford to kick an engineering model around, tear it apart, rebuild

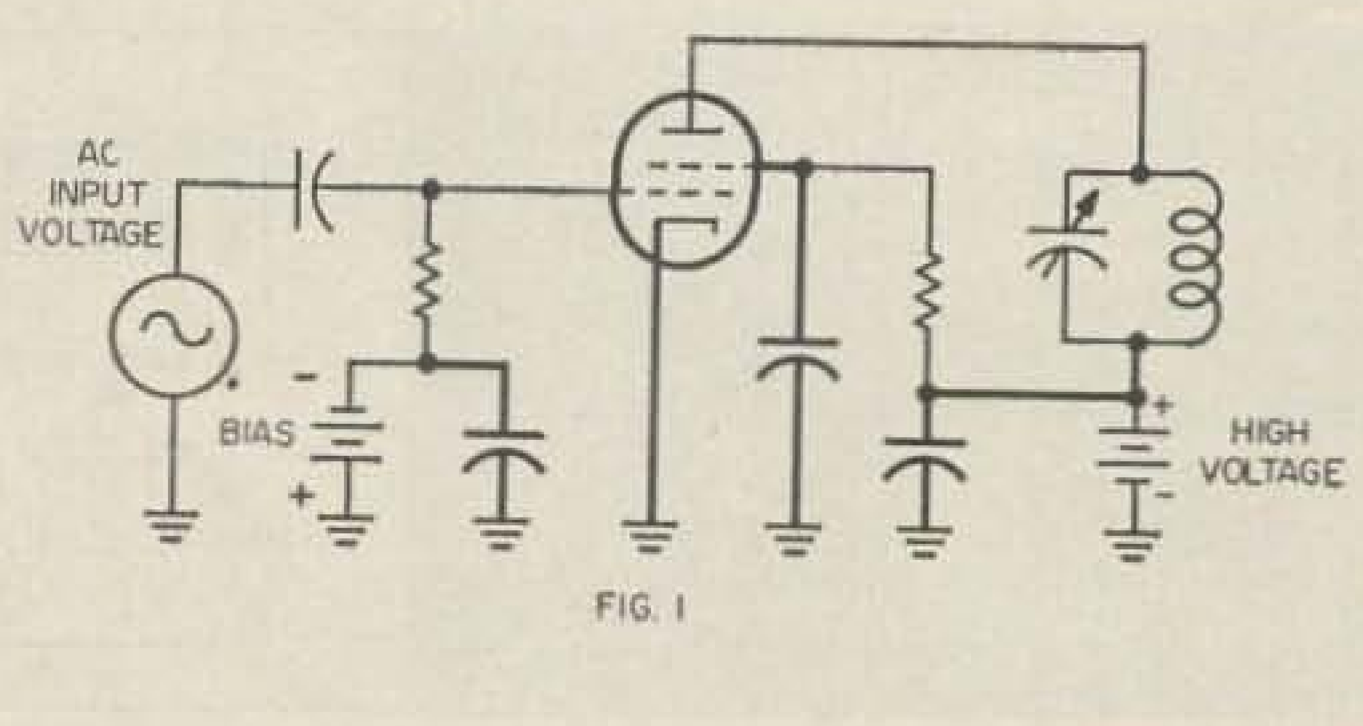


FIG. 1

it, and eventually find out how many short-cuts it can stand and still work. The home builder cannot afford such luxury. A few dollars wisely spent on de-bugging devices, whether they are actually needed or not, will prove the most economical course. Since the home builders project is a "one-of-a-kind" piece of gear it is pointless to engage in any form of simplification or austerity program after construction is completed.

The purpose of this article is to outline some common engineering problems and some of the solutions which should aid the constructor in designing his own equipment and keeping it housebroken.

## By-passing

The by-pass capacitor's reason for existence is to do two things (1) Provide a completed ac path within the individual circuit of which it is a part, and (2) Prevent ac energy from escaping and traveling between circuits via dc or other ac paths not designed to transport it.

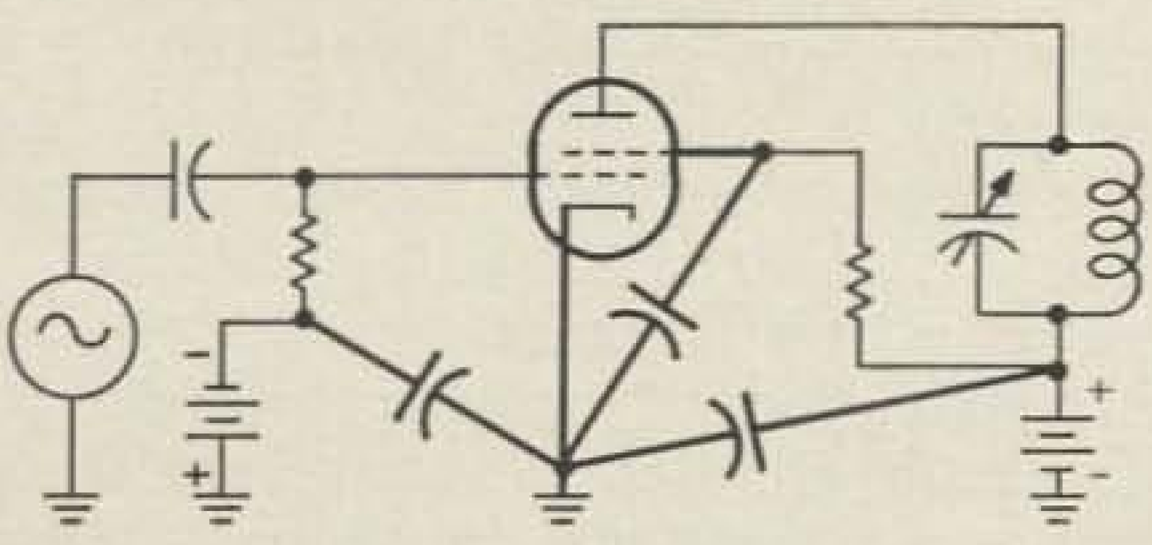



FIG. 2

Let's investigate the first reason for the by-pass capacitor; the completion of an ac path within an individual circuit.

Circuits for amateur gear using tubes (and transistors) fall into three basic categories: Grounded Cathode (Conventional), Grounded Grid, and Grounded Plate (Cathode Follower).

## By-passing the Grounded Cathode Circuit

Grounded cathode are conventional amplifiers in which the signal to be amplified or the portion of the signal to be fed back to sustain oscillation is applied between the grid and the cathode. The amplified signal appears between the plate and cathode. The cathode is the common reference point and both the grid and plate circuits must have complete paths for ac to it. In the vast majority of cases, to simplify construction and the application of the necessary dc voltages, the cathode is operated at ac (signal) ground potential.

When ac ground potential coincides with dc ground potential by-pass capacitors installed to the dc ground or chassis (Fig. 1) will usually be adequate.

The main problem with this circuit lies in eliminating the return of ac from the grid and plate circuits through long paths through chassis material, which, surprising enough, at high frequencies, may present sufficient inductance to both circuits in common to permit exchange of energy from the plate to grid circuit and cause unwanted oscillation. The wisest course of action is to make the by-pass leads as short as possible and direct to the cathode ground connection as shown in Fig. 2.

Note that screen by-pass capacitors in the case of tetrodes or pentodes are also returned directly to the cathode.

Most pentode circuits require the supressor grids to be grounded direct to the cathode. In those cases where a suppressor grid voltage must be applied, the by-pass capacitor should be brought directly to the cathode in the same manner as the screen by-pass capacitor in Fig. 2.

The same rules apply for beam forming plates in beam power tubes.

Circuit configurations in which the cathode is not operated at dc ground potential, and ac and dc ground potential are not coincident, are more common than the ideal case given above. An excellent system as far as economy of dc power supplies is concerned is to use the static dc plate current flowing in the output circuit to provide a voltage drop through a resistor between the dc ground and the cathode. This voltage is determined by the size of the resistor and places the positive potential of the cathode (with respect to the zero dc potential of the grid) at the proper bias value for operation or for protective bias for an emergency should the normal biasing arrangement fail. This system, while economical in some respects, has the disadvantage of complicating the by-pass problems.

The usual circuit arrangement is shown in Fig. 3 (A). This arrangement is satisfactory

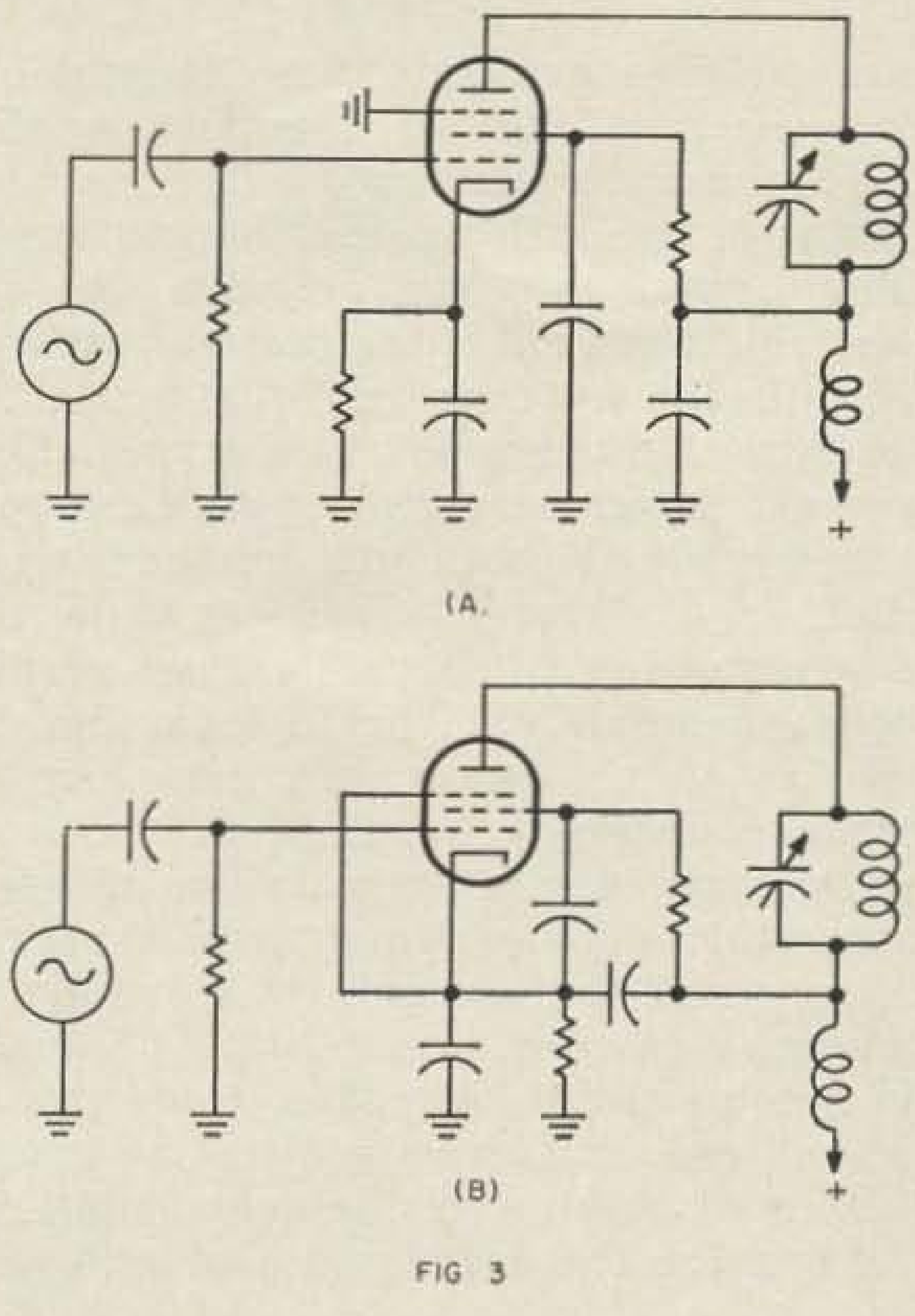



FIG. 3

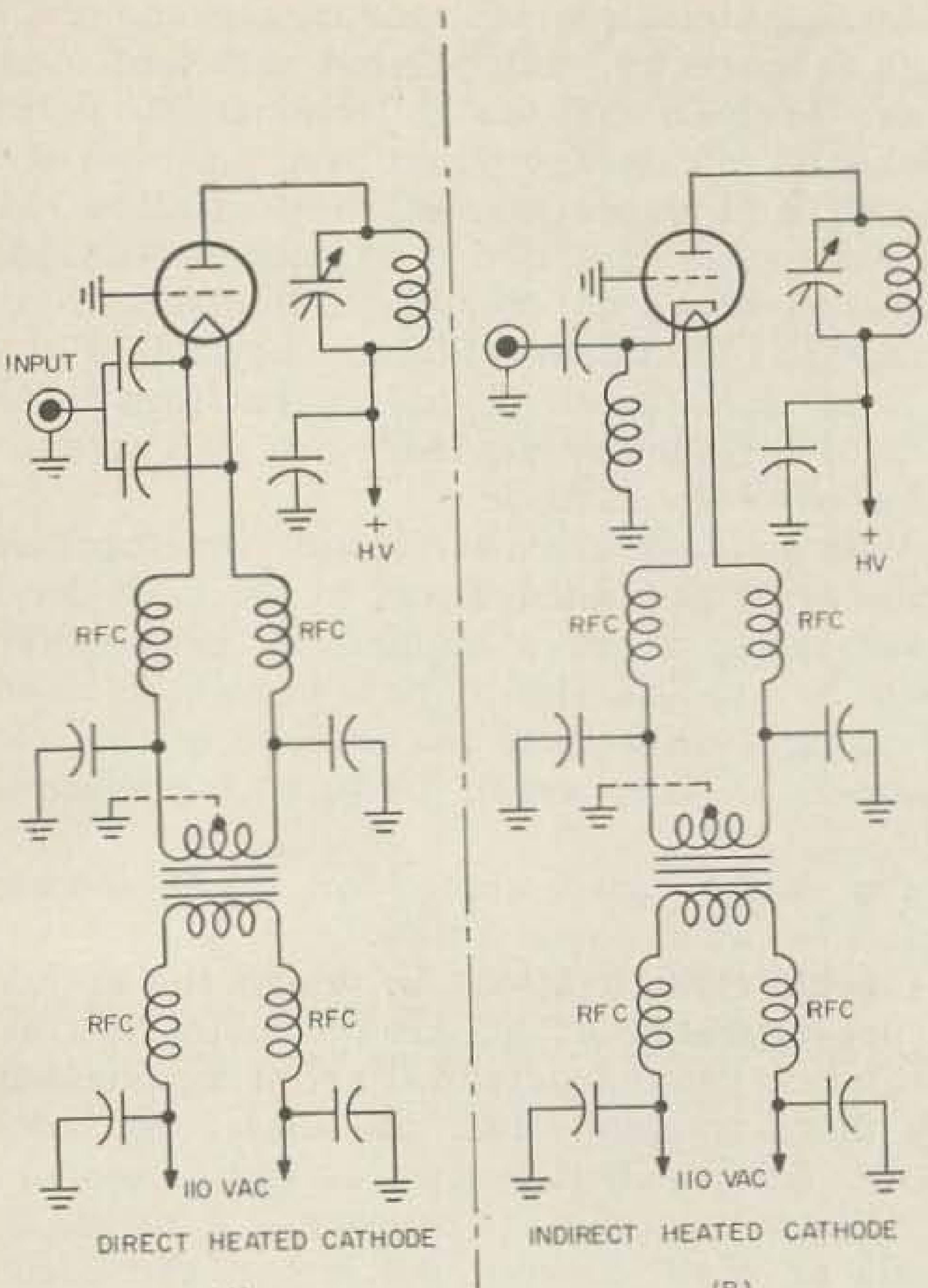


FIG. 4

for audio and lower frequency circuits but leaves much to be desired as the frequency of operation goes higher. A more stable by-pass arrangement is shown in Fig. 3 (B). Note that the plate by-pass, screen by-pass and the suppressor grid are tied directly to the cathode and any ac signal voltage appearing across the cathode resistor and by-pass capacitor does not alter the relationship between the screen, plate, or suppressor with respect to the cathode.

### By-passing the Grounded Grid Circuit

Grounded grid are amplifiers in which the signal to be amplified, or the portion of the signal fed back to sustain oscillations, is applied between the cathode and the grid and the amplified signal appears between the plate and the grid. The grid is the common reference point. Both the cathode and the plate must have low impedance paths to the grid. Fortunately most grounded grid amplifiers operate with the grid at both ac and dc ground potential.

The grounded grid circuit is, as a rule, a well behaved amplifier. The insertion of parasitic chokes in the plate and grid leads are all that are normally required in the line of de-bugging procedures. Installation of by-pass capacitors to a point common with the chassis grounding point for the grid will usually cure any tendency toward instability.

It is recommended, however, that grounded grid amplifiers utilize separate filament supplies, isolated from the filament supplies of other stages of the same piece of equipment. A unique source of trouble in grounded grid amplifiers is feed-back of output energy through the filament circuit or transformer, eventually arriving into the 110V. ac supply line. This energy can cause trouble with TVI, BCI and instability in other stages of the same piece of equipment or adjacent equipment. For this reason the grounded grid filament supply should have isolation and by-pass circuits installed as shown in Fig. 4 (A) and (B).

### By-passing the Grounded Plate Circuit

Grounded plate circuits or "cathode follower" amplifiers find considerable popularity as "isolation amplifiers" between oscillators and succeeding stages. Their use isolates the oscillator from load variations and contributes to stability.

In grounded plate amplifiers the input signal is applied between the grid and the plate and the amplified signal appears between the cathode and the plate. The plate is the common reference point and is usually at ground potential for ac. Seldom is the plate of such an amplifier at ground potential for dc. Consequently a coincident ac and dc ground reference point seldom exists. Fortunately this circuit is characterized by less than unity voltage gain and is consequently quite stable.

The application of cathode follower amplifiers is usually limited to low power transmitter and receiver stages. In these applications the by-pass arrangement shown in Fig. 5 will usually be adequate. If one side of the filament is grounded then only one by-pass capacitor is required from the "hot" filament lead to ground.

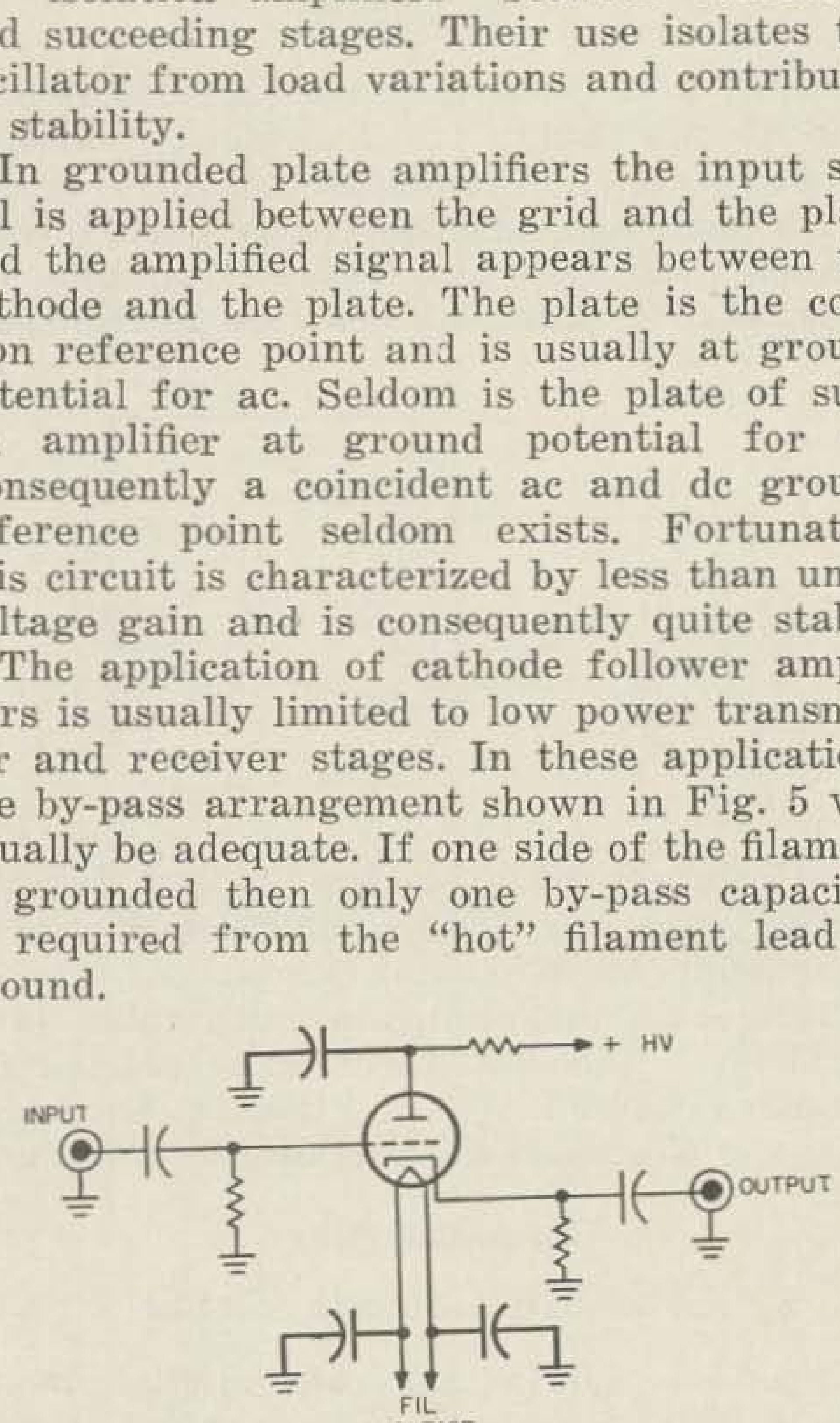


FIG. 5

If high power application is made of the cathode follower circuit (and a distinct possibility exists for such application) then the same precautions should be taken with the filament supplies as were taken with the grounded grid amplifiers.

### Decoupling Networks

When installed properly the by-pass capacitor can accomplish its first task very adequately. The circuit, if isolated, behaves admirably and accomplishes its business in a stable and efficient manner. Unfortunately the circuit, of which the by-pass is a part, must usually work in conjunction with other circuits sharing the same plate and bias supplies.

The by-pass capacitor can, instead of accomplishing its second task of preventing output energy from escaping and traveling between circuits, actually assist in the unwanted transfer and loss of this energy. This is not quite as confusing as it sounds.

As an example of how this can come about, let's look at Fig. 6. In this diagram all screen grids and suppressor grids have been omitted for the sake of simplicity. Observe that the plate tank circuits of $V_1$ and $V_2$ have a common power source; and a ganged tuning capacitor with the rotors grounded and by-pass capacitors $C_2$ and $C_4$. There is nothing unusual about this circuit. The same configuration is used in dozens of different applications. $C_2$ and $C_4$ provide low impedance paths to complete resonant circuits $C_1L_1$ and $C_3L_2$. All looks very good and proper!

Don't believe it!

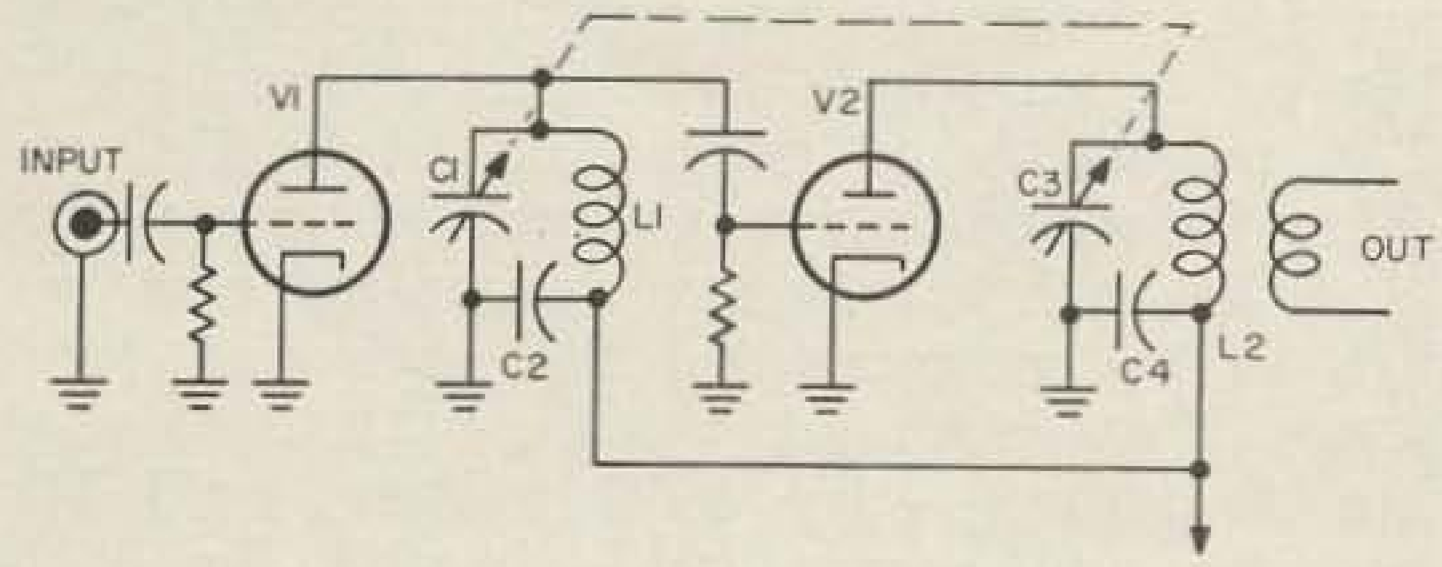



FIG. 6

Suppose we substitute the internal impedance Z of the power source for the B+ to ground and simplify the circuit components we are interested in. We come up with an initial circuit similar to Fig. 7 (A).

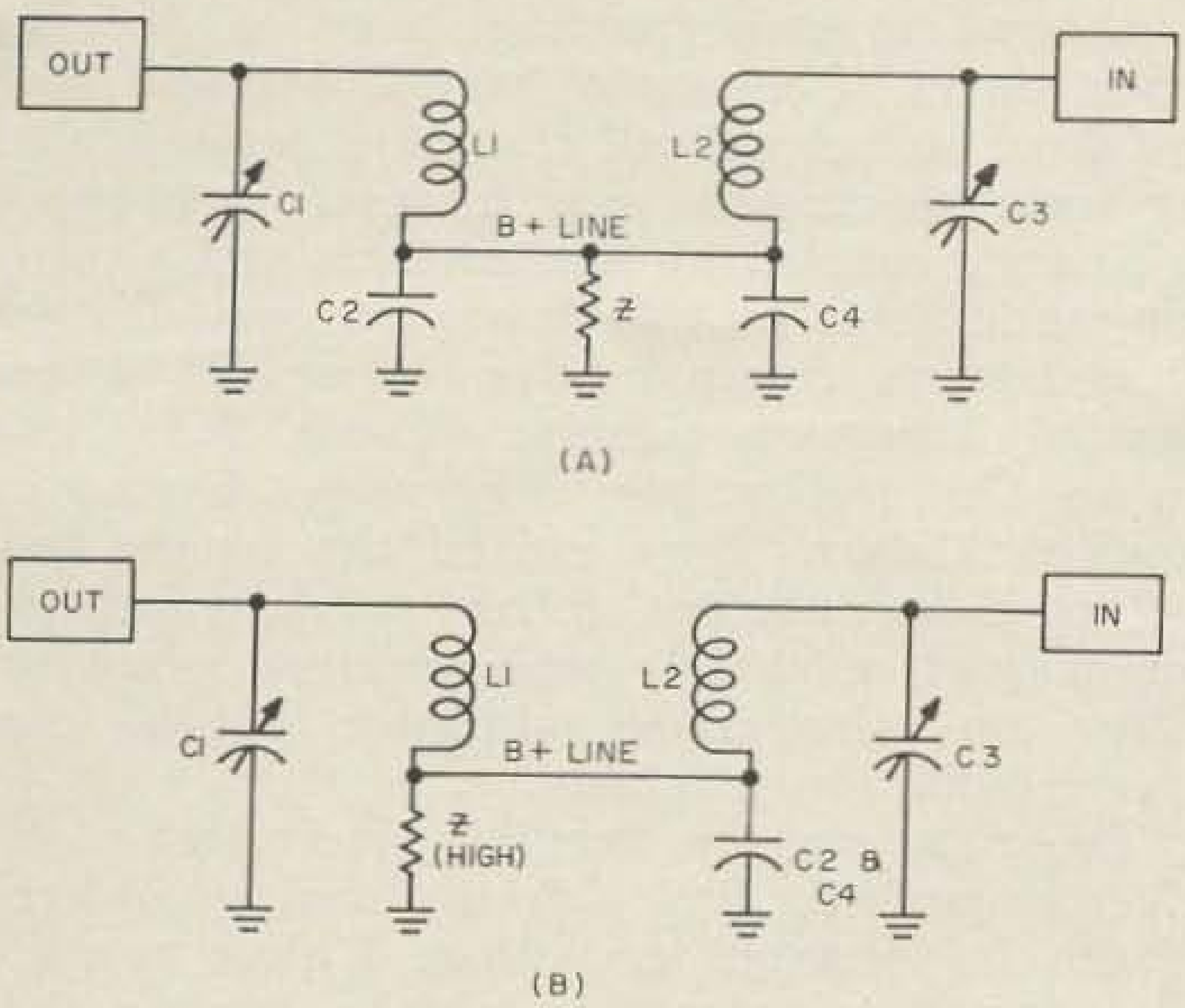



FIG 7

Z represents the impedance (to rf) of the power supply. Power supply filters may provide excellent characteristics at 60 or 120 cycle ripple frequencies but take on the form of considerable inductive and resistive reactance at rf frequencies. Z is actually much higher than simple mathematics would indicate and for practical application Z may be large enough to almost be ignored completely. The circuit under these circumstances approaches that of Fig. 7 (B). $L_1C_1$ and $L_2C_3$ appear as two PI networks, back to back and connected by a transmission line of medium loss. As long as the losses of the transmission line are large enough all is well, but when these losses permit sufficient transfer of energy between the two circuits (and it takes very little) then instability results.

The B+ line shown in Fig. 7 (A) and (B) is only an example. An AVC line of a common bias source can be just as guilty. The vermin trap necessary for breaking up this neat little arrangement is a decoupling network.

Decoupling networks serve to increase the rf losses in the interconnecting transmission line until a point is reached where the exchange of energy from one stage to another becomes so small that instability from this exchange ceases to be a problem. This loss can best be inserted by using an arrangement in which the low impedance output of the PI networks feed into a high impedance (for rf) transmission system. Such a system is shown in Fig. 8.

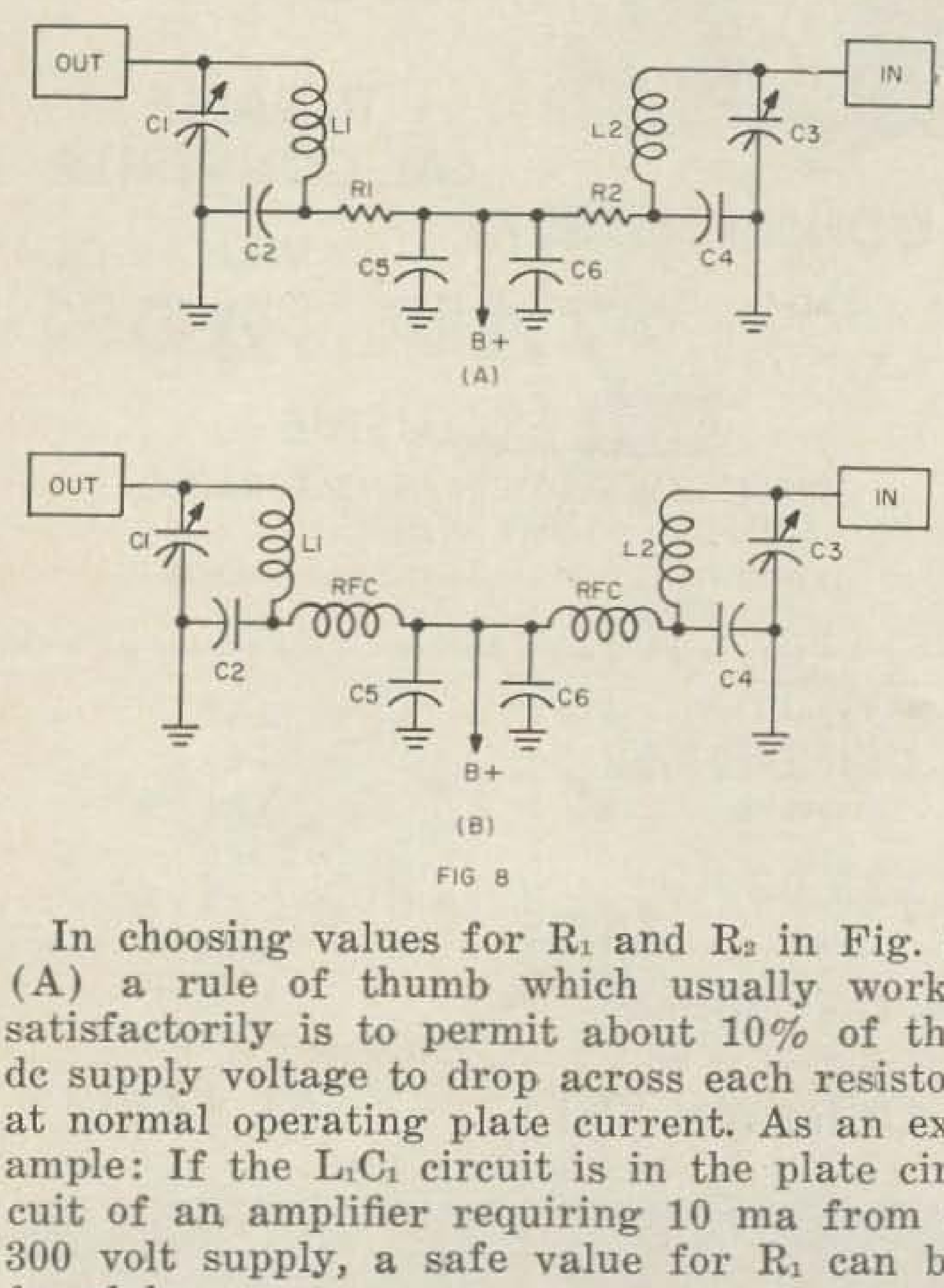



FIG 8

In choosing values for $R_1$ and $R_2$ in Fig. 8 (A) a rule of thumb which usually works satisfactorily is to permit about 10% of the dc supply voltage to drop across each resistor at normal operating plate current. As an example: If the $L_1C_1$ circuit is in the plate circuit of an amplifier requiring 10 ma from a 300 volt supply, a safe value for $R_1$ can be found by:

$$R_1 = \frac{30}{.10} = 3000 \text{ Ohms @ 1 Watt}$$

If the circuit $L_2C_3$ is in the plate circuit of an amplifier requiring 50 ma from the same 300 volt supply, then using the same rule and math $R_2$ would equal 600 Ohms @ 2.5 Watts.

Recommended values for $C_5$ and $C_6$ are $C_5$ equal to $C_2$ and $C_6$ equal to $C_4$, with $C_2$ and $C_4$ the usual values employed for the frequency of the circuits in use.

The above decoupling system, using an RC network, is satisfactory for low power applications or where the small loss in available voltage to the circuits will not tend to degrade the over all performance of the equipment or introduce problems due to the possible supply voltage fluctuations resulting from poor voltage regulation. In cases where a drop in voltage becomes a detrimental factor the more expensive decoupling network shown in Fig. 8 (B) is recommended. The rfc chokes chosen should provide an inductive reactance at the operating frequency of from 20 to 100 times the capacitive reactance of $C_1$ of $C_3$. Values for $C_1$, $C_3$, $C_5$ and $C_6$ will be the same as above.

The insertion of only one leg of an RC or LC decoupling network will usually cure all but the most stubborn cases of intercoupling of this nature. As a rule, however, the same power supply is used to serve more than just two or three simple stages. In most cases it provides power for many varied stages operating on a multitude of different frequencies. The possibility of generation of birdies and other intermodulation products becomes very acute in such a case and decoupling networks are to be recommended for each and every stage. Plate leads are not the only leads needing decoupling—the AVC system, grid bias supplies and screen grid circuits should be given the treatment.

## Shielding

The isolation between stages provided by bypass capacitors and decoupling networks assist greatly in taming complex gear but it can be compared to only putting bars on the big front doors. Unless the back doors and open windows are closed all the good accomplished by these safeguards may be lost.

Energy carried by electrostatic and electromagnetic fields may leak around carefully designed traps, jump across filters and detour around balanced circuits. These fields can cause birdies, images, back-wave, harmonics and instability. They can be the reason that balanced modulators refuse to balance and suppressed sidebands and carriers reappear. They can also cause oscillator pulling and intermodulation products.

The first step in keeping electrostatic and electromagnetic fields from lousing up the works is to avoid crowding. Unless a rigid space requirement exists which demands that a piece of equipment fit into one particular cubbyhole and no place else, a great deal of money and effort can be saved by employing standard panels, chassis, bottom plates, brackets and cabinets universally available. The present trend by manufacturers toward super-super compactness is commendable but hardly worth duplication by the home builder. If elbow room exists to build the equipment in the first place then sufficient room will usually exist to operate it when it is finished. The use of uncrowded construction will also permit some future modification and bug chasing without the underneath of the gear becoming too much of a brier patch.

Shielding can be designed to accomplish one or both of two functions. It can prevent the transfer of electrostatic and electromagnetic energy or it can serve as a baffle to reduce the transfer of heat. An ideally constructed piece of equipment would provide an electrically isolated container for each stage, maintained at a constant temperature well below the failure temperature of the weakest component. This is an order that is impossible to fill. The home builder should, however, shield until it hurts!

The ideal shield encloses the stage on all sides. It controls the energy entering to only one path from one source and the energy leaving to only one desired path. It also provides for the transfer of heat away from the stage as fast as it is produced and prevents heat from external sources from effecting the value of its enclosed components.

A practical shield will serve the purpose of controlling the transfer of energy to a low enough level to be practical. A practical shield need not completely enclose the stage or stages it is designed to serve. It must, however, prevent direct exposure to annoying fields and make the paths these fields must follow sufficiently long and complex to reduce their effects to something less than a critical level. Examples of practical shields are shown in Fig. 9 and Fig. 10.

In the design of such shields particular importance must be placed on their mechanical rigidity. A flimsy shield baffle, free to move or vibrate, can cause mechanical instability such as microphonics and frequency instability during temperature changes. More often than not these shield baffles are also used to support capacitors, switches, and other manual controls. Unless they are rigid they may contribute to backlash and frequency instability due to mechanical warping during operation.

Profuse use of shield cans for tuned circuits is recommended. In the use of shield cans, choose a size large enough so that the can shields the circuit without becoming a part of it. Cans smaller in diameter than three times the diameter of the enclosed coil form, or shorter than twice the length of its enclosed coil, add a distressing amount of capacitance to the circuit. Two small shield cans may also produce the same undesirable effects associated with flimsy shield baffles. The moral of the story?—Bottle 'em up tight but don't be stingy with the bottle!

I once made the mistake of mounting a 4E-27A next to the components of an ECO in the same transmitter. No electrical interaction was experienced, but as soon as the carrier was put on the air, and that blazing red 4E-27A began to pump out heat, the ECO took off across the band like a greyhound after a rabbit. In about one minutes time the signal had covered 15 Kc of the twenty meter band and was still going strong. A double shield baffle (Two pieces of aluminum with a quarter

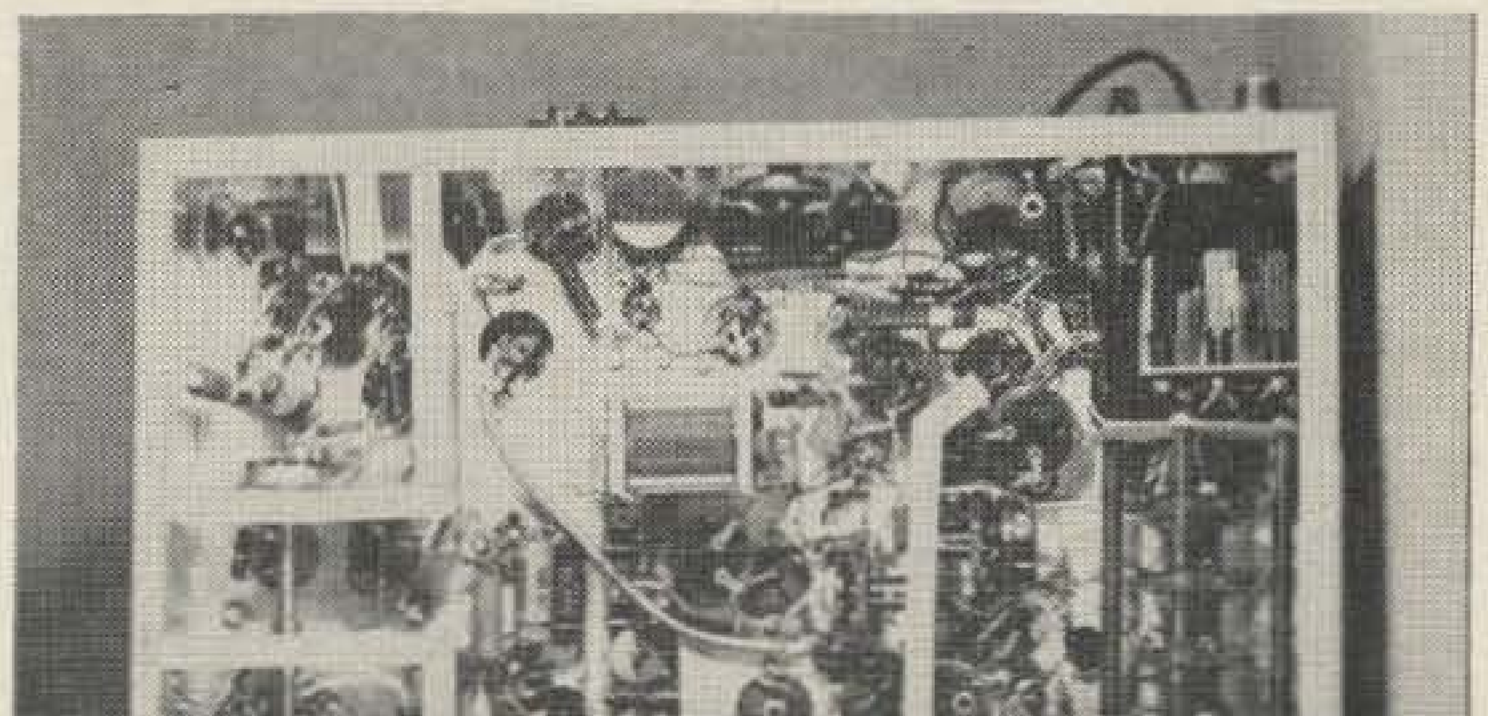


Fig. 9. Accented white lines show practical shield baffles installed in an SSB exciter to isolate frequency converter stages and succeeding amplifiers.

Fig. 10. Accented white lines show shield baffles installed in a triple conversion SSB receiver. Note the parts mounted on these shield baffles.

inch air space between) reduced the drift to about 5 kc per five minute transmission.—Quite respectable stability in those days! The installation of a blower to further remove more heat generated by the 4E-27A and temperature compensation of the oscillator would probably have reduced this drift much further.

## Temperature Compensation

This brings us around to temperature compensation of oscillators. To work properly, the components of a temperature compensated oscillator circuit must be brought to operating temperature *slowly* and *evenly*. Any sudden heating (such as in the case mentioned above) will result in uneven heating of the various components and the oscillator will drift wildly both higher and lower in frequency as the various parts change temperature.

The presence of shield baffles assists the slow and even distribution of heat in four ways:

(1) By blocking direct radiation paths.
(2) By increasing the length of the path of movement of heat by conduction.
(3) By reducing the transfer of heat by convection. (Air-currents).
(4) By increasing the overall bulk of the material into which the heat may dissipate. This increase in bulk of material also helps in normal cooling since the larger the radiating surface of a body the faster it tends to lose heat to its surroundings. (This is also the principle of the heat sink).

Heat shields should be carefully designed to prevent overheating one portion of a circuit while protecting another. Ventilation of heat producing tubes and high current dropping resistors is particularly important to prevent overheating not only those components but also the entire piece of gear. Small phonograph motors of the type used in the RCA 45 rpm record changer are cheap and when fitted with a two or three inch homemade fan make a quiet blower which takes up little space. They also make no noise in the receiver. These blowers are satisfactory for use in gear where a little cooling seems the wisest option. Heavier blowers of course must be employed to cool components which normally require forced air cooling.

The mere movement of air within a shielded enclosure is not enough. Air should have a ready path through the equipment from an outside intake to another outside exhaust. When air is circulated a suitable dust filter to remove dust particles at the intake is almost a necessity. Dust particles, if not removed, have a tendency to accumulate a charge from high voltage components with which they come in contact and then to electrostatically adhere to neutral surfaces. This build up of dust can become severe in a surprisingly short period of time and may result in electrical deterioration and ultimate failure of the equipment.

Since air cannot pass through solid shielding baffles, some form of screening which will permit the passage of air but not of electrical energy becomes a necessity. A solid sheet of metal perforated with a multitude of very small holes is the most satisfactory solution to the ventilation problem. Screen material covering and carefully bonded to the edges of several relatively small ventilating holes is the next most effective solution and a screen covered single large hole is the least effective. In any case the amount of air that can be moved through such ventilating devices will be restricted to only about one third the flow that would pass through an unrestricted hole of the same size. The overall area dimensions of the ventilation openings must be made sufficiently large to compensate for this restriction. A word to the wise on this score—Don't forget that a one and three-quarters inch diameter hole will pass three times as much air as a one inch diameter hole. Multiplying the hole diameter by three is overdoing things a bit!

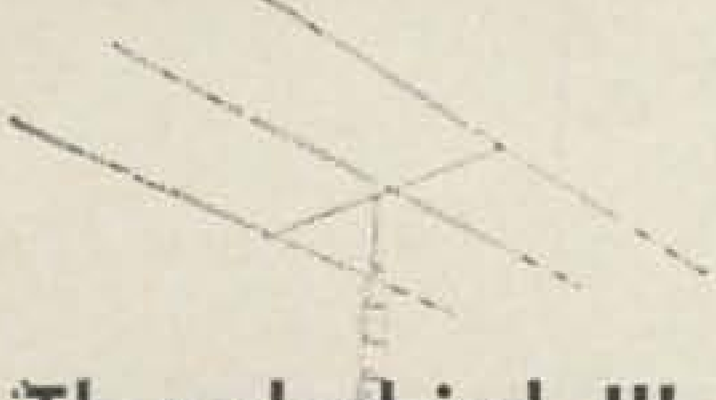
The subject of vermin traps for home made radio gear could go on for a thousand pages. Nothing has been said about parasitic oscillations, harmonic generation in transmitters, images in receivers, distortion, AC hum, or a score of other little beasties that plague radio equipment. The editor is a nice guy—but he has to have a few pages of this months issue for the advertisers. After all it is the advertisers that pay the bills!

This article should answer some of the questions on how to tame a home made piece of equipment—before it is even ready to plug into the wall socket. So shoulder your soldering iron, strap on your wire strippers and venture forth to smash dragon eggs. A smashed dragon egg never hatches into a full grown fire-breathing dragon!

. . . W2TBZ/4

# BEST

measure
**the difference**



### Thunderbird III

The "industry standard" tribander for 10, 15 and 20M. Boom is 14 ft. x 2" OD, longest element 26 ft. Elements telescoping 1¼"-3/4". 100% rustproof. Less than 2:1 SWR. Wt.: 33 lbs.

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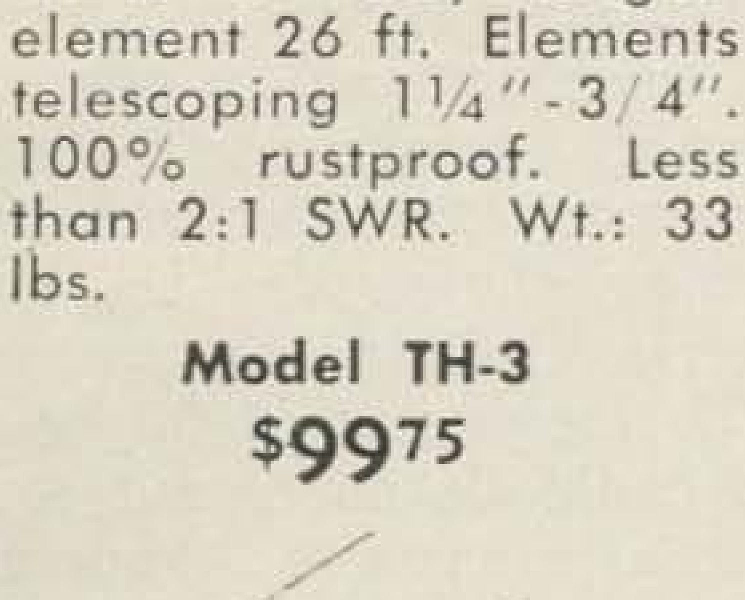
**$99^{75}$**



### Thunderbird IV

16'x2" OD boom, 1¼" telescoping to 3/4" elements, 32 ft. and all aluminum. Full size element and full size boom. Interlaced 4th element allows higher gain and F/B ratio on ten meters. Wt.: 38 lbs.

**Model TH-4**
**$117^{50}$**

# of the
# Compact Tribanders

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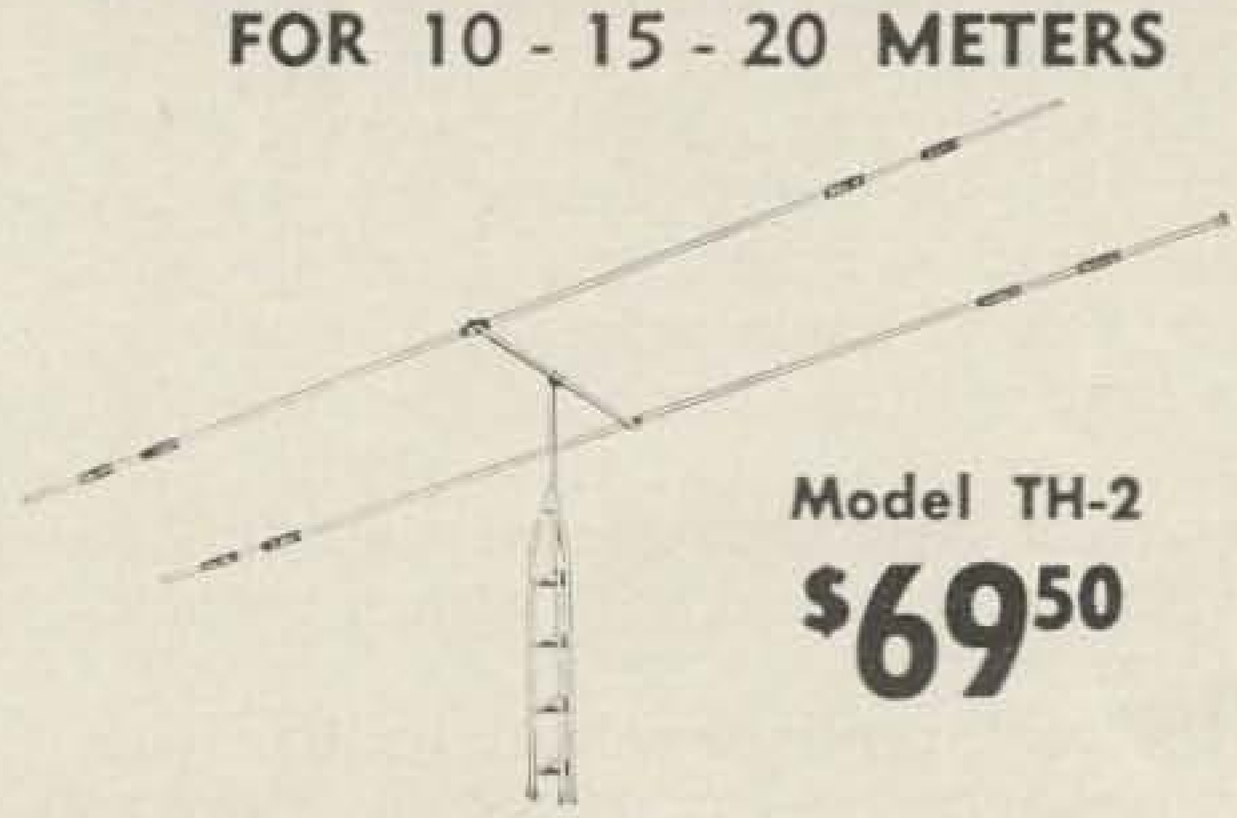
# Thunderbird II

**FOR 10 - 15 - 20 METERS**



**Model TH-2**
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The Hy-Gain Thunderbird II has the superior construction of the Thunderbird Series, yet has a turning radius of only 13 ft. — 2" OD boom and 1¼" OD elements with built-in, weather-protected Slim Traps and iridite treated steel mast clamps and hardware. The total weight of the Thunderbird II is only 19 lbs., light enough to be rotated by a good TV rotator . . . yet strong enough to survive winds of 100 mph.

The Thunderbird II features the exclusive Hy-Gain Beta Match, eliminating mast lighting and allowing an optimum transfer of energy. The beam is at DC ground, reducing possible hazards from lightning. SWR less than 2:1 on all three bands.

The Thunderbird II has gain of 5 db, with 18 db F/B ratio.

For superiority in design and construction; for power handling capabilities; for reduction in space requirements; and for efficiency in low-cost operation . . . the Hy-Gain Thunderbird II is your best buy in 10, 15, and 20 Meter three-band arrays.

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**DEPT. 1216** **LINCOLN, NEBRASKA**

*The World's Fastest Growing Manufacturer of Distributor Marketed Products*


*The printed circuit board for this project is available from: Irving Electronics, P. O. Box 9222, San Antonio, Texas.*

Don Wherry W6EUM
2121 Grandview Drive
Camarillo, California

# Selectivity Number 1

THROUGH the past years the big problem which has constantly plagued amateur CW operators has been one of interference. This problem started years ago, during the hey-day of the spark outfits, reaching serious proportions at the peak of their activity. The advent of the tube transmitter alleviated the situation for a number of years but now again, with the thousands of new stations on the air, the poor CW operator is faced with a near intolerable situation.

During the past, receiver selectivity has been increased time and time again in an effort to keep pace with this interference problem and, in the case of the better receivers, has been partially successful. There are a number of receivers now on the market which have a bandwidth of 500 cycles at the 6 db point, however, these receivers are not cheap and for many of the ham fraternity are beyond reach. The cheaper models, meanwhile, are simply not able to handle the situation as it exists today. The little device to be described here is primarily for use with receivers in this latter category, however it is still able to improve the selectivity of the best of them.

A few words regarding receiver selectivity in general perhaps are in order here. As you know, "selectivity" is a function of the "Q" of a circuit and of the center frequency of its

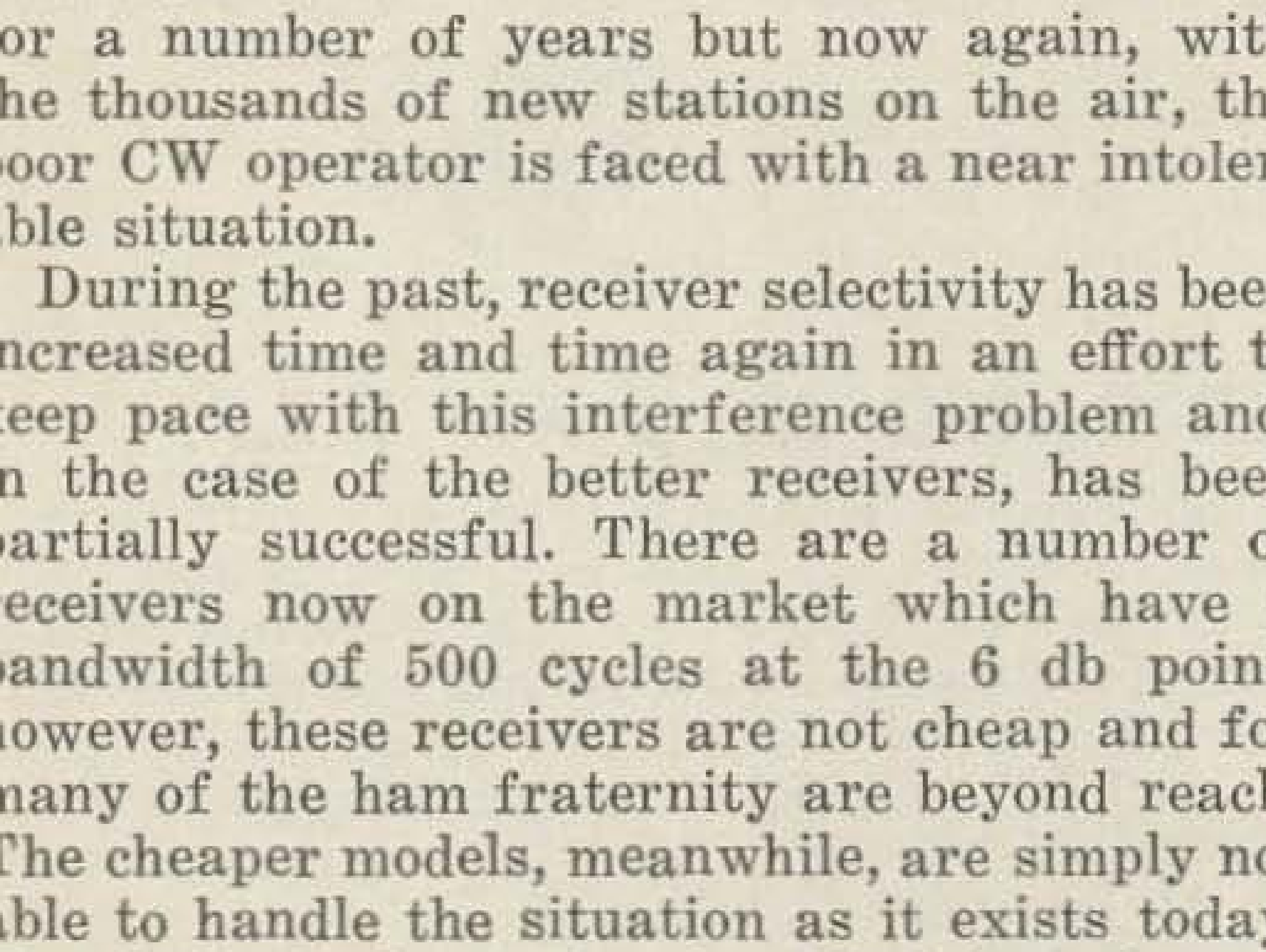
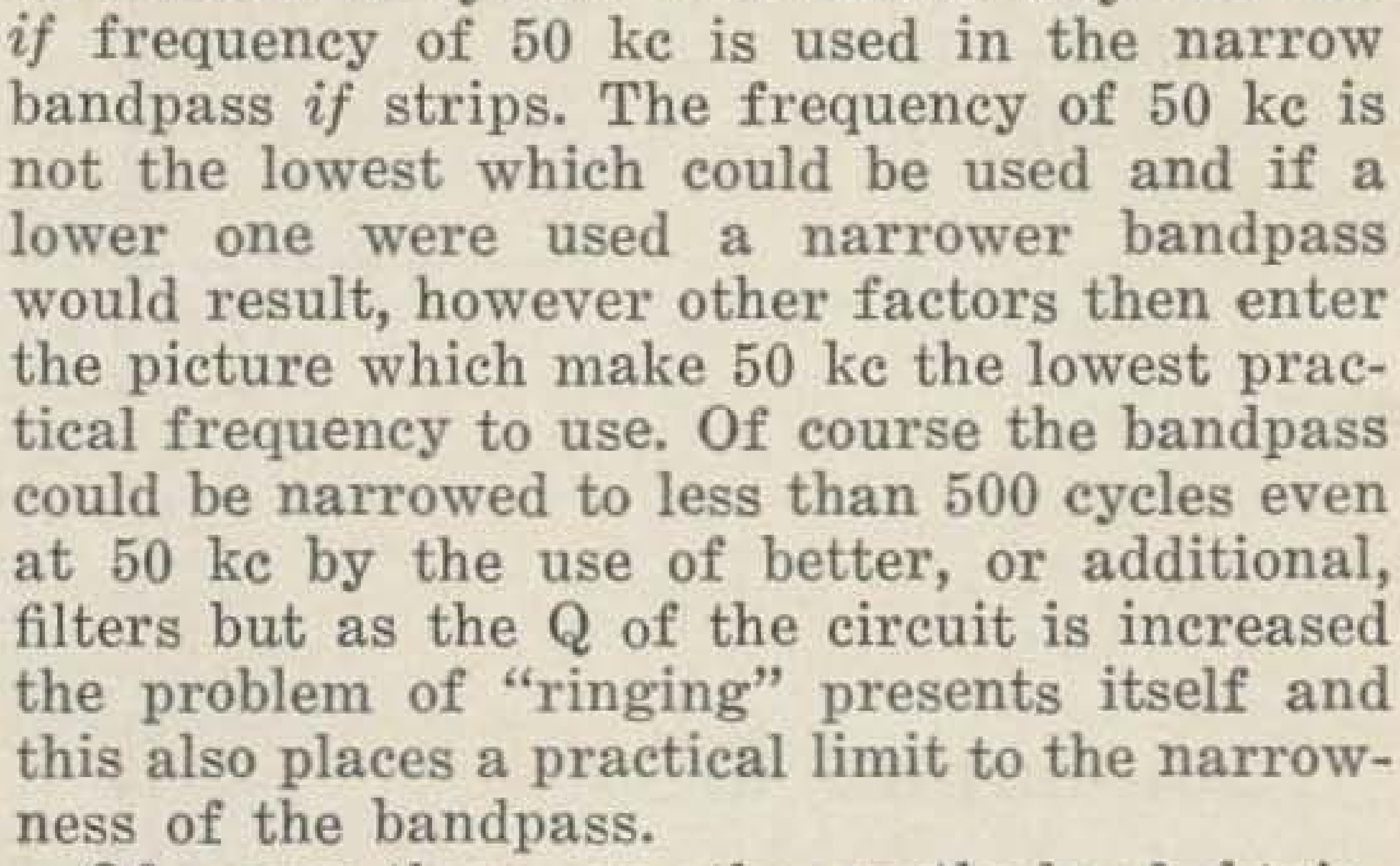



FIG. 1

passband—when you measure the selectivity in cycles, not percentages. In other words a tuned circuit of a given "Q" will have a certain bandwidth at the 6 db point for one frequency and a very different one for another frequency —that with the bandwidth measured in cycles. As the bandwidth when measured in percentages stays approximately the same it follows that the lower the frequency the narrower the bandwidth in cycles. This shows why the low *if* frequency of 50 kc is used in the narrow bandpass *if* strips. The frequency of 50 kc is not the lowest which could be used and if a lower one were used a narrower bandpass would result, however other factors then enter the picture which make 50 kc the lowest practical frequency to use. Of course the bandpass could be narrowed to less than 500 cycles even at 50 kc by the use of better, or additional, filters but as the Q of the circuit is increased the problem of "ringing" presents itself and this also places a practical limit to the narrowness of the bandpass.

Of course there are other methods of obtaining high selectivity in *if* amplifiers such as the mechanical filter of the Collins equipment, but normally it is obtained by the used of high Q tuned circuits at a relatively low *if* frequency.

Now since we have decided that lowering the resonant frequency will result in a narrower bandpass while using the same Q, and with the same amount of ringing, we should be able to use a filter at some audio frequency and



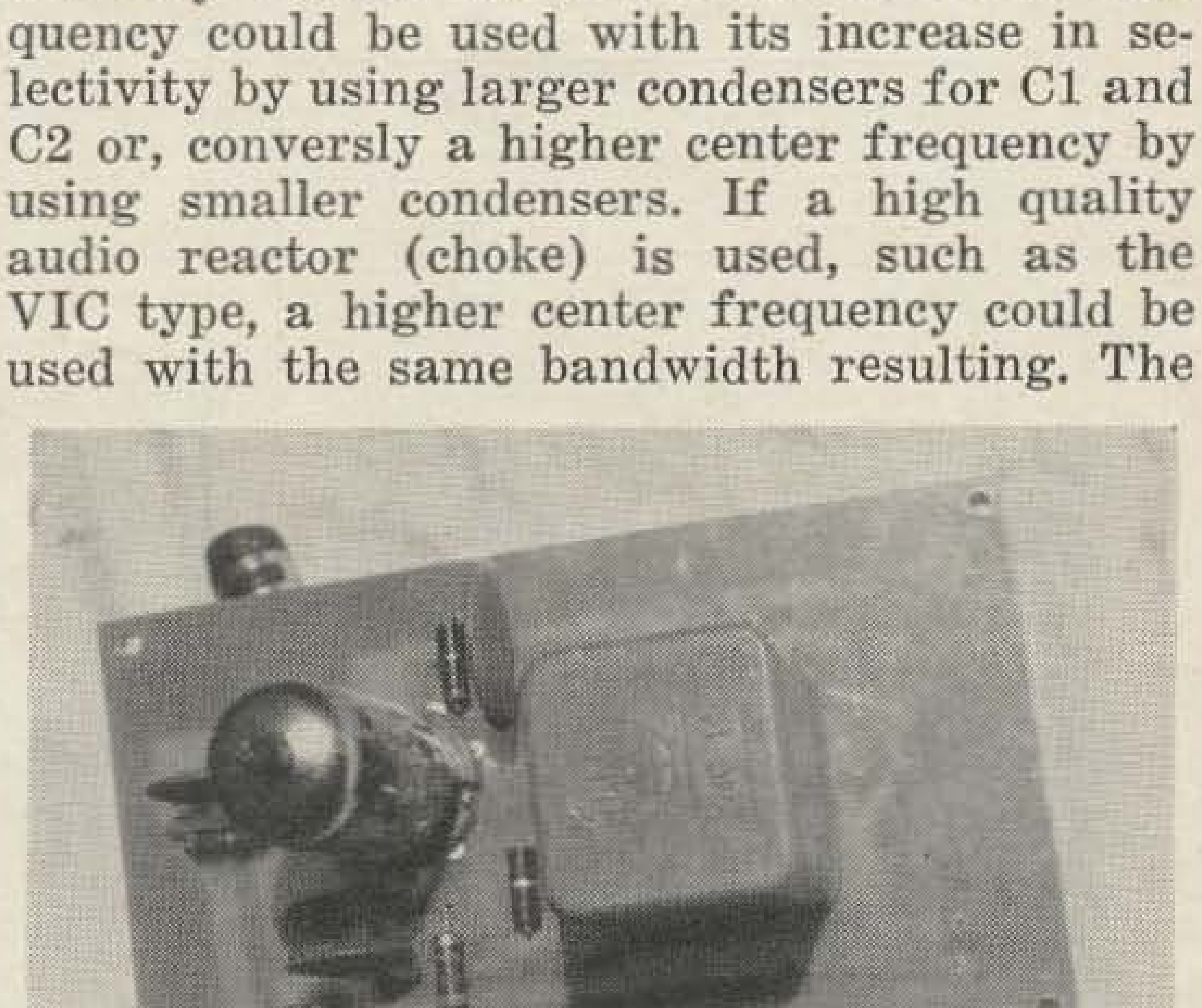
increase the usable selectivity and still circumvent these objections of a narrower bandpass at 50 kc.

The unit shown in the photo is such a device. It uses an audio filter which is peaked at 460 cycles and has a bandwidth of 105 cycles at the 6 db point. Please note that 105 cycles is a very narrow bandpass—nearly 5 times as narrow as the usual run of big receivers. Fig. 2 shows the bandpass curve.

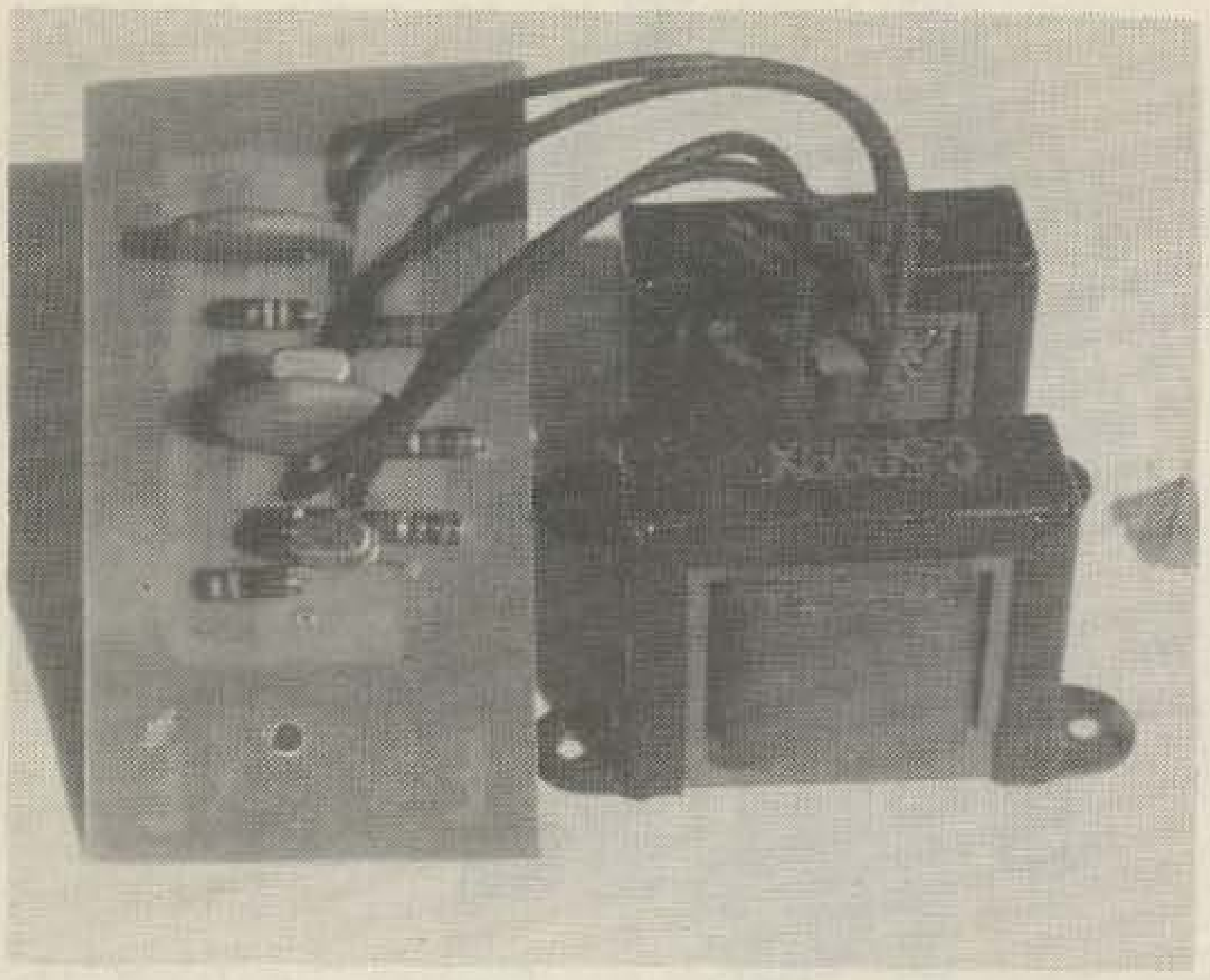
The schematic diagram (Fig. 1) shows the unit to be a two stage transistorized amplifier using a series tuned resonant circuit in the input of each stage. Transistors, with their low input impedances are particularly well adapted to the use of such input circuits. The first stage uses a Texas Instrument transistor, type 2N368 in a common collector circuit. This is, of course, similar to a cathode follower stage using a vacuum tube, and as such has a gain of less than one. A gain in this stage is not needed however, and such a circuit lends itself admirably to the task of driving the following amplifier stage. The tuned circuit in the input of this first common collector stage consists of a 0.015 microfarad condenser in series with an eight henry filter choke. You will note that this choke (L1) is called out as an ordinary 8 henry filter choke of the garden variety. This may sound strange to the audio man and should be explained. First; a high quality audio reactor such as the UTC VIC type could be used with an increase in selectivity (narrower passband) but in this case an improvement over the filter choke is not needed and, second, the difference in cost between such an audio reactor and an ordinary 8 henry choke amounts to several dollars. This does not mean you can not use a VIC reactor—you can and it would be very good.

The output of the first stage is taken from the emitter connection where it is fed through another series resonant filter identical to the one in the first stage and from there to the base connection of the second stage transistor. This second stage, which also uses a 2N368, is a common emitter circuit which gives the unit the necessary gain.

The center frequency of 460 cycles was arbitrarily chosen for the filter. A lower frequency could be used with its increase in selectivity by using larger condensers for C1 and C2 or, conversly a higher center frequency by using smaller condensers. If a high quality audio reactor (choke) is used, such as the VIC type, a higher center frequency could be used with the same bandwidth resulting. The



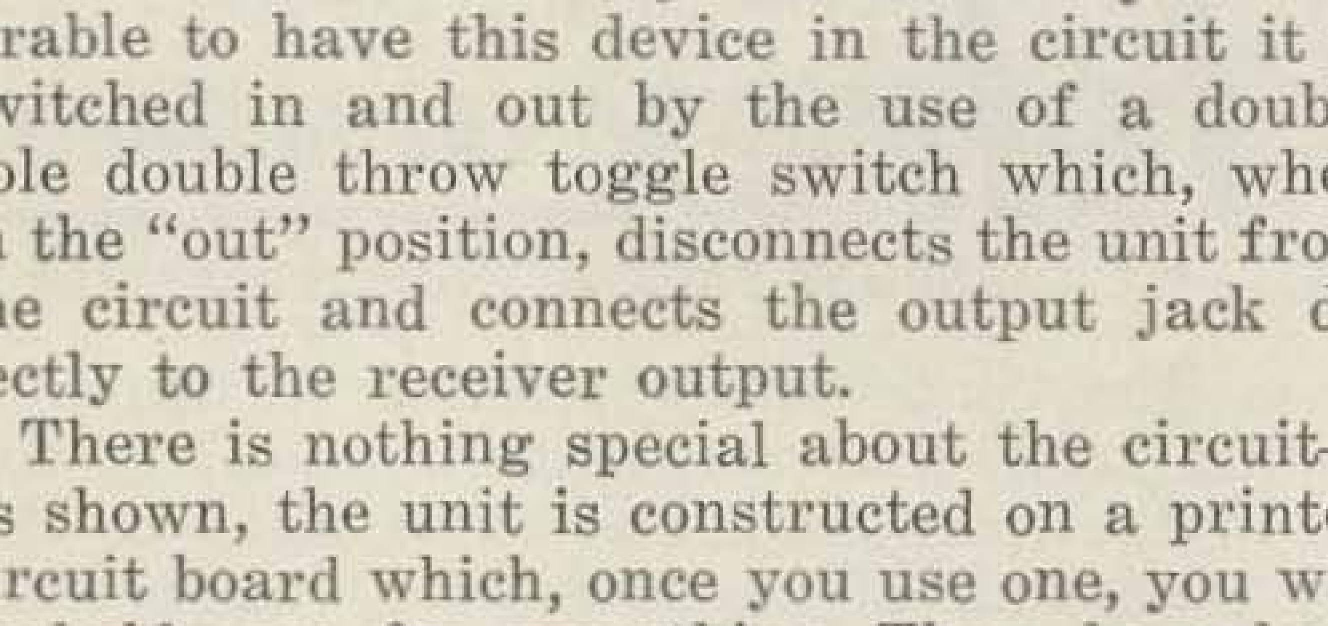
one thing to remember when choosing the center frequency to use, is that you are accustomed to hearing a lot of fairly high frequency background hiss, static, etc. when you listen to the amateur bands, but when you narrow the passband down to 100 cycles and center it below 500 cycles this is all gone and you get the feeling that you are down in the bottom of a well. This is no real problem however and after you listen to hissless, crackless sig-



nals for awhile you won't notice it.

As it will not always be necessary or desirable to have this device in the circuit it is switched in and out by the use of a double pole double throw toggle switch which, when in the "out" position, disconnects the unit from the circuit and connects the output jack directly to the receiver output.

There is nothing special about the circuit—as shown, the unit is constructed on a printed circuit board which, once you use one, you will probably use for everything. There have been several articles printed on how to use this material but just a few words probably would not be amiss. The circuit is laid out on a piece




C - COLLECTOR
B - BASE
E - EMITTER

FIG. 3

of paper—roughly at first—and carefully after the general layout is decided. The final drawing, on which all the resistors, condensers etc. will fit is then traced on the copper of the circuit board by the use of carbon paper. The copper to be left is then painted, using a very small pointed artists brush, and any kind of enamel or paint you might have on hand. The non-painted copper is then etched away, the paint removed, and you're in business. Any kind of a glass dish or pan can be used to hold the acid while you etch. The board and etchant can be purchased quite reasonably from several radio stores. Fig. 3 is the board used in this unit, drawn to scale so you may, if you wish, copy it directly from the magazine.

The Texas Instrument transistors used are general purpose types costing approximately $1.70 each at radio stores. Other similar types could probably be substituted with little or no difficulty. The board layout shown in Fig. 3 is drawn so that C1 and C2 may be two capacities in parallel instead of the one as shown if such are needed to peak both filters to the 460 cycle center frequency. If two identical filter chokes are used this peaking should not be necessary however. Also, sometimes 0.015 ceramics are hard to find so in that case two condensers in parallel can be used.

The unit is mounted in a box 3 by 4 by 5 inches with the audio input and output in the rear—this can be changed to the front if desired, of course.

This little device is truly a "bomb." Just try tuning in a CW signal to a beat of 460 cycles with some bad interference at say 1,000 cycles and flip the unit into the circuit. You will be very surprised at the way the interference, static, background noise etc. drops down and the signal you want jumps out at you. It will many times allow perfect copy to be made of a signal normally unreadable from the receiver output. It won't turn your $76 kit into a 75A4, but it will come a lot closer than anything I know of for the few bucks spent.

The unit uses a 7½ volt battery for power and, since it draws only 0.7 milliamperes, the battery will last for months. The on-off switch, not shown on the schematic (Fig. 1) is a single-pole single-throw toggle switch in the battery lead.

Just in case you are one of those who prefer vacuum tubes this device can be constructed using a 12AU7 as shown in Fig. 5. Everything previously said will also apply to this tube unit. In this case, however, a UTC audio reactor type VIC-14 was used instead of the filter choke and it gives a slightly narrower passband that the transistor model. The curve is shaped like Fig. 2 but is only 45 cycles wide at the 3 db point, 75 cycles at the 6 db and

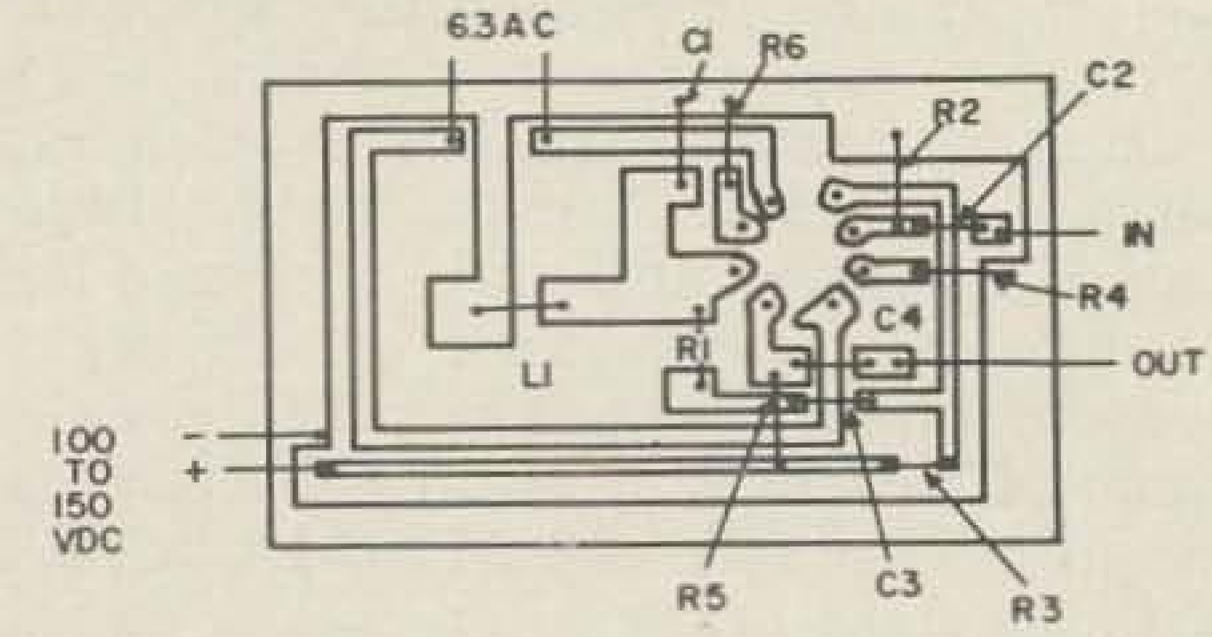



FIG. 4

125 cycles at the 10 db points. The overall gain is approximately 3 when using a 12AU7, which is sufficient. However if you would like more gain than that you may substitute a 12AY7 or a 12AT7 for the 12AU7 which will do the trick with no circuit changes. The printed board for this model is shown in Fig. 4 and is also drawn to scale.

While the two filter systems for the two models perform the same function, they do so in somewhat different ways. The series resonant filter of the transistorized model takes advantage of the fact that a transistor is a low impedance input device and must be fed from a low impedance source. The impedance of a series resonant circuit is very low at resonance, amounting to the ohmic resistance of the reactor plus the losses etc. so this imposes very little resistance in the coupling between the two stages and also in the input of the first stage. As the input frequency is varied from this resonant point the reactance of the series circuit goes up rapidly, very quickly putting a high resistance in the coupling circuit which "decouples" the stages and cuts the gain. These series resonant filters are, in effect, a frequency conscious volume control.

The filter in the tube version acts on a different principle. In this model the characteristics of a parallel tuned circuit are utilized which are directly the opposite to those of a series tuned circuit. The reactance of a parallel circuit is very high at resonance decreasing rapidly as the input frequency is moved away from that point. By placing such a filter from

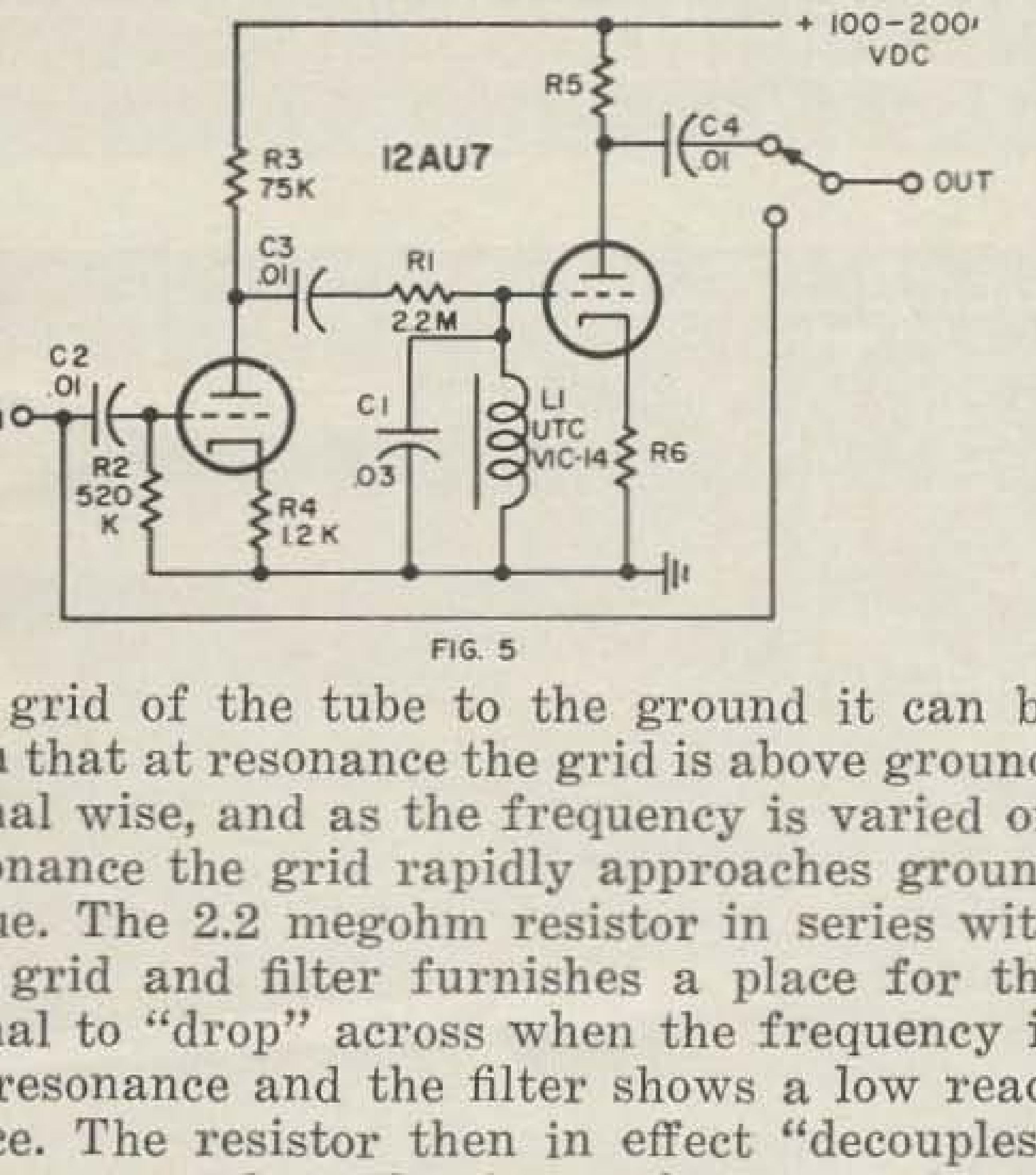
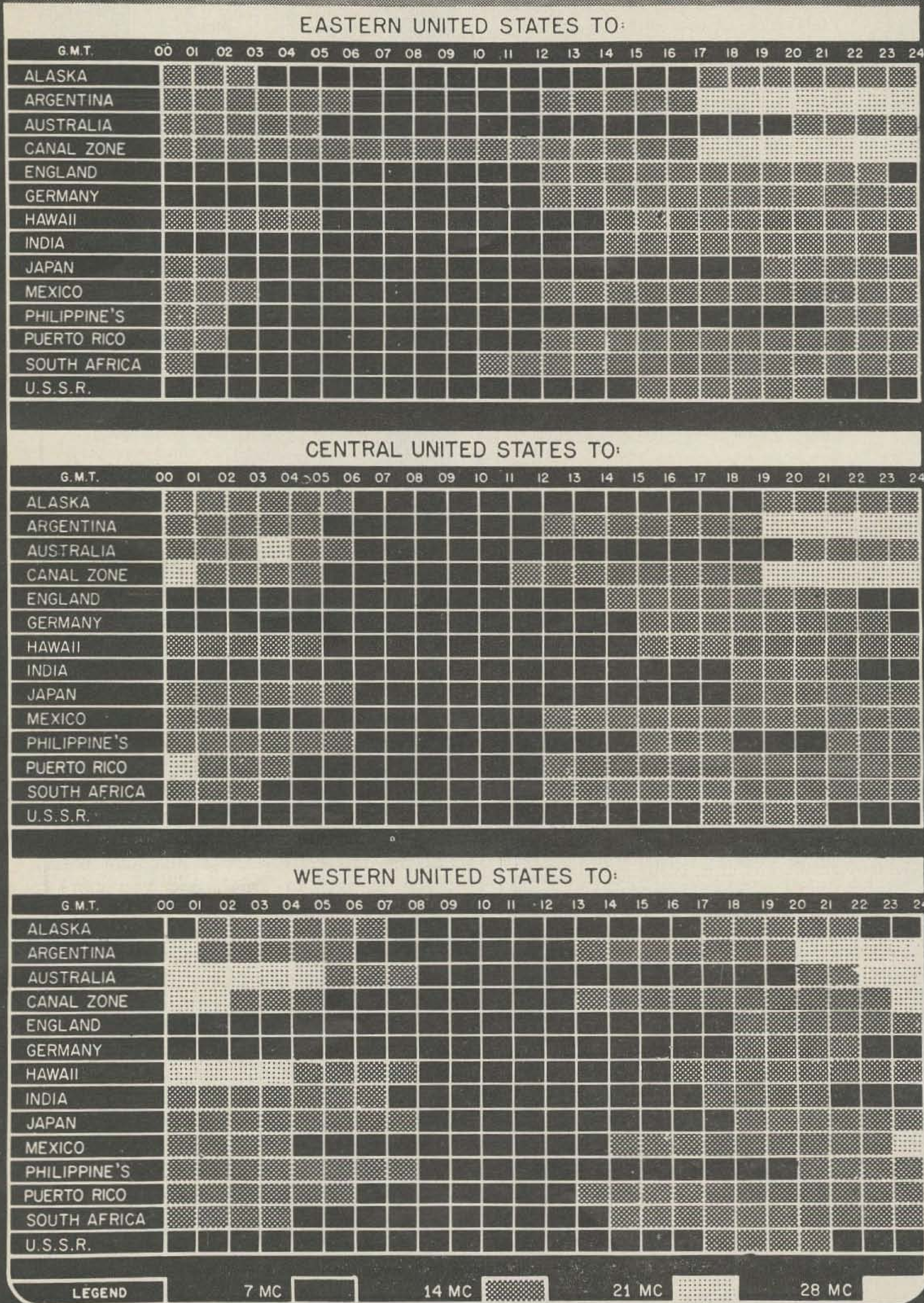



FIG. 5

the grid of the tube to the ground it can be seen that at resonance the grid is above ground, signal wise, and as the frequency is varied off resonance the grid rapidly approaches ground value. The 2.2 megohm resistor in series with the grid and filter furnishes a place for the signal to "drop" across when the frequency is off resonance and the filter shows a low reactance. The resistor then in effect "decouples" the stages when the input frequency is off resonance. This is a "losser" method of getting the desired result but as a gain is not needed this is of no matter. The 2.2 megohm resistor can be reduced in value and recoupe some of the lost gain if such is desired but if reduced too far some decrease in selectivity will result. Probably one megohm should be the minimum value. It is better to use the 2.2 megohm value and go to a higher gain tube such as a 12AT7 as mentioned earlier.

These two units will improve the capabilities of any receiver, regardless of the cost and when used with the $100 variety makes the difference between no copy and a solid copy in a large percentage of cases of QRM. But even if you do have an expensive receiver and dc have a minimum of trouble with interference this unit is small and cheap to build (either model) so throw one together—it just might save that rare DX contact that you have been working on. ... W6EUM

# PROPAGATION CHART



# Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

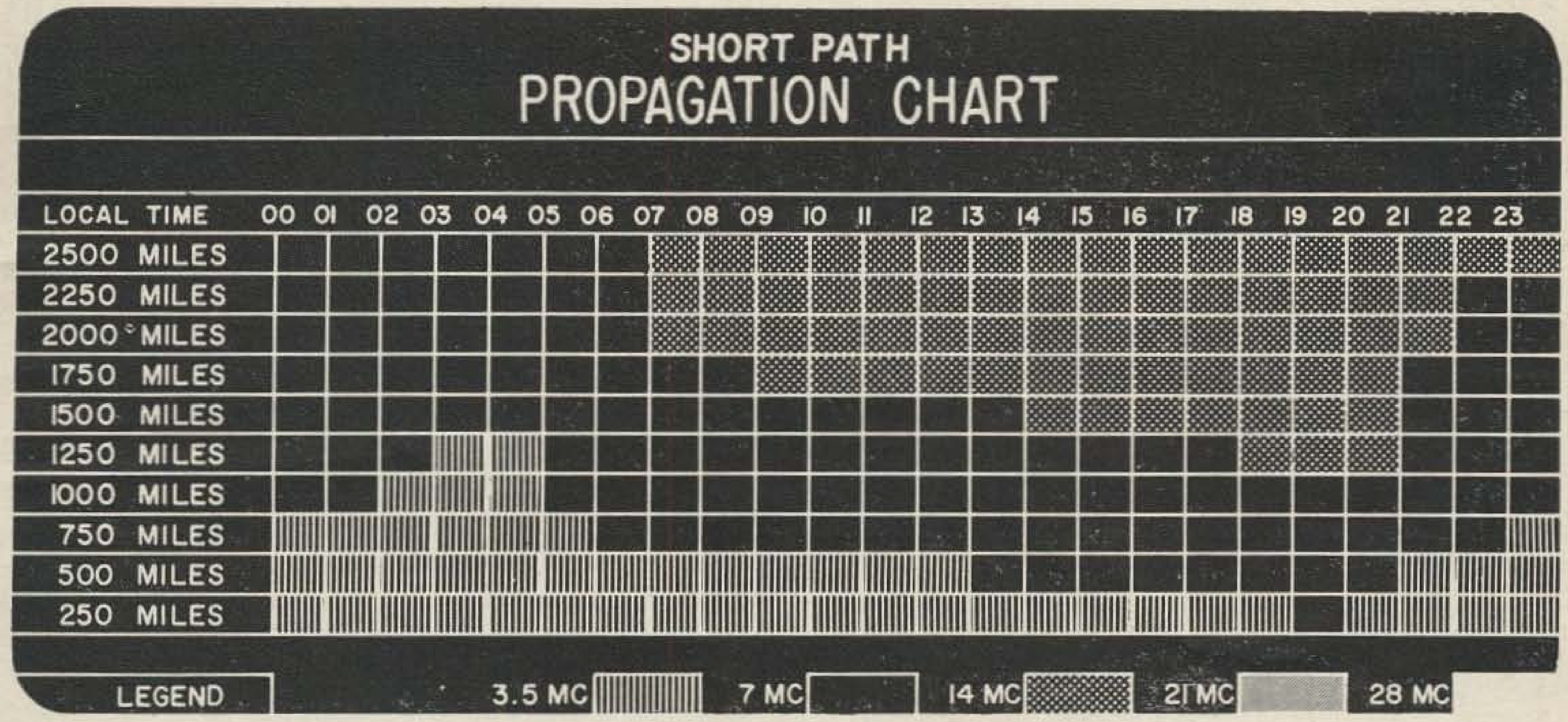
The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

**Advance Forecast: July 1962**

Good: 3-13, 21-26

Fair: 1-2, 14, 16-20, 27-29

Bad: 15, 30-31



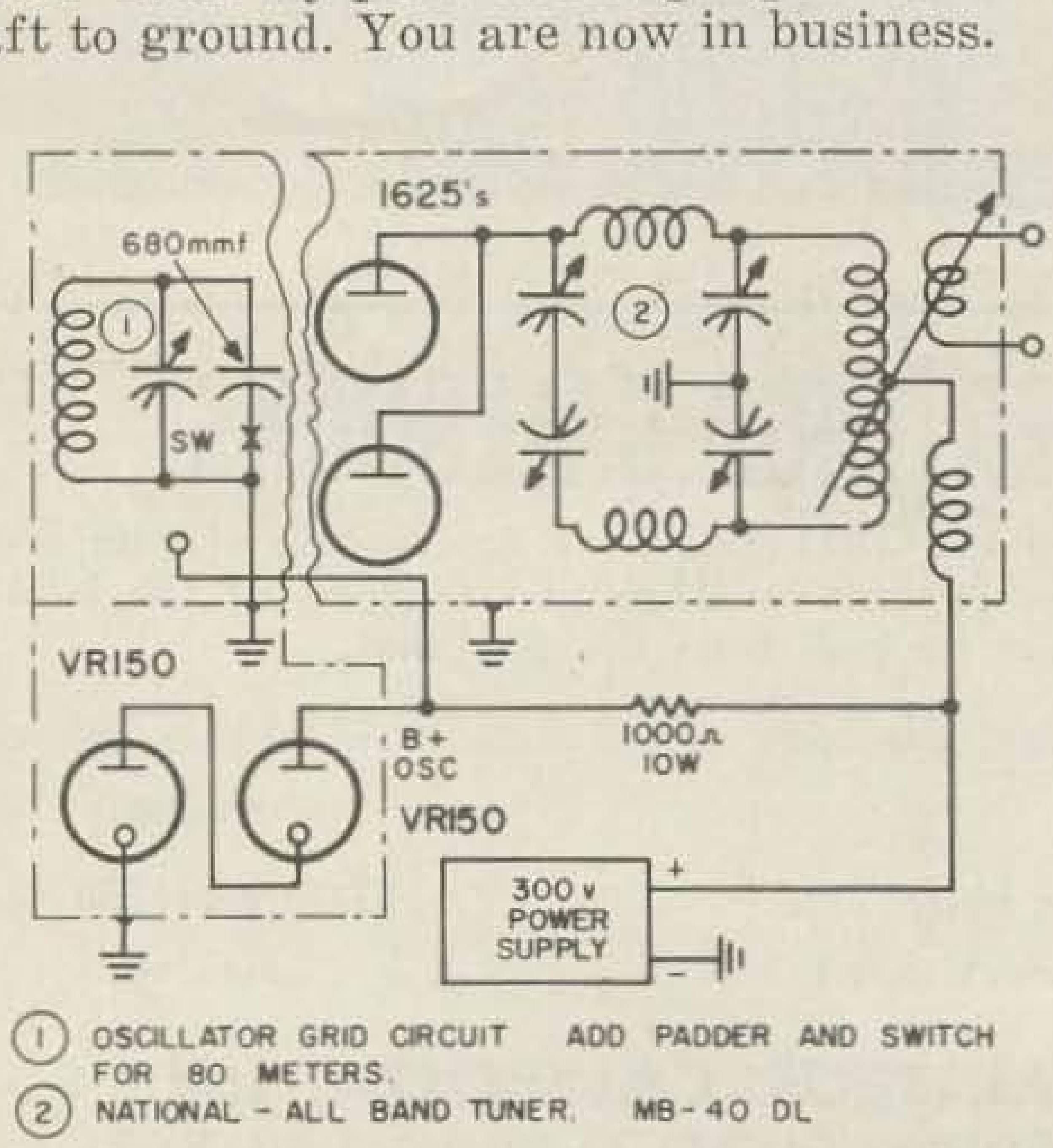
# Old Friend in a New Suit

## *Arc-5 Exciter*

Bob Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

I have always been too proud or too Scotch to purchase a store bought transmitter or even a store bought exciter. Likewise I have hesitated to buy the necessary parts to build a sure 'nuf all band home brew job. Consequently I have limped along for years with a one-band rig or a GF-11 with the coils rewound to work on 20 or 15 meters, the latter not being any too stable at times. It has always seemed to me that there ought to be a simple, "cheap and dirty," way to solve this problem. I think I have stumbled on to it.

The stability of the ARC-5 "command transmitter" is well known. More of them have been cannibalized in one way or another than any piece of surplus gear to come out of World War II. They are still for sale in every magazine you pick up. The only trouble is that, without extensive revision, they are good for only one band or two at most. If you start on 80 meters you need multipliers after you get below 40; in fact, it's difficult to cover both 80 and 40 with one coil. The advent of National all band tuners at bargain prices caught my attention; so I bought a couple of the small size and one of the larger size. The small one made possible about the simplest revision of the ARC-5 yet devised. All you need to do is take out the roller coil and the final plate coil and set the All Band Tuner in its place. Leave the tubes in parallel as they were originally and connect the tuner as per diagram by National. See Fig. 1. Use the existing rf choke and add a .002 mica by-pass from ganged condenser shaft to ground. You are now in business.

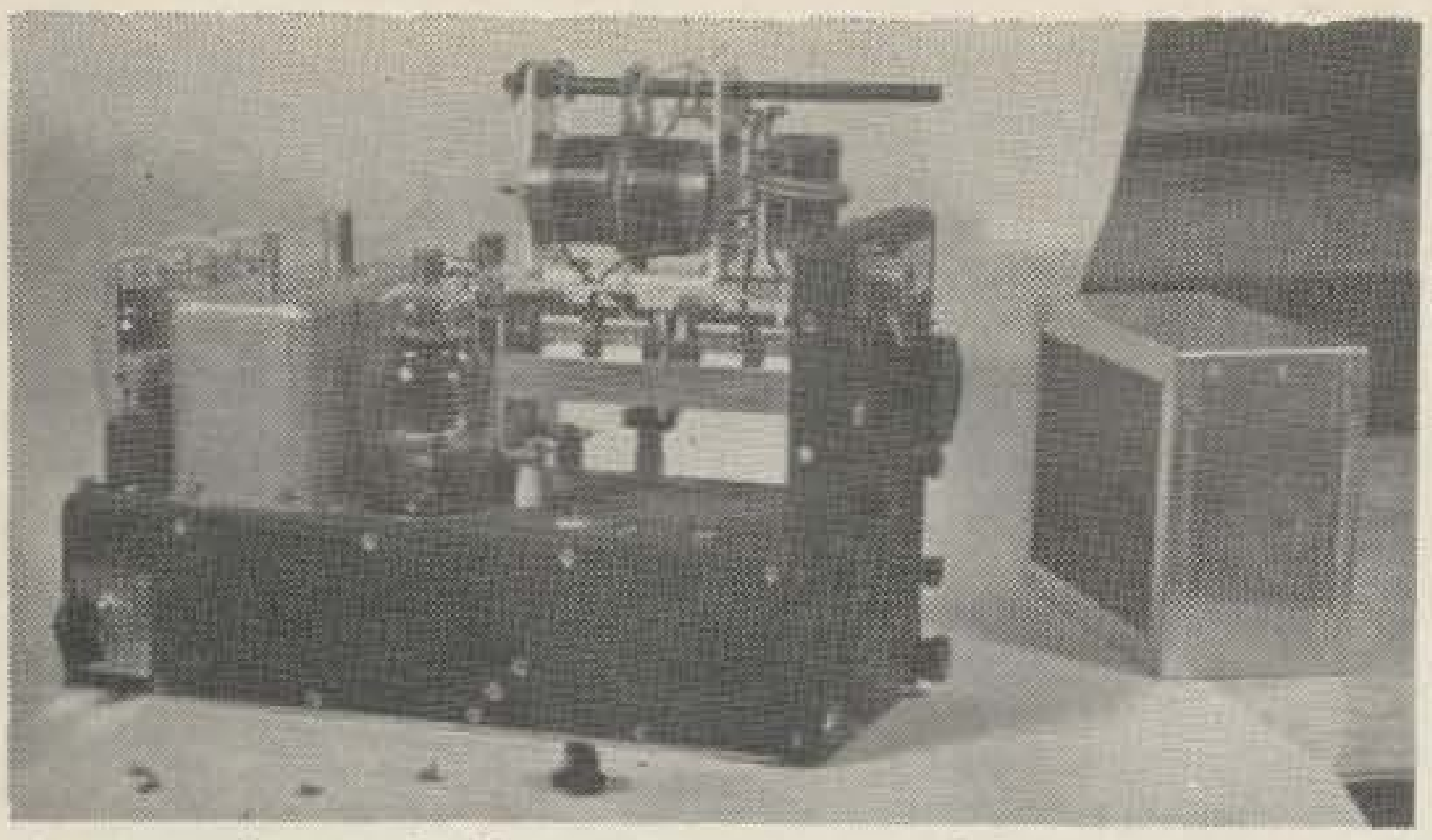



(1) OSCILLATOR GRID CIRCUIT ADD PADDER AND SWITCH FOR 80 METERS.
(2) NATIONAL - ALL BAND TUNER. MB-40 DL

FIG. 1

Well almost in business, that is. I chose the 7 to 9 mc unit for two reasons. First of all I had one on the shelf that had already had the crystal and eye tubes removed and replaced by VR tubes, affording a 255 volt regulated voltage for the oscillator. Secondly it looked like a natural to cover 40, 20, 15 and 10 meters. Such proved to be the case. Using a 300 volt supply (also found on the shelf) I obtained adequate output from 40 to 10 meters to drive something the size of a 6146 or 807. 40 and 20 meters provided sufficient power to drive an amplifier requiring a couple of watts drive. All you have to do is turn the dial on the tuner! Switching in a 680 mmfd silver mica padder in parallel with the grid tuning condenser makes it possible to also cover a 200 kc portion of the 80 meter band with a watt or two of output. A 1000 ohm 10 watt resistor was placed in series with the 300 volts and the oscillator-VR tube combination, the VR tubes already being on the rear deck of the ARC-5. 300 volts was fed directly to the 1625 stage, which is also connected to the series screen dropping resistor as well as the plate circuit.

If you're considering driving something on the order of a 6146 you can stop right here. I was planning on driving a 200 watt final that required a little more drive than could be obtained on 10 meters; and even 15 was a bit short. So it was decided to investigate the ARC-5 a bit farther. Removing the shield can from the oscillator reveals an air padder in parallel with the main tuning capacitor in the oscillator. If you disconnect this padder you will find that the oscillator fundamental frequency can go as high as 14.5 mc and somewhere in the middle it tunes to 10.6 mc. Surprisingly the stability is about as good as before. And now by doubling in the 1625 stage you can get either 15 or 10 meters with lots of output. So the final circuit used in the oscillator as seen in Fig. 2. incorporates a three position two gang rotary switch. Position #1 puts the silver mica padder in parallel with the main tuning and places the oscillator and hence the 1625 stage on 80 meters; in all other positions the silver mica is out of the circuit. Position #2: Oscillator circuit is the same as the original and the 1625 stage operates on either 40 or 20 meters. Position #3: the padder under the shield is disconnected and by tuning to the proper dial setting the oscillator is either on 10.6 mc or 14 mc and the 1625



stage gives full output on either 15 or 10 meters.

Due to the size of the all band tuner the cabinet of the ARC-5 had to be slightly modified. As can be seen from the photo, it was necessary to put a "top hat" on top of the original can. A little work with the tin snips was required to clear the tuner and a 5 x 6 x 3 inverted aluminum chassis was added. The only other mechanical change, aside from mounting the above mentioned rotary switch, was pulling a couple stator plates out of the old padder capacitor in the 1625 stage. This

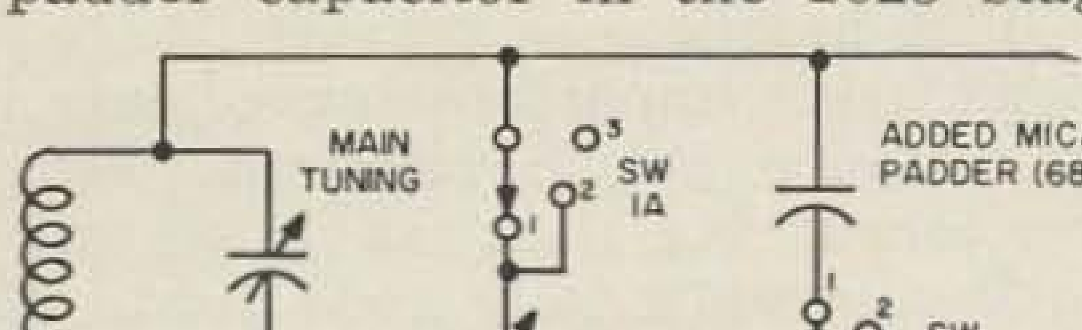



FIG. 2

was necessary to get screw driver clearance for mounting the all band tuner. The holes came thru the base of this old padder. In my case this capacitor is no longer in use although it could be used, as well as the old 1625 main tuning capacitor, for part of the padder to get to 80 meters. In any event the removal of a couple of stator plates would not seriously harm the operation.

So, for well under $10 in addition to the ARC-5 you have a five band tuner! To those who have a 40 meter ARC-5 or command transmitter on the shelf and no all band exciter in the shack, this bit of refurbishing should be of interest. ...W7CSD

# Dear

*Keeping the Indians*

HAVE you recently moved to a new neighborhood? Are you planning to make such a move in the near future? Are you getting ready to put a new rig on the air? Has your rig recently become a bulging teepee for a tribe of Tennessee Valley Indians? Does your neighbor's TV set have a "wide-open" front end or a 21-Mc i-f? If you can answer "yes," or even "maybe," to any of these questions, this article may be just what the doctor ordered to keep tempers cooled until you can bury the TVI hatchet.

One of the most important ingredients in a TVI stew is good public relations. Yet, too often overlooked, but just as important as your neighbor being a jolly good (until now) fellow, is his understanding of the basic problem. If he doesn't have the faintest idea about the causes and cures of TVI, he can easily turn into an awful stinker, more out of sheer ignorance than impatience. This article has been prepared for the layman, in his own language, so that through his understanding the sometimes rocky road to a TVI cure can be more comfortable for both you and your neighbor.

Dear Friend,

You have an interesting neighbor with a fascinating hobby! He is a member of a worldwide fraternity of over a quarter-million inquisitive men, women, and children, in several hundred countries, who thrive on the never-ending magic of electronics and the adventure of interchanging ideas across oceans and continents at the speed of light. The farthest corners of the world are at his fingertips; just the flick of a dial will take him into the home of another amateur, perhaps thousands of miles away.

But the very mysteries of electronics which make this hobby so fascinating can bring something less than ecstasy to people who live near an amateur station, even to you. No amateur wants this to happen, and most go to fantastic efforts to make sure, as well as they can, that it doesn't. As embarrassing as the rare cases of interference are to amateurs, they can be downright frustrating to someone who is not familiar with their causes and cures. Even more important, is that tracking down

# Friend

## *on the Reservation*

Douglas G. Hedin KφOFB
219 Blanchard Blvd.
Syracuse 9, New York

causes of television interference (TVI) often are two-man jobs; the amateur sometimes needs help from the owner of the TV set, who obviously can't be of much help unless he knows something about the problem.

In the early days of radio, both amateur and commercial stations often operated on frequencies (dial settings) very close to each other. Because of this, and because we didn't know very much about radio, it was not uncommon for a home-owner to hear amateur stations on his house radio. However, as we learned more and more about electronics, and as newer frequencies came into use, home and amateur equipment was designed so that neither would interfere with the other, provided, of course, that both were constructed and operated properly. But then came television, and we had to start learning from scratch all over again. We still have a lot to learn!

A radio or television set is like your house. Your house has a front door through which you may invite in or keep out anyone you wish, with just a turn of a key. Similarly, you may invite in or keep out of your radio or television set any radio signals you wish, with just a turn of the dial. However, just as an intruder may break into your house or sneak in through an unlocked window, unwanted radio signals may find their way into your TV set, whether you invite them in or not, either because the signals are in the wrong place or because the lock on the electronic door is defective.

There are three primary causes of interference to television sets: (1) defective amateur equipment, (2) defective television sets, and (3) freak, unsuspected oddities of nature that occasionally appear (and sometimes disappear) unpredictably. Although each type of interference may look the same to the layman, the different types usually can be identified by an experienced amateur.

When the problem is traced to the amateur transmitter, the amateur merely locates the source of trouble within the transmitter and eliminates it. All amateurs have to take special tests, given by the Federal Communications Commission (FCC), to demonstrate that they know how to operate and maintain radio equipment properly. Once an amateur has passed these tests and has received his license, he may be fined heavily, or even imprisoned, if he willingly operates his equipment improperly. Such stern measures seldom prove necessary, however, because most amateurs are nice people and they believe in the high standards they are pledged to uphold.

A defective television set, on the other hand, presents a somewhat different problem. For example, suppose you have had your television set for a number of years and it has always worked fine (lucky you!). Then, an amateur station goes on the air in your neighborhood, and blooie; your television set has conniptions! What should you do? What *can* you do? Not knowing the answer can be more frustrating than the trouble itself.

Unfortunately, some television sets were not made to be used in close proximity to radio transmitters such as those used by amateurs. Certain circuits and types of construction were omitted because, at the time, they were not needed; there were relatively few television sets and even fewer amateurs. In addition, the extra features would have increased the cost of all television sets, not just those few purchased by people destined to live near an amateur station. Now, however, most television sets are constructed so that they will operate properly only a few feet away from an amateur antenna.

Should your television set prove to be defective, a competent serviceman probably can bring it back to tip-top shape again at nominal cost. In addition, the manufacturers of some of the early-model television sets will be glad to furnish, either free of charge or at cost, a modernization kit which a serviceman can install easily. Your serviceman probably can tell you the exact policy of the manufacturer of your set.

Fortunately, the third possible source of television interference, those gremlin-type unpredictables, does not occur very often. When it does, however, it usually is a first-class headache, because seldom does one of them resemble another. For example, in one case a rain-gutter was the culprit; in another case, the trouble was traced to defective house wiring; and in another, it was found that the amateur signals had combined with other types of radio signals to produce other, interference-type signals. A complete list of these freak circumstances, not to mention those that never could be figured out, probably would fill a dozen pages.

But regardless of the source of the interference, whether it is the amateur equipment, the television set itself, or whatever, the amateur will go the limit to help straighten things out. Then, when the problem is licked, he probably will invite you over to see his set-up and perhaps talk to a friend a thousand miles away (long-distance rates are *really* cheap on amateur radio).

KØOFB

(W2NSD from page 4)

which reduced the efficiency of that experimental project somewhat below the expected norm, however I feel that we should learn from our failures and use them as guideposts to the future rather than as monuments to the past."

"Cut out all the baloney Mr. Green, are we going to get better mail service or aren't we?"

"Well, for one thing we're going to increase the postage rates on first class letters from five cents to seven cents and postcards from four cents to five cents. Then we're going to introduce a new class of mail, class 1A, which will go at two cents for postcards and three cents for letters. These will both be one standard size so they will go through automatic address readers and sorters. The addresses on these letters and cards will have to be printed by a special coding system similar to that used on your bank checks. This will require new typewriters and addressing stencils, but the saving in postage for the new class mail will make it practical for businesses and we should soon see a large part of our mail being posted under this new class. Within a very few years we should see 90% of our first class mail using this new system and being handled in a fraction of the present time. A letter will be able to be posted in Boston and be automatically sorted and shipped to San Francisco, right down to the individual mailman, without be-

(Turn to page 71)

## BOUND VOLUME $15

We have had a tough job getting enough volumes of 73 bound to meet the demand, even at the price of $15. This may be because so many fellows have seen one around and have a hankering for the bright red cover and the first fifteen issues of the magazine that are bound inside.

## YEARLY BINDERS $3.00

These are also in bright red and are stamped either 1960-1 or 1962. You tell us which you want. We managed to get some 1960-1 binders that will hold 14 copies of the magazine. This makes for a better fit if you don't have all 15 issues. Specify large or small binder for this year.

## MRT-90 CONVERSION: 50c

This booklet gives complete conversion instructions for converting the little pack-set surplus units into a fine two meter walkie-talkie. An article appeared in 73 on this unit in the October 1961 issue.

## HAM-TV $3.00

TV is one of the newest and most exciting phases of ham activity. This book gives clear and simple instructions for getting an operating TV station on the air for under $50 outlay! It is no wonder that hundreds of fellows are rushing to get on the air. The interest has been so high that a bi-monthly bulletin has now been started to keep everyone up to date on the advances and latest stations to get into operation.

## IMPEDANCE BRIDGE $1.00

Here is a complete set of full scale drawings of the parts for the Impedance Bridge which was featured in the August 1961 issue of 73. This bridge is one of the most useful pieces of test equipment that you could possibly build. It would cost you hundreds of dollars to buy this unit commercially made. This set of plans comes complete with a reprint of the original article.

## SSB TRANSCEIVER SCHEMATIC $1.00

There have been many requests for a giant sized schematic of the wonderful little transceiver that appeared in the November 1961 issue of 73. This schematic comes complete with a spare issue of the magazine in case you missed it.


## INDEX TO SURPLUS $1.50

This is a masterful compilation of all articles that have ever been printed on surplus conversions, complete with a brief run-down of the content of each article.

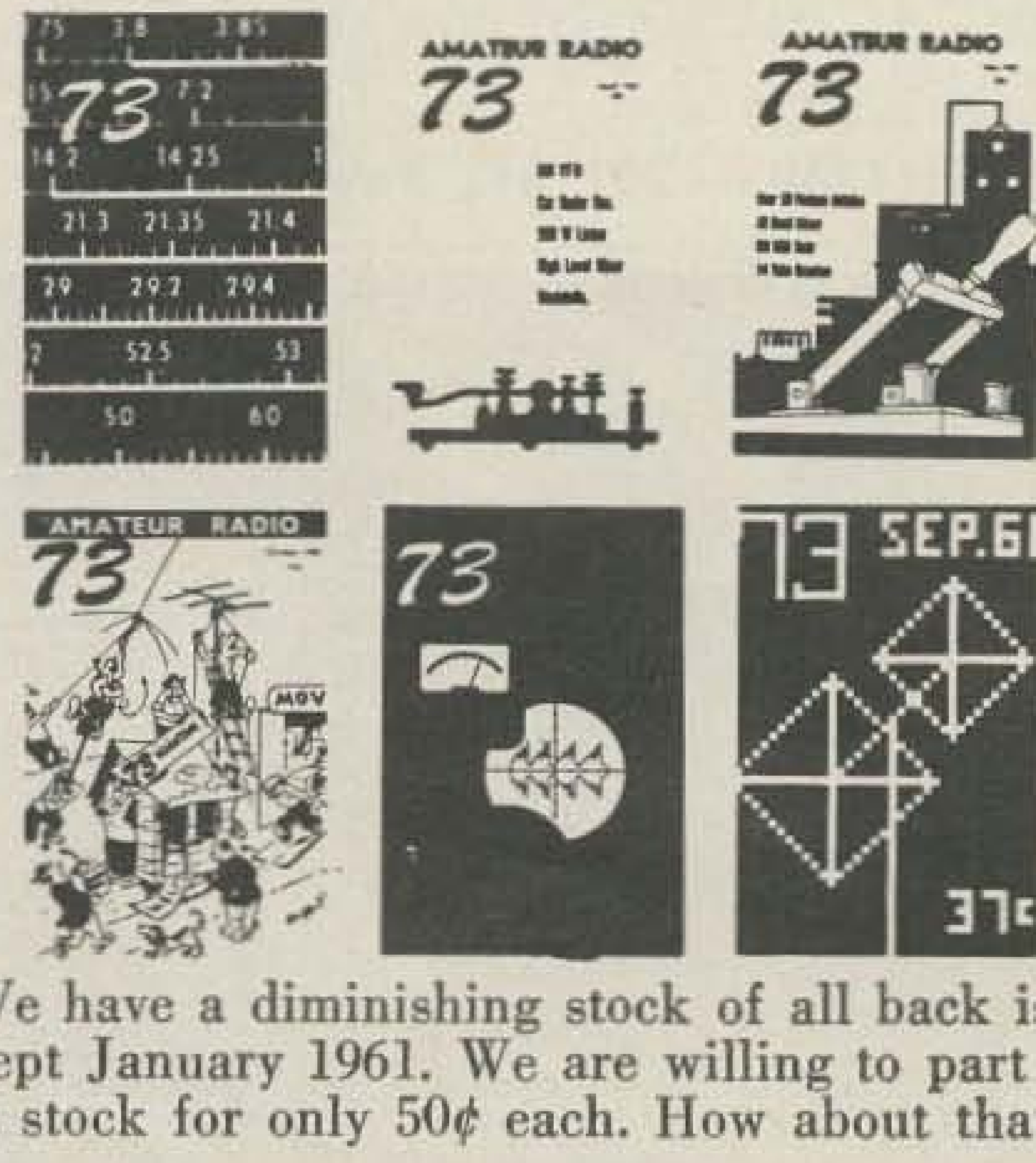
## TV BULLETIN $1.00 per year

The first issue of the TV Bulletin is now ready for mailing. This is a bi-monthly bulletin designed to keep all fellows interested in Ham-TV up to date on technical improvements in Ham-TV gear and on all activities. In the first issue of the Bulletin there is a list of all known hams who are reported to be getting on the air on TV. The Bulletin is edited by Mel Shadbolt, WøKYQ, the author of the popular HAM-TV book. Get in on this from the first issue and have a complete set of information at your fingertips. The present plans call for six issues of the Bulletin per year, with at least 12 pages per issue.

## MICKEY MIKER 50c

This is the first of our small booklets to come off the press. It is a complete description of the construction and operation of a little device which will measure capacity to a high degree of accuracy. This is a gadget that can be built out of most junk boxes and will forever be a handy item to have around when you are building something new or fixing something old.

## BACK ISSUES




We have a diminishing stock of all back issues except January 1961. We are willing to part with this stock for only 50¢ each. How about that!

**73 Magazine Peterborough, New Hampshire**

(W2NSD from page 69)

ing hand sorted once. Mail will be sorted once, but it will be sorted just like IBM cards."

"This sounds like quite a step ahead. However, wouldn't this eventually make it possible to reduce the number of post office employees? And hasn't this prospect created some political difficulties for you?"

"If you are referring to the exaggerated reports in the papers about my connections with the company that has patented the special typewriters and stencils for our proposed new automated system, there is absolutely nothing to it. The small interest that I had in that company was turned over to my brother two years ago and I no longer have the slightest connection or interest in the company."

## Help

This magazine is getting to be a little more than Virginia and I can handle all by ourselves, so we're looking around for someone to work with us. We'll be moving our office this summer and would like to find someone with a strong back for that, plus some building experience to help put in a very elaborate ham station.

I thought I'd mention it in case there happened to be any readers who might have a summer to squander in exchange for a little loot and a lot of experience. This could even be a career for the chap with the right background.

## Author-Author

Perhaps you are not aware of the prodigious number of articles we have been publishing in 73. You may appreciate this more if you whip out a copy of QST and CQ and start counting. For instance, in the May issues of all three magazines we find that QST ran eight feature technical articles and CQ ran seven. Compare this with the twenty-six in 73 and you'll see what I mean. You may have noticed that we had not had to sacrifice quality in order to publish this volume.

How do we do it? Well, first of all we have an unequalled record of fast high payment for articles which has been bringing us the pick of the new articles. Our policy of paying for all articles on acceptance, a policy which brings home the bacon from one to three years sooner than many old hands at ham writing

(Turn to page 73)

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73 Magazine PETERBOROUGH, NEW HAMPSHIRE

# Warning

If you don't order at least one of these specially selected books this month you are going to feel awful. This will be the combined result of your realizing that you've let another month of your life go by without improving your reference shelf and the guilt, shared with all other 73 readers, for reducing the Bookshop personnel to near starvation. This is such a humanitarian gesture all the way round that it should be tax deductible.

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

**57A—HOW TO OBTAIN YOUR CITIZEN'S RADIO LICENSE**—Orr .............................................**$1.00**

**21—VHF HANDBOOK**—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

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**80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I** (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. **$3.00**

**81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II.** Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. **$3.00**

**82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III**—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. **$3.00**

**83—THE SURPLUS HANDBOOK, VOLUME I**—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. This book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARC-5 VHF, ARN-5, ARR-2, ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, -1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. **$3.00**

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(W2NSD from page 71)

had become accustomed to, has encouraged many of the established writers to get back to their typewriters.

If we are to continue to publish this vast rash of articles we have to have 'em coming in. This means that if you build something of interest to the gang it is up to you to see that an article is prepared on it and the information is passed along.

The rules are simple. Use a typewriter, double space, check the article for typing errors and spelling, make sure the schematics are clear enough for our draftsman to understand and have all parts indicated on the schematic. In the article tell just what people have to know to duplicate your efforts, but don't go on at length. Keep it short and sweet . . . the money will be long and green.

### Mismatch

WØRUF is putting out a whopper of a bulletin out in Iowa. This is a strongly club-oriented publication and will be of interest to everyone in the Midwest. Subscription is $2.00 per year. This compliments Western Radio Amateur for West and Florida Skip for the South. Support your local publications.

### High Power Mobile

There may be a few problems still to solve, but it looks as if Electra-Power has the best answer yet to running a mobile KW. E-P is now marketing a very small alternator (5" dia.) that will furnish over 2000 watts at 120 vac. This alternator is designed to mount on your engine and be driven from the fan belt or from a separate pully attached to the drive-shaft. E-P has installation parts that fit almost all cars.

The Electra alternator was originally designed for fixed-mobile uses where people needed ac and no power lines were available. In this application the car engine would be adjusted to a fixed rpm and the alternator would put out 120 vac at 60 cps. This was great for lots of uses, but hams have to have their power while they are driving, and this means that a voltage regulator was needed that would hold the voltage constant over a wide range of engine rpm's.

The regulator is now available ($47 extra) and it will hold the voltage from the alternator steady at any engine speed over 1100 rpm. This is a medium-fast idle, but will not greatly inconvenience the driver. The regulator absorbs about ⅓ of the available alternator output, dropping the 3000 watts available to about 2100 watts regulated. This should be plenty.

As the engine speed changes the voltage stays constant and only the frequency changes. This should cause little difficulty. Since the frequency does not go below 60 cps there will be no problem of transformer heating. At higher frequencies the transformers are more efficient and will operate cooler. You have to be careful not to try to run synchronous fans from this varying source. Other than that you should be able to take any piece of home gear out and plug it in the car and have a ball.



So far, Electra points to several installations using their alternator successfully. The Swan and Collins transceivers are being used because of their physical size, but I doubt if it will be long before we see some higher power putting around.

If any of you fellows work up any mobile linear amplifiers to make use of this alternator we sure would like to have as much information as possible on it.

### Delicensing

Such a high percentage of the hams around the world are really nice fellows that we have overlooked the few crumbums that have snuck into our midst. Maybe it is just because people come to me with their troubles, but I'm hearing about more and more miseries that just shouldn't be permitted to continue. I have watched with horror the procedure that the FCC has to go through to revoke an amateur license. It is unbelievable. We could rid ourselves of these conscienceless heels if the FCC would modify their system to permit more painless delicensing.

Suppose, for instance, a petition signed by ten amateurs were made grounds for an investigation. A fellow has to be pretty obnoxious if he is going to get ten fellows mad enough at him to have them register an official complaint. Then, at the convenience of the nearest FCC official, the petitioners, the offending ham, and any witnesses for either side could get together for a discussion of the situation. If the FCC official decides that the scoundrel obviously has been making trouble then his license should be revoked on the spot for a couple of years or permanently.

A procedure of this nature would take care of the mere handful of serious cases such as I have run into in my 25 years of hamming. Do we really want to protect amateurs who are nasty and uncooperative about TVI, fixing their rigs when they splatter, etc? Do we want to keep being annoyed by fellows who broadcast smut in our bands or who indulge themselves in biggoted tirades on the air? These people are, by our standards, insane and should be put off the air. And how about the few amateurs who devote considerable time to interfering with QSO's for the perverse delight in making people mad? Who needs 'em.

### Mobile SSB

A few years back there was great interest in mobile operation. What happened to mobile? I don't know about everyone else, but my problem was one of compounded frustrations which finally discouraged me. By the time I got through trying to trick reluctant antenna coils into occasional performance I found that few fellows could hear my pip-squeak signal anyway. As soon as I encountered this setback with higher power my car battery committed suicide.

Never Say Die, says I. I met this turn of events with a higher power generator and a huge battery. After an intense effort to single-handedly boost sales of auto accessories via three of these generators, five regulators and two more batteries in dismal succession I threw in the towel and decided to wait for mobile sideband gear to come on the market so I could work out without having to muster up all those expensive dc amperes.

Mobile sideband did arrive, but not for me. I found that I had the choice of either of two well over $1500 units. With a sigh I decided to sit it out and wait for someone to work out a more economical arrangement. Sure, I know, if I had spent my time making money for myself instead of making others rich I could easily have enKWM'ed myself.

My waiting period is about over. By fall we should have a dozen different makes of sideband transceivers fighting for room under our dashboards. The Swan transceiver (advertised *only* in 73) was the first of the lower priced rigs to get into production. Their pileup of back orders was enough to convince even the hardest heads in the industry that transceivers are going to be "it" for some time to come. Some of the companies had their engineers working on their own transceiver design, others rushed out and bought a Swan to use as a prototype. One company even went so far as to buy a used Swan rig from another manufacturer that had just finished making their own carbon copy.

If as many fellows have been waiting around for this gear as I suspect we could have quite a boom in the ham industry this year. This would carry other products into high sales too: noise silencing kits put out by Sprague and Johnson, mobile antennas and mounts, microphones, alternators, ad infinitum. Try to stick to 73 advertisers as much as possible, eh?

## July Last Year

We have a good supply of last July on hand. This was quite an issue and you should have one in your files. The lead article was on portable two meter antennas and described a

(Turn to page 76)

(W2NSD from page 75)

simple system for making up all sorts of exotic antennas out of easily available materials. We have had many letters of approval on this article. Next we ran an interesting article on how to hook your mobile rig to any passing water towers in order to put out a whopping signal from the car for emergency purposes. Then there was a fine two meter nuvistor preamplifier for souping up your old converter or receiver. W7CSD's article on AM Modulation Systems was clear and lucid and brought a great deal of understanding to an obscure subject. K5RPB explained how to figure distances on the globe from longitudes and latitudes. W3QA discussed doings on the very low frequencies and described a simple converter for listening to these frequencies (10 - 30 kc). K8NIC's little transistorized six meter converter has found its way into a lot of cars during the year since it was first published. Two transistors are used.

The July issue had part II of the New Panadaptor unit. This described the construction details and operation of the gadget. This unit hooks your shack scope to your receiver so it becomes a panadaptor. K6UGT explained how to plate modulate the DX-40 and other similar rigs. Sockets for the 4-1000A are hard to come by, W4API described a substitute. Then there was an article on measuring frequency accurately using simple equipment.

One article that is still bringing comments is "From My Side Of The Counter" by W2BNW, one of the dealers down on New York's famous Radio Row. K6EAW did a beautiful job of explaining how to set the bias for transistor stages. This was particularly interesting because it was a practical article and didn't horse around with a lot of formulas. Our Big Technical article for July, in addition to the Modulation article, was on power supplies. This covered regulated supplies, zener diodes, silicon diode supplies, etc. Another little construction project was the K1NFE Band Edge Marker, using a 3.5 mc crystal. W8KTJ wrote up a little demonstrator for showing how transformers work which will be valuable to anyone who is trying to teach electricity fundamentals.

There were a few smaller articles and our most unusual cover to further warrant your investing in this issue. If you want it send 50c. This is a good buy for 18 articles, all still topical.

Wayne

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HRO-60 . . . . . 369.00
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# The National NC-303 is *not* for every amateur...

Frankly, the NC-303 is an expensive receiver. And not every ham is willing to spend $449 to enjoy the maximum in receiving convenience and performance. The NC-303 is not a "compact" light weight. It's packed with 78 pounds of husky components to provide a little bit better reliability and performance than the next receiver. The NC-303 offers certain advantages. Sensitivity, for example, is an honest 1.0 microvolt or better for 10 db AM signal-to-noise ratio (this is not a misleading CW measurement or one based on a 6 db S/N), and the NC-303 is quiet — no operator fatigue from background noise bursts.

Selectivity is remarkable (six tuned circuits at 80 KC result in extremely steep skirts on SSB and CW) . . . and the '303 offers the widest selectivity range available on any hamband receiver — 400 cycles through 8 KC. Stability, both mechanical and electrical, is quite out of the ordinary. No need to tip-toe around the shack. In fact, tune a CW signal and employ the classic "drop test" to see for yourself. Incidentally, we consider 100 cycle thermal drift after a short warm-up to be unusual.

"This is all very well", you may say, "but not a great deal better than competitive receivers" We agree — for four hundred and fifty dollars you should expect much more than this, and so we give more to you. The most expensive dial drive in the industry to provide smoother inertia tuning than any receiver on the market, regardless of price. The NC-303's band switch mechanism even employs a Geneva movement . . . you just start it on its way . . . it does the rest of the job by itself. No wiggling back and forth to make sure every contact is engaged. This switch snaps in with a satisfying clunk and stays there. (Try tuning a signal on one band, then flip to another band and back again.)

Other extras include complete coverage from 160 (by the way, the '303 is the only SSB hamband receiver now on the market which incorporates 160) through 1¼ meters with separate 12" slide rule drum dials for each band, and accessory converters are available for the three VHF bands. Even a separate converter input is provided. Dial calibration is to 1 KC on the lowest band, to 2 KC through 15 meters.

The '303 also offers the best SSB AVC you've ever heard. No pops, thumps or distortion . . . just a constant gain level through local or DX QSO. There's an audio response control for CW peaking or VHF scatter work . . . an active nulling Q multiplier for 50-60 db notches, complete with depth control . . . an unusual noise limiter which cuts impulse noise without signal distortion, plus adjustable CW/SSB limiting. Even external provision for RF gain control for CW break-in operation and an accessory socket for receiver accessories or adapters are included.

The NC-303 was not designed to meet competitive price or performance, but to provide maximum hamband performance for every type of operation. Not just SSB, not just AM, not just CW . . . but every mode. As a result, it costs more than the average ham receiver. On the other hand, if your requirements are for more than "the average", perhaps the '303 should be your next receiver. Why not operate one soon and find out?


## National Radio Co., Inc.

37 Washington Street, Melrose, Massachusetts